Street Railway Journal

PHILADELPHIA
THE CONVENTION CITY

As the school histories have made familiar to most American school boys, Philadelphia, the City of Brotherly Love, was founded by William Penn, the great Quaker, in 1682. In history, in science, and in the social, commercial and industrial life of the nation, the city has played an important and memorable part. The town was one of the storm centers of the Revolution. Within the range of vision on a clear day, from the great tower of the Philadelphia public building, lie the battlefields of Brandywine, Paoli, Germantown, Whitemarsh, Trenton, Princeton, Redbank, Ft. Mifflin and Valley Forge, all of them marking events momentous in the early life of the American people. Almost within a stone's throw from the same vantage point are Carpenter's Hall, where assembled the first congress called to resist British encroachment; Independence Hall, where the Declaration of Independence was drafted and signed, and where, after the war, the Constitution of the United States was framed, and which is now the resting place of Liberty Bell; Betsey Ross's house, where a humble woman sewed together the stars and stripes of the first American flag; Penn Cottage, where William Penn lived and transacted the business of the Colony; Congress Hall, where the United States Congress met for many years, and where Washington was inaugurated president. Within the confines of the city limits are found buildings and sites whose names are inseparably associated with the scientific, artistic, educational and industrial progress of modern times. Among these are Cramp's ship yards, the Baldwin Locomotive works, United States Mint, League Island Navy Yard, Frankford Arsenal, American Academy of Fine Arts, Academy of Natural Sciences, Commercial Museum, Girard College, University of Pennsylvania, Franklin Institute, and the Philadelphia Bourse.

The list of inventions, discoveries and institutions that have had their birth in Philadelphia is nearly as long as the string of the kite flown by the immortal Franklin. Philadelphia claims the first law school in America, the first American volunteer fire company, the first mint in the United States, the first medical school and the first college of pharmacy in America, the first paper mill, the first pianoforte ever manufactured, the mariners' quadrant, the first city waterworks, the first hospital, the first public library, the first experimental railroad track laid down in the United States, old Ironsides, the first locomotive erected in the new world, the first daguerreotype or photograph of a human face, the first English Bible published in America, the first daily newspaper, the first turnpike road, the first experiments for moving water vessels by steam, and of course, the first demonstration of the theory that lightning is electricity.

Impressive statistics concerning the modern city very easily can be quoted to the point of tiresomeness. The city limits now include an area of 129 square miles, and Philadelphia stands in point of area third among the cities of the United States, New York City having 326 square miles and Chicago 191 square miles.

In population, Philadelphia also ranks third among the cities of this country and ninth among the great cities of the world. Her relative ranking with the cities having upwards of a million population is exhibited in Table II. on the following page.

The present population is estimated at approximately 1,400,000. The population per square mile is about 10,000. The population per acre is 14.8

There are said to be 275,000 separate homes within the corporate limits, this tendency on the part of her citizens to have separate houses having earned for Philadelphia the appellation of the "City of Homes," as well as that of the "City of Brotherly Love," exemplified by its name.

Fairmount Park, covering 3341 acres, is the largest public park in America. Many portions of this great tract have been left in their original state, with wooded vales, hills, rocks and groves as nature made them. Other portions have been beautified by the art of the landscape gardener. The park is the site of the Zoological Garden, one of the most complete in America; Memorial Hall, erected during the year 1875 as one of the Centennial Exposition buildings, and left as a memorial of that great event; the Smith Memorial, erected to the memory of the soldiers and sailors of Pennsylvania; Horticultural Hall; the Sunken Gardens and many monuments and examples of statuary erected by the city or donated by philanthropic citizens. Many of the natural charms of the place, as well as the buildings and points of interest, have in late years been rendered more accessible by the electric lines of the Fairmount Park Transportation Company, which are laid wholly within the confines of the park, and during the summer season afford the only convenient means of moving about the great area included in the park tract. These electric lines are not operated during the winter months.

The Philadelphia City Hall, erected at a cost in excess of $24,000,000, with its tower measuring 547 ft. 11¼ in. from the ground to the tip of William Penn's hat at the apex, is, with the single exception of the House of Parliament in London, the largest public building in the world.

As a port of entry and sailings, both for passengers and merchandise, the city is exceeded in importance only by New York among the American cities. The value of the foreign maritime traffic aggregates over $50,000,000 per year. In ship and locomotive building, and in many special lines of industry, the city ranks first.

The Pennsylvania Railroad, Philadelphia & Reading Railroad and the Baltimore & Ohio Railroad, with their branch and leased lines, connect Philadelphia with all parts of the country. There are 1000 regular inward and outward bound passenger trains daily.

The city has over 20 miles of water front navigable by ocean steamers of the largest tonnage, and there are direct freight and passenger steamship lines to England, Belgium, Germany, the West Indies and many of the important ports of the United States.

ANALYSIS OF TRANSPORTATION CONDITIONS IN PHILADELPHIA

All of the older section, and the greater part of the present city of Philadelphia, are located on a long peninsula between the Delaware and Schuylkill Rivers. This peninsula is about 2 miles wide at Market Street, which is its narrowest point until just before the Schuylkill River flows into the Delaware River at League Island, some five miles below the City Hall. Practically all of the important shipping interests of the city are confined to the frontage on the Delaware River, which is kept open in winter from Philadelphia south by the passage of many ferry boats and other traffic, although it is frozen over for some distance down from Trenton. For a long time the Delaware River ferry boats furnished the only means of transportation from Philadelphia to the New Jersey shore, but within the last few years an extensive bridge has been built across the river just north of Philadelphia by the Pennsylvania Railroad. This bridge connects this company's main line with its Camden Atlantic Division, and thus furnishes an all-rail route from Philadelphia to its largest and nearest seashore resort—Atlantic City.

The Schuylkill River, which forms the western boundary of the old city, is navigable for only a short distance from its mouth, or to the Fairmount Park dam. Thence it extends north and west through Fairmount Park, past Manayunk, Norristown and Reading, to its source in the Blue Mountains. Crossing the Schuylkill at various points during its passage through the city of Philadelphia, are some eight or nine railroad and highway bridges, over which there is a constant stream of traffic. The latest of these bridges is that now being built by the Philadelphia Rapid Transit Company just north of the present Market Street Bridge, to carry two surface tracks and two elevated railway tracks. The Schuylkill River can be considered in no sense, therefore, as a barrier to the extension of the city westward. In fact, it has not so proved, and, while the city is growing north rapidly, it is developing west at an even more rapid rate, and one of the most important questions for the future will be the proper care of the traffic from west of the Schuylkill River into the business districts. That the Philadelphia Rapid Transit Company fully appreciates this situation is indicated by the construction first of the West Philadelphia section of its underground and elevated rapid transit system, and by the provisions which have already been made and are being continued to care for the rapid increase of population in this district.

North and northwest of Philadelphia are a great many most attractive suburban residential districts whose beauty is famous. Prominent among these suburban towns are Germantown, which lies within the city limits of Philadelphia; Ardmore, Bryn Mawr, Wayne and West Chester. Southwest of the city limits there is practically a continuous succession of residences and manufacturing establishments, extending along the river in a section a mile in width, to the Pennsylvania and Delaware State lines, 17 miles in a direct line from the Philadelphia City Hall and almost to the city of Wilmington.

Table I. gives the population of the city for the last four decades, and Table II., the populations of the thirteen largest cities of the world. From the latter it will be seen that Philadelphia is the third largest in this country, and ranks ninth among all of the world's largest marts.

TABLE I., SHOWING POPULATION OF PHILADELPHIA BY DECADES

Year	Population	Per Cent Increase
1870	647,022	...
1880	847,170	30.9
1890	1,046,964	23.6
1900	1,293,697	23.6
1906 (estimated)	1,400,000	8.1

TABLE II., GIVING POPULATION OF LARGEST CITIES OF THE WORLD

City	Population
London	4,536,541
New York	3,437,202
Paris	2,714,068
Berlin	1,888,848
Chicago	1,698,575
Vienna	1,674,957
Canton	1,600,000
Tokio, Japan	1,440,121
Philadelphia	1,293,697
St. Petersburg	1,267,023
Calcutta	1,125,400
Constantinople	1,125,000
Peking	1,000,000

TRAFFIC DISTRICTS

The business center of Philadelphia is confined practically to a section about 1½ miles square, extending from Fifteenth Street east to the Delaware River, and from Callowhill Street on the north to Walnut Street on the south. Fortunately for the city, the Pennsylvania and Reading Railroads, both of which do a large commuter business, extend to or into this district, and the New Jersey commuters from across the Delaware can be landed directly at its eastern border. Table III. shows the number of passengers

TABLE III., SHOWING NUMBER OF PASSENGERS ARRIVING AT AND DEPARTING FROM THE PRINCIPAL STEAM RAILROAD AND FERRY TERMINALS IN PHILADELPHIA DURING 1904

Railroads—	
Pennsylvania Railroad, Broad Street and West Philadelphia:	
Arriving	8,968,104
Departing	8,898,016
Philadelphia & Reading, Market Street Station:	
Arriving	8,108,986
Departing	7,617,361
Total of these two railroads	33,592,467
Ferries—	
Market Street, Philadelphia, and Federal Street, Camden.	16,272,563
Vine Street, Philadelphia, and Cooper's Point, Camden..	1,283,354
Shackamaxon Street, Philadelphia, and Cooper's Point, Camden	510,514
Total ferries	18,066,431
Total of above railroads and ferries	51,658,898

arriving at and departing from these municipal railroad stations and those transported by the ferries during 1904. Comparatively little additional transportation in this district is required by the army of commuters who use the steam railroad and ferry lines in reaching their office work. Nevertheless, the vast majority of the working population of the lofty buildings which line the business streets of Philadelphia reside within the city itself, as in all large cities, and this class is entirely dependent upon the purely urban lines for transportation.

The district in Philadelphia which has been defined as the business district, and which has been bounded, includes as well the financial district, which for the most part is located along Fourth, Fifth and Sixth Streets, between Market Street and Walnut Street; the theater and hotel district, which is centered on Market and Chestnut Streets, between Eighth and Fifteenth Streets, and also on South Broad Street, and a considerable portion of the manufacturing district, which clusters along the steam railroad tracks, extending between Callowhill and Green Streets. The other manufacturing districts of the city lie to the northeast, in Kensington and Richmond, along the Delaware River, and to the

AMERICA'S LIBERTY BELL

INDEPENDENCE HALL

THE PHILADELPHIA CITY HALL

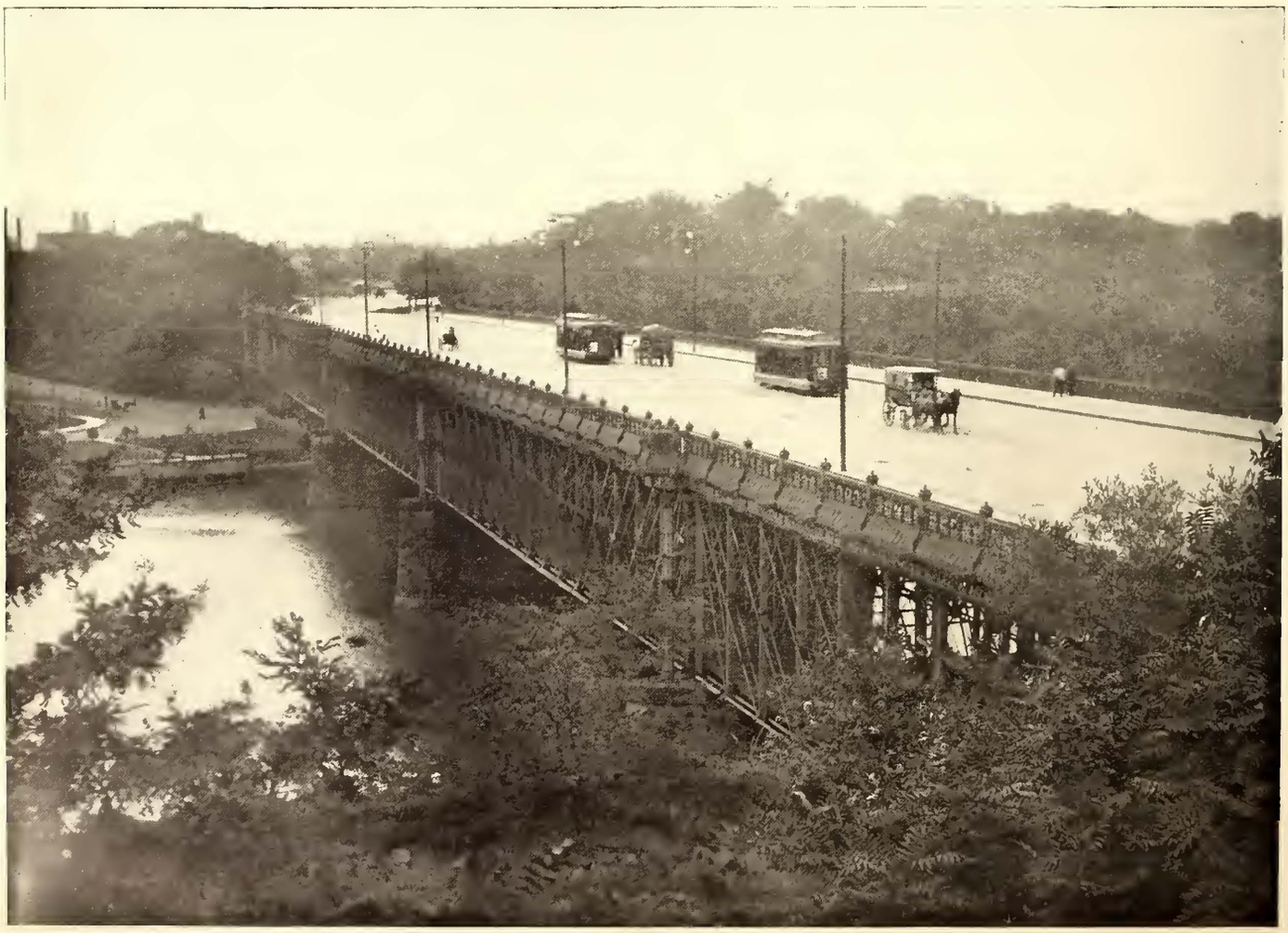
BROAD STREET LOOKING NORTH, SHOWING SKYSCRAPER HOTELS AND OFFICE BUILDINGS ON EITHER SIDE AND CITY HALL IN DISTANCE

Plate III

PANORAMA OF PHILADELPHIA, TAKEN FROM COMMONWEALTH BUILDING, AT TWELFTH AND CHESTNUT STREETS, SHOWING 80 DEGREES OF THE HORIZON

THE SKYLINE OF PHILADELPHIA FROM THE CAMDEN WATER FRONT

BIRD'S-EYE VIEW OF PHILADELPHIA AND PART OF FAIRMOUNT PARK, TAKEN FROM A BALLOON ONE MILE HIGH



THE NEW GIRARD AVENUE BRIDGE OVER THE SCHUYLKILL RIVER INTO FAIRMOUNT PARK

southwest of the city, along or near the Schuylkill. The finest residence district of the city is on North Broad Street and neighboring streets, near Spring Garden, although many of the older aristocratic families reside along the western part of Chestnut, Walnut and parallel streets south of Market Street. Chestnut Street and Market Street, from Eighth to Fifteenth Street, are recognized as the leading thoroughfares for the largest retail stores, while Eighth Street appeals more to those shoppers who are seeking bargains.

CONDITIONS WHICH AFFECT TRANSPORTATION

Topographically, Philadelphia possesses certain advantages, as well as disadvantages, from a transportation standpoint. One of the principal points in its favor is that the city is located on what is practically a plain or plateau, which rises from the Delaware River by a slight acclivity. With the exception of the Schuylkill River, which, as has already been described, is hardly an obstacle, there are then no natural barriers or grades westward until beyond a distance of some 5 miles from the City Hall. The sharpest grades are along the Schuylkill River in the neighborhood of Fairmount Park, and further on in the direction of Manayunk, but hardly any portions of the city proper are at an elevation of greater than 100 ft. above tide water.

A second advantage which Philadelphia possesses from a transportation standpoint is that a very large proportion of the residents live in separate houses. In fact, the city as stated is familiarly known as the "City of Homes," and many of these houses, especially those at some distance from the center of the city, have some ground around them. This makes the city one of magnificent distances, so that transportation is a necessity.

Another consideration favorable to surface transportation is that the streets are laid out on the rectangular system. Practically the only exceptions are Ridge and Germantown Avenues, which extend diagonally northwest across part of the northern end of the city, and Passyunk Avenue, which extends diagonally southwest across a part of the southern end of the city. Most streets running north and south are numbered, and those extending east and west are named. The blocks are nearly square, but not entirely so, as the north and south streets average about eight to the mile, and the east and west streets ten to the mile. Unfortunately, this spacing has been found to be too great, and the result is that between a great many of the main streets intermediate streets, or alleys, have been constructed. This fact accounts for most of the named north and south streets, which do not add anything to the attractive appearance of the city. The original designers of the city were equally unfortunate in the width which they selected for the streets. They provided, it is true, two broad thoroughfares—one, Broad Street, extending north and south for a distance of 10 miles, and the other, Market Street, which runs east and west for 6 miles, and intersects Broad Street at the square on which the City Hall is located. Each of these streets is about 70 ft. wide from curb to curb. Most of the other streets, however, and in fact practically all those in the older section of the city, are only 26 ft. from curb to curb, and 50 ft. from building line to building line. In fact, 90 per cent of the streets in Philadelphia are limited to this width.

This consideration compelled the construction, which is almost universal in Philadelphia, of a single track to each street, with the cars running down one street and back on a parallel street. In constructing a loop route of this kind, adjoining streets are not always used. Early in the history of street railroading in Philadelphia, the different lines were operated by different companies, and, as the franchises were sought, the most desirable two unoccupied streets within the same neighborhood were selected. As the public became familiar with these combinations of the streets, the routes have been largely retained, so that one line, for instance, runs south on Fourth Street and north on Eighth Street; another line, south on Seventh Street and north on Ninth Street; another, south on Fifteenth Street and north on Thirteenth Street, etc. The combinations of east and west lines are largely the same character, although somewhat more complicated, but all routes have, of course, been modified to a considerable extent since all the companies came under one organization In addition to its north, south, east and west lines, the Philadelphia Rapid Transit Company has a third system of lines, known as the "L" lines, and which run on routes that are a combination of both directions.

TABLE IV.—SHOWING TRAFFIC AT BUSY TRACK INTERSECTIONS

Crossing	Market St. and 8th St.		Chestnut St. and Fourth St.			Ridge Ave., Spring Garden and Twelfth St.		
Kind of crossing	Two tracks crossing one track		One track crossing one track			Triangular crossing—2 tracks crossing 2 tracks and 1 track		
Width of Streets between Curbs	Market St. 68 ft. Eighth St. 26 ft.		Chestnut St. 26 ft. Fourth St 26 ft.			Ridge Ave. 34 ft. Spring Garden St 88 ft. Twelfth St. 26 ft.		
Day Selected	July 8, 1905.		July 8, 1905.			July 8, 1905.		
Busiest Hour Selected	5 P. M. to 6 P. M.		5 P. M. to 6 P. M.			5 P. M. to 6 P. M.		
TRAFFIC.	Headway in Seconds.	Number of Cars in Hour.	TRAFFIC.	Headway in Seconds	Number of Cars in Hour.	TRAFFIC.	Headway in Seconds.	Number of Cars in Hour.
E. bound on Market St.	28	126	E. bound on Chestnut St.	34	106	N. bound on Ridge Ave.	90	40
W. bound on Market St.	21	166	S. bound on Fourth St.	36	99	S. bound on Ridge Ave.	90	40
Total E. and W. bound	12	292	Grand Total at Intersection	17	205	S. bound on Twelfth St.	120	30
N. bound on Eighth St.	36	99				Total N. and S. bound	....	110
Grand Total at Iutersection	9	391				E. bound on Spring Garden St.	180	20
						W. bound on Spring Garden St.	90	40
						Total E. and W. bound	....	60
						Grand Total at Intersection	21	170

THE CONGESTION PROBLEM

This system of single tracks on narrow streets, which has just been described, results in two very serious obstacles to satisfactory street railway operation. In the first place, it greatly multiplies the special work and street crossings. This will be realized from the fact that there are over 1100 street railway crossings on the Philadelphia Rapid Transit system, in addition to 400 surface steam railroad crossings. Another unfortunate, but necessary, consequence entailed by this arrangement of narrow streets is the congestion at the street corners. At intervals of about every 600 ft. through the center of the district every east and west line has to cross a north and south line, and between 5 and 6 o'clock in the evening, when these crossings are crowded with delivery wagons, drays, automobiles and other vehicles, it would require more than the traditional skill of a London "bobby" to keep all of the traffic moving. Flagmen are located at some of the most congested corners, and the skill with which these men pass the cars over the intersecting tracks is remarkable, and could have been acquired only through long years of experience. Some figures showing the actual number of cars passing particularly busy corners are presented in Table IV.

This table has been prepared to represent three characteristic types of crossings as existing in Philadelphia, viz.: (1)

a single track crossing a double track, which is typical of all of the crossings on Market Street; (2) a single track crossing a single track, which is the kind of crossing by far the most prevalent in Philadelphia; (3) a triangular crossing, of which there are only a few in the city. The figures given in this table are in no sense the maximum number of cars which have been passed during an hour at these respective crossings, but were compiled during the preparation of this article as indicative of the rush-hour traffic during an average summer day in Philadelphia.

As the cars pass out into the suburbs, the congestion grows less, so that there is a striking difference between the speeds within and outside the congested area. This is clearly brought out in Table V., which has been prepared from the schedules of the five or six principal east and west and north and south lines. As will be seen, there is a difference in running time, which varies from 2 to 4 miles per hour.

The congested conditions at certain crossings in Philadelphia are probably no worse than those in certain other large cities.

TABLE V.—SHOWING SCHEDULE RUNNING TIMES WITHIN CONGESTED DISTRICT AND FOR ENTIRE RUN WITH AVERAGE SPEEDS PER HOUR

North and South Lines.	Total Run.		Run in Congested Portion of City.			Speed in Miles per Hour	
	Length of Run, Miles.	Time of Run, Minutes.	Limits Taken.	Length of Run, Miles.	Time of Run, Minutes.	In Congested Portion.	Outside Congested Portion.
Second and Third Sts.	18.42	141	South St. on South, and Girard Ave. on North...	3.83	37	6.21	8.41
Fourth and Eighth Sts.	26.54	162		3.83	37	6.21	10.90
Fifth and Sixth Sts.	19.24	139		3.83	36	6.38	8.98
Tenth and Eleventh Sts.	11.63	89		3.83	32	7.18	8.21
Twelfth and Sixteenth Sts.	16.75	114		3.83	32	7.18	9.44
East and West Lines.							
Market St.	13.42	99	Delaware River on East, and Schuylkill River on West	4.26	41	6.23	9.45
Chestnut and Walnut Sts.	12.72	99		4.26	40	6.39	10.15
Spruce and Pine Sts.	15.35	104		4.26	37	6.91	9.93
Lombard and South Sts.	11.15	82		4.26	34	7.52	8.61
Arch St.	14.65	96		4.26	37	6.91	10.56
Lancaster Ave.	12.50	95		4.26	41	6.23	9.16

There is the difference, however, that whereas in New York, Boston, Chicago, Brooklyn and other cities where this trouble is encountered there is severe congestion at certain points on the system, the condition in Philadelphia is much more prevalent and occurs at a large number of places all over the central part of the city. If it was not for the early completion of the subway and elevated systems, the condition would be a serious one, and would undoubtedly militate against the industrial progress of the city. Reducing the delay to dollars and cents, we find that approximately nine-tenths of the business population of Philadelphia, through this condition, is obliged to waste an extra quarter or half hour each day in going to and returning from business. If we capitalize this time according to the salaries paid or money value of the time of the passengers, the aggregate amounts to an enormous sum. While the subway will relieve the situation somewhat, the subject is clearly one which, in the minds of a disinterested outsider, should receive the serious attention of the city authorities. The only relief available is the regulation of other traffic, because the streets cannot be made wider and the cars are carrying all the people they can. In Philadelphia, as in New York up to within recently, the street car possesses no greater privileges on the public highway than any other vehicle, and the progress of cars, not only during the rush hours, but at all times of the day, is seriously delayed by the disregard which drivers of drays and other vehicles for the transportation of bulky material pay to the rapid progress of the car. It is no uncommon sight, especially on the streets nearest the river, like Second and Third Streets, to see a car held up for five minutes or longer while the driver of a coal or brewery wagon takes his time to get off the track or deliver his load in a leisurely manner. The adoption and vigorous enforcement of "rules of the road," somewhat similar to those now in force in New York, but even more strict in their application, seem one of the most essential requirements in Philadelphia.

One other source of relief ought to be suggested, although its adoption would run counter to the Philadelphia traditions. The

TABLE VI.—SHOWING CAR MILES AND PASSENGERS CARRIED ON SIX PRINCIPAL NORTH AND SOUTH AND EAST AND WEST LINES AND "L" LINES FOR YEAR ENDING JUNE 30, 1905.

	Car Miles.	Passengers Carried.
Six Principal North and South Lines:		
Second and Third, Frankford	1,506,791	8,960,541
Fourth and Eighth, Chestnut Hill	2,463,191	14,100,559
Fifth and Sixth, via Berks St.	1,445,343	8,713,289
Tenth and Eleventh	1,556,385	10,900,304
Twelfth and Sixteenth	1,633,904	14,079,492
Thirteenth and Fifteenth, Erie Ave.	1,423,054	10,578,841
Six Principal East and West Lines:		
Market, Sixty-third and Vine Sts.	1,336,808	10,609,188
Market St., Haddington	1,379,522	9,043,323
Market St., Lancaster Ave.	1,479,835	10,220,726
Chestnut St., Darby	1,706,632	9,857,402
Lombard and South Sts.	1,198,712	6,938,778
Girard Ave., Sixty-third St.	1,667,553	10,798,369
Six Principal "L" Lines:		
Columbia Ave.	1,479,130	10,617,015
Seventeenth and Nineteenth Sts.	1,504,651	11,614,385
Seventeenth and Eighteenth Sts.	767,948	8,059,284
Nineteenth and Twentieth Sts.	657,953	6,104,879
Berks and Montgomery Sts.	825,737	6,206,960
McKean St., Seventh and Ninth Sts.	1,494,624	8,726,899
Total of all North and South Lines	28,500,420	165,537,343
Total of all East and West Lines	27,108,938	148,662,218
Total of all "L" Lines	14,134,412	88,694,684
Grand Total of all Lines	69,743,770	402,894,245

built. In Berlin the situation is largely the same as in New York, and the avenue itself is short and its equipment with tracks would not appreciably relieve the traffic situation, while the Thames Embankment will undoubtedly be equipped within a few years. This must ultimately be the course adopted in Philadelphia, as the actual cost to the city and to its residents of devoting the only available and satisfactory street for north and south travel to lumbering stages and to the automobiles and other carriages of the wealthy is enormous. When this is done and the surface transportation in Philadelphia is supplemented by a subway extending under the entire, or the greater part of, both Market and Broad Streets, the traffic situation will be greatly relieved.

founders of the city, who made the mistake of establishing too narrow a width for practically all the streets in Philadelphia, did adopt the wise provision of laying out the two broad thoroughfares, Market Street and Broad Street, which cross the city north and south and east and west, as already explained, and with a commendable forethought of possible future expansion and the need of good means of access between all parts of the city, provided that these streets should extend through what is still practically the closely inhabited portion. Market Street has been used for commercial purposes, and has possessed car tracks almost since the introduction of street cars in Philadelphia, but Broad Street, the only other highway in Philadelphia which deserves the name of avenue, has been guarded against encroachment with a jealousy comparable only to that which has been adopted with Fifth Avenue in New York, the Thames Embankment in London and the Unter den Linden in Berlin. The comparison with New York is not fair, however, because Fifth Avenue is paralleled at intervals of less than 800 ft. by ten other avenues of equal width, upon which car tracks are

MAP OF

PHILADELPHIA AND VICINITY

Showing the Lines

CONTROLLED AND OPERATED

by the

PHILADELPHIA RAPID TRANSIT COMPANY

September 23, 1905

EXPLANATION:

PHILA. RAPID TRANSIT COMPANY'S LINES

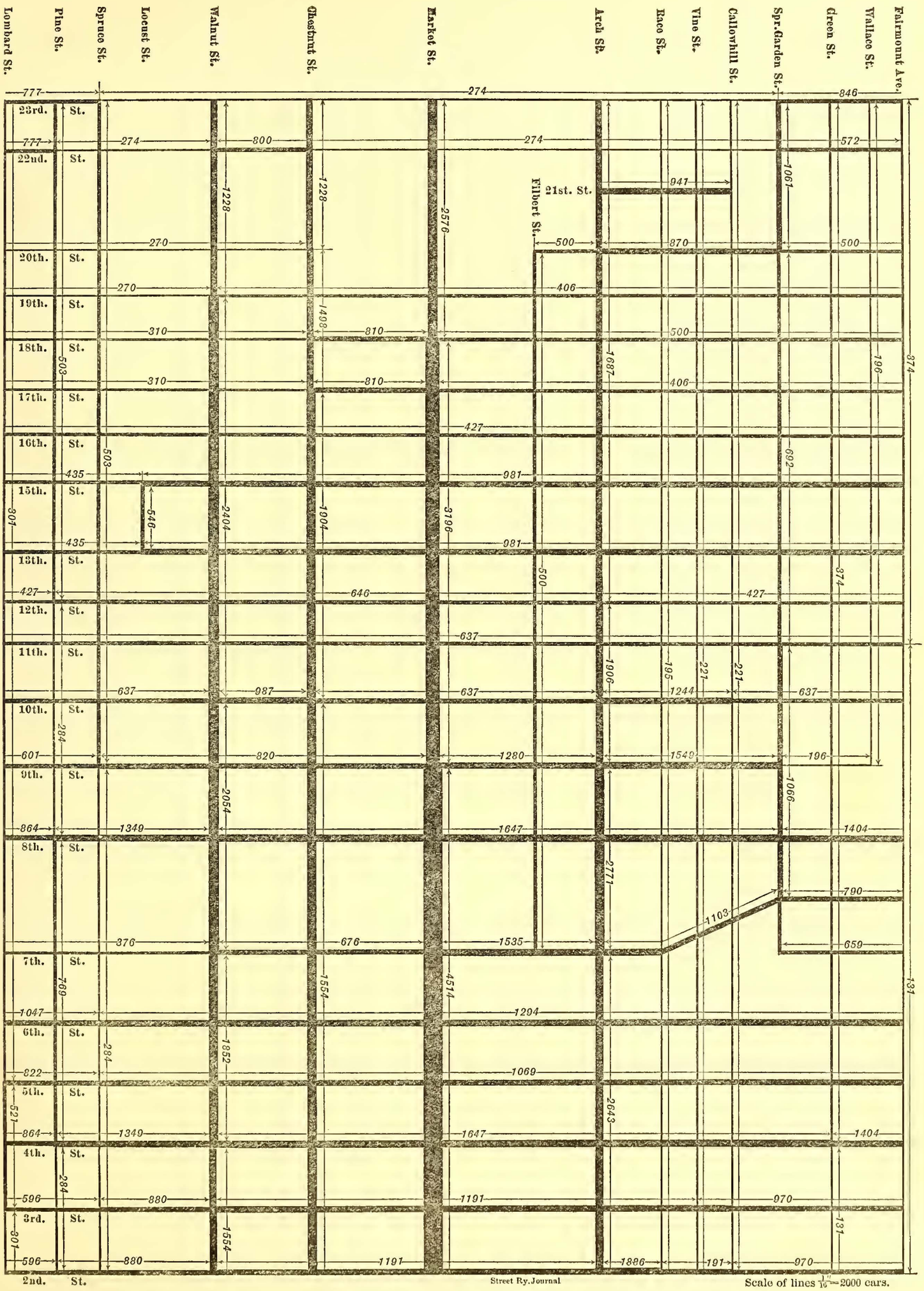
STEAM RAILRDADS

PARKS AND PDINTS OF INTEREST

SCALE: 1 INCH—1 MILE

TWO MILE CIRCLES INDICATE AIR LINE DISTANCES FROM CITY HALL, BROAD AND MARKET STREETS.

Prepared and Engraved for The Street Railway Journal, by J. L. Smith, Philadelphia



SCHEMATIC DIAGRAM, SHOWING BY WIDTH OF LINE THE TRAFFIC ON THE PRINCIPAL DOWNTOWN LINES IN PHILADELPHIA

TRENDS OF TRAVEL

The map on page 477 is a schematic diagram of the central part of the city, showing the extent of travel in terms of the total number of cars during twenty-four hours, for an average day during last July. For convenience in comparison, this map is not drawn to linear scale, but the width of the lines showing each street is drawn to the scale of 1-16 in. to 2000 cars per twenty-four hours. The actual number of cars on each section of track is also indicated by figures.

This map clearly brings out the congestion on certain lines and corners already described, and will, it is thought, help to elucidate the problem which has already been discussed. The method will also, it is thought, find some use in parallel cases in other cities. As will be seen, the Eighth Street line is the heaviest north and south line, although in passengers carried it is nearly equaled by the Twelfth and Sixteenth Street line. The Market Street line, which is double track, is the heaviest east and west line.

Table VI. shows the amount of traffic on the six principal lines of each kind, as well as the total on each kind. It will be seen that there is a slightly larger traffic north and south than east and west. The preponderance of the north and south travel is north of Market Street, and of the east and west travel is west of Eighth Street. The east and west travel east of Eighth Street is principally on the lines extending to and from the Market Street ferries running to Camden, and is consequently upon the Walnut Street, Chestnut Street, Market Street and Arch Street lines. The two last are double-track lines.

Table VII. gives the monthly variation in passengers and car mileage for the different classes of lines in Philadelphia. It will be seen the traffic is heaviest in summer, both as regards passengers and car-miles. The column giving passengers per car-mile shows that the highest figures are attained in the late fall and spring months, viz., in October, November and December, and in April, May and June. The reason for this is that during the summer, while more passengers are carried, they ride longer distances, while the ratio during the winter months is undoubtedly explainable by the inclement weather.

TABLE VII.—SHOWING VARIATIONS BY MONTHS OF THE DIFFERENT CLASSES OF LINES FOR THE YEAR ENDING JUNE 30, 1905.

MONTHS.	North and South Lines.		East and West Lines.		"L" Lines.		All Lines.		
	Passengers.	Car Miles.	Passengers.	Car Miles.	Passengers.	Car Miles.	Passengers.	Car Miles.	Passengers Per Car Mile.
July	14,754,182	2,748,844	12,813,000	2,364,924	7,113,270	1,192,851	34,680,452	6,306,619	5.5
August	14,554,511	2,722,476	12,593,680	2,354,041	7,068,877	1,194,789	34,217,068	6,271,306	5.4
September	13,924,771	2,350,924	12,418,468	2,227,312	7,242,937	1,163,908	33,586,176	5,742,144	5.8
October	14,004,208	2,278,381	12,816,015	2,243,659	7,641,619	1,186,102	34,461,842	5,708,142	6.0
November	13,176,297	2,186,124	12,045,725	2,170,693	7,379,319	1,144,232	32,601,341	5,483,049	5.9
December	13,310,489	2,213,568	12,166,831	2,224,642	7,805,727	1,191,002	33,283,047	5,629,212	5.9
January	12,359,363	2,195,287	11,287,441	2,209,322	7,019,878	1,167,334	30,666,682	5,571,943	5.5
February	10,874,736	1,975,407	10,002,473	2,011,184	6,227,461	1,055,571	27,104,670	5,042,162	5.3
March	13,097,509	2,240,157	12,002,543	2,287,698	7,421,969	1,203,904	32,522,021	5,628,735	5.7
April	13,718,751	2,212,616	12,753,000	2,255,020	7,547,647	1,161,099	34,019,398	5,731,759	6.0
May	15,523,629	2,523,462	14,120,923	2,417,370	8,132,172	1,239,347	37,776,724	6,180,179	6.1
June	16,238,897	2,853,174	13,642,119	2,343,073	8,092,808	1,234,273	37,973,824	6,430,520	5.9
	165,537,343	28,500,420	148,662,218	27,108,938	88,693,684	14,134,412	402,893,245	69,725,770	

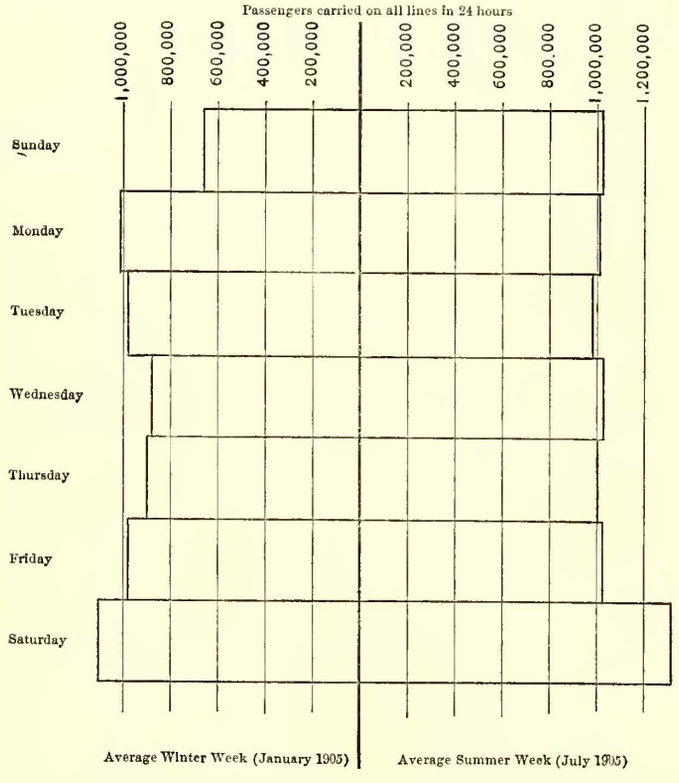


DIAGRAM SHOWING BY DAYS PASSENGERS CARRIED ON ALL LINES DURING AN AVERAGE WEEK IN WINTER AND IN SUMMER

TABLE VIII.—SHOWING THE VARIATION IN PASSENGERS CARRIED FOR AN AVERAGE WINTER WEEK AND AVERAGE SUMMER WEEK, ALL LINES.

	Passengers Carried (Winter Week) January, 1905.	Passengers Carried (Summer Week) July, 1905.
Sunday	667,018	1,092,767
Monday	1,017,024	1,077,112
Tuesday	983,323	986,376
Wednesday	884,658	1,081,882
Thursday	917,730	1,013,753
Friday	969,365	1,048,570
Saturday	1,103,777	1,335,376

Table VIII. gives the daily variation of passengers carried by all lines for an average winter week and an average summer week. It will be seen that the day of least travel in winter is Sunday, and in summer is Tuesday. The heavy traffic on Sunday in summer is an indication, of course, of the amount of excursion or pleasure traffic which occurs on that day. In both weeks a large traffic is indicated on Saturdays and Mondays, with Saturday showing the highest figure. The latter fact is partly accounted for by the fact that Saturday is a half-holiday in many offices, banks and business offices, especially in summer, and many persons use this period for excursions. The larger traffic figures of both days is also largely attributable to the fact that most wage-earners receive their pay on Friday night or on Saturday, and this makes it possible for their families to do their purchasing either on Saturday or the following Monday. The other variations have no great significance, and are undoubtedly due to the weather or other local conditions which influence passenger travel. A greater aggregate of travel is shown in summer than in winter. This is due entirely to the pleasure travel, as the lines which cater to business and shopping travel, like the Twelfth Street and Sixteenth Street line, show a decrease during the summer months on account of the absence from the city of a large number of business men and their families.

HISTORY, ORGANIZATION AND FINANCIAL CHARACTERISTICS OF THE PHILADELPHIA RAPID TRANSIT COMPANY

To begin at the beginning of transportation matters in Philadelphia, it is necessary to trace back to the period from 1792 to 1814, during which time there were built several turnpike toll roads from Philadelphia to outlying towns. A number of the franchises of these old turnpike companies were afterward utilized for the construction of street railway lines. In 1830, the area of Philadelphia, which had not been enlarged since the grant of the original charter by Penn, embraced about two square miles and contained a population of about 80,000. As the place grew in size, the citizens demanded quick, regular and cheap conveyance from the business centers to the outskirts of the city. This demand was felt and recognized as early as 1831, and in that year the first regular horse omnibus line was established and made hourly trips from Schuylkill, Seventh and Chestnut Streets down Chestnut Street to the Merchants' Coffee House in Second Street. The line was known as "Boxall's Accommodation," but it was not a paying venture and its life was short. The next attempt was the inauguration of a regular omnibus line in 1833, which accommodated travel between the navy yard and Kensington by way of Second Street and Beach Street; this line flourished. New omnibuses were added and other routes were established, and in a short time a regular omnibus service was running on all the principal streets. The fares at first were 10 and 12½ cents, but these were soon reduced to 6 and, in some cases, to 5, 4 and 3 cents, where competition was keen. For 23 years these vehicles were the only regular means of local travel.

The first horse railway operating vehicles over a permanent track was introduced in 1858 by the Philadelphia & Delaware River Railroad, which was first incorporated to build a steam road from Kensington to Easton. Failing to carry out their plans for constructing a steam railroad, the promoters conceived the idea of utilizing the Philadelphia end of their project as a horse railway, in accordance with the experiments with horse traction which had already been successfully carried out on the New York & Harlem Railroad in the city of New York. Under new charter rights, the road was extended to Frankford (now an important section of the city of Philadelphia), and in 1861 the title of the company was changed to the Frankford & Southwark City Passenger Railway Company. The first lines were laid in Fifth and Sixth Streets and to Frankford. The first horse car ran Jan. 21, 1858.

The success of this project led almost immediately to the establishment of similar passenger railways on other streets, and in 1858 and 1859 some fifteen or twenty companies were organized and built tracks. Cars began running on Market Street to Eighth Street in July, 1858; on Tenth and Eleventh Streets on July 29, on Race and Vine Streets on Sept. 28, and on Spruce and Pine Streets on Dec. 4 of the same year.

The entrance of so many independent street railway companies into the comparatively restricted area of the city, as then constituted, almost immediately developed a strenuous and disastrous competition for business, and at the outset it became evident to the promoters of the various enterprises that the life, to say nothing of the financial profit, of all the companies required some kind of a working agreement or alliance if any of the companies was to retain its existence. This recognition of the futility of useless competition, as early as 1859, resulted in a call, which was issued by James Verree, president of the Second and Third Street Passenger Railway Company, inviting the presidents of all the other companies to meet at his office for the purpose of considering matters of interest pertaining to passenger railways. This meeting resulted in the formation of a Board of Presidents of street passenger railway companies, in which ten separate companies were represented at the outset, but which gradually included the presidents of most of the other companies. This alliance was in effect a working agreement as to rates of fares, transfers and other details of operation. The board remained in active existence until the formation of the Union Traction Company, in 1895, when the policy of unity which it had been created to maintain was perpetuated by actual merger of the various corporations.

During the early period of horse railway operation, the fare was 5 cents for any distance over the lines of the respective companies. After a number of the crosstown roads had been built, a system of exchange tickets was devised by which passengers might be transferred from the lines of one company to those of another. At first the rate for an exchange ticket was 7 cents, but about the time the Civil War broke out, in consequence of the high price of horse feed, the single fare was increased to 7 cents and the charge for exchange tickets to 9 cents. At a later period the single fare was reduced to 6 cents. In a later year the present system of straight 5-cent fares and a charge of 8 cents, or 3 cents extra, for an exchange ticket, was inaugurated.

The institution of free transfers on any of the lines was made on Jan. 1, 1880, at which time the Union Passenger Railway Company consolidated several of the independent roads and established a system of free transfers over all of the branch routes included in the united system. At that time the longest ride was about 5 miles. The transfers were printed in different colors, one color for each day for eight days, so that the same color did not come on the same day of the week for 56 days. The transfers were not bound in pads, but the conductors carried them loose in their pockets and there was about 40 per cent of waste. The pad system was started ten years ago, in July, 1895. Some of the earlier forms of transfers and exchange tickets are reproduced on the next page as a matter of historic interest.

The following table shows the results of operation for all of the companies and gives an idea of the street railway situation in the city up to the year 1890.

TABLE IX.—STATEMENT OF MILEAGE, PASSENGERS CARRIED AND GROSS EARNINGS OF ALL STREET RAILWAY COMPANIES IN PHILADELPHIA FOR SEVERAL YEARS.

Year.	Miles of Track	Passengers Carried.	Gross Receipts.
1870	205	59,020,618	$3,662,066
1875	311	87,205,387	5,615,885
1880	359	99,045,515	5,251,375
1885	381	117,171,681	6,524,740
1890	403	164,458,842	7,869,659

SUNDAY CARS

The development of transportation matters in Philadelphia was marked by a number of incidents which in the light of present day ideas seem rather humorous. For instance, for a number of years the street cars were not run on Sundays. Efforts made by one of the companies to run Sunday cars resulted in a lawsuit, and not until 1867, when the Supreme Court handed down a decision to the effect that the running of a railway car on Sunday was not a breach of the peace, were street cars operated on every day in the week.

THE RACE QUESTION

While the contention over the question of Sunday cars was going on, another issue appeared that aroused new discussions. This was the question of the admission of negroes to the same cars occu-

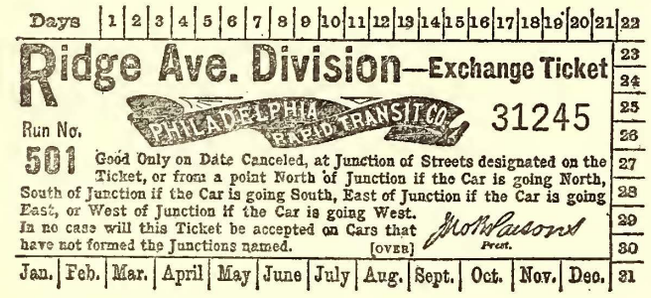
pied by white people. As Philadelphia was virtually a Southern city, the race question was a lively one, and from the first colored people were denied the privilege of riding in the cars. After the Civil War, however, the sentiment in this regard began to change, and in 1867 an act was passed by the Legislature admitting colored people to the street cars on equal terms with their white neighbors.

INTRODUCTION OF MECHANICAL TRACTION

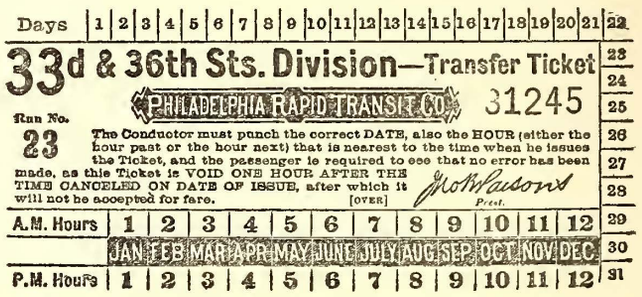
Up to the year 1885 all of the passenger railways in the city were operated with horse traction. The growth of the city and the increase in traffic soon brought about an imperative demand for better means of propulsion, and all of the companies began to give serious attention to several forms of mechanical traction which were then just beginning to be discussed. About this period a number of cable roads had been laid down in different cities and the cable seemed to promise the best solution of the transportation problem in large cities. The first company to change from horses was the Philadelphia Traction Company, and in 1885 a cable line was laid down on Market Street. The first installation was rather crude, the roadbed being laid with 40-lb. tram rail. The following year the cable system was extended to several other lines, although it was not generally adopted throughout the city. In 1890 three or four of the companies made thorough experiments with various forms of storage battery cars, which were then receiving considerable attention in New York and other large cities, but no permanent results were secured from this form of traction. By 1891 and 1892 electrical operation with the overhead trolley had been demonstrated as feasible and economical in several cities, and the companies in Philadelphia soon recognized that this was the coming system for passenger railways. In 1892 the Philadelphia Traction Company equipped one of its lines with electricty, and the results were so successful that all of the companies began to substitute electricity for horses, and by the end of the last decade practically all of the lines had been changed over.

THE STRIKE OF 1895

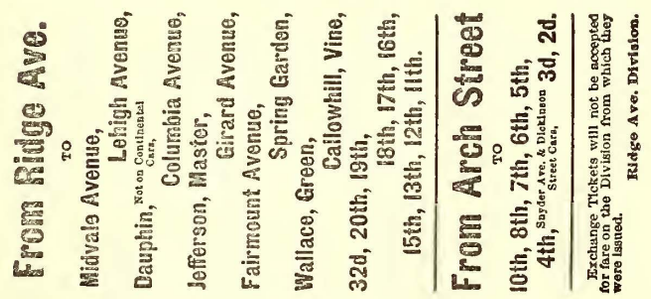
The close of the year 1895 was marked by an unfortunate conflict between the company and its employees, brought about ostensibly by failure to agree on questions of hours of work and pay. However, the real point at issue was the question as to whether or not the company should be permitted to assume the full responsibility of operating its lines without dictation from outside agitators. Failing to secure recognition of their organization, the men inaugurated a general strike on the morning of Dec. 17. The company repeatedly agreed to meet a committee of the employees, as such, and adjust all differences, but firmly adhered to its original refusal to treat with outside organizations. On the morning of the strike, a few cars were run under police protection, but by night-fall the company decided to call in its cars in order to avoid rioting. On the following morning more cars were placed in service, and by the third day the company was able to assume its schedules with some degree of regularity. Late on Friday night the strike was declared off, but it was renewed again on Saturday, when the company refused to reinstate some of the leaders in the strike movement. For three days more the people of Philadelphia were required to suffer the inconveniences of disordered schedules and were kept in constant apprehension of violence. At the end of this period, however, the company and its men came to an agreement on the matter of hours and pay and, although attempts were made by some of the discredited leaders to renew the strike, within a short time the situation quieted down to normal conditions.



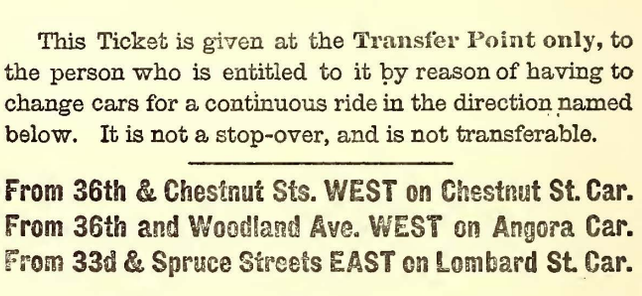
FACE OF SAMPLE EXCHANGE TICKET USED IN PHILADELPHIA



FACE OF SAMPLE TRANSFER TICKET USED IN PHILADELPHIA



REVERSE SIDE OF EXCHANGE TICKET



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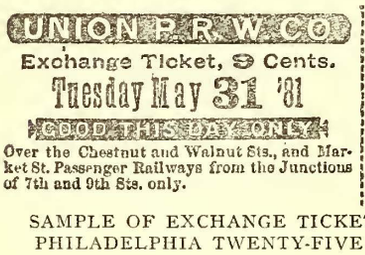
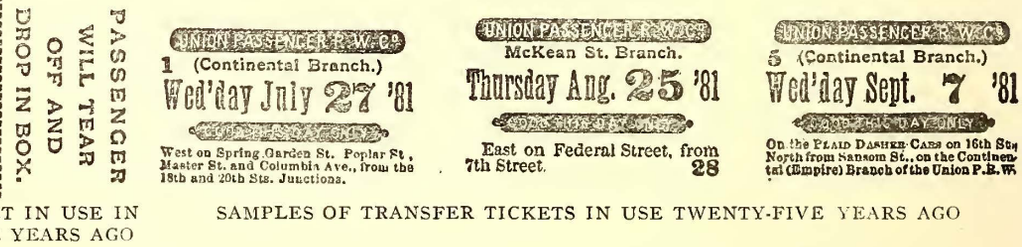


SAMPLE OF EXCHANGE TICKET IN USE IN PHILADELPHIA TWENTY-FIVE YEARS AGO



SAMPLES OF TRANSFER TICKETS IN USE TWENTY-FIVE YEARS AGO

CONSOLIDATIONS AND FAMILY TREE

In the meantime, the work of merging the various independent companies into larger systems was going on and, as will be noticed from the "Family Tree" accompanying this article, the number of companies gradually decreased, until the street railways of Philadelphia and the suburbs were controlled by practically four great systems, the People's Traction, the Electric Traction, the Philadelphia Traction and the Hestonville, Mantua & Fairmount Passenger. In 1895-6 the first three of these controlling companies were merged into the Union Traction Company, and in 1898 the fourth, known as the Hestonville system, was also absorbed, thus bringing all the properties under one management. The Philadelphia Rapid Transit Company was incorporated under the laws of Pennsylvania on May 1, 1902, and immediately acquired by lease all of the properties controlled by the Union Traction Company. Since that time the parent company has secured franchises for surface railways on certain streets not covered by the Union Traction system, and for elevated and underground railways on several principal streets of the city. The result of these consolidations gives the company complete control of the entire transportation systems of Philadelphia. In 1898 the Union Traction Company had in operation about 448 miles of track. Keeping pace with the growth of the city, new lines have been built and extensions made to existing lines, increasing the total trackage operated to about 545 miles at the present time.

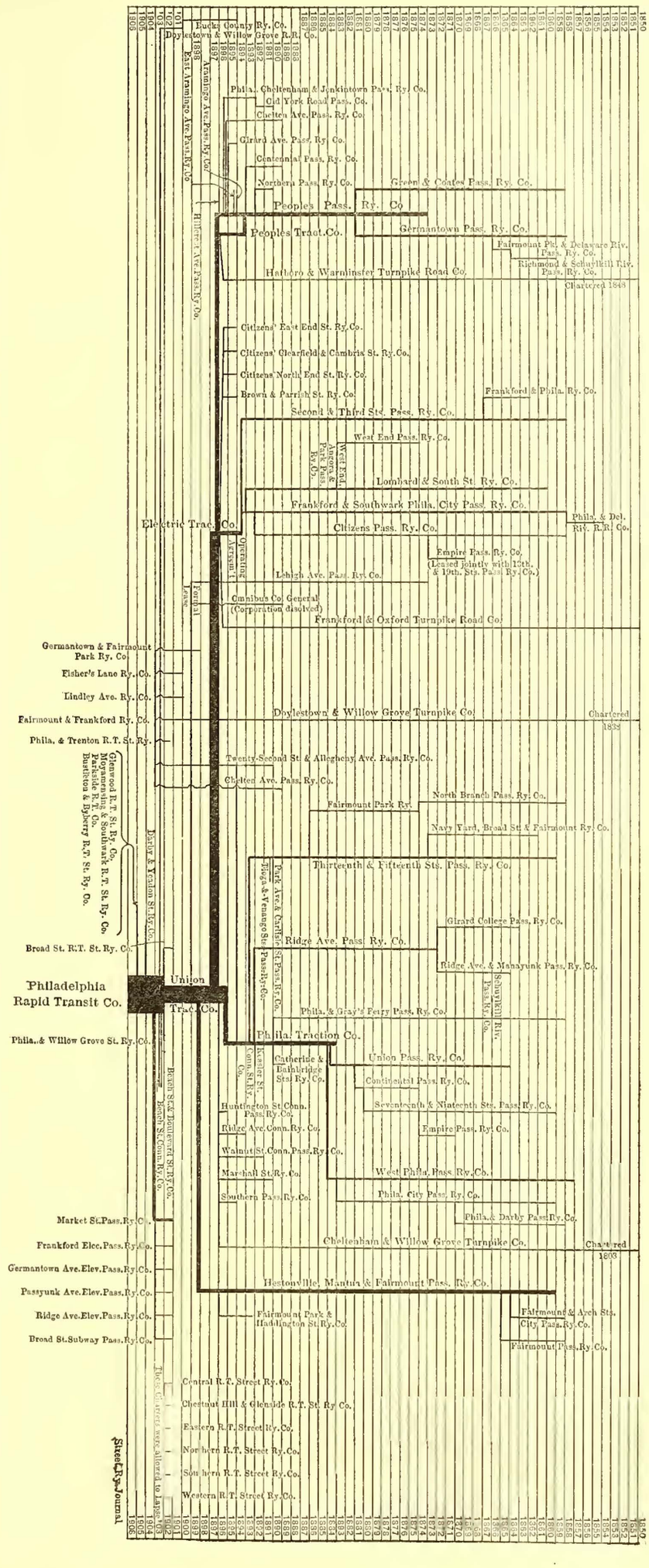
Practically all of the mergers of the underlying companies have been on the basis of long-time leases at guaranteed rentals on sliding scales. These leases were assumed by the Union Traction Company, and have since been assigned to the Philadelphia Rapid Transit Company.

The Philadelphia Rapid Transit Company has an authorized capital of $30,000,000, divided into shares of $50 par value. Prior to 1905, $15 per share had been paid in. On Jan. 20, 1905, a call of $5 a share was made, and last August an additional payment of $5 per share was due. The company has no funded debt of its own, but has assumed the leases and payment of interest on the underlying securities of the Union Traction Company and of the subsidiary companies.

EXCHANGE TICKETS AND TRANSFERS

The system of selling exchange tickets is a distinguishing feature of street railway transportation in Philadelphia, and is a concession made to the riding public of the city and suburbs as a result of the consolidation of the various independent lines under one management. Before the final merger, a passenger wishing to go from one portion of the city to another frequently had

FAMILY TREE OF PHILADELPHIA RAPID TRANSIT COMPANY, SHOWING DATES OF INCORPORATION AND DATES OF MERGERS OF ALL UNDERLYING COMPANIES



to pay two, or sometimes three, 5-cent fares to reach his destination. Several years before the actual consolidation, a number of the independent operating companies, by joint agreement, issued what were known as "exchange tickets" between connecting lines, for a charge of 3 cents in addition to the 5-cent fare, giving a continuous ride for 8 cents. When the present management took over the various independent properties many of the routes were rearranged, enabling passengers from virtually every part of Philadelphia to reach the downtown districts for a single 5-cent fare. If a passenger wishes to pass through the central portion of the city and continue his ride in another direction, the system is arranged so that he may do so by paying 3 cents additional and taking an exchange ticket. The exchanges are printed in two colors, a light green for the east and west lines, and yellow for the north and south lines. The tickets are bound in pads of 100, and are issued by the conductors upon the payment of the fare. The tickets bear a double number, one indicating the run number of the conductor issuing the same, and the other the consecutive serial number for the particular run. At present there are four series of run numbers in use, corresponding to the old divisions prior to the last consolidation. When the conductor issues an exchange ticket he punches the day and month of issue, but tickets are accepted for passage at any time without regard to the time limit.

When the conductor sells an exchange ticket he registers one fare on the cash-fare register, and all exchange tickets collected are also rung up on the same register. At the end of the day's work, therefore, the conductor must turn in 5-cent cash fares or exchange tickets collected to the total amount of the register indication. He must also turn in an additional amount of cash equivalent to 3 cents for each exchange ticket sold. As before stated, the exchange tickets are numbered consecutively and the conductor is charged with the number of tickets delivered to him, when he commences his day's work. The difference between the number delivered and the number returned at the end of the day gives the total number to be accounted for.

Inasmuch as the exchange tickets are good until used, it is possible for the regular patrons of the street cars to secure transportation at an average cost of 4 cents for each ride, providing they care to take the trouble of buying an 8-cent exchange whenever they pay their fare. As a matter of fact, a considerable number of the regular riders make it a practice to buy these tickets whether they intend to use them immediately or not, and it is a frequent sight to see passengers when asked for fare produce a number of old exchanges and sort out the right one for the particular line on which they may be riding. To many managers this fact that patrons of the road can secure two separate and distinct rides for 8 cents may seem undesirable. The system has one good feature, however, which would not be possessed in a system of selling straight ride tickets for 4 cents each. This feature, and it is a very important one, is that in practice the 4-cent fare is available only to those persons who patronize the lines frequently and regularly, and this is the class that should be most favored by a street railway company if any distinction is made. The stranger in the city, as well as those who ride only occasionally and those to whom the reduction of one cent is no object, pay the 5-cent fare. The system is conducive to short-distance riding, as a person will very frequently ride on a car if he happens to have an exchange ticket good on that line, whereas if he had to pay a 5-cent cash fare he would be more inclined to walk.

In addition to the exchange tickets, the company has in force an extensive system of free transfers which has been carefully worked out, with the end in view of enabling suburban residents to reach the city for a single 5-cent fare. The transfer tickets are printed in red in order that they may be readily distinguished from the exchange tickets. The conductors do not register the transfers collected. The free transfer privilege has also been extended to certain lines on which the cars turn off at right angles to the general direction of travel, with the view of permitting passengers who wish to continue their ride in the same direction to do so without additional cost.

TABLE X.—SHOWING PASSENGERS CARRIED, POPULATION AND RIDES PER CAPITA IN PHILADELPHIA.

Year.	Passengers Carried.	Population.	Rides Per Capita.
1865	25,013,398	*600,000	41
1870	59,020,618	†674,022	87
1875	87,205,387	*750,000	116
1880	99,045,515	†874,170	113
1885	117,171,681	*950,000	123
1890	164,458,842	†1,046,964	157
1897	228,102,758	*1,220,000	187
1898	238,939,353	*1,244,348	192
1899	259,527,668	*1,269,021	204
1900	292,237,924	†1,293,697	226
1901	302,225,286	*1,318,330	229
1902	325,801,963	*1,343,003	240
1903	365,908,051	*1,367,676	268
1904	390,532,689	*1,392,349	288

* Estimated. † U. S. Census. ‡ Police Census.

TABLE XI.—SHOWING GROSS INCOME AND OPERATING EXPENSES, ALL LINES.

Year.	Gross Income.	Operating Expenses.	Ratio of Operating Expenses to Gross Income.
1896	$10,759,705	$5,707,435	.53
1897	10,907,451	5,260,583	.49
1898	11,236,437	4,619,375	.41
1899	12,036,266	4,793,366	.39
1900	13,249,819	5,624,898	.42
1901	13,431,680	5,836,185	.43
1902	14,118,158	6,402,338	.45
1903	15,436,573	7,234,893	.47
1904	16,096,363	7,993,315	.49

At the present time there are 68 different forms of exchange tickets and 70 different forms of transfers in use. The general design of the face and back of exchange tickets and transfers will be understood from the engravings on page 480. It will be noticed that on the back of each ticket is printed the names of the lines on which it will be accepted.

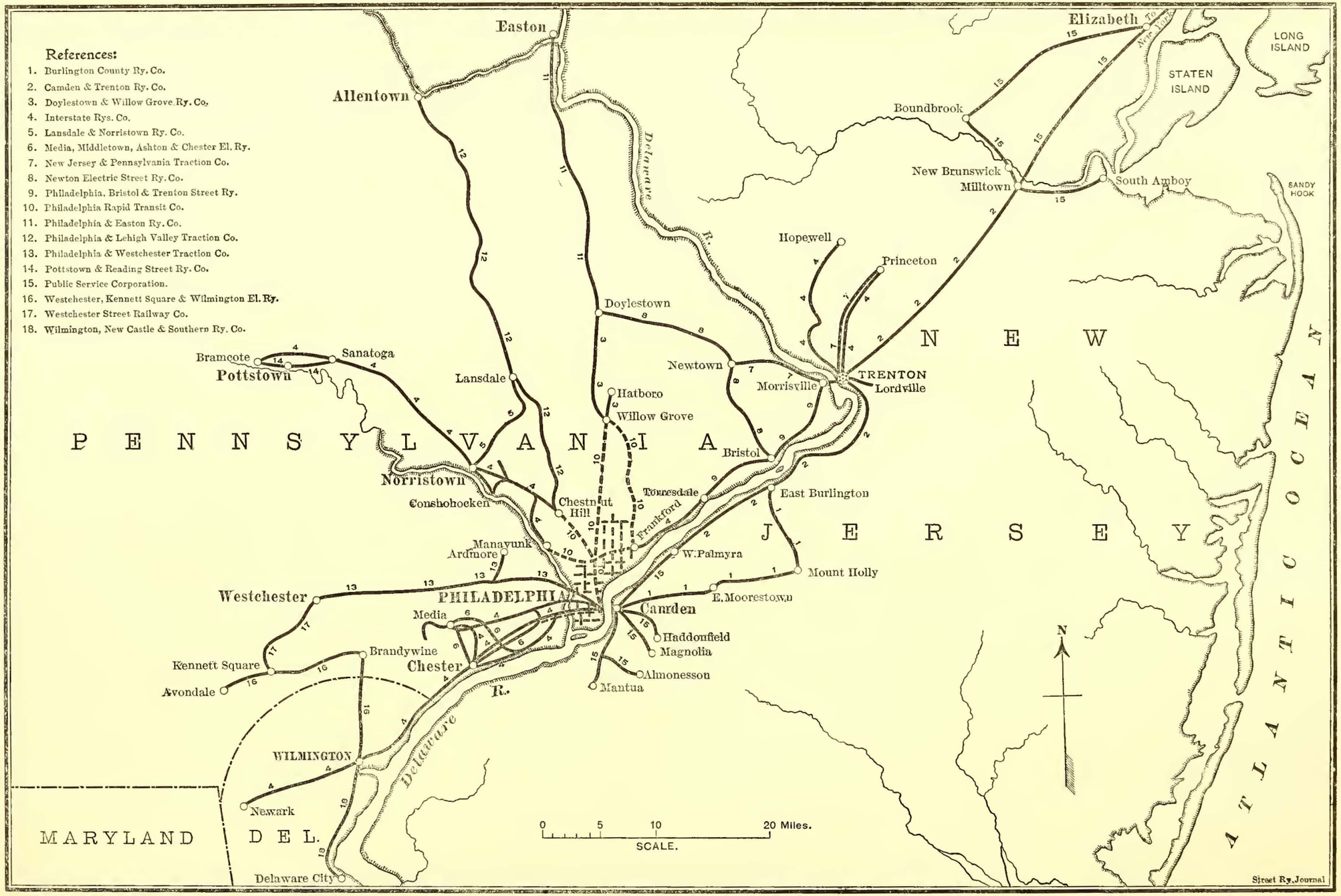
The relative proportion of number of exchanges, free transfers and cash fares will be understood from the following extract from the company's report for the year ending June 30, 1905:

Cash fares	143,798,644
Five-cent tickets	1,024,737
Number of transfers issued	31,699,934
Number of exchanges sold	111,717,048
Number of exchanges received	111,105,956
Frees	3,576,926
Total passengers carried	402,893,245

CONDITION OF EMPLOYEES

In the matter of generous consideration of the welfare of the men in its employ, the Philadelphia Rapid Transit Company is taking a broad and eminently fair attitude. Under the system of schedules as described elsewhere in this issue, no man is required to work in excess of eleven hours, and practically all of the regular employees are able to perform their day's work in approximately ten hours. The pay is in excess of $2 per day, and even the men on the extra list, by reason of the arrangement of schedules adopted, are able to make a good living wage, and for the majority of the extra runs the pay is the same as that of the regular men. The company has the welfare of its men sincerely at heart, believing that aside from philanthropic considerations, the interests of the company and its employees are identical, and the management is constantly working toward the end of creating a spirit of harmony and mutual good will between the corporation and its employees.

In view of this attitude, it is interesting to contrast the condition of the men at the present time and the situation as it was in the horse-car days. For instance, in 1885 the average pay for drivers was 12 cents an hour and the average time worked, accord-



MAP SHOWING ALL INTERURBAN ELECTRIC RAILWAYS RUNNING OUT OF PHILADELPHIA

ing to Bulletin 57 of the Bureau of Labor, was 15 hours, 11 minutes and 17 seconds. Of a total of 912 men, fifty worked 12 hours or less than 13, fifty worked 13 hours or less than 14, 155 worked 14 hours or less than 15, 372 worked fifteen hours or less than 16, 235 worked 16 hours or less than 17, and fifteen worked 17 hours or less than 18. Although these hours seem excessive, the day's work was no longer than in neighboring cities, as at the same time the average time of the drivers in Pittsburg was 15 hours, 41 minutes and 24 seconds. On the whole, the conductors worked slightly longer than the drivers in both cities, but the stable men a somewhat shorter time. To-day the average pay in Philadelphia is 20 cents an hour for both conductors and motormen and the day is 10 hours.

TAXES

Under the franchise and ordinance conditions now in force the company is paying to the city and State, in the form of taxes and paving charges, over 11 per cent of its gross receipts; and in this matter of taxes, it would appear that the company is doing its full duty to the municipality and Commonwealth.

In the form of direct taxation, the company pays to the city an annual car license of $50 for each car that it operates, and also an additional license fee of $50 on all cars that cross the various bridges over the Schuylkill River. As most of the routes cross one or another of these bridges, the company is paying into the city treasury $100 per car per annum on practically its entire rolling stock equipment.

The company also pays for many of the underlying companies a tax of 6 per cent on all dividends in excess of 6 per cent paid by these companies during the year. There is also a real estate tax of approximately $1.50 for each $100 of valuation on power houses, car houses and other properties owned by the company.

To the State the company pays a tax of 8 mills on the gross receipts of the entire property, a tax of 5 mills on the appraised value of its capital stock, and a tax of 4 mills on the par value of all loans and bond issues of all the underlying companies.

In addition to all these tax obligations, which last year amounted to $1,060,897, the franchises under which the roads are being operated require that the company must pave the entire surface from curb to curb on all streets upon which it has tracks. This includes not only laying the pavement, but maintaining it in good condition and renewing it when it is worn out. In case the company desires to renew its roadbed on any street or change the position of the rails, under these franchise conditions it is required to relay the entire paving, amounting in most cases to repaving the whole street, so far as the surface is concerned. The amount of pavement thus maintained by the company aggregates 6,685,000 square yards, of which about 4,300,000 square yards are belgian block, 1,500,000 square yards are asphalt, and the balance macadam, brick and cobble. In the company's books the expense of taking care of paving is charged to maintenance of way and not to taxes.

If to these charges are added the indirect taxes, such as the removal of snow and ice and the free transportation of firemen, policemen, and city officials, it would appear that the company is the largest single taxpayer in the county.

TABLE XII.—PERCENTAGE DISTRIBUTION OF GROSS RECEIPTS.

	Philadelphia.	New York.	Brooklyn.	St. Louis.	Boston.	Pittsburg.	Baltimore.	Minneapolis.	Average of United States
Year ending	June 30, '04.	June 30, '04.	June 30, '04.	Dec. 31, '04.	Sept. 30, '04.	Mar. 31, '05.	Dec. 31, '04.	Dec. 31, '04.	June 30, '02.
Operating expenses	49.66	55.38	58.39	52.76	69.40	54.06	52.77	50.22	57.3
Taxes	6.59	5.42	4.98	4.88	7.44	4.07	} 41.18	21.03	5.3
Interest and miscellaneous deductions	42.38	45.58	27.40	24.52	16.49	45.13			26.6
Net income	1.37	.....	9.23	17.84	6.67	.....	6.05	28.75	10.8
Total	100.	106.38	100.	100.	100.	103.26	100.	100.	100.

TABLE XIII.—OPERATING EXPENSES IN CENTS PER CAR MILE.

	Philadelphia.	New York.	Brooklyn.	Boston.	Pittsburg.	Baltimore.	Minneapolis.
Maintenance of Way and Structures	1.47	1.17	1.08	1.72	1.83	1.83	1.40
Maintenance of Equipment	1.14	2.00	2.16	1.70	1.81	1.50	2.08
Operation of Power Plant	1.19	1.45	2.63	1.95	} 8.47	2.24	2.77
Operation of Cars	5.85	9.23	6.65	9.37		4.66	6.20
General	1.72	3.70	2.53	3.12	2.22	2.07	3.00
Total	11.38	17.55	15.05	17.86	14.34	12.30	15.46

PASSENGERS CARRIED AND RIDES PER CAPITA

Table X. shows the passengers carried, population of Philadelphia and rides per capita for all lines for five-year intervals from 1865 to 1890, and also for 1897 to 1904 by years. The early figures in this table for population were derived from a pamphlet recently issued by Chandler Brothers, bankers, of Philadelphia. The population for the even decades were obtained from the Census Reports. Those marked "estimated" were obtained by interpolation between the census figures. The diagram on page 485 corresponds to table X., and shows by years since 1897 the total receipts, number of passengers carried per day and rides per capita. As will be seen, the average yearly increase in receipts during the last seven years has been 7.6 per cent.

TABLE XIV.—PERCENTAGE DISTRIBUTION OF OPERATING EXPENSES.

	Philadelphia.	New York.	Brooklyn.	Boston.	Pittsburg.	Baltimore.	Minneapolis.	Buffalo.	*Seventeen Largest Companies
Maintenance of way and structures	12.97	6.67	7.16	9.61	12.79	14.89	9.08	8.25	8.1
Maintenance of equipment	10.01	11.42	14.32	9.53	12.65	12.22	13.48	8.89	12.8
Operation of power plant	10.42	8.23	17.50	10.94	} 59.09	18.19	17.92	15.46	12.7
Operation of cars	51.45	52.56	44.19	52.42		37.90	40.11	47.11	47.3
General	15.11	21.10	16.80	17.48	15.48	16.80	19.42	20.29	19.1
Total	100.	100.	100.	100.	100.	100.	100.	100.	100.

* For June 30, 1902.

GROSS RECEIPTS

Table XI. gives the report of gross receipts and operating expenses for all the Philadelphia lines. An analysis of the percentage distribution of gross receipts among operating expenses, taxes, interest and net income for Philadelphia, and as practiced in the seven other largest properties in the country from which such

STATUE OF BENJAMIN FRANKLIN IN FRONT OF POST OFFICE

CHESTNUT STREET, ABOVE NINTH STREET—THE BROADWAY OF PHILADELPHIA

PENNSYLVANIA RAILROAD BROAD STREET STATION, BROAD AND MARKET STREETS OPPOSITE CITY HALL

PHILADELPHIA & READING TERMINAL ON MARKET STREET

BROAD STREET LOOKING SOUTH FROM CITY HALL

THE LOOP AT FOOT OF MARKET STREET, NEAR ENTRANCE TO CAMDEN FERRIES

CORNER OF EIGHTH AND MARKET STREETS, LOOKING NORTH ON EIGHTH STREET—ONE OF THE CITY'S BUSY INTERSECTIONS

figures are obtainable, is presented in Table XII. The figures for New York and Brooklyn represent the operation of the New York City Railway Company and of the Brooklyn Heights Railroad Company, as reported to the Railroad Commissioners, and not of all the lines in the respective territories. The final column in this table presents the average for all the companies in the United States not doing a lighting business.

The examination of this table reveals immediately two very interesting facts. The first is that Philadelphia is the only city among those selected in which an operating ratio of less than 50 per cent obtains, and that it has an operating ratio of 7.6 points less than the average rate in the United States. This of itself is a distinction of which any company might be proud, coupled as it is with the fact that the ratio has been less than 50 per cent ever since 1897, or for eight years. Such a fact immediately stamps the Philadelphia Rapid Transit Company as a corporation whose methods are worthy of the most careful study, and which, in the opinion of the editors of this paper, justifies the devotion of an entire issue of the STREET RAILWAY JOURNAL to a consideration of its methods and policies.

Another striking feature of the report is the fact that the fixed charges of the Philadelphia Rapid Transit Company, including taxes, amount to practically 49 per cent of its gross receipts. When the Union Traction Company, the predecessor of the Philadelphia Rapid Transit Company, was organized it assumed

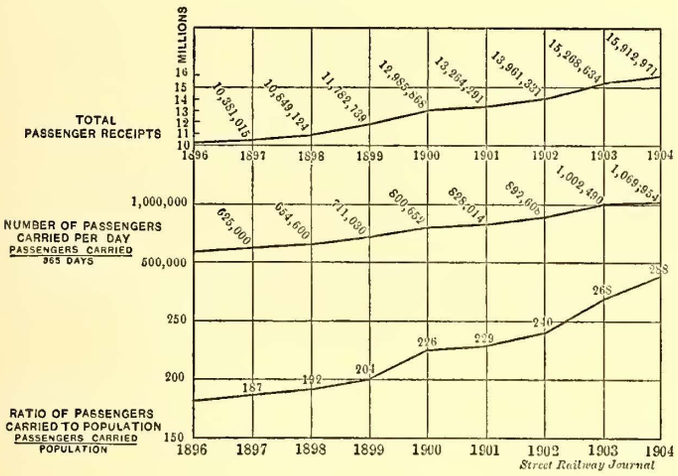


DIAGRAM SHOWING RECEIPTS, PASSENGERS CARRIED AND RIDES PER CAPITA FOR LAST EIGHT YEARS, ALL LINES

such a very large amount of obligations than many predictions were made that the company would never be able to carry them out. Moreover, a number of the underlying companies were leased on a sliding scale, so far as guaranteed dividends were concerned, which still further emphasized the gloomy prognostications of those who took an unfavorable view of the company's financial future. Many of the same forecasts were repeated in 1903, when the lease of the Union Traction Company to the Philadelphia Rapid Transit Company went into effect, especially as the dividend guaranteed on the Union Traction stock increased on a gradually-increasing amount, commencing with $1.50 per share in 1903, and ending with $3 in 1909, after which it continues at this figure. Nevertheless, the company has been able to earn a net income ever since its organization. The subsidiary companies, which were leased on a sliding scale, have all, with the exception of the Union Traction Company, now reached their maximum rental basis. The only additional charges on the system, outside of the Union Traction stock assumed by the new company, have been $1,480,000 on Union Traction collateral trust 4s; 500,000 on Doylestown & Willow Grove 4s, and $1,000,000 on Philadelphia & Willow Grove 4½s, making a total increased yearly fixed charge of $124,000. For this reason, with the increased traffic, it is fair to assume that the percentage of fixed charges in proportion to the income will gradually decrease.

ANALYSIS OF OPERATING EXPENSES

From a study of the percentage distribution of gross receipts, the first step is naturally a consideration of the distribution of the operating expenses among the five main divisions of expenses. This is shown in Table XIII. The fiscal years are the same as those stated in Table XII., and the same cities are included, with the exception of one in which this division is not made public. As cost of operation varies largely with the wages paid, and as the latter is dependent to a considerable extent on the cost of living in each city, it is difficult to make comparisons from Table XIII. as to the relative amounts chargeable to the different items of expenses. For this reason, Table XIII. should be studied in connection with Table XIV., which gives the percentage distribution of operating expenses. In Table XIV., the final column gives the average for the United States during the year ending June 30, 1902, of the seventeen largest companies in the country. These companies, referring to them by the names they then bore, are: The Boston Elevated Railway Company, Cleveland Electric Railway Company, Cleveland City Railway Company, Interurban Street Railway Company, of New York; Third Avenue Railroad Company, of New York; Brooklyn Rapid Transit Company, United Railways & Electric Company, of Baltimore; St. Louis Transit Company, United Traction Company, of Philadelphia; Chicago City Railway Company, Chicago Union Traction Company, International Railway Company, of Buffalo; Crosstown Street Railway Company, of Buffalo; Cincinnati Traction Company, United Railroads of San Francisco; Jersey City, Hoboken & Paterson Street Railway Company, and North Jersey Street Railway Company, of Jersey City. The aggregate operating expenses of these seventeen companies were $56,809,980, or about two-fifths of the total operating expenses of all the street railway companies in the United States. The selection of these large city companies as an average for comparison is also more desirable than the average of all of the roads in the United States, because they are all strictly urban systems. The fiscal years covered in these two tables are the same as for those given in Table XII.

The first feature which will strike the reader from a study of Table XIII is that the operating expenses in cents per car-mile is less in Philadelphia than in other cities. Carrying the study still farther, it will be seen that, compared with most of the other cities, the saving is in the last four items on the list, and not in maintenance of way and structures. This is due largely to the fact that the Philadelphia company has carried on for the last few years an extensive amount of track reconstruction, which has been charged into this first item, and also that its expenses for paving are charged to this account. The cost of operation of cars per car mile is lower than the same item in any other city except one. Comparing the items with that of the average of all large cities, as shown in Table XIV., the items for Philadelphia which are larger are maintenance of way and structures, and operation of cars. Those smaller are maintenance of equipment, operation of power plants and general. These later items are those which are most susceptible of reduction by very careful management. On the other hand, the cost of maintenance of way and structures depends largely upon the policy of the company in this respect, while that of operation of cars depends more upon the average wages in the district covered and in the speed of the cars than in any other two factors.

It would be most interesting to compare the cost of "operation of cars" in Philadelphia and other cities on the car-hour basis, as this is really the only proper unit to use in a final analysis. Unfortunately, very few of the companies in this country publish reports giving this figure, and the average for the United States or for any group of roads on the car-hour basis has not been worked out by the census authorities. The car-hour basis is employed by the Philadelphia Rapid Transit Company, however, and, in the year ending June 30, 1904, the company ran 9,193,971 car-hours. The passenger earnings per car-hour were $1.7368, and

the miscellaneous earnings per car-hour were $0.0153, making gross earnings per car-hour of $1.7521; the operating expenses per car-hour were $0.87. The detailed figures of operation of cars per car-hour in Philadelphia is given in Table XVI.

Table XV. presents a distribution of operating expense per car-mile for the five largest companies in the country, whose reports on this subject are matters of public record, viz.: Philadelphia Rapid Transit Company, New York City Railway Company, Brooklyn Rapid Transit Company, Boston Elevated Railway Company, and the International Railway Company, of Buffalo. The fiscal years in each case are for those ending June 30, 1904, with the exception of Boston, which is for the year ending Sept. 30, 1904, and the figures in all these cases are taken from the reports of the Railroad Commissioners. Owing to the form of accounts required by the Massachusetts Railroad Commission, by which all of the expenses of power, including maintenance, are grouped together, a satisfactory comparison cannot be made of the power figures of this city with those of other large cities. The New York power figures are also affected by the fact that a considerable amount of power is sold. For this reason, a proportional reduction has been made in the case of this company in this table, as well as in Tables XIII. and XIV.

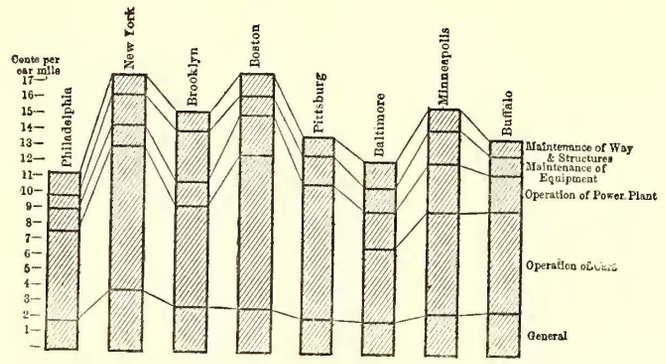


DIAGRAM SHOWING EXPENSES PER CAR-MILE

The final two columns in Table XV. give the distribution of operating expenses in percentages of the total for the Philadelphia Rapid Transit Company and for the seventeen largest companies already mentioned. This table presents some very interesting comparisons.

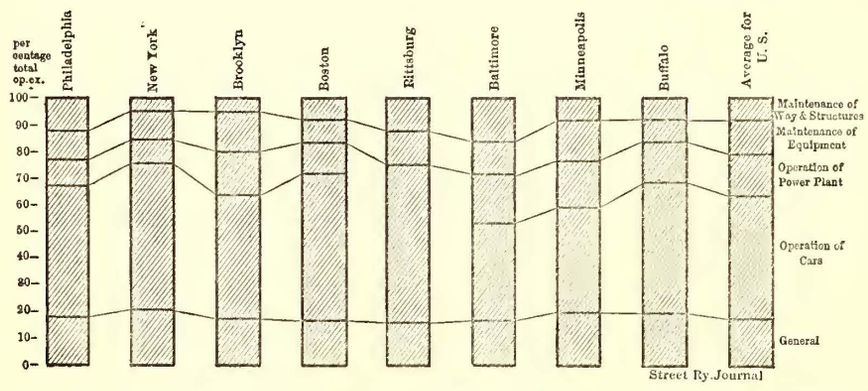


DIAGRAM SHOWING PERCENTAGE DISTRIBUTION OF OPERATING EXPENSES

TABLE XVI., SHOWING TRANSPORTATION EXPENSES PER CAR-HOUR, PHILADELPHIA RAPID TRANSIT COMPANY

Wages of conductors	19.89
Wages of motormen	19.92
Wages of miscellaneous car service employees	1.39
Wages of car house employees	1.17
Car service supplies, cleaning and sanding tracks	2.39
Removal of ice and snow	.14
Total	44.90

SOME OPERATING FACTORS

The remarkable showing in Philadelphia can be attributed largely to a number of causes. The first and foremost of these must undoubtedly be the excellent organization which the company possesses. This alone could not account for the situation as it is found in Philadelphia, but the fact remains that there is a remarkable esprit du corps among the officers and employees of the Philadelphia Rapid Transit Company, from the president down, which manifests itself in a constant endeavor to secure the best results possible in every branch of the work. Undoubtedly this condition has been brought about largely by the policy of the company in retaining the services of its ablest men, and in making most promotions in its service from the ranks. There are two policies which may be followed in the management of any large industry or transportation corporation. One is to take men from outside for responsible positions, and this policy is often accompanied by one of frequent or fairly frequent changes in officials occupying responsible positions. The other policy is that of giving the preference to the older men in a company whenever there is any opening for advancement. Arguments can be cited in favor of each method, but the fact remains that it always takes a new man some time to become acquainted with local conditions, especially in a street railway system, and that, other things being equal, the older man will give the best service. This, at any rate, has been the general policy adopted by the Philadelphia Rapid Transit Company, and there is hardly a head of any department in Philadelphia who has not been connected with the system for ten or twelve years, while some of those who occupy the most responsible positions have been connected with street railway service in Philadelphia during practically all of their active lives. This condition has obtained in spite of the fact that during the last fifteen years there have been a large number of consolidations, and at least three different active presidents.

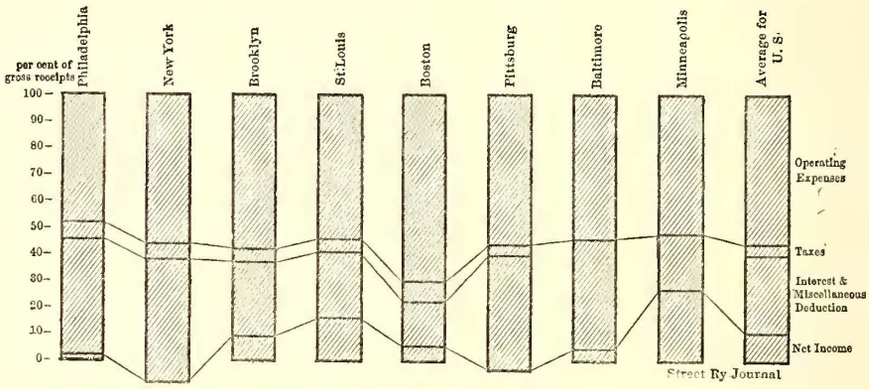


DIAGRAM SHOWING PERCENTAGE DISTRIBUTION OF GROSS RECEIPTS

Other reasons which have tended to bring about this remarkable result are described in detail in the pages which follow this article, and which are intended to be a summary of the practice in operating methods of the Philadelphia Rapid Transit Company. Two, which, although important, can be summarized briefly, will be described below, leaving the more extended discussions of the different branches of work to separate articles. These are the system of fire insurance, which was established in 1895, and the method of providing for depreciation.

FIRE INSURANCE

The Philadelphia Rapid Transit Company carries its own fire insurance, covering all its properties, rolling stock and equipment. When the Union Traction Company was organized in 1895, it was deemed feasible, owing to the wide territory over which its properties extended, for the company to assume its own fire risks by setting aside a certain amount of the original capital to be invested as a nucleus from which to start a fire insurance fund. Accordingly, the sum of $250,000 was set aside and invested in the securities of some of the underlying companies. The directors of all the lesser companies agreed to accept the fund as sufficient guarantee for the clause in their leases, which compelled the lessee company to insure their properties in fire insurance companies of recognized standard. A statement was prepared showing the amount of premium which the company would naturally be required to pay to insurance companies for the same insurance, and agreements were made whereby one-twelfth of this amount was to be set aside monthly as a fund from which to pay fire losses. This is not merely a book credit, but each month a check is properly drawn and deposited to the credit of the fire insurance fund. Since the inception of this arrangement a considerable sum has been accumulated, and from time to time is invested in underlying securities of the parent company. At the end of the fiscal year ending June 30, 1904, the fire insurance fund consisted of the following:

3650 shares Philadelphia Traction Company stock;
4674 shares Union Traction Company stock;
$100,000 Electric and People's 4 per cent stock trusts;
$20,000 Union Traction Company 4 per cent collateral trust mortgage gold bonds;
$420,000 in first mortgage on real estate;
$1,437.60 in ground rents and $47,393.71 in cash.
Total valuation, $1,154,427.98.

Up to the end of the last fiscal year, fire losses aggregating $75,522.26 have been paid out of this fund.

Comprising an important factor in this general scheme of self-insurance is a thorough and systematic inspection of all the properties covered in the insurance fund, with the end in view of preventing fires. If anything, this inspection is more thorough than the usual inspections specified by the old-line insurance companies. The company employs two inspectors whose entire time is devoted to visiting the various car houses, power houses and buildings of every sort in regular and frequent rotation, and whose duty it is to report in minute detail the condition in which all premises are found. They are also charged with the responsibility of calling attention to any irregularities or conditions that might increase the fire hazard. The inspectors make daily report to the general manager on a blank which includes some fifty questions, each one of which calls for an answer touching some detail in relation to the fire risk.

In addition to these rigid inspections, once every six months an outside expert examiner is engaged to make an independent inspection of all the properties. His reports serve the purpose of checking the work of the company's regular inspectors, and his recommendations in the line of reducing risks of fires are given most careful consideration.

At all of the principal buildings owned by the company the precautions against fire include the placing of hose and other flame-fighting apparatus at advantageous points, and the designating of these points by notices painted on the walls near each piece of apparatus, which notices also emphasize the necessity for keeping these locations free from accumulations of dirt and rubbish that would interfere with the prompt handling of the fire-fighting equipment.

TABLE XV.—DISTRIBUTION OF OPERATING EXPENSES.

	Per Car Mile.					Percentage of Total.	
	Phiadelphia.	New York.	Brooklyn.	Boston.	Buffalo.	Philadelphia.	Seventeen Largest Companies.*
Maintenance of Way and Structures:							
Track and roadway	1.135	.620	.550	1.130	.904	9.97	5.2
Electric lines	.273	.457	.281	.353	.181	2.40	2.2
Building and Equipment	.067	.093	.247	.233	.063	.59	.7
Maintenance of Equipment:							
Steam plant	.087	.097	.209	(‡)	.039	.76	.9
Electric and cable plant	.024	.110	.120		.036	.21	.8
Cars	.582	.850	.710	.....	.587	5.11	6.2
Electric equipment of cars	.406	.940	.692	1.012	.467	3.57	3.8
Miscellaneous equipment	.039	.035	.150	.673	.037	.34	.5
Miscellaneous shop equip.	.....	.....	.273	.016	.067	.....	.6
Operation of Power Plant:							
Power plant wages	.232	.327	.625		.216	2.04	2.7
Fuel for power	.920	.951	1.602		.267	8.08	7.2
Water for power	.009	.108	.186	1.953	.004	.08	.5
Lubricants and waste	.014	.059	.032		.011	.12	.2
Miscellaneous supplies	.012		.092		.007	.10	.3
Hired power	.....	.....	.096		1.637	.....	1.8
Operation of Cars:							
Superintendence of Transportation	.....	.749	.362		.253	.....	2.4
Wages of conductors	2.594	6.469	2.326	8.096	2.357	22.79	18.8
Wages of motormen	2.597		2.281		2.265	22.82	18.6
Wages of miscellaneous car service employees	.334	.545	1.166		.935	2.93	2.1
Car service supplies	.312	.176	.062	.085	.092	2.74	4.8
Miscellaneous car service expenses		.063	.216	.364	.253		
Cleaning and sanding track		.002	.038	.....	.100		
Stable equipment	.....	1.018	†.038	.050	§.005		.....
Removal of ice and snow	.018	.205	.157	.589	.268	.16	0.6
Station and signal expenses and cleaning tracks	.....	.....	.....	.187	.....		.....
General:							
Salaries of general officers and clerks	.189	.279	.300	.432	.436	1.66	2.5
Printing and stationery	.039	.....	.023		.041	.34	.3
Miscellaneous office expenses	.041	.145	.044		.044	.36	.4
Store expenses and advertis'g	.....	.....	.041	.654	.104	.....	.2
Stable expenses	.015	.....	.....		.046	.13	1.4
Miscellaneous gen'l expenses	.180	.025	.065		.157	1.58	1.3
Damages	.967	1.669	1.239	1.165	1.556	8.49	7.8
Legal expenses in connection with damages		1.018	.423	.527	.066		2.3
Miscellaneous legal expenses	.070	.091	.070		.070	.61	.7
Rent of buildings	.006	.059	.016	.102	.071	.53	.3
Rent of track and terminals	.....	.228	.039	.018	.....	.....	.6
Insurance	.213	.191	.266	.224	.223	1.87	1.2
						100.	100.

* For June 30,1902. † Freight, mail and express. ‡ Included in transportation § Hired equipment.

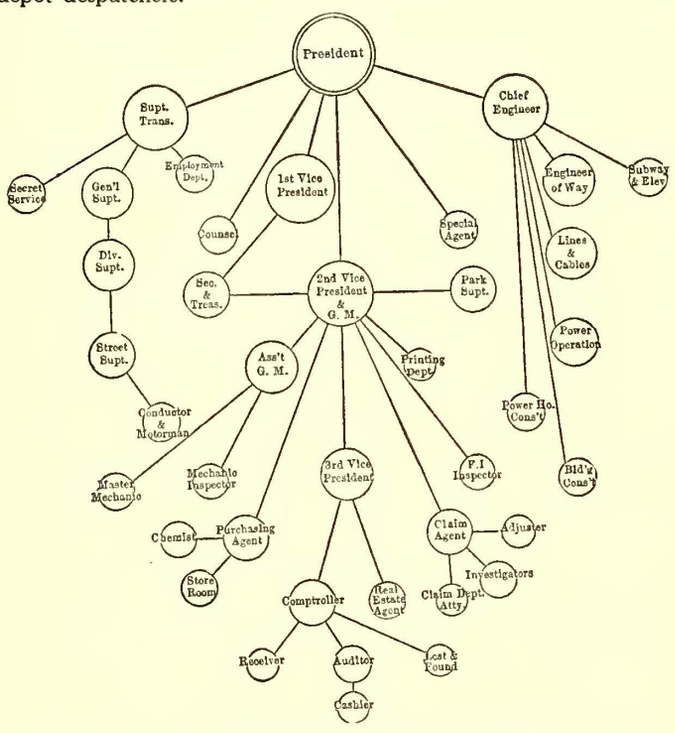
DEPRECIATION RESERVE

The Philadelphia Rapid Transit Company is one of the few companies in the country which charges off at stated periods certain amounts for depreciation and places them in the reserve fund. This plan was inaugurated in 1898 and has been continued regularly ever since. A division is made in the depreciation fund between the three heads of depreciation of roadway and track, power account, and an accident or damage fund. The amounts charged off for these three items at the present time are respectively 7 per cent of the gross receipts for the roadway and track item, 6 per cent for the power account, and 5 per cent for the damage account. The charges to depreciation account are not carried in the balance sheet, but the amounts are expended each year, and charged up to operating expenses.

OPERATING METHODS IN PHILADELPHIA

OPERATING ORGANIZATION

As will be noticed from the organization diagram published in this connection, the head of the operating department is the superintendent of transportation, who reports directly to the president. The superintendent of transportation has direct charge of the secret service and the employment bureau. The actual operating force is headed by the general superintendent, who reports to the superintendent of transportation. Under the general superintendent there are seventeen division superintendents and forty street superintendents who represent the division superintendents on the street, and are responsible for the maintenance of schedules, conduct of employees on cars and other matters coming directly under the operating department. These men perform the duties usually assigned in other cities to what are termed "street inspectors." A noteworthy feature of the operating organization is the fact that there are no regular despatchers at the depots for starting cars and crews on the runs. As told elsewhere in this issue, the posted schedules themselves cover all the duties usually performed by depot despatchers.



ORGANIZATION OF DEPARTMENTS, PHILADELPHIA RAPID TRANSIT COMPANY

President, John B. Parsons.
First V.-P., Geo. D. Widener.
Sec. and Treas., R. B. Selfridge.
Second V.-P. and Gen. Mgr., Chas. O. Kruger.
Assist. Gen. Mgr., F. H. Lincoln.
Third V. P., Alexander Rennick.
Compt., J. D. Hiestand.
Special Agent, Jas. J. Springer.
Chief Engineer, W. S. Twining.
Supt. Transportation, Jas. Bricker.
Gen. Supt., Walter Ellis.
Head of Secret Service, H. A. Bricker.
Head of Detective Force, H. C. Silcox.
Park Supt., Geo. C. Wynkoop, Jr.
Master Mechanics, Frank Wampler and R. G. Oliver.
Pur. Agt., W. L. Maize.
Chemist, L. Cass.
Storeroom Keeper, H. J. Nece.
Auditor, W. J. Kelly.
Receiver, R. L. Walker.
Cashier, Geo. C. Shelmerdine.
Head Clerk Lost and Found Dept., W. W. Dwier.
Real Estate Agent, Thos. B. Foote.
Claim Agent, S. L. Rhoades.
Asst. Claim Agent, H. L. Goshorn.
Supt. of Printing Dept., J. S. Skinner.
Engineer of Way, H. B. Nichols.
Assistant Engineer of Way, Geo. B. Taylor.
Assistant Engineer, C. B. Voynow.
Acting Supt. of Lines and Cables, Jas. Heywood.
Asst. Supt. Lines and Cables, E. E. Gilmore.
Supt. of Power Operation, Charles Hewitt.
Asst. Supt. Power Operation, E. O. Macfenan.
Supt. Building Construction, R. C. Heath.
Electrical Engineer, A. B. Stitzer.
Engineer Subway and Elevated, C. M. Mills.
Asst. Engr., Subway and Elevated. F. R. Fisher.

POSTING SCHEDULES

The method of making schedules and posting assignments to runs at the operating depots is somewhat unique. As far as this matter is concerned, the actual car numbers are disregarded and the cars are operated under what are termed "block numbers." For purposes of illustration, the "block number" may be defined as the day's work for a car, in distinction to a "run number," which represents a day's work for a crew.

After the headway for a given line has been decided upon for the entire twenty-four hours, the leaving times of the cars are plotted in chart form, as may be understood by reference to the accompanying time table. The trips to be made by each car during the day are arranged in columns, and this group of trips for each car is given a block number, which stands at the head of the particular column. It does not necessarily mean that the same car will run on the given block number all day, but in the event of a breakdown or any other cause, any car can be at once assigned to fill out any block run.

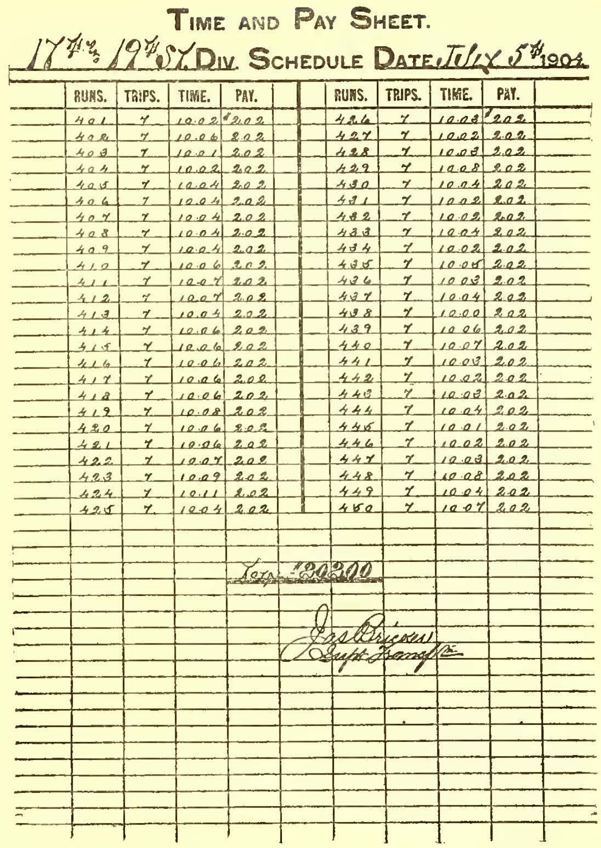
The runs for the car crews are based upon the block numbers; that is, each block number representing a day's work for a car, is divided into two, three or more sections, as the conditions may require, and the crews are assigned in accordance with these divisions. By reference to the accompanying time table, the system may be more clearly understood. For instance, a crew is assigned to run No. 401. By referring to the run guide, which is shown on the lower half of the time table (the time table for each run being posted in blue-print form at the despatching depot), the conductor and motorman find that the first part of their day's work is to be performed under first section of block 425. Referring then to the block numbers at the head of the columns in the upper half of the time table, they find that under block No. 425 the first car is scheduled to leave at 5:48. For this particular line the time necessary to make a round trip (as indicated by the time chart printed on the schedule) is 1 hour and 20 minutes. The crew would therefore be due back at the depot, after making the round trip, at 7:08. According to the second figure under the block No. 425, the next car under this block will leave at 7:18, thus giving in this particular instance a lay-over of 10 minutes. Starting out at 7:18, and taking 1 hour and 20 minutes for the round trip as before the car is due at the depot at 8:38, and the next leaving time, as shown by the third figure in the column, is 8:46. Taking 1 hour and 20 minutes as before the car is due back at the depot at 10:06. This completes the first section of block 425, as indicated by the heavy line drawn across the column. From this the crew understand that they have completed the first part of their day's work. Referring back to the run guide, they find that the second section of their day's work is to be performed under the second section of block 404. Referring as before to the block numbers in the upper part of the time table, the men understand that their next trip is to be made on the car scheduled to leave the depot at 11 o'clock. They, therefore, have a lunch relief from 10:06 to 11. Taking out their car at 11 o'clock, they make the round trip as before in 1 hour and 20 minutes, and are due back at the car house at 12:20. According to the next figure given in the column under block 404, the car on the next trip is to leave at 12:28, giving in this instance a lay-over of 8 minutes. The car makes this run in 1 hour and 20 minutes, and is due back at 1:48. The next leaving time in the column is 1:56, and, taking the time of the round trip as 1 hour and 20 minutes, as before, the car is due back at 3:16 and leaves on its next trip at 3:24. After making this round trip, the car is due at the depot at 4:44, and this particular crew know that they have then finished their day's work, inasmuch as the space opposite run 401 in the run guide under their section is blank.

From the explanation given it is believed the principle upon which the time tables are formed will be understood. It will be seen that the chief aim is to give all the men, including regulars and extras, a chance to perform a full day's work, and this is accomplished by dividing the block numbers or car runs into sections and then combining these sections in such a way as to give every man

an opportunity to do a fair day's work, and thereby earn a fair wage. This method of arranging schedules does away entirely with tripper runs, and the extra men know if they are assigned to a run at all they will earn as much as the regular men.

In execution, the block numbers are designated by two small wooden signs about 4 ins. x 6 ins., which are painted black with the block number in white figures. Two of these small block signs are hung on each car, one over each platform just under the hood. As before stated, as far as the operating department is concerned, the actual car numbers are disregarded, and the conductor and motorman carry out their assignment of runs entirely in accordance with the block numbers. It is the duty of the depot foreman to have cars in waiting on the car house floor with block numbers in place in the order they are to leave, as called for by the schedule. This arrangement avoids all unnecessary shifting of cars in order to bring certain car numbers in rotation on the car house floor, as any car available can be run out under any given block number, and in the event of it becoming necessary to call in a car for any defect or other cause, the block number is merely shifted to the first available car without disarranging the schedule or causing confusion in the minds of the crews as to what car they are to take out on any trip. Each division of the road has its own series of block numbers, the numbers on the first division, for instance, running from 1 to 100; on the second, from 201 to 300, and so on.

In conjunction with the time table for each division or line, there is printed a "time and pay sheet" for the given schedule. The corresponding "time and pay sheet" for the Seventeenth and Nineteenth Street Division, which has just been discussed, is also reproduced herewith. This is an average schedule, and it will be seen that all the crews on this division make seven trips in the day,



TIME AND PAY SHEET.

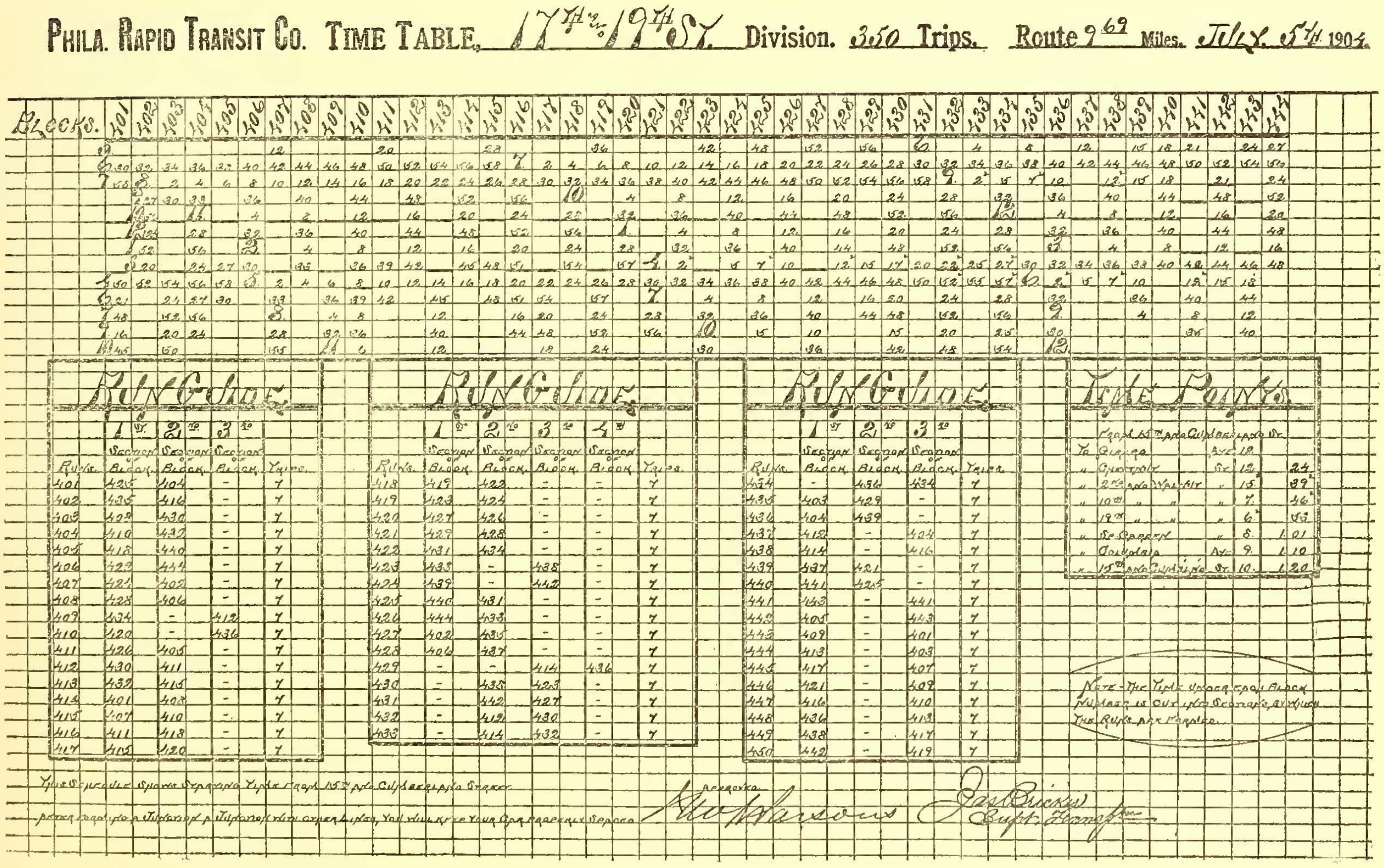
17th & 19th St. Div. SCHEDULE DATE July 5th 1904

RUNS.	TRIPS.	TIME.	PAY.	RUNS.	TRIPS.	TIME.	PAY.
401	7	10.02	$2.02	426	7	10.03	$2.02
402	7	10.06	2.02	427	7	10.02	2.02
403	7	10.01	2.02	428	7	10.03	2.02
404	7	10.02	2.02	429	7	10.08	2.02
405	7	10.04	2.02	430	7	10.04	2.02
406	7	10.04	2.02	431	7	10.02	2.02
407	7	10.04	2.02	432	7	10.02	2.02
408	7	10.04	2.02	433	7	10.04	2.02
409	7	10.04	2.02	434	7	10.02	2.02
410	7	10.06	2.02	435	7	10.05	2.02
411	7	10.07	2.02	436	7	10.03	2.02
412	7	10.07	2.02	437	7	10.04	2.02
413	7	10.04	2.02	438	7	10.00	2.02
414	7	10.06	2.02	439	7	10.06	2.02
415	7	10.06	2.02	440	7	10.07	2.02
416	7	10.06	2.02	441	7	10.03	2.02
417	7	10.06	2.02	442	7	10.02	2.02
418	7	10.06	2.02	443	7	10.03	2.02
419	7	10.08	2.02	444	7	10.04	2.02
420	7	10.06	2.02	445	7	10.01	2.02
421	7	10.06	2.02	446	7	10.02	2.02
422	7	10.07	2.02	447	7	10.03	2.02
423	7	10.09	2.02	448	7	10.08	2.02
424	7	10.11	2.02	449	7	10.04	2.02
425	7	10.04	2.02	450	7	10.07	2.02

Total $202.00

Jas. Bickey
Supt. Transp.

TIME AND PAY SHEET USED IN CONNECTION WITH TIME-TABLE



PHILA. RAPID TRANSIT CO. TIME TABLE, 17th & 19th St. Division. 350 Trips. Route 9.69 Miles. July 5th 1904.

Run Guide

Runs.	1st Section of Block.	2nd Section of Block.	3rd Section of Block.	Trips.
401	425	404	-	7
402	435	416	-	7
403	425	430	-	7
404	410	432	-	7
405	418	440	-	7
406	422	444	-	7
407	424	402	-	7
408	428	406	-	7
409	434	-	412	7
410	420	-	436	7
411	426	405	-	7
412	430	411	-	7
413	432	415	-	7
414	401	408	-	7
415	407	410	-	7
416	411	418	-	7
417	405	420	-	7

Run Guide

Runs.	1st Section of Block.	2nd Section of Block.	3rd Section of Block.	4th Section of Block.	Trips.
418	419	422	-	-	7
419	423	424	-	-	7
420	427	426	-	-	7
421	429	428	-	-	7
422	431	434	-	-	7
423	433	-	438	-	7
424	439	-	442	-	7
425	440	431	-	-	7
426	444	433	-	-	7
427	402	435	-	-	7
428	406	437	-	-	7
429	-	-	414	436	7
430	-	435	423	-	7
431	-	442	427	-	7
432	-	412	430	-	7
433	-	414	432	-	7

Run Guide

Runs.	1st Section of Block.	2nd Section of Block.	3rd Section of Block.	Trips.
434	-	436	434	7
435	403	429	-	7
436	404	439	-	7
437	412	-	404	7
438	414	-	416	7
439	437	421	-	7
440	441	425	-	7
441	443	-	441	7
442	405	-	443	7
443	409	-	401	7
444	413	-	403	7
445	417	-	407	7
446	421	-	409	7
447	416	-	410	7
448	436	-	413	7
449	438	-	417	7
450	442	-	419	7

Time Points

From 15th and Cumberland St.

To Girard	Ave.	12	
" Oxford	St.	12	24
" 2nd and Walnut	"	15	39
" 10th " "	"	7	46
" 19th " "	"	6	52
" Sp. Garden	"	8	1.01
" Columbia	Ave.	9	1.10
" 15th and Cumberland	St.	10	1.20

Note—The time under each block number is cut into sections, by which the runs are formed.

Jas. Bickey
Supt. Transp.

TYPICAL TIME TABLE, SHOWING METHOD OF POSTING RUNS AND BLOCK NUMBERS

and work approximately 10 hours, or a few minutes over, the odd number of minutes varying for the different runs, but each man that works under this schedule is paid $2.02 for his day's work. It will be understood that it is impossible to work out all of the schedules in order to let all the men perform their day's work in 10 hours, but this is the object aimed at, and none of the schedules calls for more than 11 hours' work. The company pays 20 cents an hour, and gives the men the benefit of any odd minutes that may be required by the particular division.

As an aid in the making of schedules, it is the practice to sta-

tion men at designated points, and these men report on special blanks the condition of each car as it passes, with respect to the load, as, for instance, "very heavily loaded, could take no more;" "heavy, but room for more;" "medium, standing room half taken;" "seated load;" "seats not all taken."

ASSIGNMENT OF RUNS

Regular employees are given the choice of runs according to their seniority standing. As runs become vacant, regular men can be advanced (as long as they are not changed from one line to another) to better runs, and the runs that are left are filled from the extra list. If there are runs to fill on more than one line operated from the same depot, the choice of line, as well as choice of vacant run on it, is given to the first extra man (allowing him to choose), and this course is followed until all vacant runs are filled. No changes are made or vacancies filled except on the first day of each month, except in the case of a run being vacant for three days or more for any cause. In that event the run is filled by the oldest extra not engaged, until such time as he may be called for a regular position or the man to whom it belongs returns.

Announcement of assignments to runs is made each day by means of "a slate," which is put out each evening at a regular time suitable to the requirements of each depot, and after the slate is posted, no man is excused without reporting, as this would disarrange the slate. Regular men have the same runs every day, and on the first of each month are allowed to make their choice of runs that may have become vacant during the previous month, the order of choosing being dependent upon the standing of the men on the seniority list.

The slate arrangement for extras is made upon the following rating:

First—New men, just taught and turned in for work.

Second—Men that have finished serving time for violation of any rule.

Third—Men who made their report, but did not receive work.

Fourth—Men who were excused without reporting.

Fifth—Men who made their report and were excused; unless in case a man sees he is going to get a run that is objectionable to him, and on that account is excused, he will then stand the same as though he had worked on the run.

In case of sickness, the employee must send word to his regular reporting place by special messenger before his reporting time is up, otherwise it is called a miss. No telephone or telegraph message is accepted. A regular man's run is held for him two months on account of sickness, after which time it is filled in the regular way. Should he return to work after this time, he is placed to the best advantage at the first opportunity until a vacancy occurs on the line and in the class to which he belongs, when he is so placed. Extra men do not lose seniority positions on the list on account of sickness.

The rules governing conductors and motormen in cases where reporting time is missed are as follows:

1. In case a regular man wishes to be excused from duty, he should ask the day before, and if excused such runs should be marked up from the top of extra list (as it would stand on the next day) in the order of the reporting time of the runs to be filled.

2. A regular man missing his report, which is ten minutes before the leaving time of his car, will be given 5 a. m. report, one day for each hour or part of hour missed, and in that time to receive work only after all extras get work that want it.

3. No extras are carried to relieve men who may miss their second car, as at dinner, supper or swing time; in such case regular men, also extras who are holding regular runs, will be given one week on the extra list for each hour or part of hour missed, to the extent of four hours. To start, serving time will be placed at the bottom, after which they will be treated as other extras are, except no hold-down will be given during time of suspension.

4. Extra men will not all be required to report at one time, but each man will be given a reporting time on the slate each day, by which he will be marked present or missed, as the case may be. For example: A man has 5 o'clock report, he will notify the man who has charge of the slate that he is present, when he will be so marked; he then holds himself in readiness to be called for duty unless excused by one in authority to do so, or in case the report was not made until after 5 o'clock, the man would then be marked missed, and how much; he would, however, hold himself in readiness for work in case all other men got work that had made their report. The extra men's reporting time will be carried along at intervals according to the requirements, and those that catch runs that finish late will be given all the advantage on next day's report consistent with the proper handling of the work.

EMPLOYMENT DEPARTMENT

All conductors and motormen are employed by the employment bureau. Applicants must be at least 5 ft. 6 ins. in height and between the ages of 22 and 40. Conductors must weight 125 lbs. and motormen 145 lbs. The men must be of good physique, sound in mind and body, and of good reputation and character. Physical examination is made by inspection only. All applicants must have good eyesight. During the summer months the company accepts from 600 to 800 applicants a month, but 25 per cent of these, for one reason or another, never go to work. On the average, the department is able to accept about 50 per cent of the total applicants presenting themselves each month. Applicants must give the names of two former employers and three reliable references. It requires the services of five men to run the employment department. The company now has about 3250 motormen and the same number of conductors in its employment. The men are paid 20 cents an hour.

When an applicant for the position of motorman has been accepted and his references have been found satisfactory, he is required to spend three days on the instruction car in order to become familiar with the general method of handling controllers, switches and other parts of the car. The instruction car is a regular passenger car which has been assigned to this service. It is the practice to place the car in charge of a competent instructor, who takes from seven to ten of the new men at a time and makes trips over one of the light traveled lines. On these runs the instructor explains so much of the mechanism of the car as the motormen are required to know, and each of the new men is in turn required to handle the controller. After this period of instruction, the recruits are sent to the depots to which they have been assigned, and each man spends about seven days riding on the front platform with an older motorman so as to learn the routes. During these seven days the new recruit spends a portion of the time in the car house and is instructed by the mechanical foreman in regard to the parts of the car and their uses.

If the instructor is able to certify as to the competency of the new man, he is examined by the division superintendent. At this examination the man must show his knowledge concerning the running time, streets along the route and all other rules and regulations pertaining to the running of cars. After passing the examination satisfactorily, the employee's name is placed on the extra list for work, until such time as he becomes a "regular," when he is advanced according to seniority. In the case of prospective conductors, the applicant is required to spend four or five days in training with an older conductor, and is then placed on the extra list.

EMPLOYEES' RECORDS

Two sets of records of conductors and motormen are kept, one in the office of the superintendent of transportation and one in the general superintendent's office. The file in the general superintendent's office includes records of each man, showing secret service reports, public complaints, reports of street inspectors, etc. The secret service reports are sent to the office of the superintendent of transportation, and comprise the record kept in that office. In both of these record files the papers referring to each man are numbered and are fastened together, the papers themselves constituting the record.

CONDUCTORS' ACCOUNTS AND PAYING EMPLOYEES

The cash turned in each day by conductors is not sent to the company's main office, but is deposited by the depot superintendent in local banks near the operating car houses. This avoids unnecessary handling of the money and does away with hauling large quantities of currency through the streets. The method of handling the money from the conductor to the bank is as follows:

When the conductor has finished his day's work his first duty is to turn in his cash receipts to the receiving clerk at the depot. The clerk counts the money in the presence of the conductor and enters the amount under the amount as given on the way bill by the conductor. The two sums should of course correspond. The receiving clerk then puts his initials on the way bill, this serving as a receipt to the conductor for the money. This procedure avoids all disputes as to the amount of cash turned in by conductors.

When the returns from all conductors have been received the receiving clerk bags the money, places it in a safe and the next morning it is deposited in the bank by the division superintendent or his assistant.

After the conductor has turned in his cash, he puts all the tickets, exchanges, transfers and free passes collected for the day into a bag and drops this bag into a safe in the presence of a clerk, who initials the way bill as a receipt to the conductor for the bag. The conductor then turns over his way bill, together with unused exchange tickets and transfers and punch, to the proper clerk. The bags containing the tickets and transfers are collected from the various depots each day by special cars, and are taken to the general receiving office, where they are opened by the counting clerks. Each bag contains what is known as a "short way bill," which is a memorandum inserted in the bag by the conductor at the time he ties up the tickets and transfers collected during the day. This memorandum shows the exchange tickets received, the 5-cent tickets, the "frees," the transfers, exchange tickets sold, the 5-cent fares and total passengers and total cash. Each bag is opened separately by a clerk who counts all the tickets and compares the account with the entries on the short way bill. If the numbers correspond, the clerk checks the short way bill with a blue pencil mark. If the two accounts do not agree, the clerk recounts the tickets. If there is a difference of twenty or more the clerk calls the forewoman, who counts over the tickets, making the third count. The forewoman either verifies the original or makes correction. This count is accepted as final.

The short way bills are written up on sheets, which are afterwards checked with the transcriptions of the way bills turned in by the depot receiving clerks.

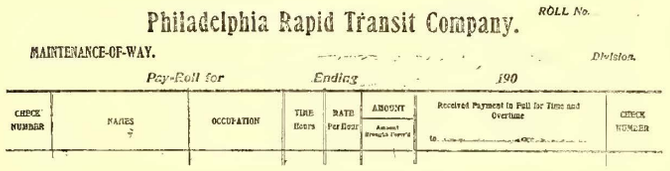
All employees of the company, with the exception of day laborers in the track department, are paid by checks drawn on local banks near the depot or shop. After the pay rolls are made up for each week a check is deposited by the company in each bank to cover the total amount of the pay checks drawn on the bank. Employees are paid four times a month, and the pay rolls are made up on the 7th, 14th, 21st and last day of the month.

The pay rolls for conductors and motormen are made up by the clerks at the depots. After the pay rolls have been certified the individual checks are drawn, signed and sent to the respective depots. The men call at a window in the depot for their checks and sign their names on the pay roll as a receipt.

In the case of employees in the motive power and lines and cables departments, the pay rolls are made up from the daily time cards, properly certified, and the checks are written out by a paymaster who delivers same to cashier's office for verification and signature of auditor. Each employee in these departments makes out daily a time card which is approved and signed by the engineer or foreman and sent to the general office. The pay rolls and checks are delivered to the paymaster, who delivers the checks to the men upon identification by the foreman or engineer in charge. The proceedure in the case of shop employees is practically the same.

The method of paying off the men in the track department is as follows:

The laborers are engaged by the division foreman, and are given brass checks which bear the monogram "P. R. T. Co." and number. The division timekeeper visits morning and afternoon the various locations in his division where work is progressing and takes down the time of the men in his time book. The men have to tell him their number or show the check. The timekeeper turns in the statement of time to the office of the division foreman on a form (which also gives the location and job number), and then the division clerk sends it in the morning to the office of the engineer-of-way on a form stating the numbers of men, the numbers of hours, the rate and amount of each man, as well as the job on which they worked. From the job sheets mentioned the division clerk also makes out four times a month (on the 8th, 15th, 22nd and end of month) a pay roll (see Form 253), which is certified by the timekeeper, who is under bond. This roll is sent to the engineer-of-way for inspection. The paymaster checks the totals with those sent up on the second form mentioned, makes out the pay envelopes, has the engineer-of-way certify it and sends it down to the cashier, who


Philadelphia Rapid Transit Company. ROLL No.

MAINTENANCE-OF-WAY. Division.

Pay-Roll for Ending 190

CHECK NUMBER	NAMES	OCCUPATION	TIME Hours	RATE Per Hour	AMOUNT	Received Payment in Full for Time and Overtime	CHECK NUMBER

FORM 253.—HEADING OF PAY ROLL SHEET FOR TRACK DEPARTMENT

fills up the envelopes, which, together with the pay roll, are sent to the auditor and general manager for inspection and approval. The pay roll and envelopes then go back to the paymaster, who goes around in a wagon to the various locations where the men are working and hands the envelopes to the men, who have to show their brass checks and sign the pay roll, in the presence of the foreman of the job. When a man is not present on the job on pay day he has to obtain a certified order from the division foreman to the engineer-of-way, and this order, if corresponding with pay roll, is retained in the engineer's office and the man is given an order on the cashier, from whom he gets his money.

CONDUCTORS' WAY BILLS

The card or sheet upon which the conductor enters the record of his day's work, known usually in other cities as the day card, in Philadelphia is called a way bill, and is of course devised to meet the special conditions in Philadelphia brought about by the sale of 8-cent exchange tickets. The form of the way bill is illustrated on the following page.

Each conductor is given a way bill when he begins his day's work and is instructed to keep upon this an accurate account of each half trip, so as to show the total number of passengers carried, cash and tickets received, exchanges sold and transfer tickets issued. The way bill must be made out plainly and blank spaces are provided for inserting the name of the division, the run numbers, the block numbers, conductor's name and number, motorman's name and number, and date; also the starting time from each end of the route as well as the car number operating on each trip.

As has been outlined, the instructions to conductors provide that at the close of the day's work and after the way bill has been properly made out, all cash received must first be turned in to the receiving clerk, who counts the money and enters the amount on the way bill, signing his initials. The conductor must then count his tickets in order to be sure they are correct as shown on the way bill, and place them in a bag, which must be securely fastened and deposited in the receiving safe. The bags must be

deposited in the safe by the conductor personally in the presence of the station master or person in charge at the time, who is instructed to raise the lid of the safe and see that each and every

REGISTER STATEMENTS.

Register No.
Ending,
Commencing,
Total,
Register No.
Ending,
Commencing,
Total,
Register No.
Ending,
Commencing,
Total,
Register No.
Ending,
Commencing,
Total,
Total Registration,

STATEMENT OF EXCHANGE TICKETS.

Ending,
Commencing,
Total Sold,

STATEMENT OF TRANSFER TICKETS.

Ending,
Commencing,
Total Issued,

Referring to Rule No. 40 in "Book of Rules,"

IN CASE OF EMERGENCY, CALL

Bell Phone "MARKET 4407"

Keystone Phone "MAIN 951"

In making up this Way-Bill all totals must balance correctly.

STATEMENT OF PASSENGERS.

Passengers.		$	Cts.
	5ct. Fares,		
	8ct. Exchanges Sold,		
	8ct. Exchanges Received,		
	5ct. Tickets Received,		
	Free Tickets Received,		
	Totals,		

Each trip must show the Car number used.

In all cases the starting time on the Schedule is the OUT trip; the return is the IN trip.

When on time, put down the Schedule time leaving each end; when not on time, put down the actual time.

In no case add Passengers of one trip, or part of trip, to those of any other trip. Each trip, or part of trip, must show for itself.

FORM 103.—REVERSE SIDE OF CONDUCTORS' WAY BILL

conductor drops a bag in the opening. No way bill or tickets must be turned in by the conductor nor received by the station master or person in charge until the receiving clerk has receipted on the way bill for the amount of cash received and the bag has been deposited in the safe.

CONDUCTORS REPORT OF DELAYS

In the event of delays to cars while in service, conductors make report on proper blank, showing the block number, time of day, time lost, number of passengers on cars, location and a full explanation of cause of delay. In case of a break-down, crippled car, broken wire, or other cause of delay or blockade, the conductor on the first car must call "emergency" on the telephone at once. The delay sheet must be filled out in every case when car is blocked for five minutes or over, and turned in at office at end of day's work.

BENEFIT ASSOCIATIONS

There is no general employees' benefit association, but each depot has its own association, the members of which comprise the employees working at or operating from the particular depot. Each of the depot organizations has its own constitution and by-laws, but most of them include sick and death benefits for the members. The company encourages these societies and furnishes suitable meeting rooms, all the printing required, and assists them in other ways.

STEAM RAILROAD CROSSINGS

There are about 400 crossings of street railway lines with steam railroads at grade. At the more important crossings the street railway company maintains its own flagman in addition to the crossing gates and flagman kept by the steam railroad company. At the less busy crossings, flagmen are not maintained, but the cars come to a full stop and the conductor goes ahead and signals the motorman when to proceed. At two crossings over which fast express trains are operated at frequent intervals, derailing switches have been installed and flagmen are stationed at these points to operate the derail.

The company's rule governing the action of employees at steam railroad crossings provides that the conductor must not allow his car to approach the railroad crossing beyond the point of safety without coming to a full stop. After the car has stopped, the conductor must announce the name of the street. After all the passengers who desire to do so have entered or left the car, the conductor must go forward to the center of the railroad crossing, and after having carefully looked in both directions and having ascertained that there is no danger, he must give the signal to the motorman to proceed. The motorman, before starting his car on this signal, must look back to assure himself that no passengers are entering or leaving the car by the back platform. At steam railroad crossings where the street railway company maintains its own crossing watchman, the conductor does not go ahead of the car, but gives the starting signal upon receipt of whistle or signal from the man at the crossing, and while the car is passing over the steam railroad tracks the conductor must give special attention to the trolley, so that in case it should leave the wire, the car would not be allowed to stand in danger without power.

STREET RAILWAY CROSSINGS

The large number of track intersections in Philadelphia call for special precautions to prevent accidents from collisions at these points. The rule governing the movement of cars at street intersections reads as follows:

By established custom and city ordinance, the cars running north and south have the right of way over cars running east and west, but this rule will not be accepted as an excuse in case cars come together while crossing intersecting streets. There must be no racing of cars to arrive at streets where lines form junctions with others, but when cars are due at the same point at the same time, and arrive there together, the car having the straight rail must hold back and allow the one having the curve to go ahead, in which case the first car will endeavor, as far as is consistent with safety,

Conductor, ... *Division.*
1st Block No. ..... *Badge No.* ..... *Motorman,* ..... *Badge No.* .....
2d Block No. ..... *Run No.* ..... *Date,* .....

Car No.	Trip	Time	5 ct. Fares	Exch's Sold	TOTAL CASH $	TOTAL CASH Cents	TICKETS RECEIVED Exchanges	TICKETS RECEIVED 5 ct.	TICKETS RECEIVED Free	Total Passengers	Register Statements, Ending by Half Trips	EXCHANGE TICKET STATEMENTS, Ending by Half Trips	TRANSFER TICKET STATEMENTS, Ending by Half Trips	Transfers Received
	1 OUT IN													
	2 OUT IN													
	3 OUT IN													
	4 OUT IN													
	5 OUT IN													
	6 OUT IN													
	7 OUT IN													
	8 OUT IN													
	9 OUT IN													
	10 OUT IN													
	11 OUT IN													
	12 OUT IN													
	13 OUT IN													
	14 OUT IN													
	15 OUT IN													
Totals														

FORM 103.—FACE OF CONDUCTORS' WAY BILL USED BY PHILADELPHIA RAPID TRANSIT COMPANY

to move rapidly and thereby leave the proper headway for the car following.

The city ordinance covering this point provides that any person violating the provisions with respect to the movement of cars at intersections shall pay a fine of $10 for each offense.

MAIL CARS

The company is now operating nine regular mail cars, which carry mail from the central postoffice in Philadelphia to suburban postoffices. The railway company supplies the cars and the conductors and motormen, but aside from this the mail service is under the direction of the postoffice department. No attempt is made to collect from street letter boxes by these cars, but they are used exclusively for transferring mail between the central office and the branch offices. Mail received in bulk is sorted en route. The arrangement of the interior includes pouch racks, pigeon holes and sorting tables, the layout conforming to the standard specifications required by the United States Government, and now followed in all cities where mail is carried by the street railway company.

NEWSPAPER CARS

A service believed to be peculiar to Philadelphia is the employment of cars for delivering newspapers in bulk from the downtown newspaper offices to suburban points over the street railway lines. The newspapers are carried in cars from which all of the seats and interior furnishings have been removed. This service has grown from its inception, so that at the present time seven regular newspaper cars are operated on week days and nine on Sundays. The leading newspapers of the city, through a distributing agency, deliver the papers in bundles to the cars in the early morning hours. The cars leave the center of the city shortly after 3 o'clock in the morning, and deliver the bundles to the retail news dealers all along the routes. The company supplies the car and the crew, and the distributing agency takes charge of the distribution of the papers. The agency pays the street railway company in accordance with the total weight of the papers carried, irrespective of the distance covered. This service has proven exceedingly popular, as it enables the residents in the suburbs to have their morning papers with the same promptness as in the downtown districts.

CHARTERED CARS

The chartered car business now amounts to about $10,000 a year. Arrangements for special cars can be made by application to the superintendent of transportation, but owing to the normally heavy traffic on the park lines, over which special parties usually desire to go, the company does not attempt to make a special feature of chartered cars. For this service regular four-wheeled closed cars are usually utilized, as the double-truck cars are all required in the regular service. It is the policy of the company to lease special cars for day trips only, and it is seldom that orders are taken for chartered cars to be used during the evening.

The regulations relating to chartered cars require that all cars be paid for when ordered. In case of rain the excursion can be postponed to the next open date suitable to the party, or the money will be refunded. The following is the schedule of rates for special cars:

TO WILLOW GROVE:

	Per Car
Three cars or less (half or all day)	$10.00
Four to nine cars (half or all day)	8.50
Ten cars or more (half or all day)	7.00

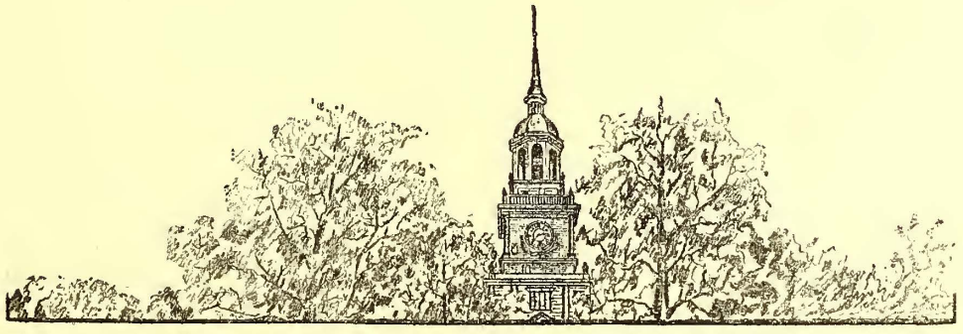
TO CHESTNUT HILL, FOX CHASE, FRANKFORD, DARBY, HADDINGTON OR ANGORA:

	Per Car
Half day, straight trip	$6.00
All day, straight trip	8.00
Half day, exchange trip	8.00
All day, exchange trip	10.00

TO GEORGE'S HILL, LEMON HILL, ZOO GARDEN, STRAWBERRY MANSION, OR WISSAHICKON:

	Per Car
Half day, straight trip, Hunting Park	$5.00
All day, straight trip	6.00
Half day, exchange trip	8.00
All day, exchange trip	9.00

Button Club House—$6 one way, $10 round trip.



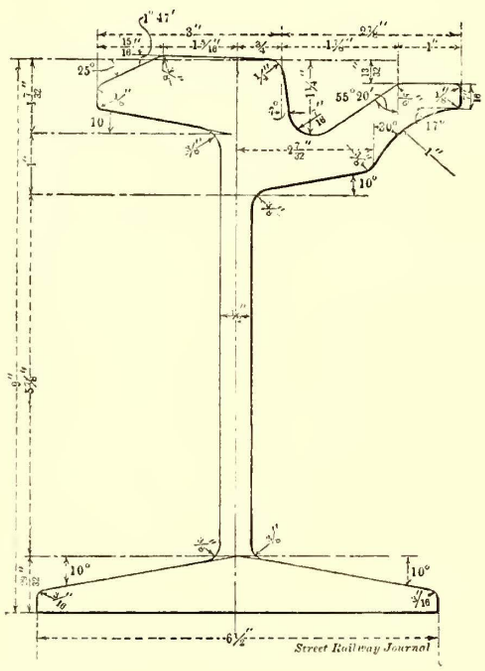
WAY AND ROADWAY MATTERS IN PHILADELPHIA

The system of the Philadelphia Rapid Transit Company now comprises 554.35 miles of track, of which 381.92 miles are single track, and 172.43 miles second track. Of this total, 25 miles are located in car houses. All street railway tracks in Philadelphia are laid to 5 ft. 2¼-in. (5.19-in.) gage.

In the work of maintaining and reconstructing this mileage, and also in building new lines, the way department has devised and adopted a number of standards in appliances, methods and processes, many of which are worthy of careful attention and study.

On straight track three sections of rail will be found to predominate; these are a 9-in. 90-lb. tram rail, an 8 25-32-in. 93-lb. tram rail, and a 137-lb. girder rail. The latter is a specially-designed section known as the Philadelphia Rapid Transit standard, and is now used in all reconstruction and new work in Philadelphia. This section has received considerable attention in the columns of the technical press, and it has been adopted in modified form in a number of the larger cities in the country. Its distinguishing characteristics may be briefly described as follows:

The web of the rail has been moved outward from the gage, presenting practically a center-bearing rail, as the load comes directly over the center of the web. In addition to this, more wearing surface is attained along the gage line, so that as the rail is worn it may be moved inward toward the center of the track, thus prolonging the life of the section indefinitely. With former designs of rail sections used in Philadelphia, after a certain amount of wear had taken place along the gage line, the neck of the rail became so weak that, owing to the eccentricity of load incident to heavy electric railway service, the head of the rail would bend down, and the life of the rail was dependent entirely upon the action of the section in this regard. A feature of the 137-lb. Philadelphia Rapid Transit section is its self-cleaning properties, due to the flaring shape of the throat of the groove. The rail offers very little obstruction to vehicle travel, as the design of the lip permits wagon wheels to turn out from the groove without difficulty. It will also be noticed that the head of the rail is 3 ins. wide, and this provides for the use in the future of wider wheel treads, toward which there is a decided tendency. At the same time, since a comparatively narrow wheel tread is still in use, the bevel at the back of the rail head prevents the wearing of false flanges in the rail. The groove is made deep to allow greater limits of wear in the rail head. The rail is rolled by the Lorain Steel Company, and its design was the result of a very careful study of all existing types of girder rails on the part of the engineers of the Rapid Transit Company and of the manufacturers.



PHILADELPHIA RAPID TRANSIT STANDARD 137-LB. RAIL, LORAIN STEEL SECTION

In all new track and in reconstruction work, the company is using the Nichols-Voynow composite or zinc joint, which has been described in detail in the columns of this paper (see STREET RAILWAY JOURNAL for March 1, 1902). This joint, and the method of constructing it, may be briefly summarized as follows:

After the rails have been placed on the ties, but before they are spiked, the ends are all thoroughly cleaned by a portable sand-blast apparatus. Two fish-plates of special form, with twelve bolt holes, are also cleaned by sand blast, and then placed on the rail ends and held in position by two steel drift pins. A steel straight edge is laid on the head of the rail, and the tread of the two rails brought to an even surface by wedging. Temporary bolts are then placed in four of the holes in the rails and plates, and the remaining holes are reamed out to 1 1-32-in. diameter by a portable pneumatic reamer. The twelve rivets are then driven home by a portable pneumatic riveter, clamping the plates solidly to the web of the rail, but leaving, owing to the special shape of the plates, a space under the head, the tram and around the foot of the rail. Iron clamps furnished with asbestos cloth pads and clay dams are then placed in position, and the whole joint is warmed by fuel oil burners to a temperature of from 300 degs. to 400 degs., after which molten zinc is poured into these hollow spaces. The claim is that the introduction of this metal in a fluid state fills up the smallest interstices between the fish-plate and the rail, giving a continuous solid bearing throughout which is impossible with the ordinary fish plate, while the crystalline nature of zinc prevents any flowing or peening under continuous shock and vibration. It is also claimed that the zinc when poured on the hot clean metallic surface of the rail and plates will practically amalgamate with them, and give a true electrical joint, into which water and corrosion will not penetrate.

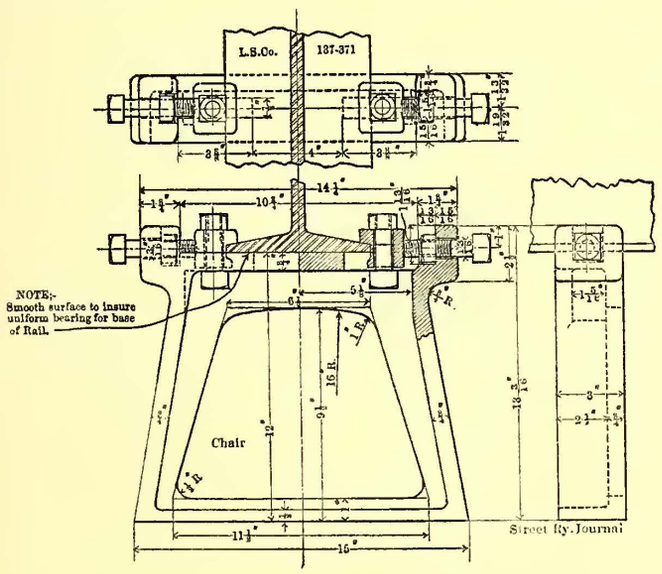
As explaining the results secured by this joint in actual service, both with respect to its mechanical strength and electrical conductivity properties, reference is made to a report of a committee appointed by the Franklin Institute for the purpose of investigating the merits of the invention. This committee reported that on a 2-mile section of track selected at random, it was impossible in any case to locate the joints without careful search, the rails showing a smooth and unbroken surface, with absolutely no appearance of greater wear at the actual joint, and no signs of hammering out of shape of the head of the rail. The wish of the committee was to select a defective joint for examination, but as none could be found which showed any signs of anything wrong, a joint was finally selected which indicated a slight depression on one rail due apparently to an original surface blister at that point. The paving was then removed from around this joint and several ties removed from under the rail, leaving the joint unsupported for a distance of 4 ft. to 6 ft. In this condition, close observation while heavy cars passed over the joint showed no apparent deflection whatever. All of the rivets in the joint were then cut and driven out, and observation while cars passed over the joint in this condition still showed no apparent deflection. The fish-plates were then wedged off, this taking very considerable force, and a close examination of the rail-joint revealed that rails and fish-plates showed clean metallic surfaces, with the peculiar whitish gray of the zinc coating. The committee further made an electrical test of some twenty rail-joints which had been in use about three years on Third Street, where the wagon traffic is very severe, and where

over 1000 cars per day pass over the joints. All but four joints in this test showed less resistance than the rail.

In making the electrical tests, the resistance of the joints was measured in terms of adjacent lengths of rail by the well-known Wheatstone bridge method. The resistance of a piece of standard rail was found to be 8.71 michroms per foot. The average resistance of the joints (30 ins. long) was .00002038 ohms (20.38 michroms). This is only 93.5 per cent of the resistance of the same length of rail, or the average joint was found to be 7 per cent better conductor than the same length of rail. The lowest joint was 44 per cent better, and the highest was 20 per cent worse. As a result of this investigation, the Franklin Institute last year awarded the John Scott premium and medal to the inventors. The manufacture of the joint is now controlled by the Lorain Steel Company.

In new track work the use of tie-rods has been practically abandoned, in accordance with the belief based on experience that the rods stretch and are generally inadequate to hold the rails to gage. In place of tie-rods, the rails are supported on specially-designed brace chairs, the special features of which will be understood from the diagram on Plate XII. The noteworthy improvement ment secured by the use of these braces is a combination of adjusting screws by which the rail may be shifted bodily over to the right or the left when bringing the rails to gage during construction or for adjusting the gage to compensate for wear in the rail head.

In practice, the chairs are attached to the ties before they leave the yard, by means of three lag screws. For this purpose a multiple drilling machine, built in the company's shops and illustrated on Plate XVI., is utilized for drilling simultaneously the six necessary holes in the tie. The vertical leg of the chair has two holes. The rails are punched with single holes as for tie-rods. After the rails are joined they are set slightly to wide gage. Standard 7/8-in. bolts are passed through the holes in the web, and engage a



DETAILS OF CAST-IRON YOKES FOR CONCRETE TRACK CONSTRUCTION

nut which is locked by a depression in the chair. By tightening these bolts, the rails are brought to exact gage, when a second 7/8-in. bolt is screwed in from the opposite direction, and when this second bolt is tightened up it presses against the inside of the web of the rail, thus holding the rails perfectly to gage. In the work first attempted, wherein brace chairs were utilized, the chairs were made of cast iron with the holes tapped. They were afterward made of pressed steel, using standard bolts and nuts. In the latest work, the chairs are made of malleable iron, which is slightly cheaper, and is also stronger. After the rails are in place on the brace chairs, and have been brought to exact gage, it is the practice to concrete in at the sides of the rail, filling the space inside the head and foot, this concrete serving to stiffen the rail and also to prevent the paving at the side of the rail from sinking.

The latest type of track construction where tracks are to be laid on the very heaviest traveled streets, such as Market, provides for the use of concrete foundations, and embodies a number of departures from concrete track construction as laid in other streets.

As will be seen from the illustration, in this work each rail rests upon a beam of concrete which is 18 ins. wide at the base and extends to a depth of 22 ins. below the surface of the paving. The two beams are joined by a bed of concrete 6½ ins. deep, extending across the track, the arrangement securing a single monolythic concrete foundation for the rails and roadbed, extending across the horizontal surface of the track and into the side trenches, beneath the rails. This mass of concrete extends along the track continuously, and at intervals has imbedded in it cross rods extending from rail to rail and acting as reinforcing rods, with their ends bent down into the side trenches in order to gain a firm anchorage in the side bodies. One of the features peculiar to the design is the placing in the concrete at intervals under each rail, of yokes. These are imbedded in the concrete, and comprise open frames with flanged sides, and provided at the upper ends with guide lugs, in which are adjusting screws, the inside ends of which bear against holding blocks that grip the foot of the rail, so that the rail is adjustable to exact gage by manipulating the screws.

In setting the rails, the horizontal trench is first excavated and surfaced. Temporary cross ties are then supported transversely in this trench, and the rails are laid thereon and roughly brought to gage. For these temporary ties it is customary to use a cross tie consisting of a wooden body surmounted by a metal channel member suitably secured thereto, and of a length greater than that of the body portion. The overhanging ends thus produced facilitate the adjustment and attachment of the rails, while the body portion is adapted to the operation of surfacing the rails by tamping up under the tie. The rail is clamped to the ends of these temporary ties by means of clips and nuts. Having secured the rails to the temporary ties, the side trenches are dug, the yokes or anchors hung upon the rails, and the concrete filled in. In this part of the process shims are interposed between the rail foot and the head of each yoke. In finishing the work, these shims, as well as the temporary ties previously mentioned, are removed, leaving the rails raised from the yokes, but adjustably held down upon the concrete by bolts passing down through the holding blocks. This construction will perhaps be more readily understood from the drawings themselves.

The principal benefit derived from this construction is the solidity and permanence of the structure, this being due as regards the stability of the rails in particular to the fact that they are supported continuously throughout their length upon the concrete. It should be observed that concrete as a general rule shrinks perceptibly in setting. In many experimental structures it has been found that it is not practicable to use supports, such as yokes, and expect to have the unsupported portions of the rails still remain in contact with the concrete after setting. The latter shrinks away from the rails inevitably, leaving them supported at comparatively widely-separated points. Hence no advantage is really gained by merely supporting the rails on yokes imbedded in the concrete, but by the use of shims, or distance pieces, as outlined, and means for forcing the foot of the rail down into close contact with the yokes and concrete structure after the concrete has settled, the rail is supported under its entire length, not upon the yokes only, but upon the concrete. In this case, the yoke serves as an anchorage to hold down the rail.

In further explanation of the principles upon which this construction is based, it may be stated, as the belief of the company's engineers in the way department, that under the action of variations in temperature as between the head of the rail and the foot, causing unequal expansion, and also, and primarily, under the rolling action of the wheels, there is uneven elongation of the rails in any track built for electric railway service. This uneven

elongation tends to spring the rail into a vertical curve. In track laid in paved streets this tendency can be detected by the wave-like motion imparted to the cars, and often can be observed by the naked eye. In ordinary tie construction the spikes, and also to some extent the paving, will in some measure resist this upheaving tendency and hold the rail to surface, and even if the rail itself bulges upward the trouble may be remedied to some extent by re-tamping. But in concrete construction, should the rail heave up, even in slight degree, there will be a hammer effect between the base of the rail and the concrete beam which will in a short time pulverize the concrete under the base of the rail and there will be no remedy. In the Philadelphia construction, the yokes or frames are put in not for the purpose of supporting the rail but for anchoring it to the concrete and preventing the heaving tendency mentioned. This end is further attained by the use of the temporary shims between the rails and the yokes, while the track is being surfaced, so that when the concrete has settled the shims may be removed. Afterwards, by means of the holding-down bolts and clips, the rail is forced down hard on the concrete beam between the yokes, thus making the chairs act as holding-down anchors only.

During the past year, about 8 miles of this concrete construction has been laid on the principal heavy lines in the down town streets, and it is being extended to other of the busiest lines. In all of this work, the Nichols-Voynow cast-zinc joint has been used.

In the work of renewing tracks now being carried out by the way department, it has been decided to put in the Nichols-Voynow joint where it is thought necessary to renew the rails entirely. When the ends of the rails are so far gone that the plates used in the cast-zinc joint will not restore the surface of the rail but the rails themselves are in fairly good condition, the joints are being cast-welded. On some lines where the rails are still in good shape and only certain of the joints are low, it is the practice to put in an offset plate joint, which is an ordinary fish-plate, with the receiving end offset to counterbalance the difference in heights due to wear between the ends of the abutting rails.

There are about 320 miles of bonded track. The standard cross bonds are No. 0000 6-ft. Columbia bonds inserted about every 150 ft. across the track. The standard joint bond is a No. 0000 6-in. bond placed under the trams of the rails. In special work, a No. 0000 40-in. bond is put in around the joint plates. Of course, where the zinc joint is put on no bonds are needed. A considerable number of bonds have been supplied by the Mayer & Englund Company.

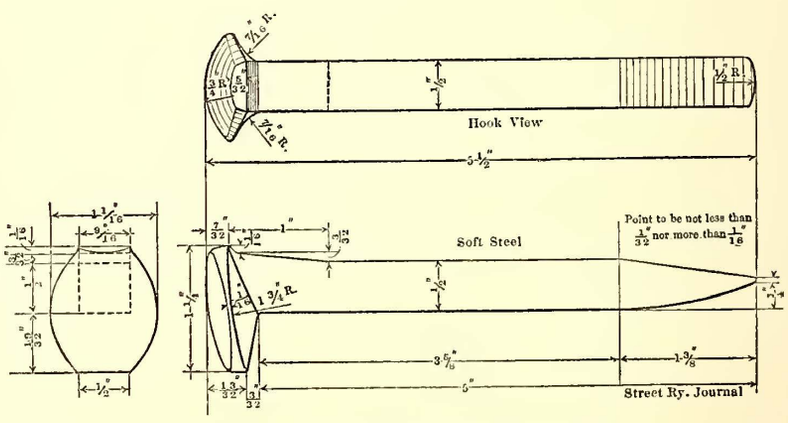
Manganese rails are used to some extent at points of great wear, notably for the curve on Market Street, opposite the Camden Ferry, shown on Plate VIII. The curve rails on this loop were designed especially for this location on account of the short radius of the curve, which is but 25½ ft. center radius. The layout, including rails, was furnished by Wm. Wharton, Jr., & Company. The inside rail weighs 165 lbs. to the yard and the outer rail about 200 lbs. to the yard, both of solid manganese construction. These rails have been in use since 1898, during which time an average of 4000 cars per day have passed around the loop. The wear on the head of the rail has been approximately 3-16 in. per year.

DETAIL STANDARDS

The work of establishing standards for the use of the way department has been made to cover not only general types of track construction, but has also been carried into many of the minute details connected with the department. These various standards which, after considerable trial have been found to be best adapted for the particular purpose they are intended to fill, have been reduced to blue-print sheets, the collection of drawings being known as the "Record of Standard Tools and Appliances for the Roadway Department." The drawings are made up into portfolios, the blue-print sheets being 12 in. x 9 in. with an upper edge of 1¼ in. for binding purposes. Sets of such drawings are kept in the offices of the general manager, the purchasing department, the division engineers, the division foremen, order clerks and chief clerk, so that whenever any tool or appliance is needed there can be no mistake about what particular article is meant. All the drawings in these portfolios bear the key letter "S", meaning standard, and are numbered consecutively. All the necessary information is put on the drawings, so that requisitions, orders, or instructions involving any of the company's standard tools or appliances may be prepared by merely referring to the drawing number.

When a particular appliance or process has been found to cover the requirements to the best advantage, and has been reduced to a standard, it is the usual practice to prepare complete specifications covering the particular appliance or process, and future orders are filled from these specifications. In this work of preparing standard specifications for supplies and material, the company's testing laboratory (described elsewhere in this issue) is of prime assistance in the matter of furnishing analytical data with respect to compositions and mixtures, as it is usual to include in requisitions exact requirements as to chemical compositions of materials and supplies.

The method of using this system of standard drawings and specifications may be illustrated by citing the single example of rail spikes. In order to meet the special requirements of track construction in Philadelphia, the engineers of the way department, after considerable study and experiment, have designed a special form of rail spike and this form in varying sizes has been adopted as standard in all track construction involving wooden ties. The drawing for a spike ½ in. x ½ in. x 5 ins. is reproduced herewith, and not only shows the novel design of the spike but also serves to illustrate the method of reducing the standards to drawings. Attention is called to the fact that in this form of spike the angle under the nose is exactly the same as the angle of foot of rail, thus giving the maximum bearing for the spike against the rail. This angle is about 10 degs., as compared with from 23 degs. to 25 degs., as found in the usual spike bought in the open market,



PHILADELPHIA RAPID TRANSIT STANDARD HOOK-HEAD SPIKE

and which gives contact for only a portion of the surface under the nose. Another feature of the P. R. T. standard spike is the curved bevel in front of the point. The reason for this is that when a spike is started under the tram of a rail it is impossible to drive the spike straight, for the tram of the rail prevents the workman from delivering a straight down blow. On this account it is necesary to start the spike at an angle to the web and the curved surface or bevel mentioned is designed with the idea of causing the spike to straighten itself under the blows of the hammer, and in practice this object is fully accomplished. Furthermore, in the back of the spike, at the head, there is a bulging or swelling of 3-32 in., designed as the result of observation to the effect that while a spike is being driven it usually moves to and from the rail at each blow, thus making an enlarged hole in the

tie, and with the ordinary form of spike this enlargement of the hole often leaves considerable space for moisture to accumulate. The bulge on the P. R. T. standard spike serves the purpose of plugging up the enlarged spike hole after the spike has been driven home.

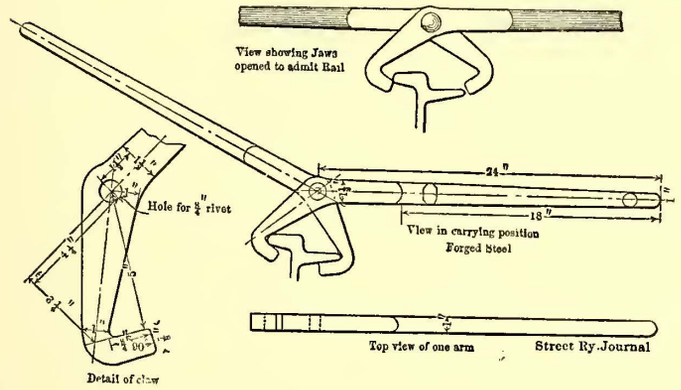
The company's specification covering the standard steel spike is as follows:

Chemical Composition.—All material for steel spikes must be of soft steel of uniform character, and manufactured by the open-hearth process, with carbon not to exceed .15 per cent, and not over .05 phosphorus.

Physical Properties.—Test pieces cut from full size bar must show:

a. Ultimate strength, 54,000 lbs. to 64,000 lbs. per square inch.

b. Elastic limit, not less than one-half the ultimate strength.



STANDARD RAIL TONGS

c. Elongation, not less than 25 per cent, measured in 8 ins.

The finished spike, when cold, must stand the following:

d. Bending test, 180 degs. flat on itself without fracture on outside of bent portion.

e. Twisting test, to stand two full turns without fracture.

f. Head test No. 1, head to be flattened in the direction of length of spike with one blow from steam hammer without fracture.

g. Head test No. 2, neck to be ground half through on inside of spike, spike to be fastened in vise so that bend can be made at ground part, and head flattened in the direction of length of spike with sledge hammer without fracture.

h. Driving test, a practical test of each spike by driving it home to the base of rail in a white oak tie, spike then struck a heavy blow with spike hammer sufficient to further embed spike and bend head slightly upward without sign of fracture.

Finish.—All spikes must be smooth, straight and not vary more than 1-64 in. in thickness nor ⅛ in. in length; have well-shaped symmetrical heads, sharp points, and in accordance with dimensions shown on accompanying plan.

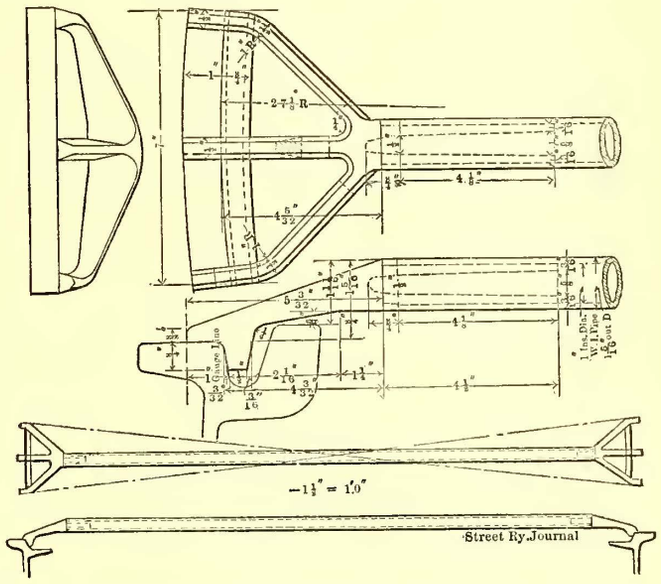
All spikes must be carefully selected and packed in kegs of 200 lbs. each, securely hooped.

Several other drawings from the portfolio are reproduced herewith.

The rail tongs shown on this page were designed to fold into compact form so as to take up little space on the repair wagon. It will be noticed that in this design the handles, when the tongs are closed, fit snugly together instead of bulging out as in the usual style.

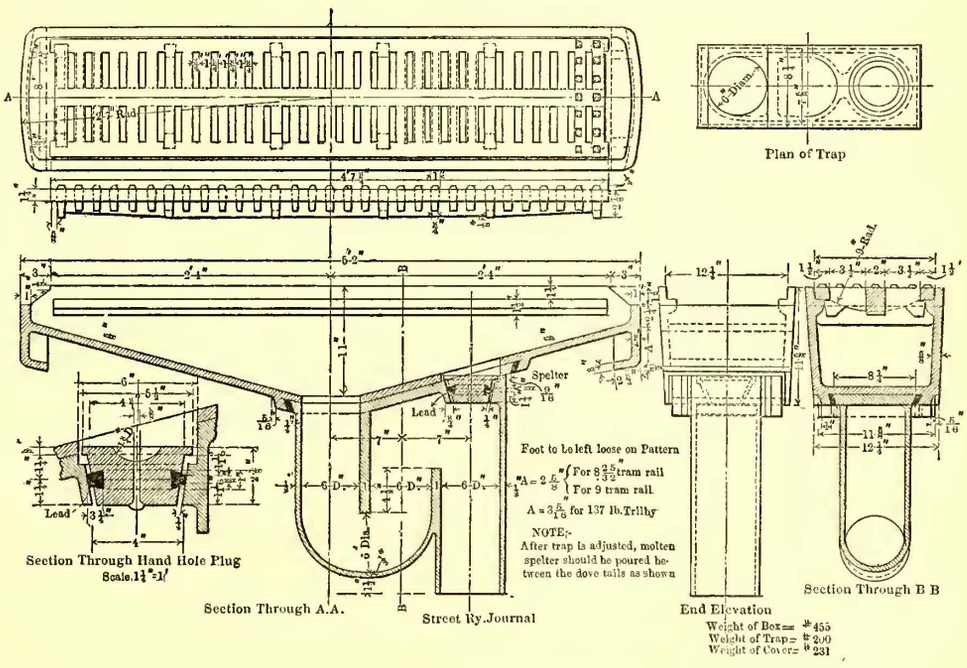
The gage rod designed for gaging track has an elongated guide shaped to a slight curve. The advantage secured is that even though the gage rod is not exactly at right angles to the rail, the guide will still give accurate gage.

One of the drawings shows the company's standard form of track drain, which has been designed to prevent sewer gas from escaping to the surface. The drain casing is made in two pieces, comprising the drain proper and the trap. These are assembled by means of a dovetailed recess at the bottom of the drain and a dovetailed projection over the top of the trap. The two sections are held together by means of spelter. The straight part of the



PHILADELPHIA RAPID TRANSIT STANDARD TRACK GAGE

trap which connects to the sewer pipe has a cast-iron plug which can be taken out by lifting up the cover of the drain. This is made for the purpose of cleaning the drain of any obstruction, especially during freezing weather. This plug has a lead ring cast around its sides, fitting accurately into the opening and designed to prevent any gases from escaping. The drain cover is



STANDARD TRACK DRAIN

cast iron and has two columns of openings, as shown, with sets of plugs extending across the face to prevent horses from slipping. At the bottom of the drain there are lugs to fit the fish section of the foot of the rail, so that the drain rests directly on the rail and there is no possibility of its sinking or shifting.

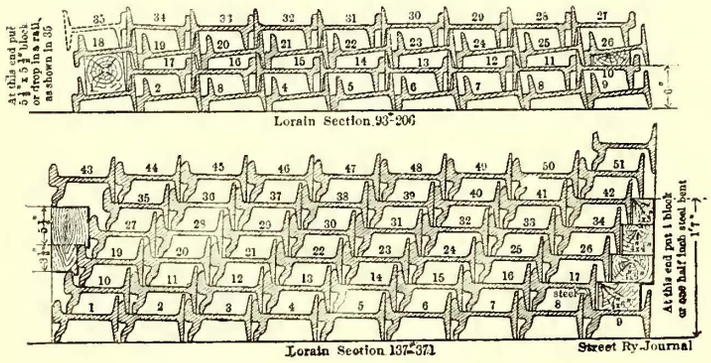
Even the method of piling rails in the store yard has been reduced to a standard, and a rail-piling diagram is included in the

portfolio of standard drawings. The diagram is reproduced on this page as being of possible interest to other companies. It was found that when rails were kept in quantities it became a question as to how to pile the rails in order to economize storeroom space as much as possible. By experiment it was found the method of piling as outlined in the diagram permits of stacking the greatest number of rails in the least possible space.

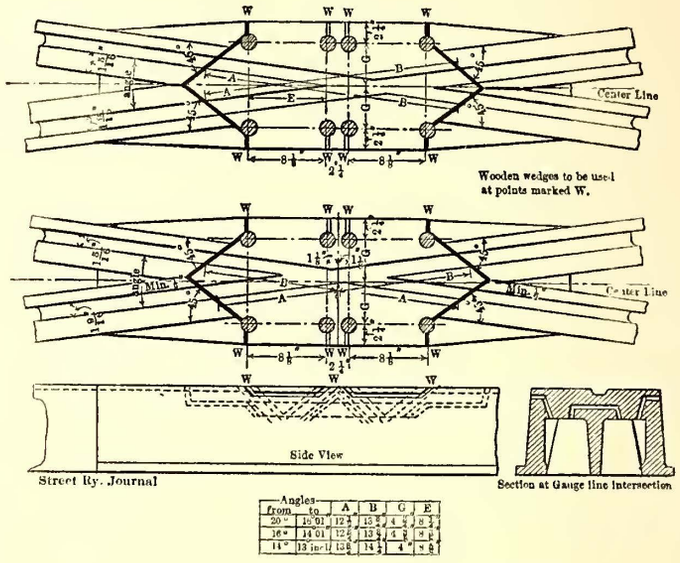
BRIDGE JOINT

One of the accompanying half-tone engravings shows the form of rail expansion joint used on the new Market Street bridge. This joint consists of two castings having elongated points for expansion, these castings being fitted into a box which is bolted directly to the buckle plates of the bridge. The ends of the casting are of the same cross section as that of the abutting rail and are joined up to these rails by standard fish-plates. These joints will permit of from 4 ins. to 6 ins. in variation in length of bridge rails without any appreciable bulging in rails or joints.

Another of the engravings makes clear the method of laying track on bridges. It will be seen the rails are supported on cast steel U-shaped chairs, which fit loosely around the rail and are riveted directly to the bridge structure. The space between the rail and the chairs is filled with spelter. Bolts pass through the web of the rail and chair to prevent the rail from creeping.



RAIL-PILING DIAGRAM



STANDARD PLATES FOR FROG CENTERS

THE MANUFACTURE OF SPECIAL WORK

It is rather interesting to note that within the city limits of Philadelphia there are 1100 street railway crossings with other street railway lines and over 400 street railway crossings with steam railroads at grade. In all there are 1800 locations of special work comprising about 3100 individual pieces of special work. About 33 per cent of these are right angle crossings, the rest being connecting curves, cross-overs, steam railroad crossings, etc. In view of the necessity for maintaining this great amount of special work, the company has found it advantageous to undertake the manufacture in its own shops of most of the crossings and other pieces of special work required on the system. For this purpose extensive shops have been built and are described in the course of this article.

The special work for the most part is of the hardened center type, but these centers are made larger than in most cities. A novel method of holding the center in the bed is employed. In addition to the usual spelter filling, the pocket and hardened steel center have diagonal recesses so that when the steel plate is dropped into the pocket these opposite and complementary recesses form four diagonal grooves converging downward toward the center. In these diagonal grooves are fitted four very thin brass tubes, and the tubes together with the under part of plate and pocket are filled with zinc spelter. The object of the brass tubing and the downwardly converging grooves is as follows: When in the course of time the hardened steel center plate is to be renewed the spelter that fills the tubes in the four grooves can be driven out with the use of a round die and sledge hammer, thus releasing the plate without disturbing the surrounding paving. The new plate can then be set into the old pocket in the same manner as when the crossing was first built. The brass tubing serves to form a separation between the body of the zinc that fills the pocket and the bolts of zinc that are to be driven out.

The distinguishing feature in the form of switch now followed as standard is the extra broad and heavy tongue. When the switch is located at the entrance to a curve the design permits of continuing the switch point in a line almost true to the theoretical outline of the curve. It will be understood that if the tongue were built to the true theoretical curve it would taper down to a very thin section, and at the point would be subject to constant wear and breakage. In the Philadelphia Rapid Transit standard switch the tongue follows the curve nearly to the tangent point, but is reinforced with a shallow shelf or ledge at the side, the clearance from the top of this shelf to top of tongue being sufficient to clear the flanges of the wheels. While strengthening this part of the tongue this shelf or ledge acts as a path for wagon wheels and carries them over the recess in the switch block, thus preventing the wheels from becoming jammed or wedged in the switch.

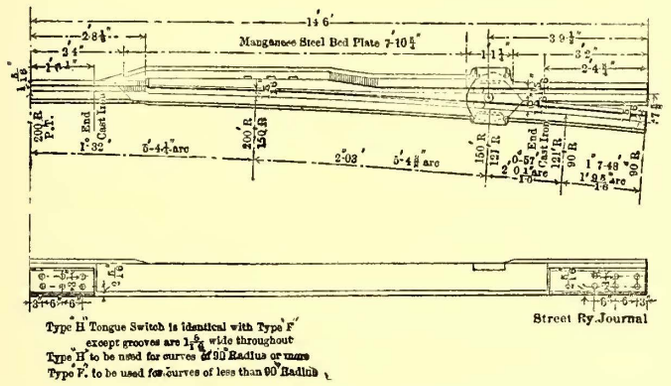
OUTFIT FOR RENEWING SPECIAL WORK

In one of the engravings, Plate XV., will be seen a repair wagon designed for use in connection with renewing hardened steel centers in special work. The wagon is equipped with air compressor and fuel oil tank, a melting pot for melting zinc spelter, two reservoirs for compressed air storage, pockets for carrying hose, two hydro-carbon blow pipes with hose attached, a tool chest for small tools and a tool chest under the rear part of the wagon for carrying long tools, such as bars, etc. The fuel oil tank is connected with the oil reservoir through reducing valves, so that the oil is under about 5 lbs. pressure, or just sufficient to force the oil to flow to the burners. The two hand blow pipes are connected to the oil tank and also to the oil reservoir and receive air at about 25 lbs. pressure. The melter consists of a cast-iron pot, about 8 ins. in diameter, surrounded by a double sheet-iron jacket which is packed with mineral wool. An oil burner under the melter supplies heat for melting, and is so arranged that the flame enters the melter longitudinally and after circulating through the space between the cast-iron pot and outside jacket is allowed to escape through an opening at the top. This opening is provided with a stand in which is kept the carbon crucible for carrying spelter from the wagon to the special work in the tracks. By this arrangement the escaping heat keeps the crucible at high temperature and prevents the spelter from chilling while it is being carried to the work. The melting pot is mounted on trunnions to

prevent the contents from splashing as well as to provide for tipping when the small crucible is being filled.

ROADWAY SHOPS

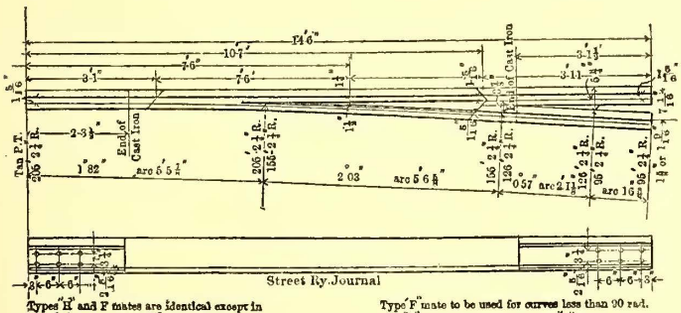
The roadway shops, where the company is building most of the special work for its entire system, including hardened steel renewable center crossings and frogs, all castings, track drains, manholes, tools, etc., are probably among the most complete of the kind in the country. The principal feature of these shops, besides their completeness, is the maximum economical utilization of mechanical power and appliances for the handling, working and finishing of the materials. The shops are located on the eastern and western side of Schuylkill Avenue, above Catharine Street,



PHILADELPHIA RAPID TRANSIT STANDARD SWITCH, TYPE H AND F

the eastern part of the buildings having been rebuilt from the first car house and power house that formed part of the Philadelphia Traction Company's first electric line. The shops occupy a plot of ground approximately 500 ft. x 194 ft. They comprise a rail yard, a layingout yard, a machine shop, a woodworking shop, a foundry, a blacksmith shop, general storeroom for the roadway department, storerooms for the shops and the offices of the shops.

The rail yard, in which stock rails are kept, is located alongside the Baltimore & Ohio main line, and consists of a structure 194 ft. x 70 ft. It is of steel skeleton construction, having brick



PHILADELPHIA RAPID TRANSIT STANDARD MATE TYPE H AND F

walls on three sides, the fourth wall, which communicates with the layingout yard, being left open, so that the rail yard is separated from the latter by the columns of both structures. Throughout the entire length of this yard runs a trackway supported on columns on which a 5-ton electric crane is operated. The capacity of the yard is 5000 tons of rail. As will be noticed from the diagram on page 498, the rails are piled very snugly, with the view of economizing space.

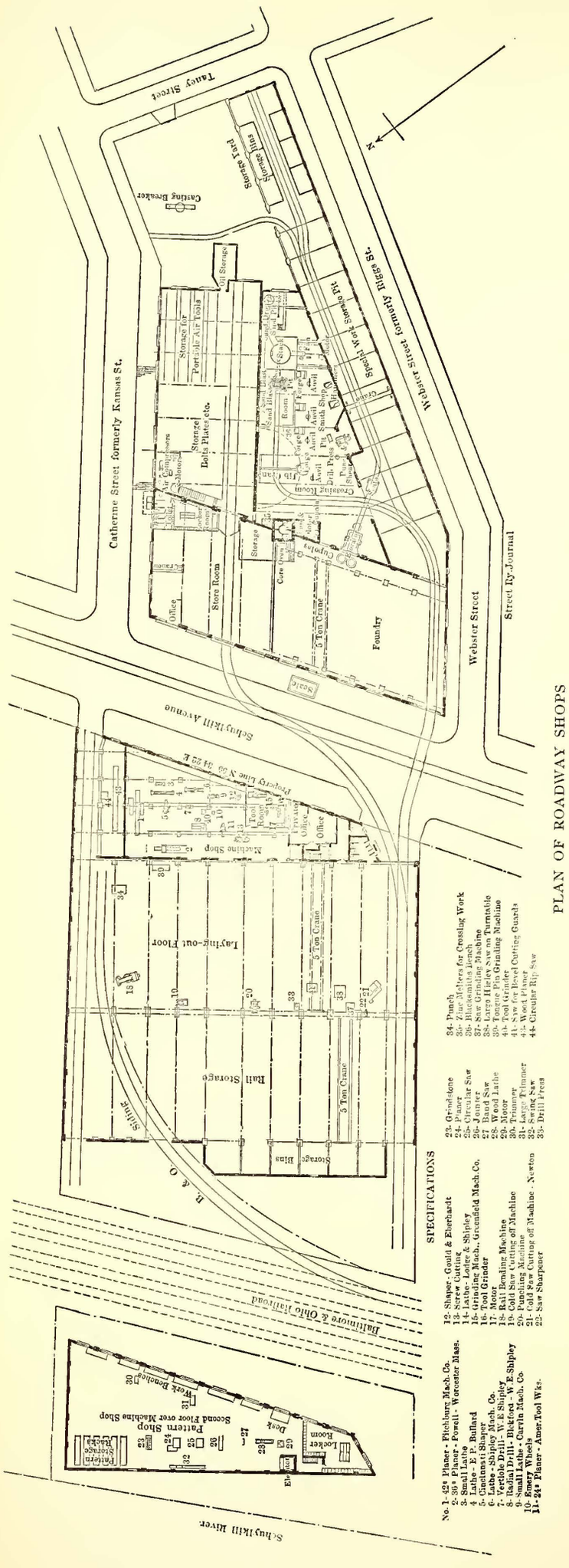
The layingout yard, which is adjacent to the rail yard and abuts the machine shop, is a structure similar to the first and occupies a space 194 ft. x 82 ft. Here also a 5-ton electric crane runs from end to end. The roofs of both these structures have large skylights and ventilators, which give good light and air. The floor in the layingout yard is built of wooden blocks cut from ties and placed on end on a bed of concrete, the joints being filled in with pitch. This gives an indestructible floor and at the same time it is very accommodating to stakes and bars that may be used in setting up work. In this yard are machines for bending rails, punches, shears, circular saws, drill presses, grinders and other machinery for building special work. Each of these machines is run direct by independent motors. The location of all machines is shown on the plan.

The machine shop occupies the ground floor of the irregular shaped plot of ground fronting the west side of Schuylkill Avenue. Here are located the smaller machinery as well as the heavy planers. A part of this is also occupied by the tool room. The heavy machines here are run by independent motors. There are two lines of shafting running from end to end. One shaft is driven by a 20-hp motor located in the tool room, and drives by belts all the light machinery, while the other line of shaft, which is driven by a 30-hp Crocker-Wheeler motor located on the floor above, operates the machinery in the woodworking shop on the second floor above the machine shop. In the woodworking shop, the patterns, flasks, templets, etc., are made, and here is also stored the lumber and patterns. The latter are distributed on pattern racks built of angle skeletons on which wire screenings are used for shelving. This gives for the patterns a good circulation of air on all sides and the shelves of wire screening prevent any accumulation of dust. A hydraulic hoist runs to this floor.

Next to the machine shop is located the office of the superintendent of the shop, as well as that of the clerks. Further south is located the men's lavatory; the space above the offices and lavatory is occupied by the men's dressing room, which has lockers of wire screening as well as washtrays.

The foundry was rebuilt from the old boiler house and is 100 ft. x 67 ft. It has two Whiting cupolas, one 48-in. and one 36-in. dia., which are supplied with blast by a positive blower. A 5-ton electric crane supported on independent I-shaped columns is operated here. The most novel features of this foundry are the universal clamps for crossings and frogs, illustrations and description of which are given herewith, and also the core oven. The interior of the core ovens is built of cast-iron plates, so that the flame and smoke which generally enter the usual core ovens is carried between the plates and the brick walls, so that while the oven is perfectly clear and clean inside, the maximum amount of heat is utilized. There are ventilating communications from the interior of the oven to the stack to carry off the moisture. The material for the cupola is served by a hydraulic hoist, located as shown on the plan. A pneumatic moulding machine is used for standard castings.

The blacksmith shop has four Sturtevant down-draft 48-in. x 60-in. style J-2 forges, and one Sturtevant circular 60-in. dia. forge, style N-3. The air to the forges is supplied by a Sturtevant size "0" monogram blower, and the gas and smoke are carried away by a 90-in. Sturtevant exhaust. The blower and exhaust are run by one 10-hp Crocker-Wheeler motor; the latter, together with the blower and exhaust, being placed on an elevated platform. The exhaust carries the gases directly into the old power house stack. Besides exhausting the fumes from the forges, the blower also carries away the dust from the sand-blast room. This sand-blast room, which is 30 ft. x 19 ft., and is used for finishing off castings, has a large square pit covered with cast-iron gratings. In this pit, several inches above the bottom, lies a terra cotta pipe connected to the 15-in. terra cotta exhaust pipe which runs under the row of forges and connects up by means of an iron galvanized pipe to the exhaust. In finishing up the castings or sand blasting, the rough castings are placed on top of the gratings and the dust is carried away by the fan, while the sand drops down to the bottom of the pit and can be used over again. In the blacksmith shop are also located the melting pots



PLAN OF ROADWAY SHOPS

SPECIFICATIONS

No. 1- 42" Planer - Fitchburg Mach. Co.
2- 30" Planer - Powell - Worcester Mass.
3- Lathe - E. P. Bullard
4- Gisholt 1 Shaper
5- Gisholt Shaper
6- Lathe - Shipley Mach. Co.
7- Vertical Drill - W. E. Shipley
8- Radial Drill - Bickford - W. E. Shipley
9- Small Lathe - Garvin Mach. Co.
10- Emery Wheels
11- 24" Planer - Amer. Tool Wks.
12- Shaper - Gould & Eberhardt
13- Screw Cutting
14- Lathe - Lodge & Shipley
15- Universal Mach., Greenfield Mach. Co.
16- Tool Grinder
17- Motor
18- Rail Bending Machine
19- Cold Saw Cutting off Machine
20- Punching Machine
21- Cold Saw Cutting off Machine - Norton
22- Saw Sharpener
23- Grindstone
24- Planer
25- Circular Saw
26- Jointer
27- Band Saw
28- Wood Lathe
29- Motor
30- Trimmer
31- Large Trimmer
32- Swing Saw
33- Drill Press
34- Punch
35- Four Meters for Crossing Work
36- Blacksmiths Bench
37- Saw Grinding Machine
38- Large Hisley Saw on Turntable
39- Portable Pipe Grinding Machine
40- Tool Grinder
41- Saw for Bevel Cutting Gussets
42- Wood Planer
43- Circular Rip Saw
44- Circular Rip Saw

OTHER APPLIANCES FOR THE ROADWAY DEPARTMENT

On the accompanying plates are shown a number of track tools and appliances that have been developed for the use of the roadway department.

The portable drop hammer was designed for breaking cast-welded joints and concrete beams when renewing old track construction. The drop hammer, as shown, is collapsible and is mounted on a flat car which is drawn by a motor car from point to point as its services are required. The winch is operated by a GE 800 railway motor. The drop hammer weighs 1500 lbs. and has a fall of 16 ft.

The portable rail punch is used for punching holes in joint plates and rails in the street. The punch is carried on the arm of a hand-wheel which is counterbalanced at the end to assist in raising the punch.

For drilling, reaming and grinding in track work the company has a number of portable electric plants, consisting of a motor mounted on a small truck with gearing, flexible shaft and attachments. The plants were furnished complete by the Gem Manufacturing Company.

One of the engravings illustrates a hand truck used for carrying short pieces of rail and parts of special work from one point to another. The rail is slipped through a chain loop hung from the

for the spelter, which is used for setting hardened steel centers. Here are also located heavy shears, power hammers, drill press and grinders. Back of the blacksmith shop is the sand-drying room, which has a large pit for the dried sand; and further back is the yard, where a pneumatic drop for breaking up scrap is located. Old special work is broken up here and assorted, the cast iron and spelter being used over again, while the rail is sold.

Alongside of the blacksmith shop and yard the old car house pits have been utilized for storing special work. This is also served by a 2-ton electric crane which runs the entire length. The general roadway storerooms, men's lavatories and lockers and one shower bath is located in the north part of the building. There are also several hoists for handling material.

The shops are heated by a boiler plant located alongside the west side of the layingout yard, and the heating is done by Sturtevant steam hot-blast system. The pipes through which the hot blast is forced run throughout all buildings. The same fans and pipes are utilized in the summer time for cooling the shops by sending volumes of air through the pipes. In one corner of the storage room are located two Fairbanks-Morse air compressors with their air reservoirs, one for low pressure up to 25 lbs., and one for high pressure of 125 lbs. A system of pipes, which end in nozzles, run from the air reservoirs to different locations in the various shops where sand blasting or various pneumatic tools and hoists are easily attached and used.

From the track layout and the hoisting machinery described in the foregoing it will be understood how economically the work is handled. When the material arrives on the rail siding, which enters the rail yard and the layingout yard, it is unloaded from the cars by the cranes. If it is rail, it is piled up as shown in the diagram, or if it is other kind of material, it is placed on a small electric service car and carried where desired. The rail proper, when it is being worked into special work, is served by the cranes from saw, bender and punch, and is placed on the ground for fitting up. When no foundry work is necessary to do on it, it is then hoisted on the construction cars, with which all the divisions are supplied, and taken to the location intended in the streets. In case the rail has to go to the foundry or blacksmith shop, the service car takes it over there and the foundry crane places it in the flasks from the foundry; again it is taken in the service car to the finishing or blacksmith shops, and then either stored away or taken to the street location. It will thus be noticed that from the time the raw material arrives and until the finished article is ready to put in the ground, all handling and hauling is done by machinery.

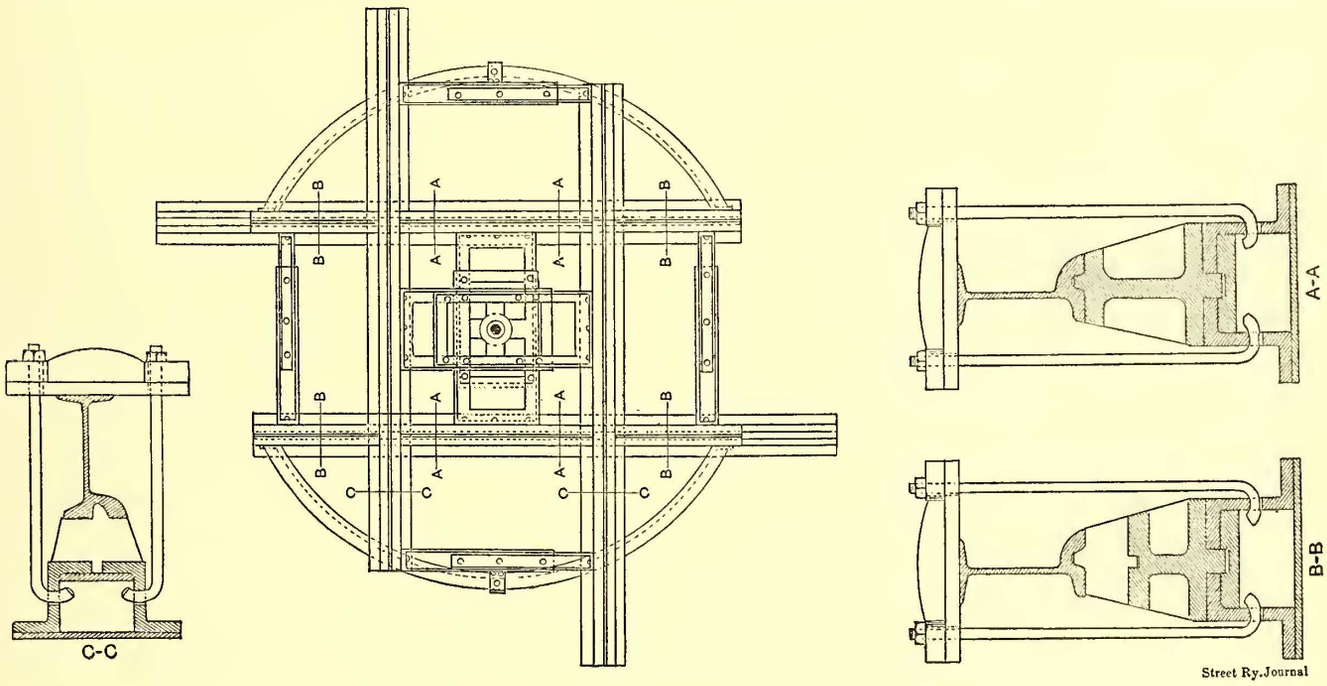
yoke of a truck and is balanced by a brace which is set a short distance out on the handle of the truck.

The night-light stands are utilized for giving illumination while doing work at night. Each stand carries a bank of 10 lamps, which receive current from the trolley wire through a fish-pole connection. The ground terminal is connected to the rails. When a car passes, the poles are raised from the trolley wire without disturbing the position of the stands.

The large amount of curves and special work require the attention of a considerable force of track greasers. In order to enable these men to get around the system without loss of time, small wagons, known as "greasers chariots," as shown in the engraving, have been devised. These wagons are large enough to hold two pails of grease, sand, salt, a switch iron and a broom, and the men go rapidly from one curve to another. All the curves on the system are greased at least once a day, and some curves three or four times a day.

RAIL CAR

For carrying long rails through the city, an ingenious car has been built as shown. With this device, 62-ft. rails can be handled around 33-ft. radius curves in 26-ft. streets without trouble.



DETAILS OF FORM FOR ASSEMBLING SPECIAL WORK

The arrangement consists practically of two specially built double-truck cars connected together with a hinged and swiveling skeleton frame. The double-truck cars have side members consisting of I-beams, over which the adjustable cranes can be moved so as to set them for any length of rails that it may be desired to haul. It will be noticed that the small wheels on which the cranes move roll along the bottom flange of the I-beam when there is no weight to be carried, but when the weight is hoisted the wheels that are farther away from the weights press against the upper flange of the I-beam. On top of each crane is carried a trolley pole, which has a special socket so that it can be easily removed if desired.

On the channel track, on top of the cranes, is a carriage, in which, on a universal hanger, the air hoists can be moved across the entire length of the car. These air hoists are connected with a long, flexible rubber hose to an iron pipe, and through the latter to the engineer's valve. Both hoists, as well as all brakes on each end of the car, are connected, so that the engineer's valves on either end of the car can be used to work both hoists simultaneously, and one man can operate the loading or unloading of the rails. The air connections for the hoists, as well as for the brakes, between the two ends of the car, are also made of rubber hose, and are carried in an iron pipe along the bottom of the skeleton frame, so that the car may easily take either sharp curves or grades. This connecting frame consists of three parts. The two end parts comprise two square frames, 7 ft. on a side, built of I-beams and braced together with channels; in the center are castings fitted into two parallel channels and pivoted directly over the king bolt to the car proper. The middle part of the connecting frame is also built of I-beams and braced with channels, and is connected to the two end portions by means of extending plates and heavy pins, thus permitting this portion to swivel vertically, and allowing the two ends of the cars to stand at different elevations, as when going over a grade. By removing the pins, the two end cars may be disconnected and used separately as construction cars.

Across the king pins of each square end of the frame are attached bolsters, on which the load of rail rests, so that the entire load rests on these two supports without touching any other part of the car, and in going over grades the load swings up or down on these bolsters. Side posts are also placed on each end of the bolsters to prevent the load from slipping off. The car is provided with four skids, two on each side. These skids are chained to the sides in such a way that when the car is moving they rest inside of the side I-beams, but when the rails are being unloaded and strung out along the streets, the skids are swung out toward the gutters, and when the necessary number of rails is unloaded and the car moves along a rail length for the next discharge of rails, the skids, by the forward movement of the car, swing themselves in toward the sides of the car, and it is only necessary to swing them out again in order to drop down the next load. The car can be operated by three men, one motorman and two laborers. The capacity of the car is from 20 tons to 25 tons. By means of this car the cost of transporting rails has been reduced from $1.50 or $1 per ton to about 20 cents per ton. The car has been in use for about three years, and has required practically no repairs. During this period over 22,000 tons of rail have been handled on the car.

PORTABLE RAIL SAW

The principal features of the portable-circular rail saw are the quick adjustment to the work, the possibility of using it without the slightest interruption of traffic, the instantaneous adjustment of the saw to the cut after the cars pass by, and the economy in time

necessary to make a cut. The work can be done at the rate of three cuts per hour, and a single cut has been made in the short time of 12 minutes. The saw consists of three parts. The clamping part, which holds the mechanism to the rails; the saw frame, on which the saw proper and gearing, as well as the feed mechanism, is attached, and the motor part. The clamp is made of two halves, connected together by a swivel, and is attached to the rail by means of a screw, which draws the clamps together and holds the saw to the rail. This screw is tightened by means of a removable hand-wheel. From the half of the clamp that fits on the outside of the rail there projects obliquely upward a frame which reaches slightly above the rail and ends in a bearing block that in cross section is diamond shape. This bearing block is split, the upper half being arranged to be locked down by a swing bolt or cam. Into this bearing the shaft of the saw frame is placed and adjusted to the cut. The saw on its shaft swings also on this bearing when it is being fed or when it is necessary to permit the cars to pass. The diamond-shaped bearing insures perfect fit and alignment regardless of wear or the presence of dirt.

The saw frame consists of a Z-shaped steel casting, to which is attached the gear and the feed mechanism. The saw gearing is of the standard Higgly construction. The feed is arranged through a friction clutch, so that in feeding, the hand-wheel is turned at a regular rate of speed, but in case the saw strikes some particularly hard portion, the hand-wheel turns without moving the feed screw. The obliquely-projecting frame has on the side nearest the web of the rail a small T-shaped slide, which in its normal position locks the frame in a position to cut, but when this T is moved toward one side it permits the entire saw frame to swing out to allow the cars to pass. From this it will be noticed that after the cars have passed the saw is instantaneously brought back to the exact position where the cutting was stopped, and ready to be continued without any adjustment. This is the most valuable feature of the saw.

The truck on which the saw is transported can be either attached to the rear of a wagon for long-distance transportation or be pulled by a man for short distances. On this truck is mounted a 4-D Christensen compressor and a small air reservoir. The saw is driven by means of a slow air motor, which is connected to the reservoir with a long rubber hose. This motor ends in a square shank, which is placed on the gear shaft when in use.

The method of operating the saw is as follows: When the truck is brought approximately near the work, the clamp is first attached to the foot of the rail, within a few inches of the spot where the cut is to be made. The saw frame shaft is then placed into the bearing and adjusted latterly so that the saw comes exactly opposite the line of cut. The motor is then attached to the shaft of the gear, and the motor started. When a car comes along the T-lock is moved out, and the entire frame and feed is swung outward and brought back again when the car passes. The rubber hose which connects the motor with the reservoir permits of the truck being a considerable distance away from the point of work, thus providing for any obstruction or wagon traffic that may be on the street.

SWITCH TONGUE PIN GRINDER

To insure the perfect working of a tongue switch it is of the utmost importance to have the pin in the tongue perpendicular to its bottom surface, and the pin itself must be to a true cylinder. If the first condition is neglected the tongue will have a tendency to jump and the rear wheels of a car passing over it may be derailed. If the contour of the pin is inaccurate, the pin cannot be made to set tight in the switch bushing. As all of the tongues made for the company are of manganese or chrome steel, a metal so hard that it cannot be machined with ordinary tools, some of the switches have been supplied with tongues having a separate pin riveted in to get a perfectly true fit. In order to avoid this, and to permit of the casting of a solid hardened steel tongue and pin in one piece, the company has designed the special pin grinder shown on Plate XVI., and which is installed at the roadway shops.

The movement of the principal drive in this machine is believed to embody an entirely new mechanical construction.

The machine consists of a bed on which is mounted the tongue rest or stand, which is arranged to move along the bed by means of a worm screw in conjunction with the support of the swiveling grinder-drive, which is fast on the bed, and the rear drive of the grinder, which is also fast on the bed. The tongue stand has a V-shaped jaw on which the pin rests and it is adjustable to bring the center of the rough pin in line of center of the grinder. After the pin is so adjusted the tongue is then gripped by means of two clamps against the outside surface of the tongue stand, thus insuring that the pin after it is ground will be perpendicular to that surface.

The principal drive of the grinder consists of a saddle fast on the bed and having on the top a perpendicular conical-shaped pin on which a fork-shaped bracket has a horizontal movement. The upper two arms of this fork end in a bearing in which is fitted a yoke having a vertical movement. This yoke carries the grinder shaft, the driving mechanism and the feed screw, and ends with a ball and socket joint fitting into the face plate of the rear drive. In the long axis of the yoke are two bearings that carry a tubular shaft in which an inner shaft carrying the grinder is loosely keyed. The tubular shaft is driven at the rate of 1000 r. p. m. by means of a pair of beveled pinions and a small pulley which is belted to the pulley of the motor above. The inner or grinder shaft, being loosely keyed in the tube and projecting from both ends of the tube, may be moved along its axis by means of the feed screw, as will be seen in the engraving. The face plate moves at the rate of 10 r. p. m., and through the ball and socket joints imparts to the grinder shaft a sweeping movement which describes the contour of two cones, which meet at the intersection of the axis of the conical pin of the saddle and the center line of the two bearings of the fork.

The point of intersection of the three movements has zero movement, as each plane of a cone parallel to its base is a circle. The grinding edge of the emery wheel which is mounted on the other end of the inner shaft describes a circle, the diameter of which may be varied by moving the emery wheel nearer to or farther from the zero point by means of the feed screw. From this it will be seen that as the pin is ground down or the emery wheel wears away, by moving the inner shaft toward the face plate, the cutting edge of the emery wheel is made to describe smaller and smaller circles. The action is equivalent to the movement of the cutting tool on an ordinary lathe towards the axis of the work.

Of course, as the emery wheel is drawn away from the tongue-rest by this feeding, the tongue-rest is also moved nearer, either by hand or by the automatic feed through the worm screw. The center of the pin, the zero point, and the center of the face plate lie in the same straight line.

PAVING

As stated elsewhere in this issue, the Philadelphia Rapid Transit Company is required by the terms of its various franchises to maintain and renew the entire paving from curb to curb on all streets in which it has tracks. As a result of these conditions the company is now maintaining 6,685,000 sq. yds. of paving, of which 64.5 per cent, or 4,316,000 sq. yds., is Belgian block; 22.4 per cent, or 1,500,000 sq. yds., is asphalt; 5.1 per cent, or 342,000 sq yds., is brick; 7.5 per cent, or 499,000 sq. yds., is macadam; 0.5 per cent, or 27,699 sq. yds., is cobble.

In streets paved with asphalt it is now the standard practice to pave between the rails with Belgian blocks, and two longitudinal rows of blocks are laid along the outside of each rail. Where the entire street is paved with Belgian blocks, the paving is laid crosswise over the surface of the street from curb to curb.

DEPARTMENT OF LINES AND CABLES

On the Philadelphia system the distribution of power is accomplished almost entirely through underground cables. These cables are installed in the company's conduits, which are used exclusively for its own power, telephone and return cables. Over 1000 miles of underground cable are in use for the distribution of power. There is one stretch of 5 miles of overhead a. c. transmission lines on the new Willow Grove route, and there are short sections of overhead d. c. feeders, but for the most part the distribution system is underground. As outlined in the maps included in this issue, the distribution centers consist of ten d. c. generating stations, two a. c. generating stations (one of which is now under construction), four chloride accumulator battery stations and six rotary converter sub-stations.

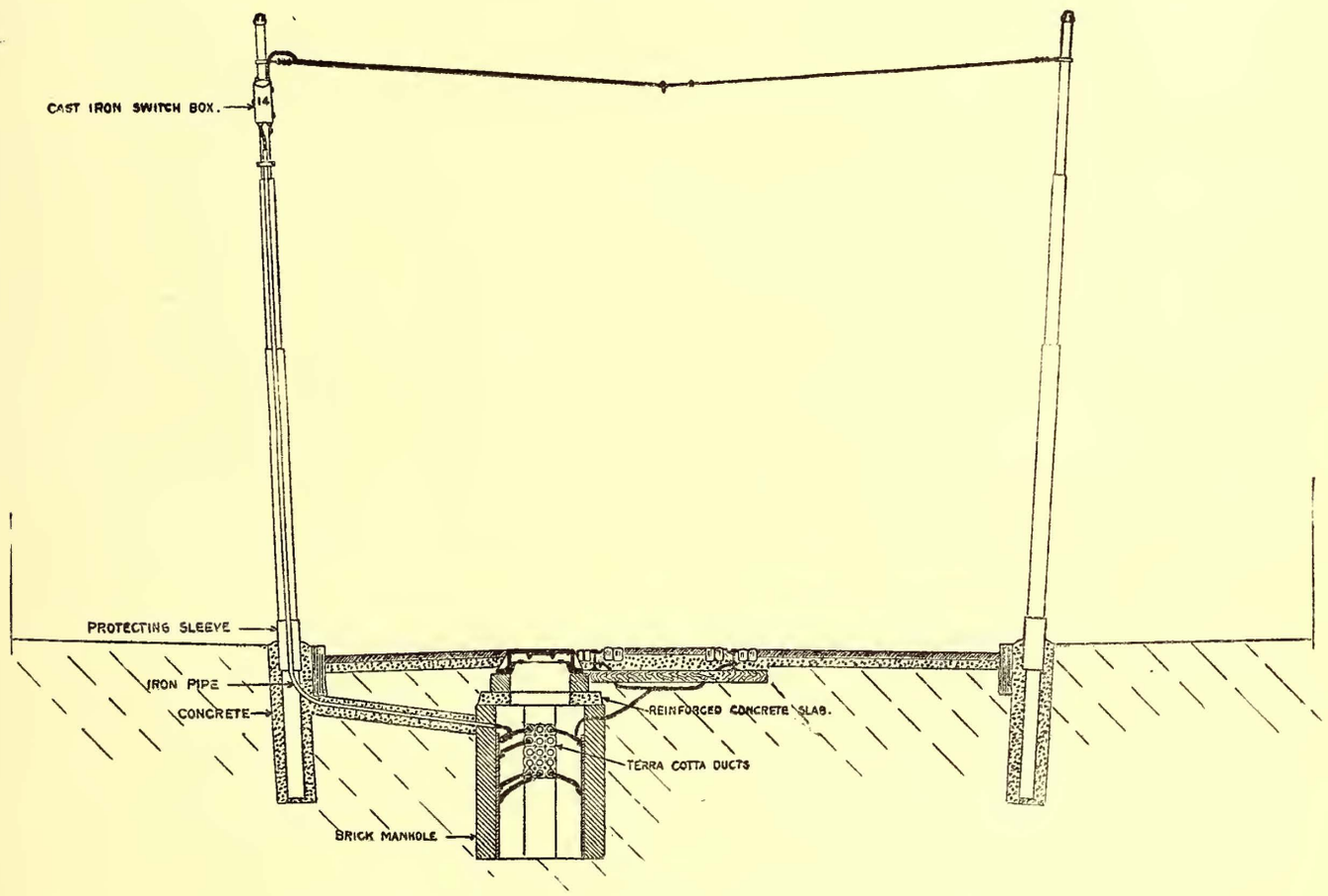
For cable conduits terra cotta ducts have been adopted as standard. These ducts are laid in single-duct formation, and are surrounded by 3 ins. of cement concrete. On straightaway stretches elliptical manholes are placed at frequent intervals, the manholes being for the most part 9 ft. long, and varying in depth and width according to the size and location of the conduits. Square manholes are placed at the junction points. The manholes are connected with the sewers by terra cotta drain pipe, and each hole is thoroughly cleansed every two months.

The d. c. cables differ in size, but the standard sizes are 1,000,000 circ. mil, 1,500,000 circ. mil and 2,000,000 circ. mil. Rubber, jute and paper insulations for cables are in use, but the standard cable is covered with 5-32-in. saturated paper insulation, with a 5-32-in. wall of lead. The size of the cables is figured on a basis of a maximum loss of 10 per cent voltage. The sections to be fed were first made short, so that in case one cable became disabled the next section would be able to carry the load, but, inasmuch as very little trouble has been experienced with the underground cables, the sections have been increased in length and in size.

Most of the trouble in the underground cables is due to mechanical injury of one form or another. Mechanical injury in manholes is now being avoided by assigning each cable a certain hanger in the manhole, and the cable is thoroughly secured in the position allotted to it.

Feeder taps are taken off at intervals of from 500 to 1000 ft. in the feeder sections. The feeder sections vary in length from 2000 ft. to 5000 ft. The taps are brought up the feeder poles through 2½-in. iron pipe. The tap cables are insulated with 6-32-in. rubber compound covered with ⅛-in. lead and protected outside the lead with a weather-proof braid. A cast-iron switch-box containing a 250-amp. switch is placed near the top of each feeder pole, and the tap cable is brought through this switch before connecting to the feed span. The feed switch has been found the most satisfactory method of connecting the taps to the feed spans. Connection is made from the top of this switch-box to the span, which is permanently connected to the trolley wire by a solid metallic hanger at the feed ear. Where the feeder connection rises from the top of the switch-box, the lead covering is continued up a short distance, to insure absolute waterproofing. The lead is then stripped off and the rubber-covered cable is continued to the tap connection. On the other side of the pole from the feeder switch is a lightning-arrester box, the lightning-arrester lead being a rubber-covered wire wrapped in circular loom, the lead passing from the under side of the switch-box to the lightning arrester. The ground from the arrester box passes down through an iron pipe to the underground return cable.

Trouble from electrolysis on the lead sheaths of the underground cables has been practically obviated by the use of special



SECTION OF FEEDER POLE, SHOWING STANDARD CONSTRUCTION

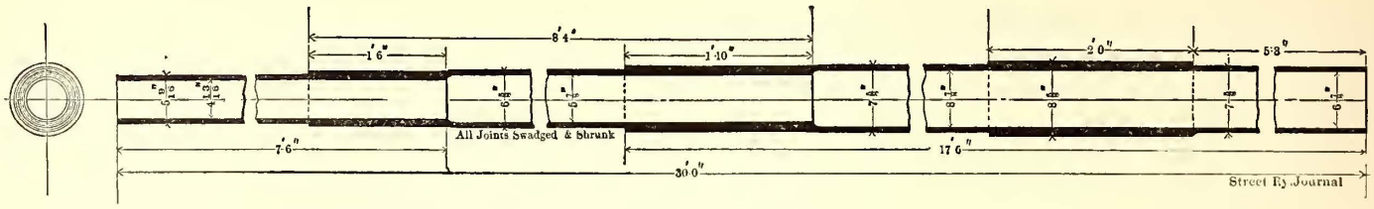
insulated return cables extending for a radius of about 1000 ft. from each power house, connected to the negative bus-bars and bonded to the lead coverings.

Ample capacity in return cables has been provided, the negative cables varying in cross section from 1,000,000 circ. mil to 3,250,000 circ. mil, and being connected to the rail at each manhole through a No. 0000 bond. The standard return feeder is a 7 x 7 strand bare copper cable.

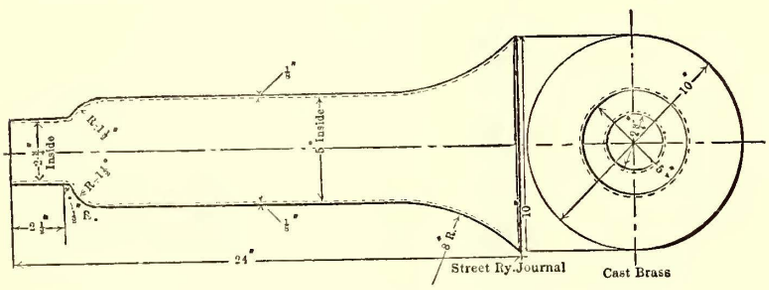
In addition to the feeder cables, numerous tie-line cables are in use between the d. c. distributing centers. The d. c. tie-line layout is shown on Plate XXX. in this issue. The tie cables, as will be readily understood, are very serviceable in equalizing the load betwen power stations and sub-stations, and are also of great service in case of breakdowns.

A. C. CABLES

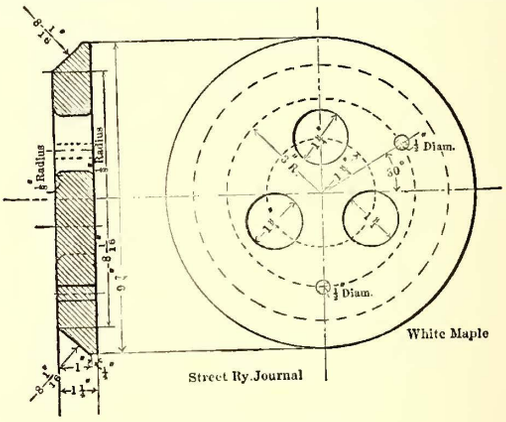
Each rotary converter sub-station is connected to the generating plant by at least two high-tension underground cables varying in size from No. 0 three-conductor to No. 0000 three-conductor. The insulation on high-tension cables consists of a 6-32-in. saturated paper wall around each conductor and a 6-32-in. belt around the three conductors after they have been twisted together. The lead covering is 5-32 ins. thick. The working voltage is 13,200 three-phase,, and each cable is subjected to a breakdown test of 26,000 volts between all conductors before the cable is placed in service. As one cable is sufficient to operate a sub-station, the other cable is kept idle. Each cable is put into service every other day, and is out of service the alternate days. This arrangement protects one cable to each sub-station from any excessive voltage surges which may occur on the system. The a. c. cables terminate in cast-bronze bells, which are supported in the power station and sub-stations immediately under the oil switches. This bell is illustrated herewith. Connection is made to the oil switch by means of three single conductor cables insulated with 14-32 in. of rubber compound, and protected by a double waterproof braid. These cables are spliced to the three conductors of the lead-covered cable in the terminal bell. The a. c. tie lines are shown on Plate XXIX.



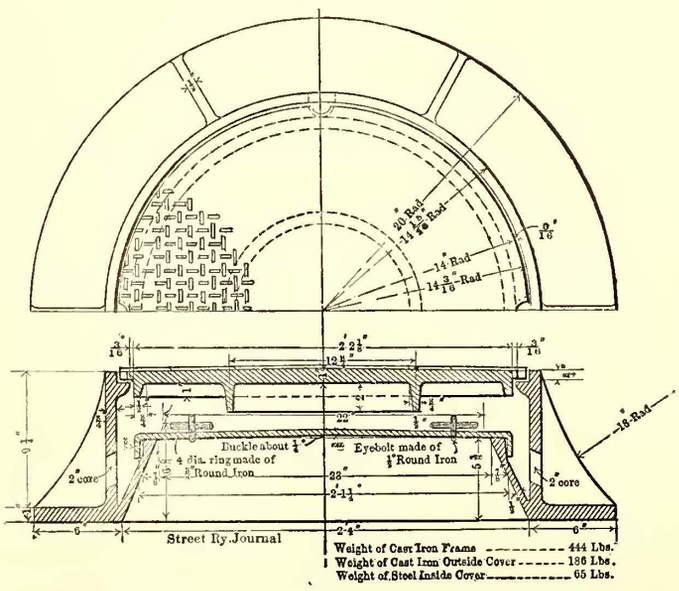
STANDARD 30-FT. STEEL POLE WITH REINFORCING SLEEVE AT SIDEWALK LINE



CABLE BELL



TOP FOR CABLE BELL



CAST-IRON MANHOLE FRAME AND COVER

OVERHEAD CONSTRUCTION

The standard overhead construction is span wire with steel poles in three sections. All bracket and center-pole construction has been abolished. Each pole has a patent reinforcing sleeve 2 ft. long swedged around the pole above and below the sidewalk level for the purpose of preventing the excessive corrosion that takes place at this point. On old poles, where this sleeve was not used in the first place, the sleeves are now being added by a patented method, which is described later in this article.

The standard trolley wire is No. 00 hard-drawn copper of circular section, suspended on soldered ears from round-top bells. No cap and cone overhead material is used in new work. Owing to the number of crossings and track intersections (there being over 1100 such crossings) it is the practice to insulate the trolley wires at all intersections so as to maintain the proper feeder sections and avoid mingling of current from different power houses. A satisfactory type of insulated crossing has been designed by the company's engineers in order to give a straight under-running. The crossings are made with removable ends, so that the end portions, which are subjected to the heaviest pounding from the trolley wheel, can be readily replaced as they become worn. All feeder sections are separated at the curves by means of a short circuit-breaker, which is placed 18 ins. from the switch on the leaving end, thus doing away with the necessity for insulated switches, which have never been very satisfactory. On curves malleable iron double and single pull-off castings with 2½-in. globe strain insulators are used. Around each curve a safety wire is run parallel to the trolley wire and attached to each pull-off on the curve, so that in case of a trolley break the pull-off cannot drop

to the ground and strike cars or pedestrians. All guy wires on curves are made up into a 2½-in. galvanized steel strand cable ring, so that only one pull-off wire crosses the intersecting trolley wire.

To avoid burning out section insulators or causing trouble at the power house when a car passes from one section to another, the poles on which breakers are located are painted with a broad white band, and motormen have instructions to shut off power when passing one of these poles.

To expedite the work of the emergency crews and for general convenience in referring to cables, every cable on the system is numbered, and this number is stamped on the joint in each manhole. The cables are numbered according to the station from which they feed. For instance, all cables fed from station No. 1 are numbered between 1 and 199; cables from station No. 2 are numbered from 200 to 299, etc. For reference purposes, the feeder lay-out is divided into sections, and blue-print maps are made of each section showing each cable, feeder tap, insulator, etc. A portion of one of these maps is shown on page 507 to illustrate the system.

For drawing cables through the conduits there has been designed an electric winch, shown on one of the accompanying plates. The winch is equipped with a 10-hp motor of the Christensen air-brake compressor type. The motor drives a shaft through gear and pinion, and the shaft is geared to the winch by beveled gear and pinion.

PHILADELPHIA RAPID TRANSIT COMPANY.

EMERGENCY REPORT. Date,_____190

Wagon No.	Time Leaving	Time Return	Reported by	Location of Trouble	Nature of Trouble	Remarks	Foreman

FORM 144.—DAILY REPORT OF EMERGENCY WAGON CALLS

EMERGENCY CREWS AND HURRY-UP REPAIR SERVICE

There are held in readiness at all times for immediate service six emergency wagons and two tower repair wagons, the latter being engaged in doing heavy repair and construction work on overhead lines. The emergency wagons respond to all calls in case of trouble, such as breaks in the overhead system, broken wagons, fires,etc. The emergency calls are received at the emergency desk, and the despatcher on duty immediately transmits the call to the nearest wagon available for the purpose, and then notifies all operating depots concerned that there is liable to be a blockade, and the routeing of cars is changed in accordance with the necessities of the case.

The emergency despatcher keeps a record of the movements and locations of all the emergency crews and wagons at all times, and uses for the purpose a large sheet with the column headings shown in Form 144. The time a wagon goes out is noted, and when the crews report they have finished the work they were assigned to do, proper notation is made on the sheet. This sheet also gives the location of the trouble and the nature of the trouble. The emergency crews turn in a report of every call to which they respond, using for the purpose Form 33. Summaries of these reports are made on Form 211 and Form 275, the former giving the emergency calls per wagon, and the latter giving the number of calls classified according to the causes of the trouble.

Each emergency wagon carries what is known as the "Linemen's Book of Cables," which shows all the line sections in the city. The book is made up of blue-print sheets bound on the loose-leaf system, and the prints show on what streets the cables run, also the location of the feeder taps and connecting cables. The emergency crews are required to know by memory the location of all the cables, taps, etc., and are examined twice a year upon this subject. Any man receiving 100 per cent on this examination receives a reward of $10; linemen receiving over 90 per cent get $5; helpers receiving over 80 per cent get $5, and drivers receiving over 70 per cent get $5. The linemen are all employees who have served as helpers, and are advanced in accordance with their proficiency.

The general instructions to emergency crews read as follows:

The lineman's book of cables must be kept on the wagon at all times. The lineman in charge of the watch will be held responsible for its condition.

When you cut out or in a cable be sure and see that the current is on the line before leaving. This test can be made by using the cluster of lamps, with which each wagon is provided.

In cutting out cables when the tap comes out of a feeder-head, always break the tap at the head instead of simply pulling the tap at the trolley wire.

When you are called to a wreck do your utmost to get the cars moving. If the injured car is in such shape that it cannot move, pull it off the track. When the wrecking car arrives on the ground you are to work under the direction of the foreman of the wrecking car.

Report in writing when you come in how long the cars were blocked, and the cause.

When you are going to and from a call always keep a sharp watch for anything that may be wrong on any of the company's property. If trouble is found on the track or in paving, report the same as soon as you reach the house to "Emergency."

Philadelphia Rapid Transit Company.

Emergency Calls and Causes.

Ending 190

CAUSES	WAGON No.	TOTAL
Break in Trolley Wire,		
" Guard "		
" Span "		
" Pull-off.—Guy Wire,		
Charged Pole,		
Trouble at Feeder Pole,		
Feed Taps and Spans,		
Painting,		
Globe Savers leaking and broken,		
Line or Cable Grounded,		
Foreign Wires,		
Ears Off and Broken,		
Bells Off " "		
Hangers Loose and Broken,		
Repairing Bridles,		
Section Insulators,		
Crossings and Crossovers,		
Frogs,		
Brooklyns Leaking and Broken,		
Odd Jobs,		
Repairs,		
Cutting in and out Cables,		
Lining up Special Work,		
Broken Studs,		
Wrecks and Car Troubles,		
Fires,		
False Reports,		
Curve Work,		
Guard "		
Pole "		
Trough Repairs,		
Lights,		
Lightning Arresters,		
Testing and Inspecting,		
Renewing Wire,		
Trimming Trees,		
Totals Jobs,		
" Calls,		
Remarks:		

FORM 275.—SHEET FOR CLASSIFYING EMERGENCY CALLS ACCORDING TO CAUSES

The lineman is in charge of the wagon and is responsible for the conduct of the other employees.

If permission to "lay off" is desired, the application must be made to the division foreman, and the request will be granted if possible.

When you receive instructions to answer a fire alarm always see that the hose tripods are put on the wagon. When you arrive at the fire the lineman can look the ground over and see if the cars are liable to be blocked, and if so, where to put the wagon so as to open the line. If you require help go to the nearest public or private telephone and notify "Emergency."

The driver and helper must stay on the wagon at all times, unless their services are required to move hose and assist in opening the line.

The emergency wagons are of the Trenton tower type, with the lower section of the tower built of structural iron. The upper section of the tower on which the platform is mounted is wood. The design is well adapted to making line repairs, and also to general wrecking work of all kinds. The towers carry a complete complement of wrecking and repair tools, such as jacks, switch blocks, motor hoists for raising a crippled motor, fire-hose tripods, etc. The emergency stations are fitted out on the pattern of fire department stations, with quick-hitching harness, etc., and in cases of hurry calls, the men and horses respond in accordance with fire department drills.

The number of emergency calls averages about 1000 per month, or 35 calls per day.

RECLAIMING IRON TROLLEY POLES

As many of the trolley poles in use in Philadelphia have been in the ground eight and ten years, the Philadelphia Rapid Transit Company has recently been confronted with the necessity of renewing the poles along many of its important lines. In these poles, the point of weakness has been found to be just at the surface of the ground, where the extreme variations in dryness and moisture cause excessive corrosion of the metal. In some cases the poles have been found so badly pitted at the ground line that the shell of the pole could be punched through with an ordinary blow. The poles, with the exception of the corrosion at this point, are in excellent condition, and show no other evidence of weakness.

Philadelphia Rapid Transit Company.

Emergency Calls per Wagon.

Ending ..... 190·

DATE	WAGON No.	TOTAL
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
HIGH.		
LOW.		
AVERAGE.		
TOTAL.		

Remarks:

FORM 211.—SHEET FOR RECORDING EMERGENCY WAGON CALLS BY DATES

Form 33. 0310. 5-15-05.

Lineman's Report.

Wagon No...... *Date,*..... *190*

Time: { *Leaving,* ..... *Return,* .....

Time out,.....

Cable No......

Trouble,.....

Material used,.....

Cars detained,.....

.....*Lineman.*

FORM 33.—LINEMAN'S REPORT OF EMERGENCY WAGON CALL

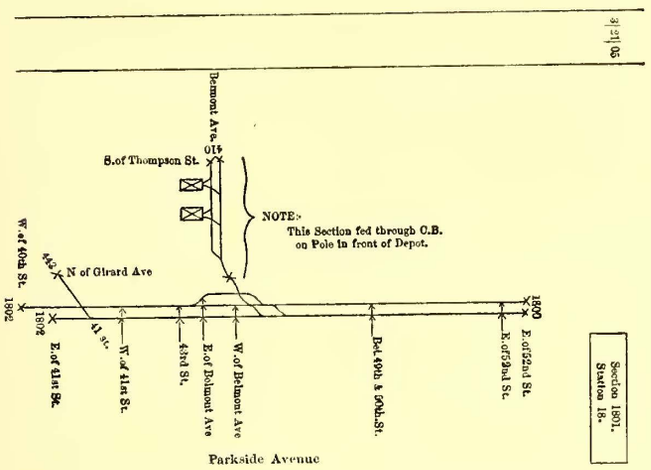
The company's engineers have succeeded in practically tripling the life of these old poles by the simple method of slipping an iron sleeve over the top of the pole, and bringing it down over the corroded portion at the ground level. This sleeve is 24 ins. long, and has a shell ¼-in. thick. The space between the sleeve and the pole is filled with molten sulphur, and concrete is poured in around the outside of the sleeve.

In carrying out this work, a hole 24 ins. square is first dug out around the base of each pole to the depth of 10 ins. The poles were formerly set in concrete, and all old concrete is broken out. The band at the top of the pole, holding the span wire, is then removed by the aid of a tower wagon, and the pole is stripped of any breaker boxes, junction boxes or other projections or obstructions. The sleeve is then slipped over the top of the pole and is allowed to slide down so that it rests with about 10 ins. of its length below the ground level and 14 ins. above the ground. Before the sleeve is in place, the base of the pole is, of course, thoroughly cleaned, a wire brush being used for this purpose. The interior diameter of the sleeve is ⅜ in. larger than the outside diameter of the pole, thus leaving a clear space of 3-16 in. all around between the pole and sleeve. Into this space is then poured hot sulphur, the composition being crude sulphur approximating 95 per cent pure. To assist in pouring the sulphur into the opening, a heavy leather strap is placed around the top of the sleeve, and the sulphur is poured from a coffee pot into the space between the strap and the pole, so that it has a chance to flow down slowly and thoroughly fill the space. The sulphur is brought up to ¼ in. above the sleeve, and is then sloped off from the pole to the edge of the sleeve, in order to turn off water that may run down the pole.

After the sulphur has set, new concrete is rammed into the hole at the base of the pole, the concrete being brought up to the level

of the sidewalk, where it is finished off with a cement block, which is brought ¼ in. higher than the pavement at the pole, and is sloped off to the pavement so as to drain water away from the pole. The pole is then painted with a dark green graphite paint for a distance of 6 ft. above the pavement.

It has been found that poles reinforced in this way are stronger



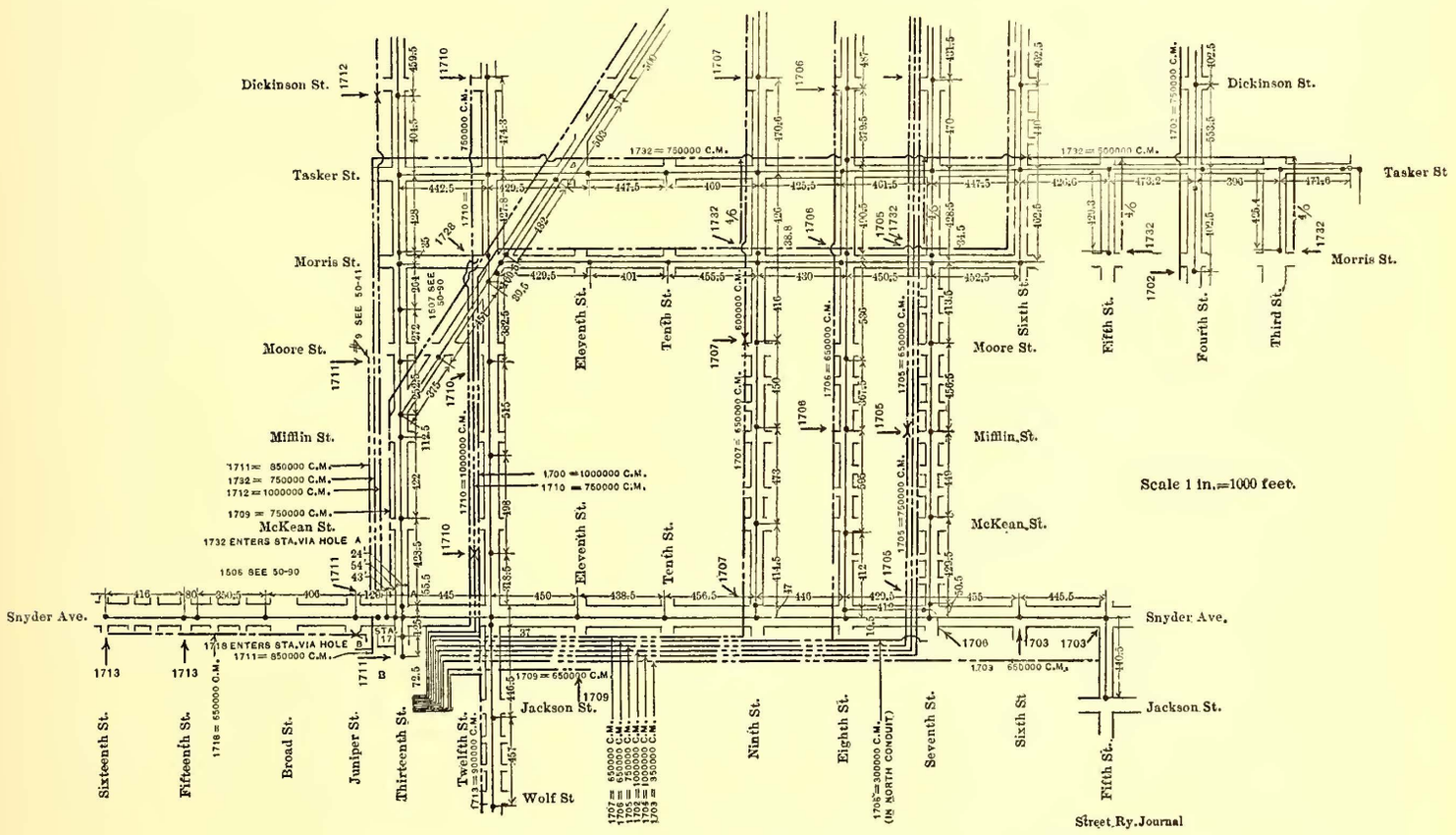
SAMPLE SHEET FROM LINEMAN'S BOOK

than they were originally, and it is believed they will last twice as long as the length of time they have already been in place. The sulphur becomes almost as hard as iron and absolutely prevents moisture from getting at the pole proper, so that any corrosion that may take place in the future will be on the outside of the reinforced sleeve, and not on the pole.

A gang for doing this work has been organized, and approximately 10,000 poles have been reinforced in this way during the past year. To expedite the work, a wagon has been rigged up for mixing the concrete cement used around the base of the poles. The wagon has a platform 4 ft. wide, 10 ft. long and 8 ins. deep, with flaring sides. The sulphur is melted in a large cast-iron pot, which is carried on a wagon. For doing the work expeditiously, a gang of twenty-eight men is required, and this gang is now going over the older lines reinforcing all of the poles as they go. From the work already carried out, it is found that the cost for putting the sleeve in place, including all materials and the labor necessary for digging out the holes, pouring the sulphur and reconcreting the hole, is from $5 to $6 per pole. All new poles ordered by the company have a sleeve swedged around the pole above and below the ground line, in order to do away with the trouble which has been experienced with the old poles corroding at this point. The process of reclaiming the poles, as outlined in the foregoing, has been covered by letters patent granted to the company's engineers.

TELEPHONE SYSTEM

The company operates and maintains its own private telephone system, but rents the telephone switchboard and all the instruments from the Keystone Telephone Company. Its private exchange comprises a two-section switchboard, with which is connected about 300 private instruments, covering the entire system, including all departments, car houses, power houses, storerooms, shops, outlying offices, parks, and about 100 street pole boxes distributed at various points. The company's central board has ten trunk lines to the central exchange of the Keystone Telephone Company, and there are ten independent trunk lines for emergency use. There is a separate telephone board known as the "emergency despatcher's desk," to which all emergency calls are transmitted. There are about 60 miles of underground telephone cables, which are carried in the company's own underground ducts. The street pole telephone sets are enclosed in cast-iron boxes fastened to the poles at important street intersections. Street superintendents are provided with keys for these boxes, and keep in touch with the emergency despatches as to the location of any trouble which may be occurring.



SAMPLE SHEET SHOWING METHOD OF KEEPING RECORDS OF FEEDERS

GENERATION AND DISTRIBUTION OF POWER ON THE PHILADELPHIA RAPID TRANSIT SYSTEM

In 1895 the company had plenty of power, but beginning with 1898 the introduction of longer cars and the increased traffic brought about a constantly increasing demand for additional power. This demand was met at first by adding new direct-current generating facilities at different points on the system, and later by installing storage-battery plants at points of heaviest load.

In the beginning of 1903 the engineers of the company recommended the adoption of alternating-current work to the Philadelphia situation, and a temporary plant was erected at Second Street and Wyoming Avenue with 2000-kw capacity in alternating-current generating apparatus. In this connection three rotary and transformer sub-stations were installed, one of 2000-kw capacity at Thirteenth Street and Snyder Avenue, one of 1000-kw capacity at Frankford, and one of 1000-kw capacity at Germantown. In 1904 the station at Second Street and Wyoming Avenue was increased by the installation of four 1500-kw Parsons turbine alternating-current units. During the time these additions were going on three additional sub-stations were built, one of 3000-kw capacity at Fifty-Second Street and Lancaster Avenue, one of 2000-kw capacity at Glenside, and one of 1000-kw capacity at Willow Grove, and the Snyder Avenue sub-station was increased to 3000-kw capacity and the Germantown sub-station was increased to 3000-kw capacity.

It was then decided to make the alternating-current generating station at Second Street and Wyoming Avenue a permanent plant instead of temporary, and there are now being installed at that station two 1500-kw additional Parsons turbine units.

The next step in the comprehensive power scheme that is in process of evolution will be the erection of a central alternating-current generating station at Delaware and Laurel Avenues, on the Delaware River, having an ultimate capacity of 50,000 kw, for which the immediate plans provide for the installation of three 6000-kw units. In connection with this plant there is now being installed a large sub-station in the center of the city at Ninth Street and Sansom Avenue, which will have an ultimate capacity of 12,000 kw, and which will take current from the new Delaware Avenue station. The new alternating-current generating station and the old alternating-current plant at Second Street and Wyoming Avenue will be tied together with underground alternating-current tie-lines, and the bus-bars of the two stations will be connected in multiple, so that any sub-station can be run from either of the generating stations. There are two cables to each of the sub-stations, except to Germantown, which has three. From Germantown to Glenside there are two high-tension cables, and from Glenside to Willow Grove there is an overhead transmission line, consisting of three single aluminum wires. This line is about 5 miles long, and is the only overhead high-tension transmission on the system, all the other lines being carried in underground conduits.

For taking care of the new elevated and subway lines, power for the city end—that is, east from City Hall—will be furnished from the Ninth Street and Sansom sub-station. The section from City Hall west to about Forty-Sixth Street will be fed from the present direct-current generating station at Thirty-Third and

TABLE XVI.—SHOWING STEAM AND ELECTRIC EQUIPMENT IN ALL THE

Station No.	Location.	Engines.	Condensing or Non-Condensing.	Generators.	Direct Connected or Belted.	Boilers.	Steam Pressure.
1	Thirteenth and Mt. Vernon Sts..	4—1,500 hp. Wetherill-Corliss..... 1—2,200 hp. Wetherill-Corliss.....	Non-cond.. Non-cond..	5—1,500 kw. West.....	D. C..	19—375 hp. B. & W..... 1—400 hp. Parker.....	145 lbs.
2	Delaware Ave. and Poplar St....	4—1,000 hp. Porter-Allen..... 1— 300 hp. Porter-Allen..... 1—1,000 hp. Wetherill-Corliss.....	Condensing Condensing Condensing	4— 800 kw. Gen. Elec..... 1— 600 kw. West..... 1— 250 kw. Gen. Elec.....	D. C.. D. C.. D. C..	14—250 hp. B. & W.....	145
3	Beach and Green Sts.....	3—2,000 hp. Allis-Corliss..... 1— 750 hp. Allis-Corliss..... 1— 350 hp. Allis-Corliss..... 1— 350 hp. Fischer.....	Condensing Condensing Non-cond.. Non-cond..	3—1,500 kw. Gen. Elec..... 1— 500 kw. Gen. Elec..... 1— 300 kw. Gen. Elec..... 1— 150 kw. Gen. Elec.....	D. C.. D. C.. D. C.. D. C..	14—250 hp. B. & W.....	150
4	Thirty-Third and Market Sts....	2—2,000 hp. Penna.-Corliss..... 2—1,500 hp. Wetherill-Corliss..... 2—1,000 hp. Penna.-Corliss.....	Non-cond., Condensing Non-cond.. Condensing	1— 125 kw. Crocker-Wheeler Motor-Driven Booster..... 4—1,500 kw. West..... 2— 800 kw. West.....	D. C.. D. C.. D. C..	16—375 hp. B. & W..... 1—500 hp. B. & W..... 2—375 hp. Parker.....	150
5	Thirty-Third and Dauphin Sts., See also Table XVII.....	3—1,000 hp. Wetherill-Corliss.....	Condensing	2— 800 kw. Bullock..... 1— 600 kw. West..... 1— 125 kw. Crocker-Wheeler Motor-Driven Booster.....	D. C.. D. C.. D. C..	8—250 hp. Berry.....	145
6	Twenty-Seventh and South Sts .	3— 600 hp. McIntosh & Seymour.... 2— 350 hp. Porter-Allen.....	Condensing Non-cond..	3— 400 kw. Gen. Elec..... 2— 250 kw. Gen. Elec.....	D. C.. D. C..	6—250 hp. B. & W.....	160
7	Ogontz.....	3—1,200 hp. Allis-Corliss.....	Condensing	3— 850 kw. Siemens-Halske..... 2— 125 kw. West. Boosters.....	D. C.. D. C..	9—250 hp. Berry.....	150
8	Willow Grove.....	2— 400 hp. McIntosh & Seymour.... 3— 250 hp. Wetherill-Corliss..... 1— 500 hp. West.-Kodak.....	Non-cond.. Non-cond.. Non-cond..	2— 250 kw. Gen. Elec..... 3— 150 kw. West..... 1— 400 kw. West.....	D. C.. Belted. D. C..	5—125 hp. Weth. Ret. Tub.. 6—150 hp. Weth. Ret. Tub..	115
9	Wheel Pump.....	1—1,000 hp. Wetherill-Corliss.....	Condensing	1— 600 kw. West.....	D. C..	5—125 hp. Weth. Ret. Tub..	115 to 120
10	Second St. and Wyoming Ave...	2—1,500 hp. Wetherill-Corliss..... 6—2,250 hp. West.-Parsons Turbines.. 2— 500 hp. West. Cross Compound.	Condensing Condensing Non-cond..	2—1,000 kw. Gen. Elec. A. C.... 6—1,500 kw. West. A. C..... 2— 400 kw. West. D. C.....	D. C.. D. C.. D C..	8—700 hp. Parker double-ended..... 2 —800 hp. Parker double-ended..... 6 —600 hp. Parker double-ended.....	160
D	Neshaminy Creek and Doylestown Pike.....	2— 200 hp. Ridgway.....	Condensing	2— 150 kw. Thompson-Ryan....	D. C..	2—250 hp. Stirling.....	140
	New Delaware Ave. Station.....	3—6,000 kw. West. Turbines.....	Condensing	3—6,000 kw. West. A. C.....	D. C..	16—800 hp. Parker.....	175

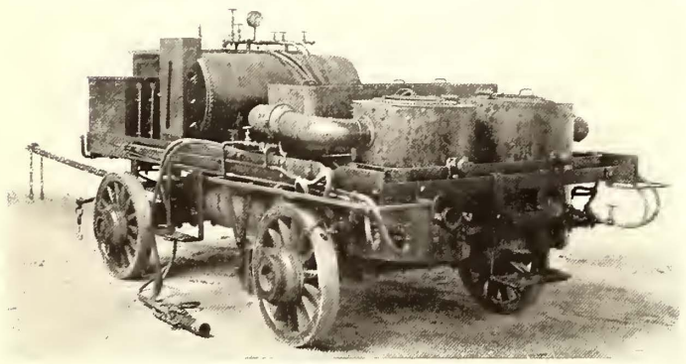
INTERSECTION OF THIRD AND MARKET STREETS, LOOKING NORTH ON THIRD STREET.—THE VIEW SHOWS THE STREET CONGESTION ON AN ORDINARY AFTERNOON

MARKET STREET, LOOKING NORTH FROM ELEVENTH STREET TOWARD CITY HALL.—THE VIEW SHOWS THE SCENE ON AN AVERAGE PLEASANT AFTERNOON

Latest Form of Sand-Blast Wagon

Sand Blasting Rail Ends and Plates

Reaming Holes

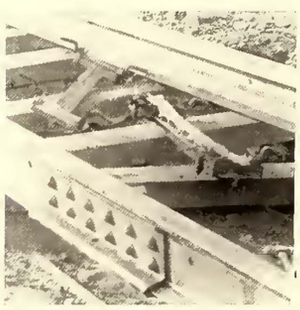


Latest Form of Melting Wagon

Pouring Joint

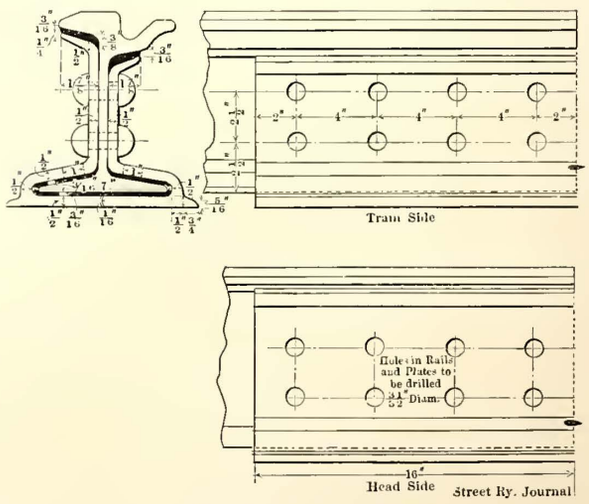
Joint After Pouring

Latest Form of Reamer Wagon



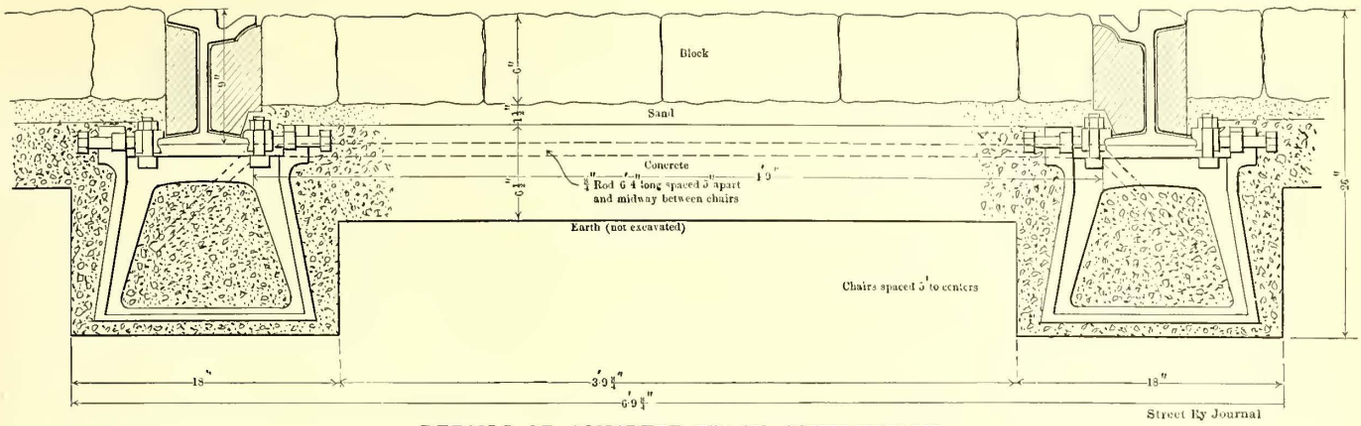
Joint with Moulds Removed

Latest Form of Riveter Wagon



Cast-Zinc Joint on 137-Lb. Rail

APPARATUS AND PROCESSES IN MAKING CAST-ZINC JOINT



DETAILS OF CONCRETE TRACK CONTRUCTION

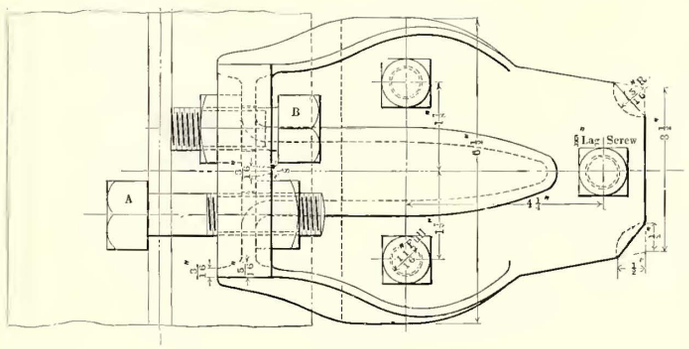
SPECIAL SLIP JOINT ON BRIDGES

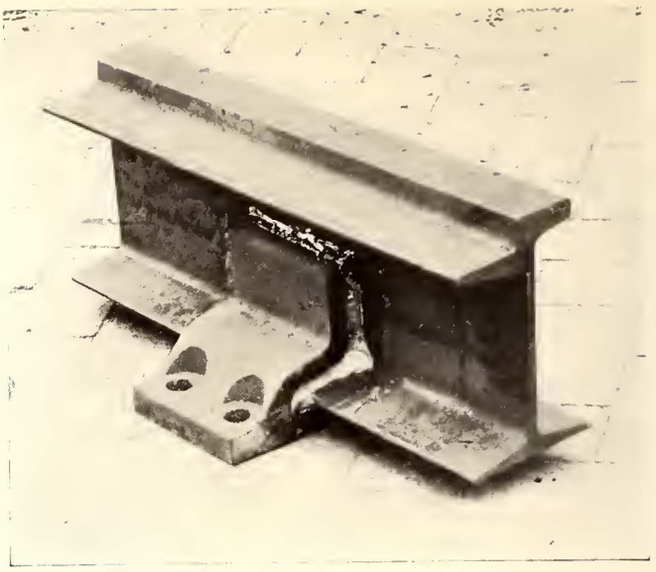
SPECIAL RAIL CHAIRS USED ON BRIDGE WORK

TRACK WITH YOKES ATTACHED PRIOR TO PLACING CONCRETE

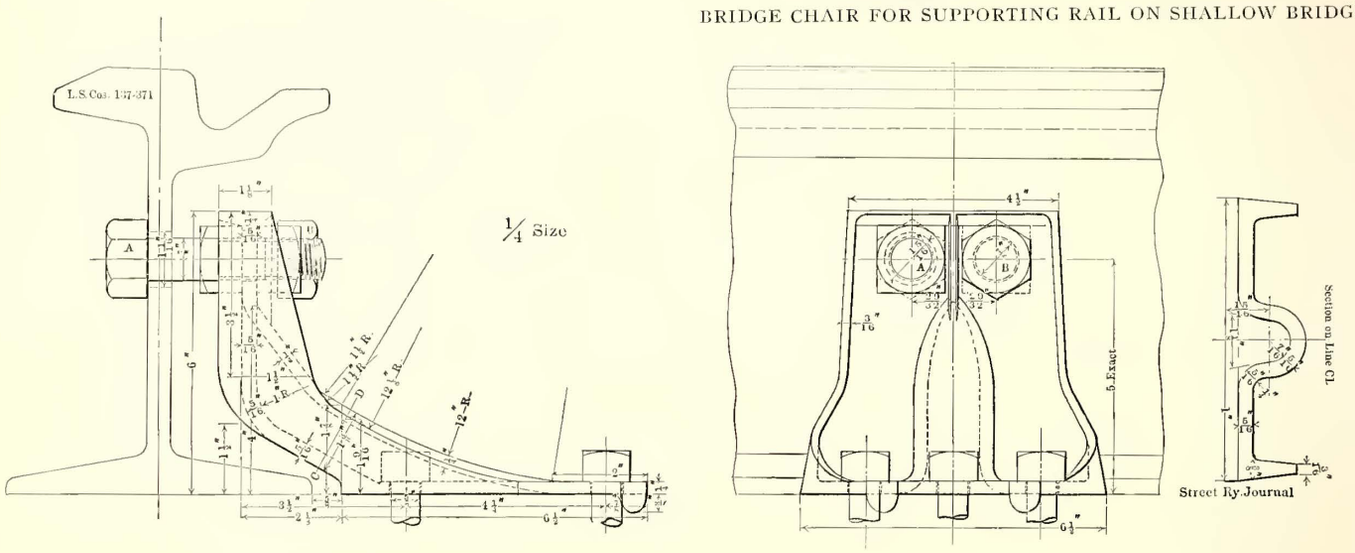
TRACK READY FOR CONCRETE

DETAILS OF SPECIAL RAIL CHAIRS ON BRIDGES



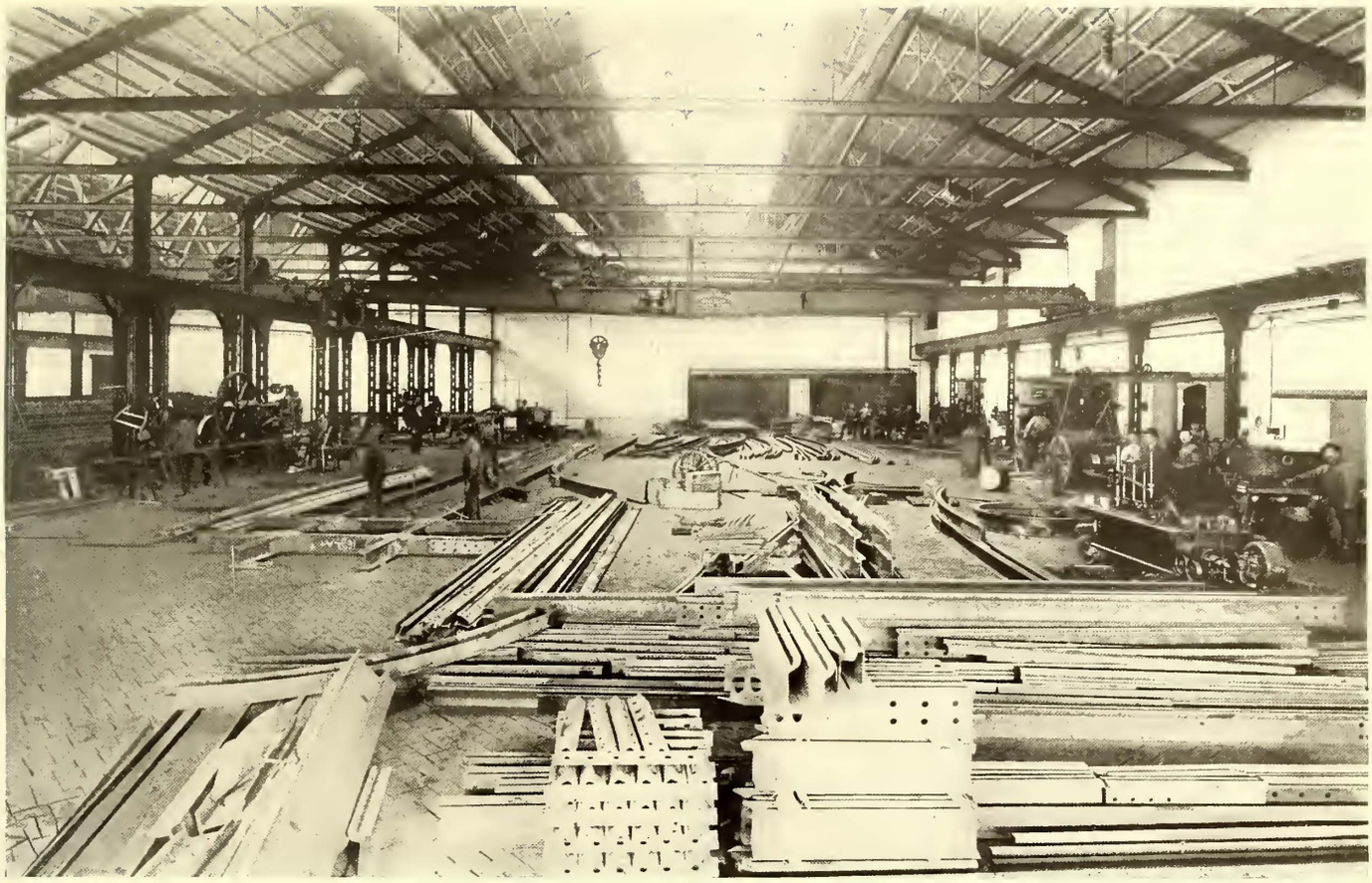


BRIDGE CHAIR FOR SUPPORTING RAIL ON SHALLOW BRIDGES



MALLEABLE IRON RAIL BRACE FOR ADJUSTING AND HOLDING RAILS TO GAGE

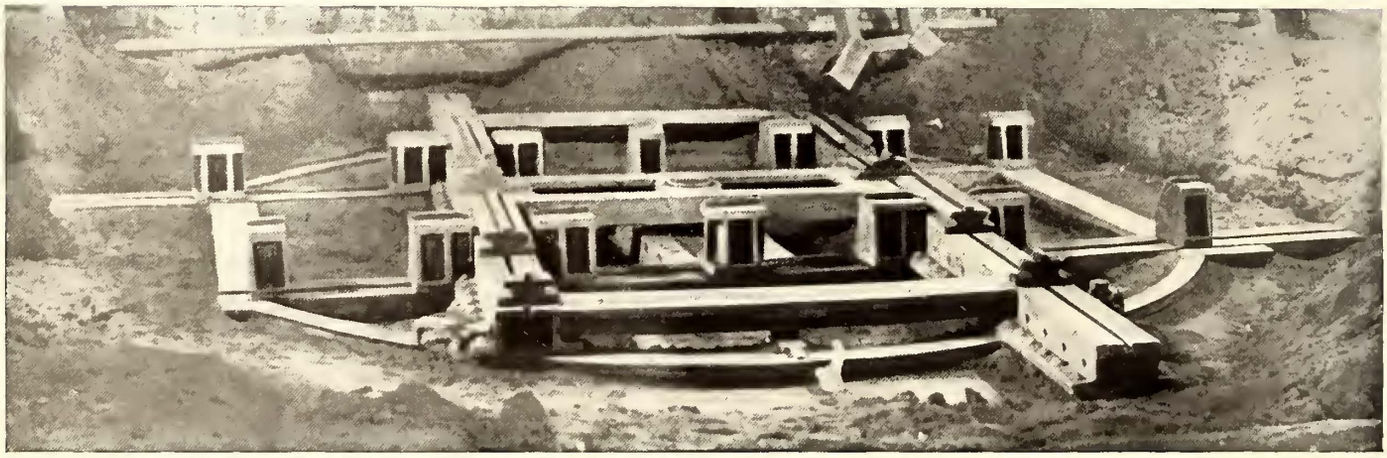
TRACK WITH CHAIR BRACE CONSTRUCTION



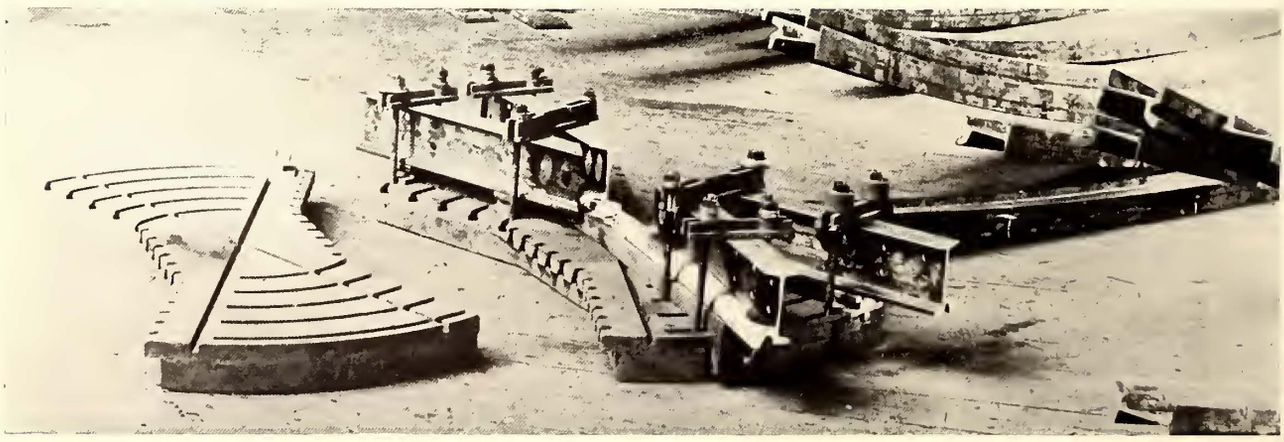
LAYOUT FLOOR FOR ASSEMBLING SPECIAL WORK IN ROADWAY SHOPS

STOREROOM FOR LIGHT MATERIAL, ROADWAY SHOPS

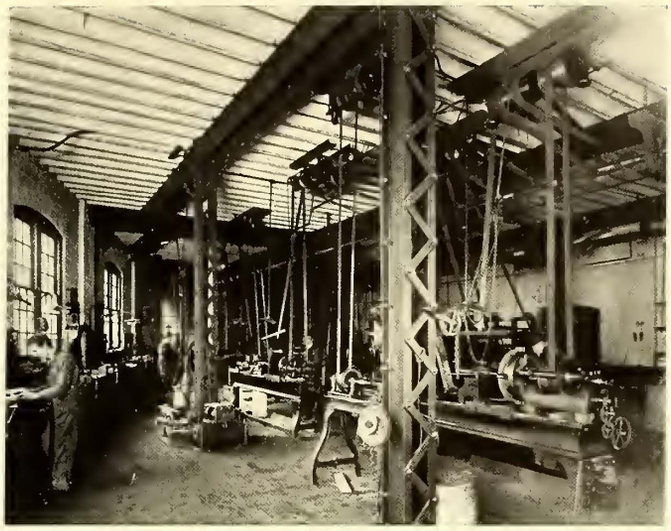
UNIVERSAL CLAMP FOR ASSEMBLING CROSSINGS



FORM FOR ASSEMBLING SPECIAL WORK



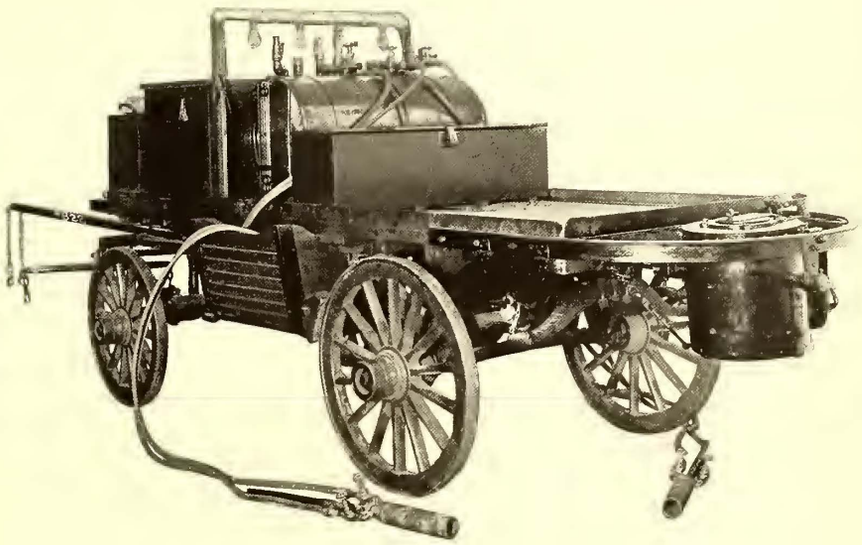
UNIVERSAL CLAMP OR MOULDS FOR ASSEMBLING FROGS



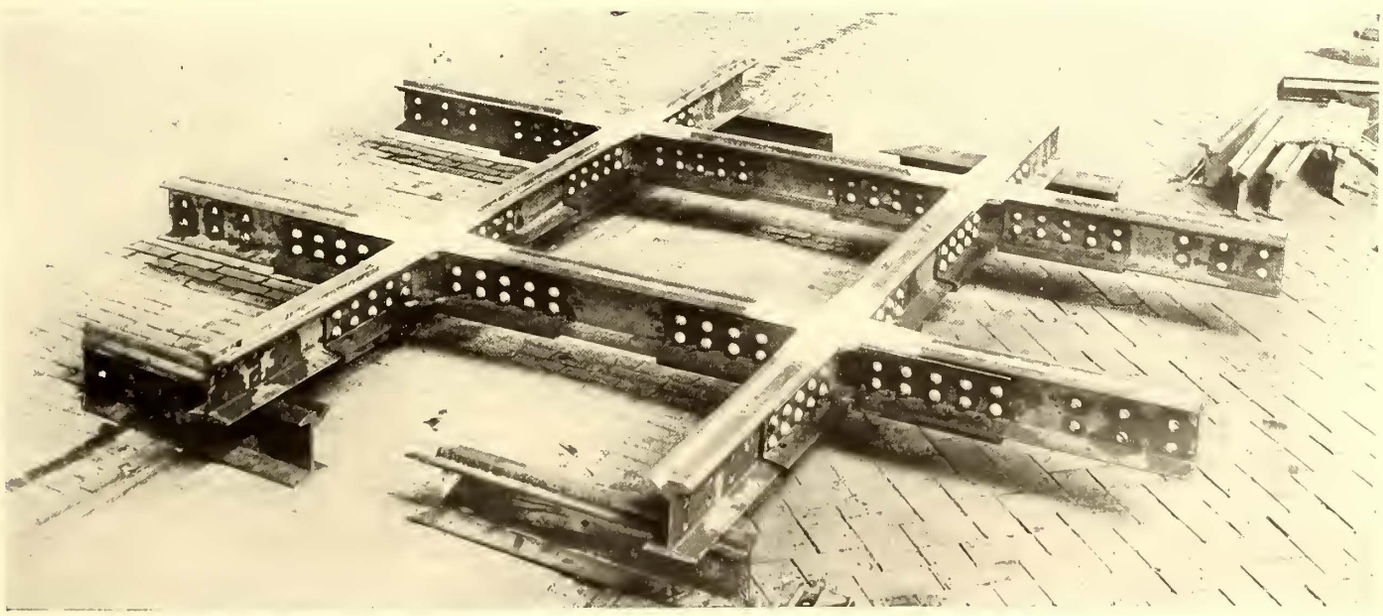
CORNER OF MACHINE SHOP, ROADWAY SHOPS

MACHINE SHOP, ROADWAY SHOPS

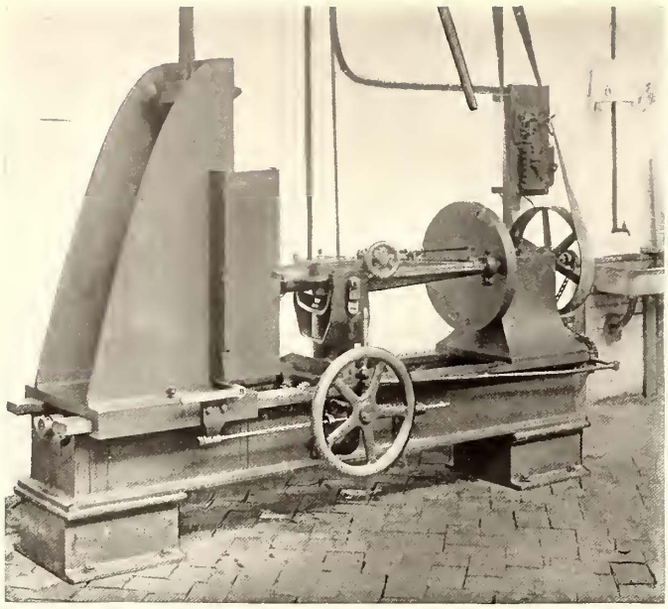
TRUCK FOR HANDLING RAIL



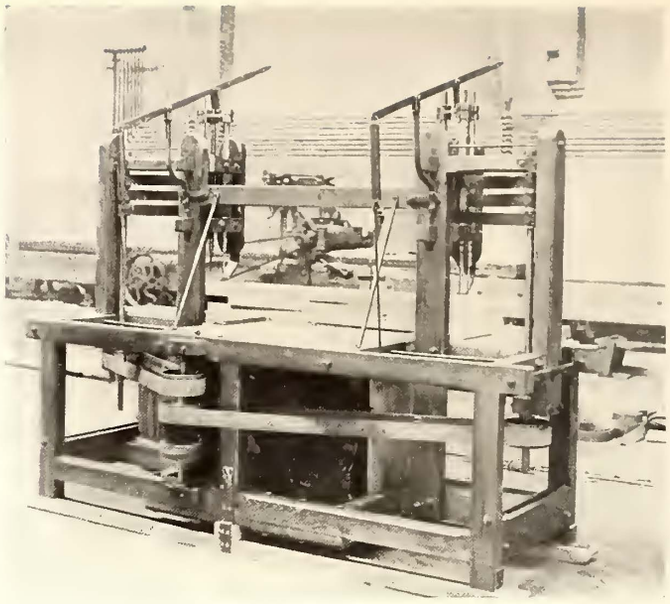
SMELTER WAGON FOR RENEWING SPECIAL WORK



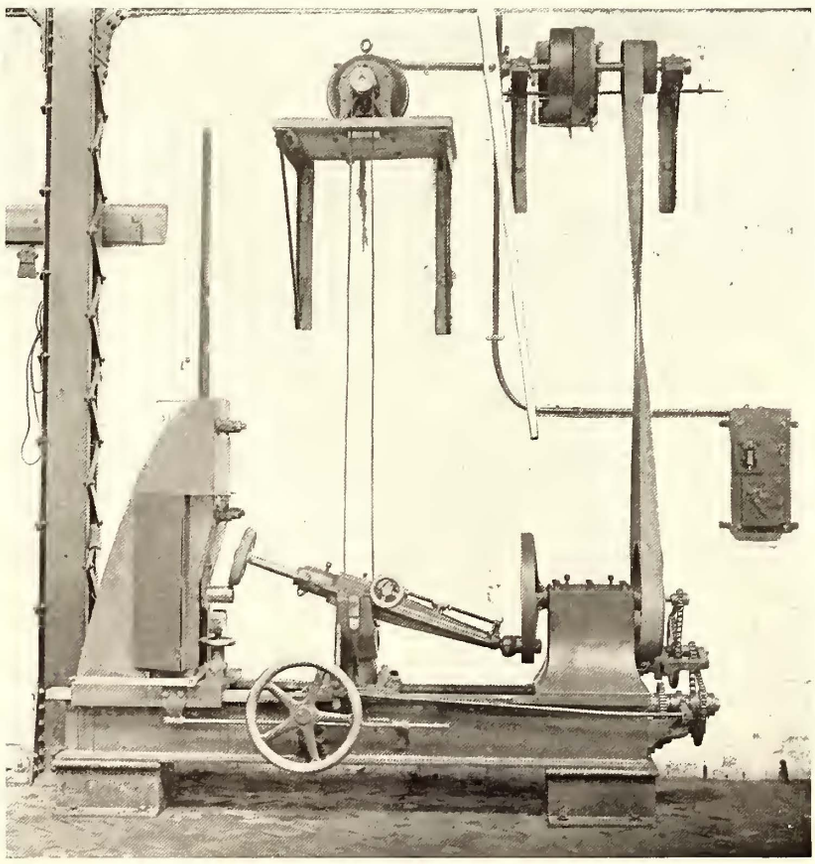
CROSSING MADE IN PHILADELPHIA RAPID TRANSIT ROADWAY SHOPS



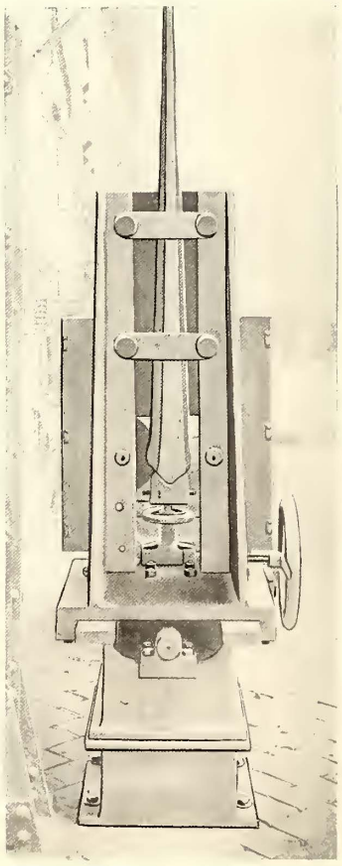
SIDE VIEW OF SWITCH-POINT PIN GRINDER



MULTIPLE DRILL FOR SIMULTANEOUSLY DRILLING SIX HOLES IN WOODEN TIES TO RECEIVE CHAIR BRACES



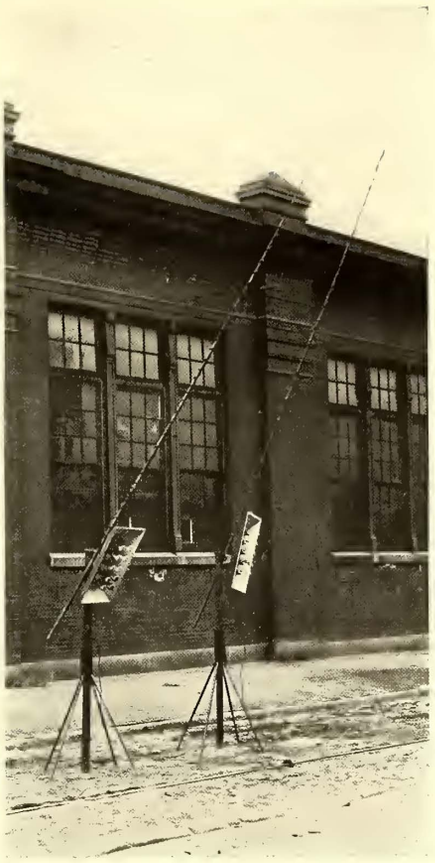
MACHINE FOR GRINDING SWITCH-POINT PINS



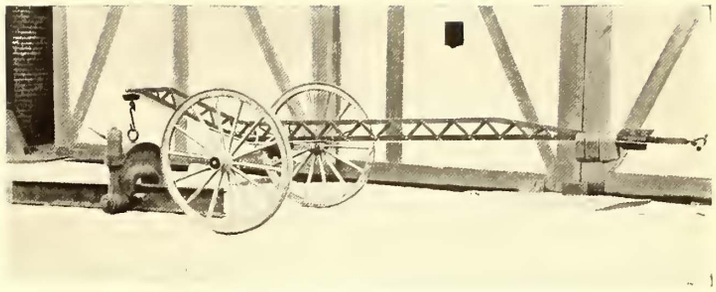
END VIEW OF GRINDER, SHOWING METHOD OF HOLDING SWITCH POINT

FOUNDRY IN ROADWAY SHOPS

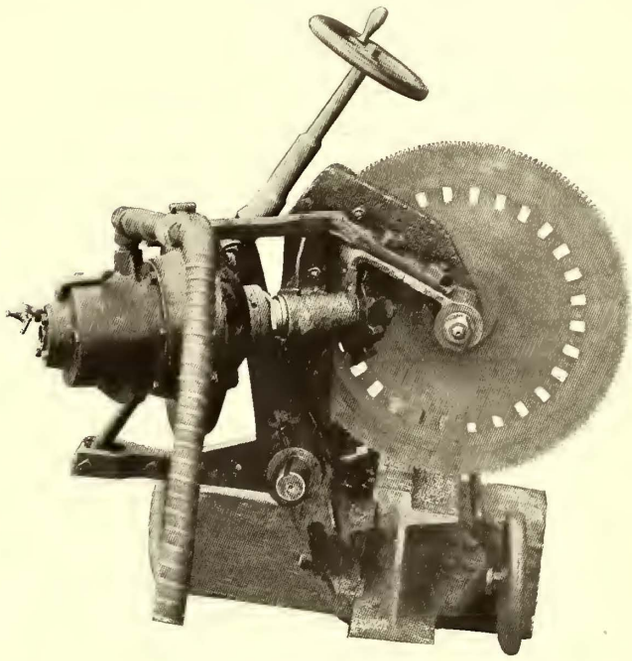
BLACKSMITH SHOP, ROADWAY SHOPS



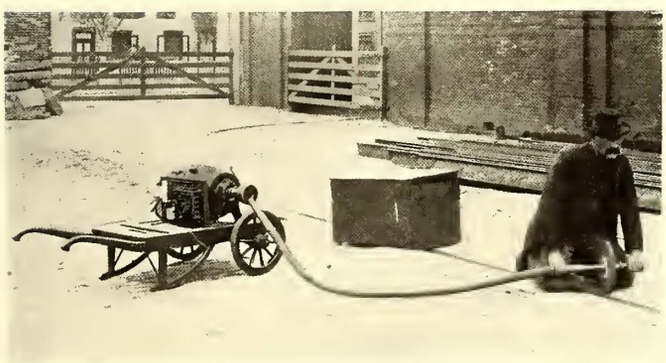
LIGHT STANDS FOR NIGHT WORK



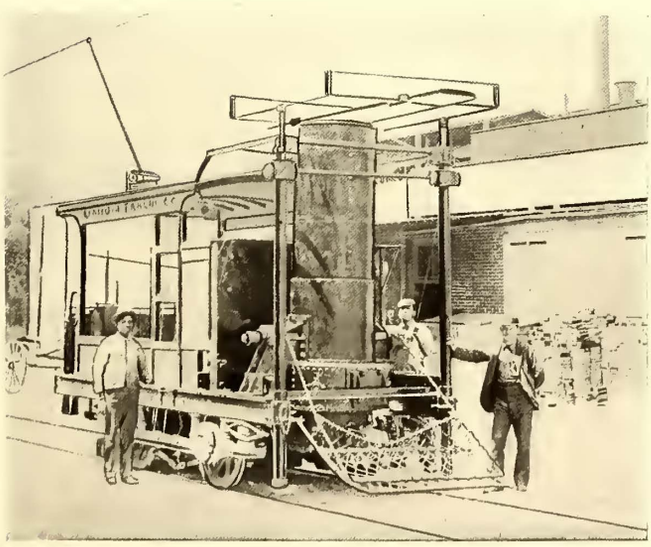
PORTABLE HYDRAULIC RAIL PUNCH



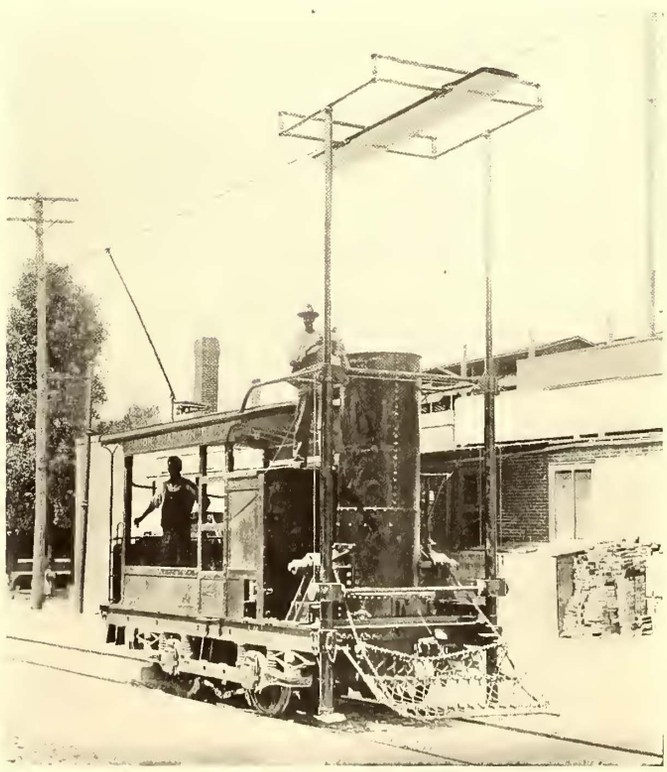
PORTABLE RAIL SAW



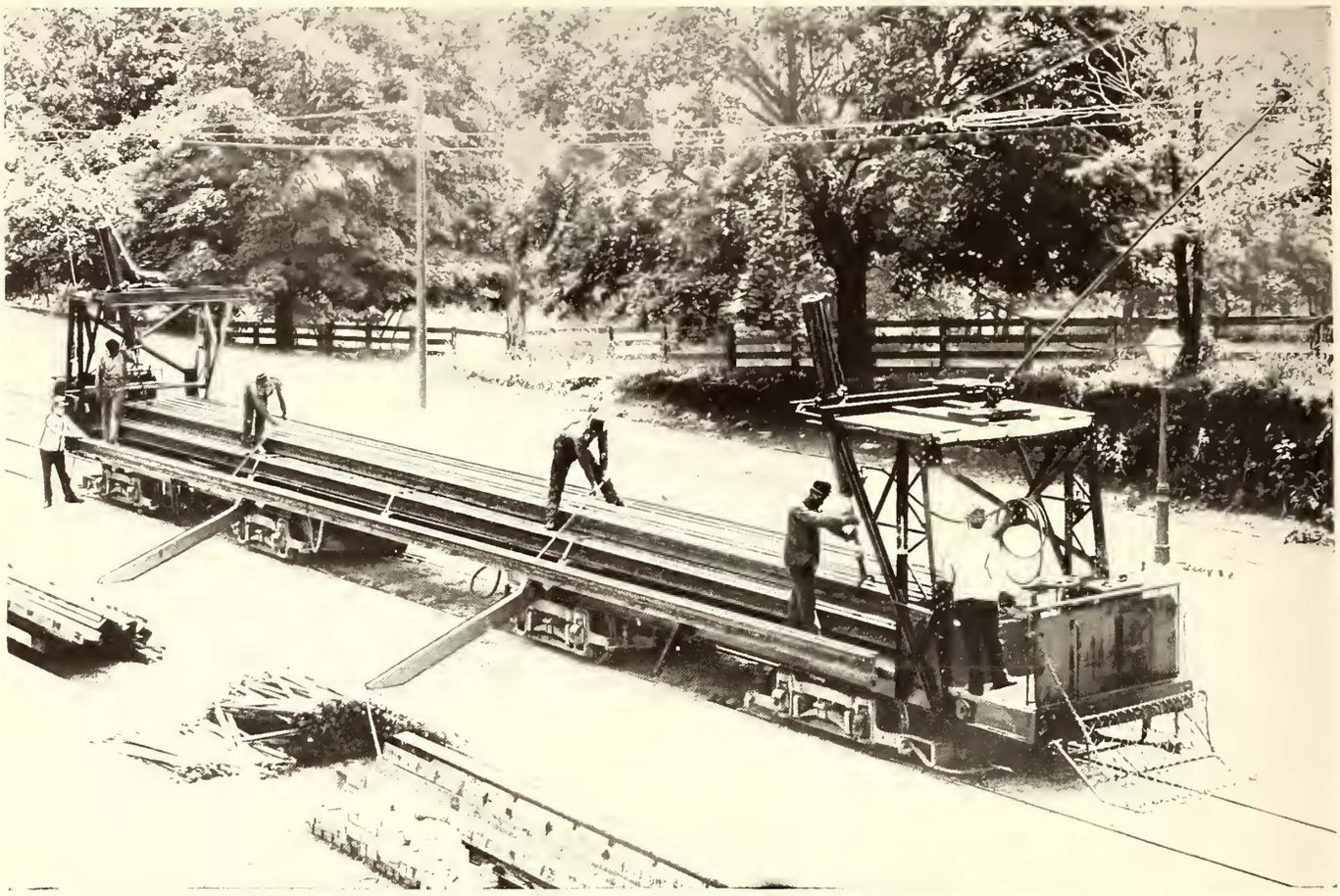
PORTABLE ELECTRIC RAIL GRINDER



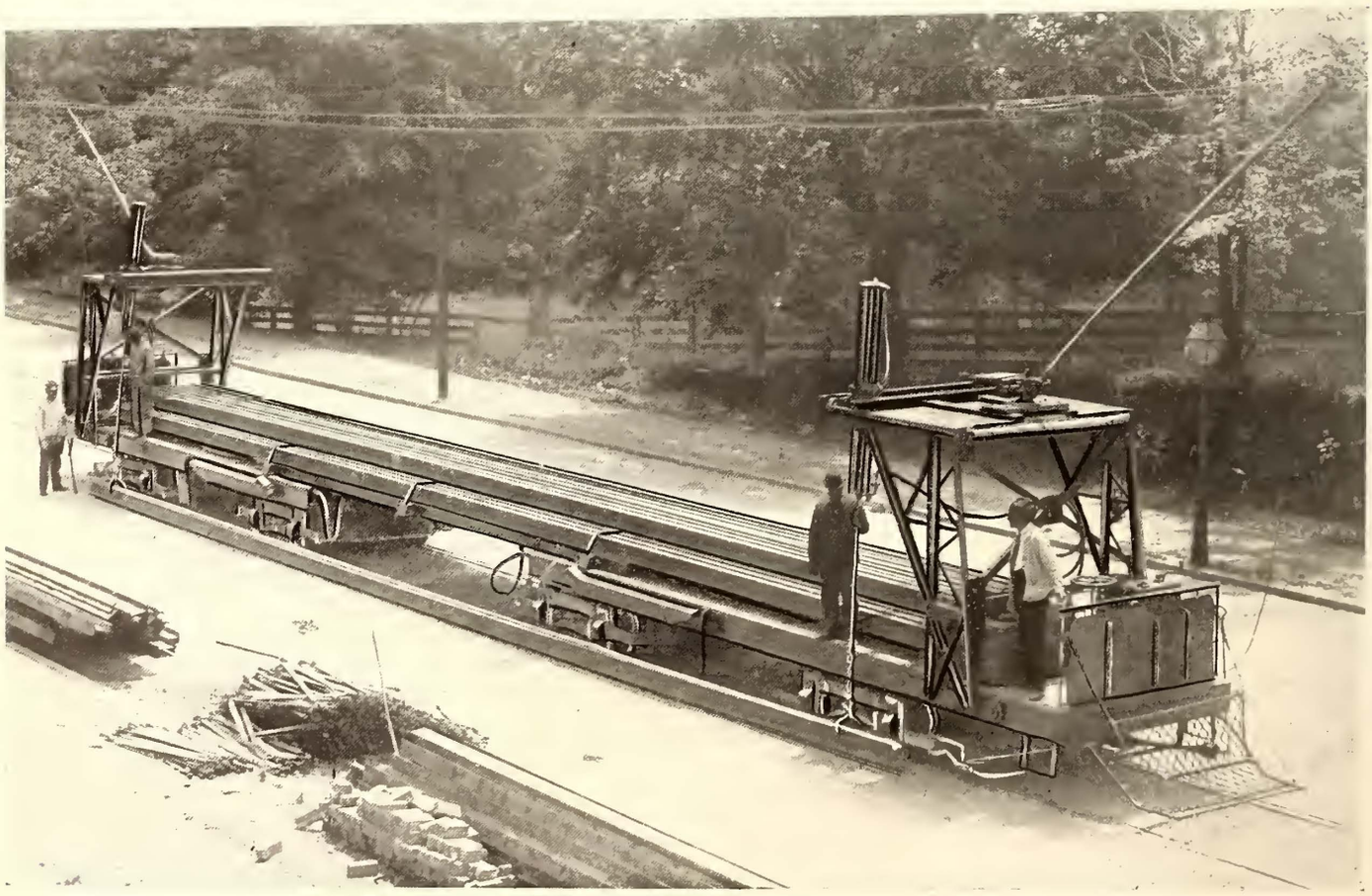
CUPOLA CAR WITH DEVICE FOR PROTECTING TROLLEY WIRE FROM SMOKE AND FUMES



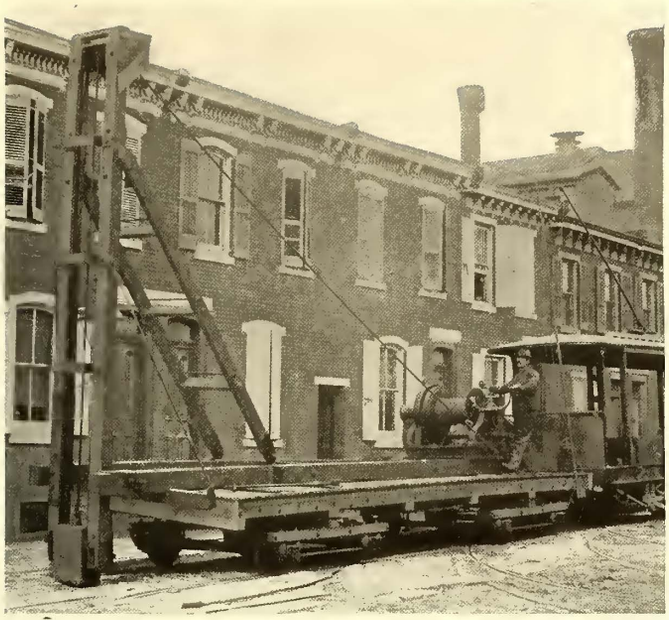
CUPOLA CAR WITH PROTECTING DEVICE RAISED



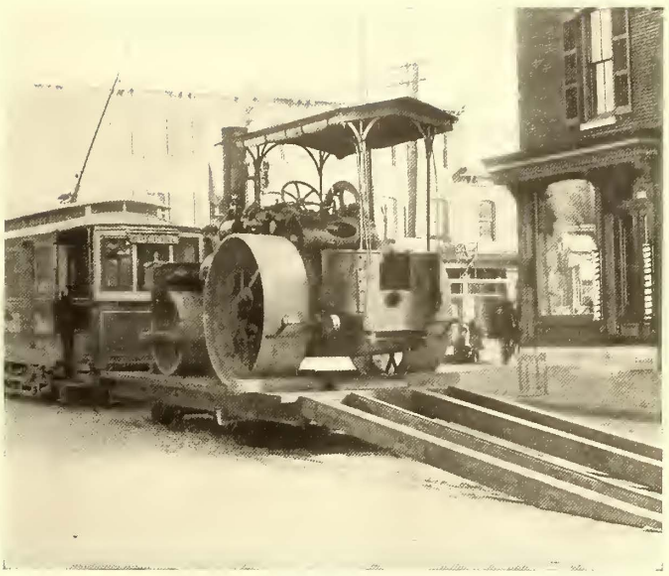
UNLOADING RAILS FROM RAIL CAR



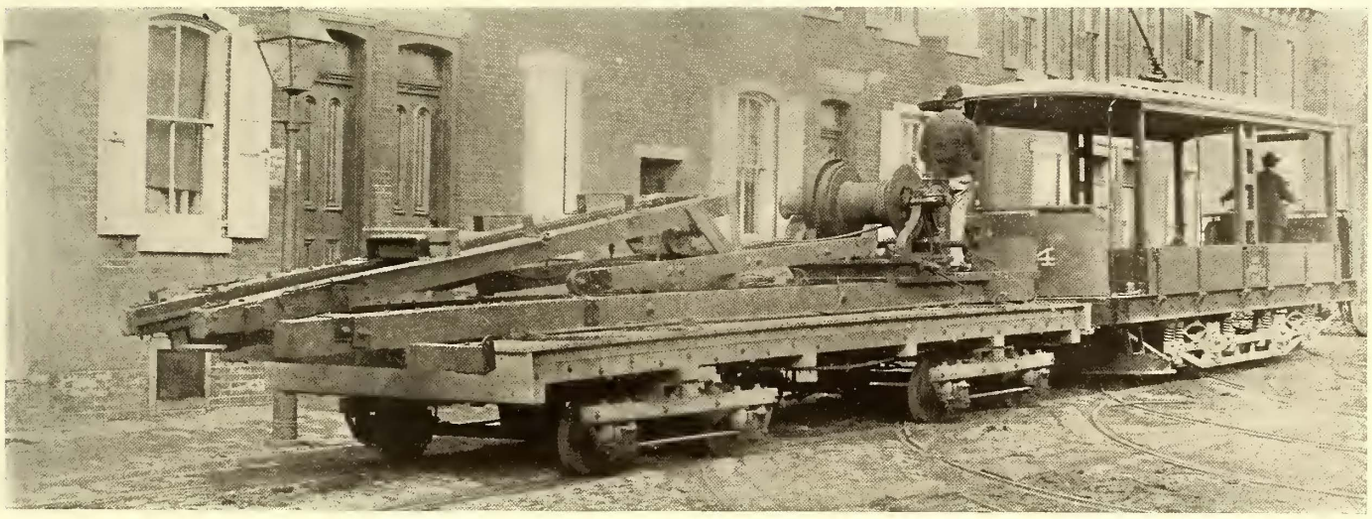
RAIL CAR FOR HAULING 60-FT. RAILS AROUND 30-FT. RADIUS CURVES IN 26-FT. STREETS



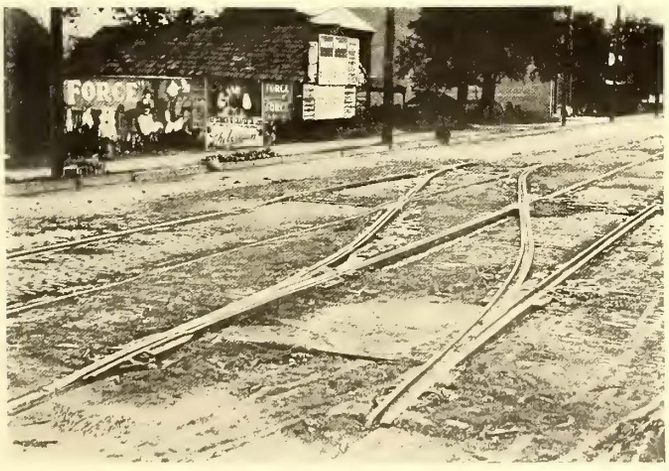
ELECTRIC DROP HAMMER READY FOR ACTION



HAULING ROAD ROLLER BY MOTOR CAR

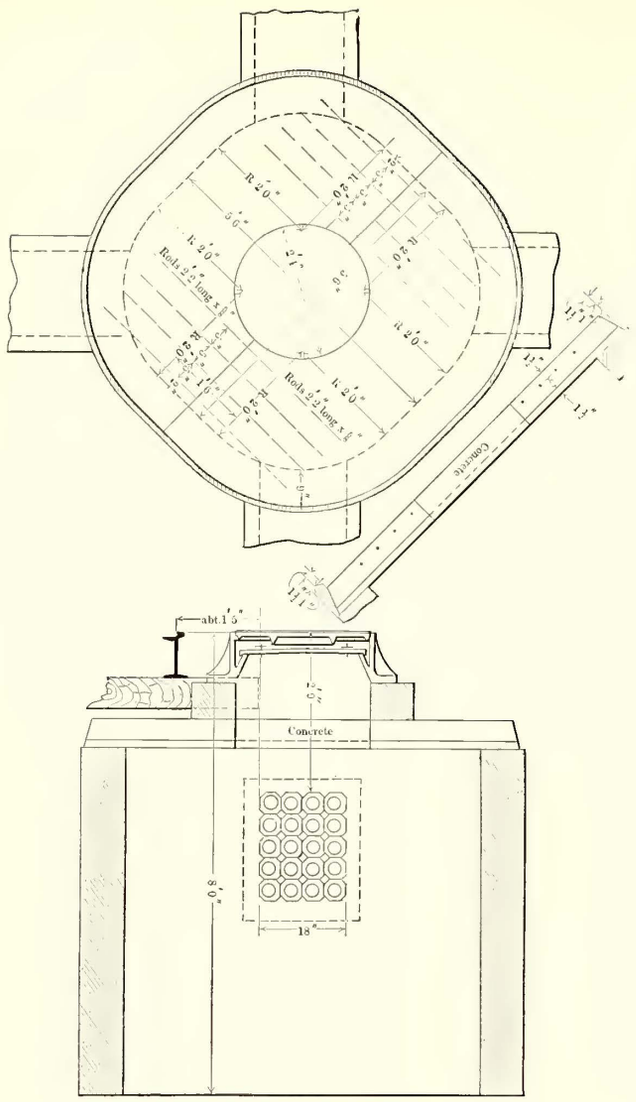


ELECTRIC DROP HAMMER IN COLLAPSED POSITION

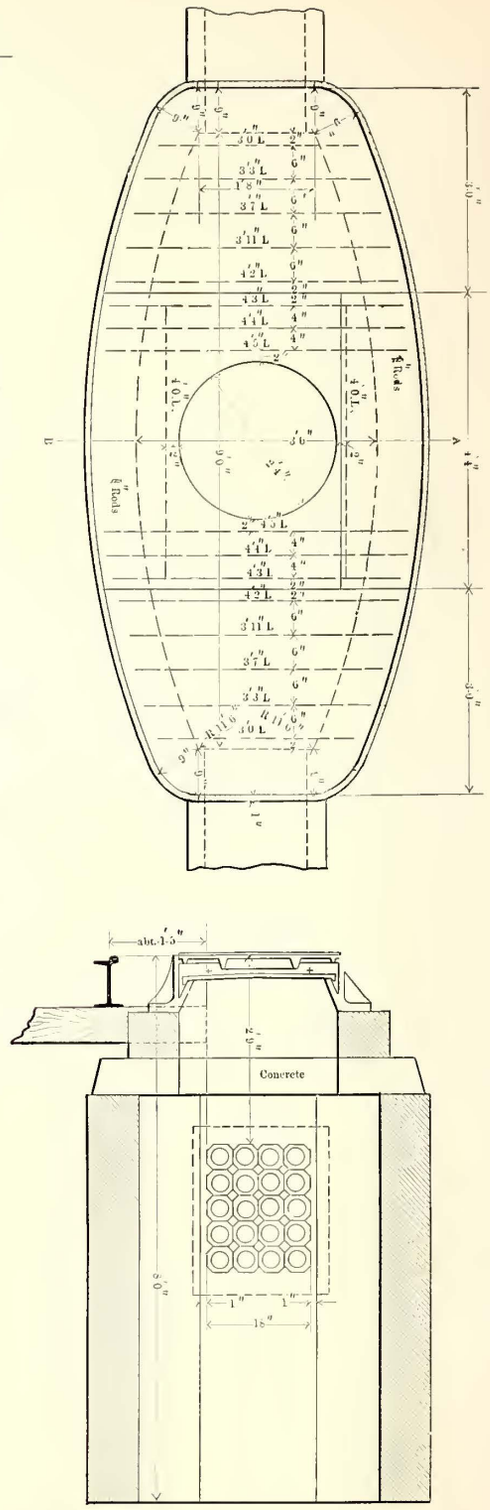


PORTABLE CROSS-OVER FOR EMERGENCY USE

GREASER'S CHARIOT

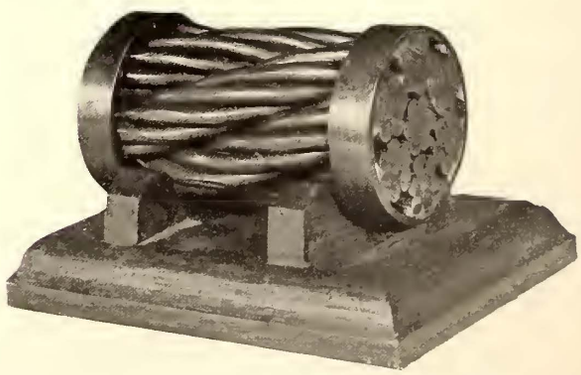


DETAIL OF TYPICAL JUNCTION MANHOLE

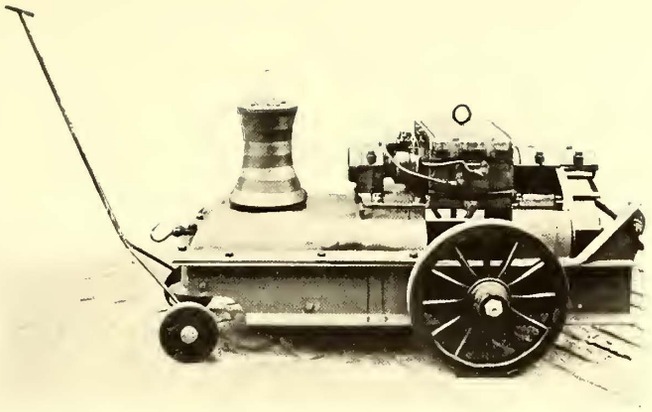


DETAIL OF TYPICAL STRAIGHT-LINE MANHOLE

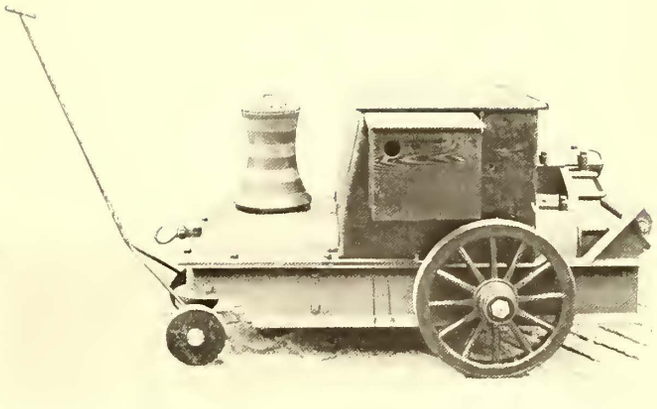
TYPICAL CABLE CONDUIT, SHOWING METHOD OF SUPPORTING CABLES IN MANHOLES



TYPICAL NEGATIVE OR RETURN CABLE

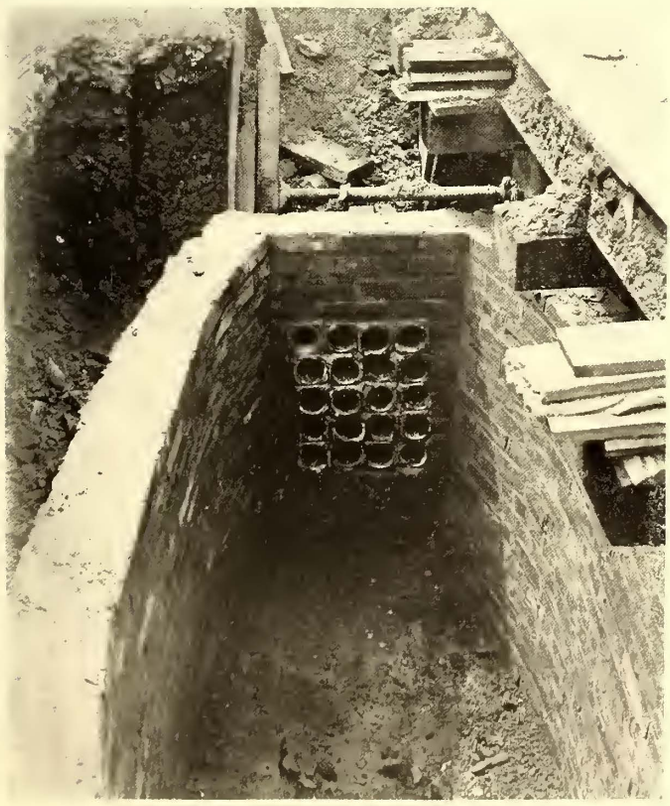


ELECTRIC WINCH FOR DRAWING CABLES THROUGH DUCTS



ELECTRIC WINCH WITH PROTECTING BOX IN PLACE

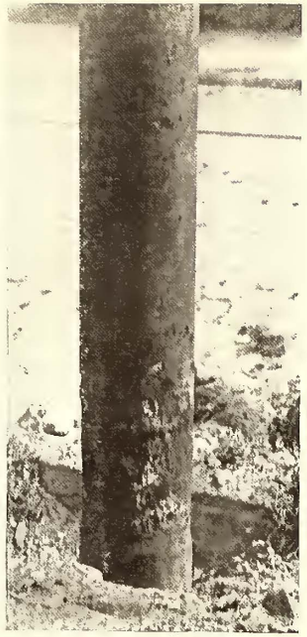
ELECTRIC WINCH DRAWING CABLE THROUGH DUCTS



VIEW IN CABLE MANHOLE

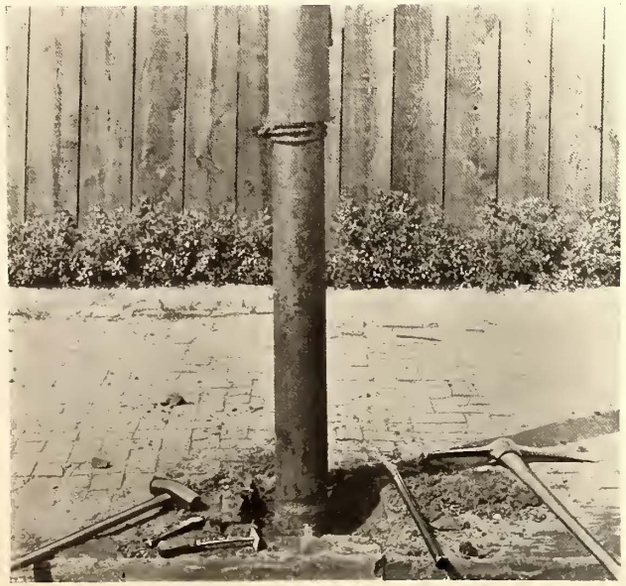
CABLES AND DUCTS IN CABLE CONDUIT

Pole Before Digging—Sleeve is Held Temporarily by Rope



Pole with Base Badly Corroded

Pouring the Sulphur—Wagon for Melting Sulphur at Right



Pole with Old Concrete Removed Prior to Slipping on Sleeve

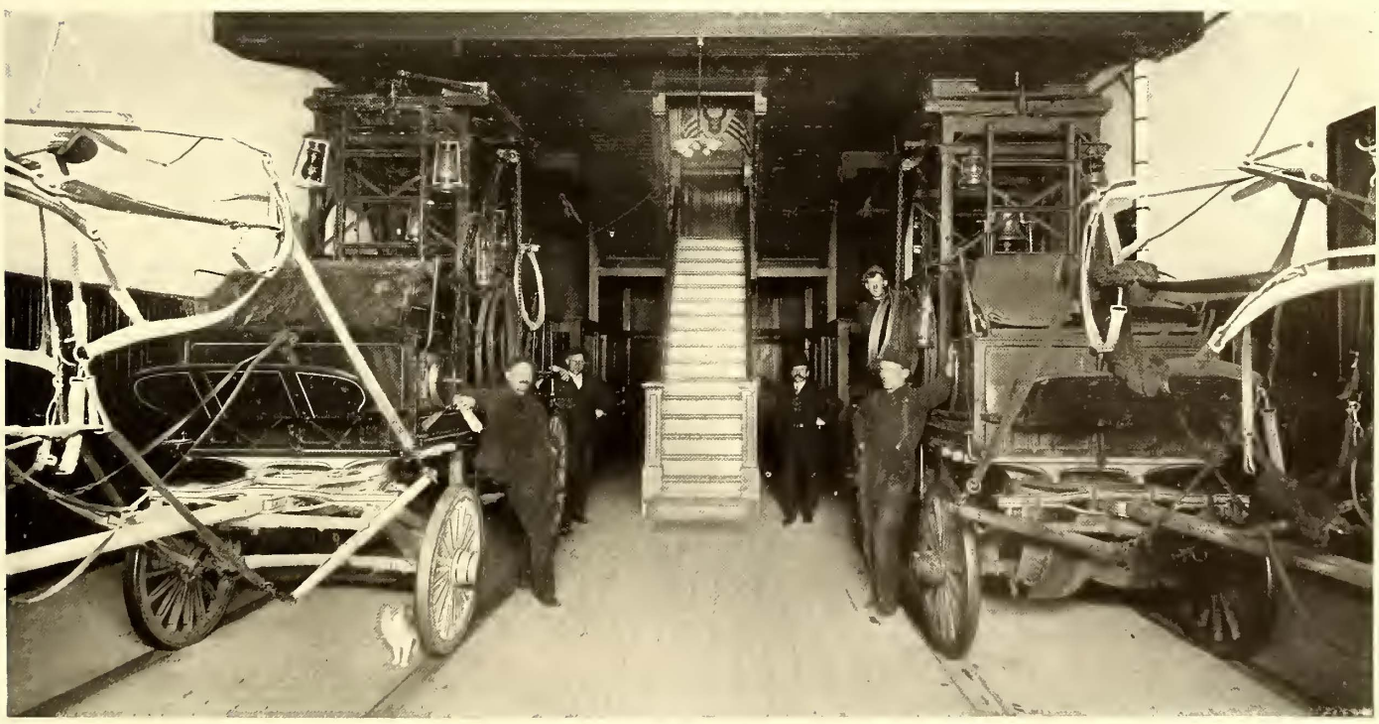
Putting in Concrete at Base of Reclaimed Pole—Portable Concrete Mixer Shown at Right

Finished Pole, with Sleeve and Concrete in Place

RECLAIMING IRON POLES

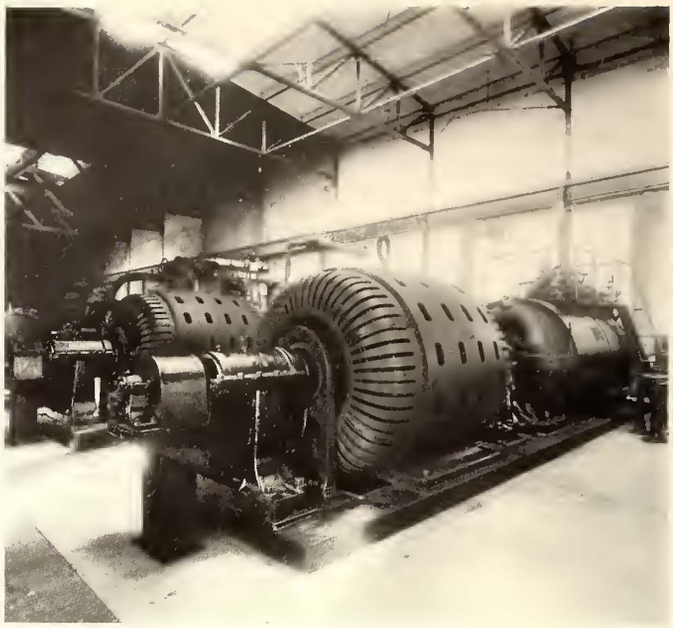
EMERGENCY WAGON, WITH PLATFORM TURNED AT RIGHT ANGLES

EMERGENCY WAGON AT WORK



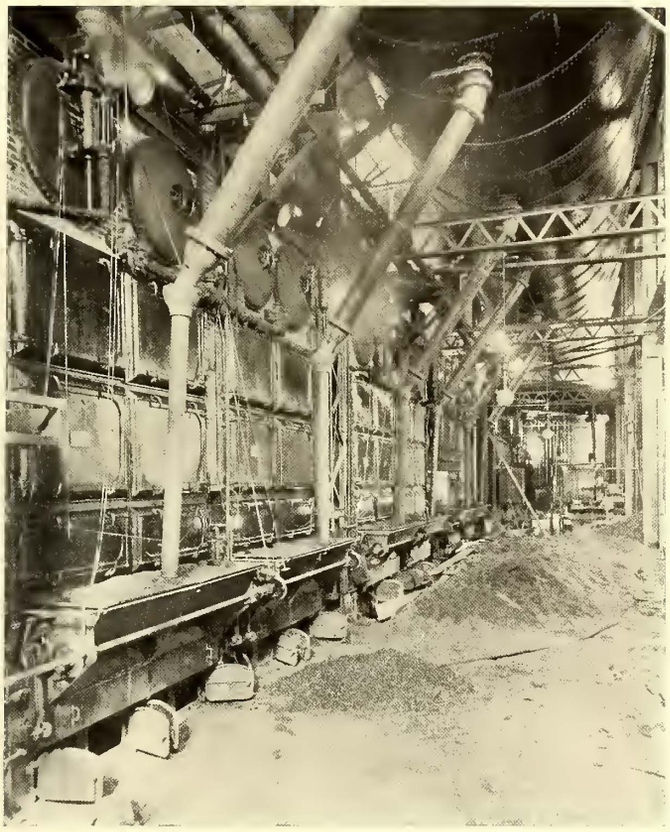
EMERGENCY WAGON STATION AT MT. VERNON STREET

INTERIOR VIEW IN TURBINE ROOM OF GENERATING STATION AT SECOND STREET AND WYOMING AVENUE

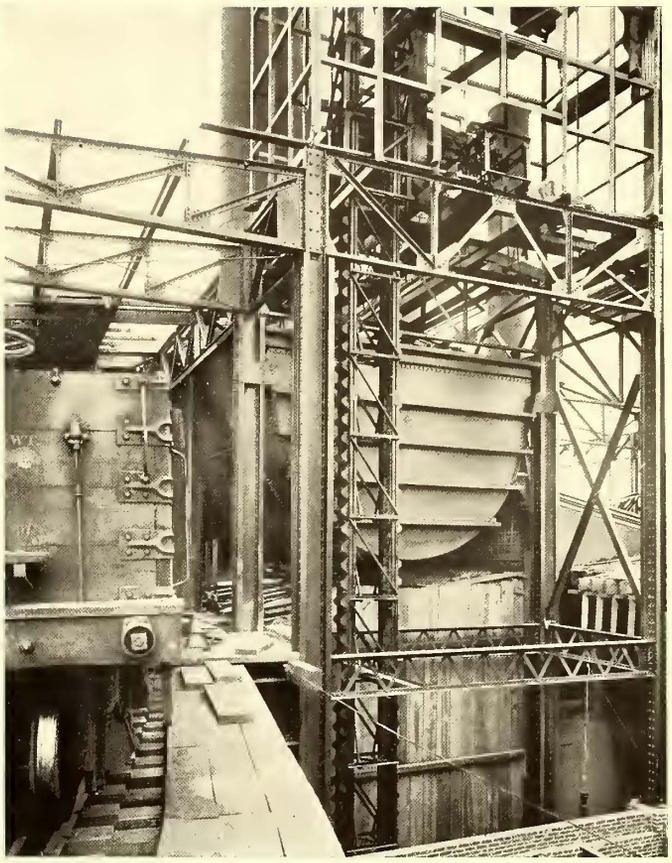


TWO OF THE 1500-KW TURBO UNITS AT SECOND STREET AND WYOMING AVENUE POWER STATION

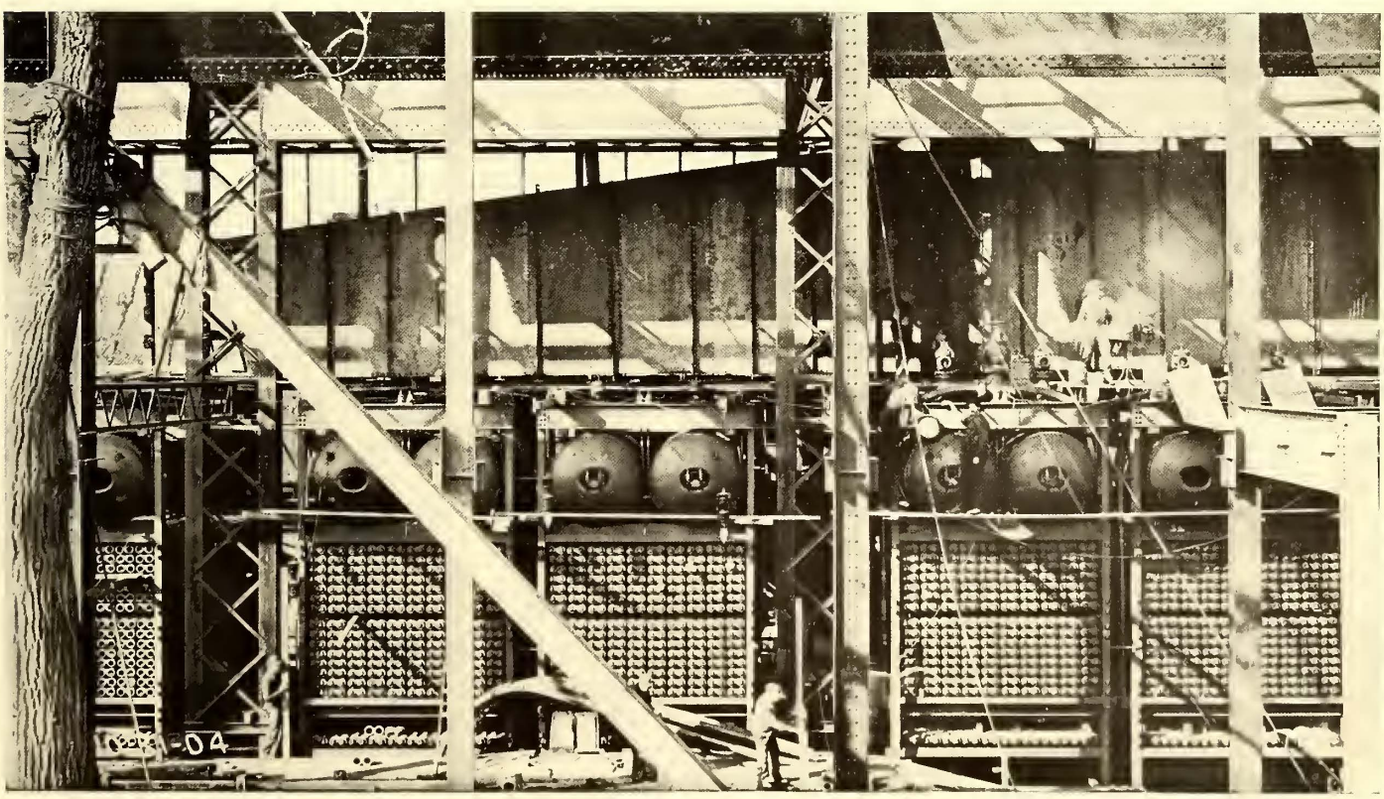
INTERIOR POWER STATION AT SECOND STREET AND WYOMING AVENUE SHOWING THE 1500-KW TURBO UNITS



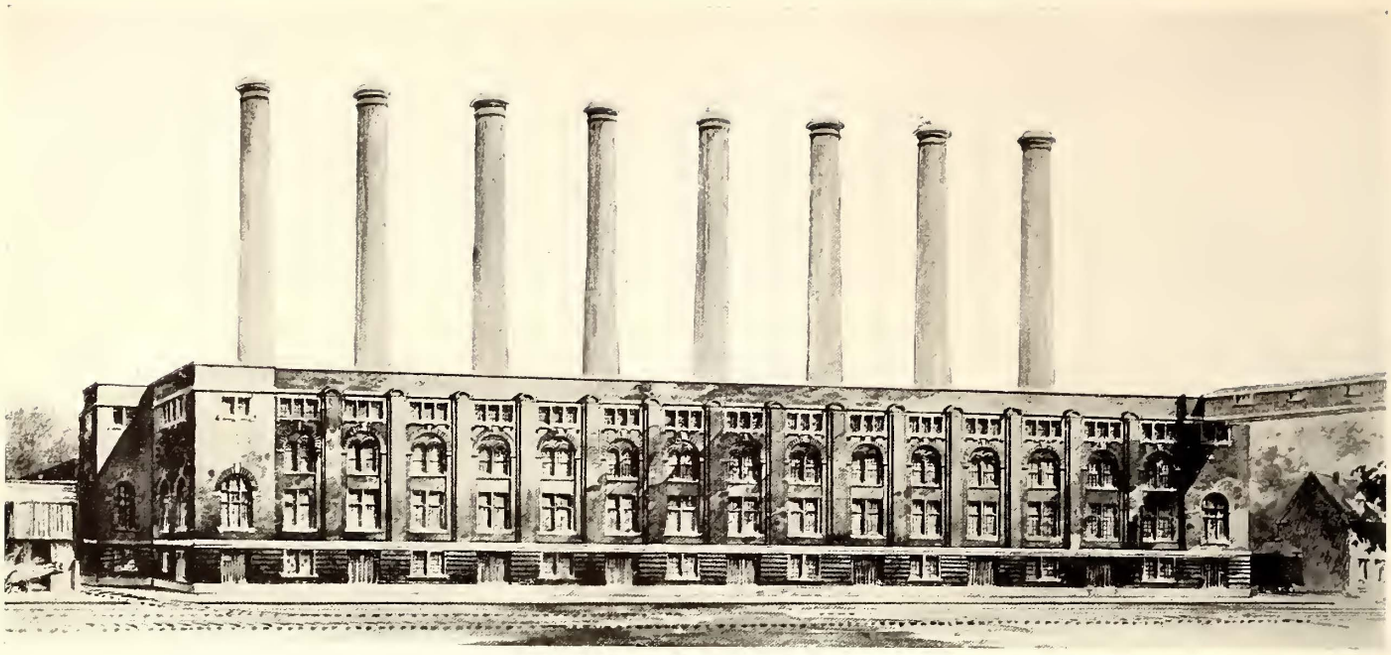
FRONT VIEW OF BOILERS IN SECOND STREET AND WYOMING AVENUE POWER HOUSE



COAL BUNKERS AND COAL HANDLING ARRANGEMENTS AT SECOND STREET AND WYOMING AVENUE POWER HOUSE



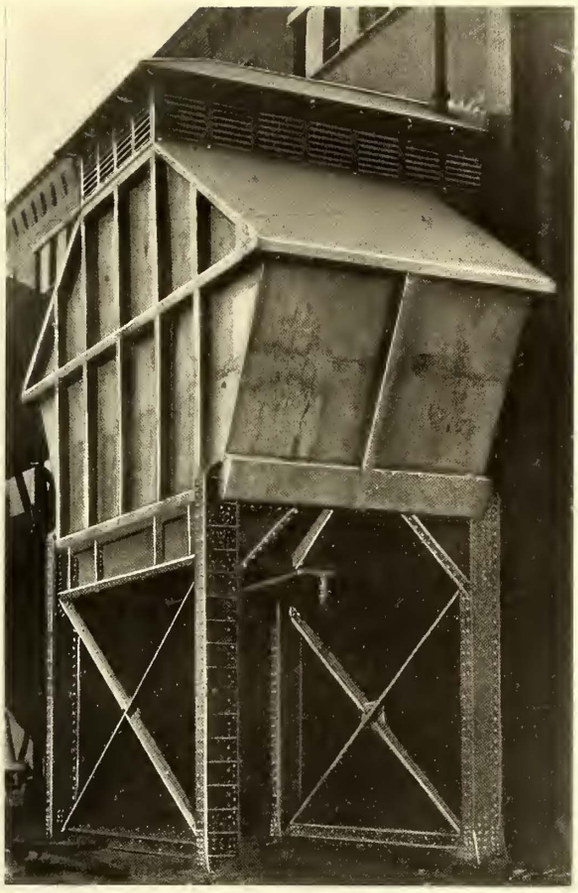
DOUBLE-END BOILERS AT SECOND STREET AND WYOMING AVENUE POWER HOUSE



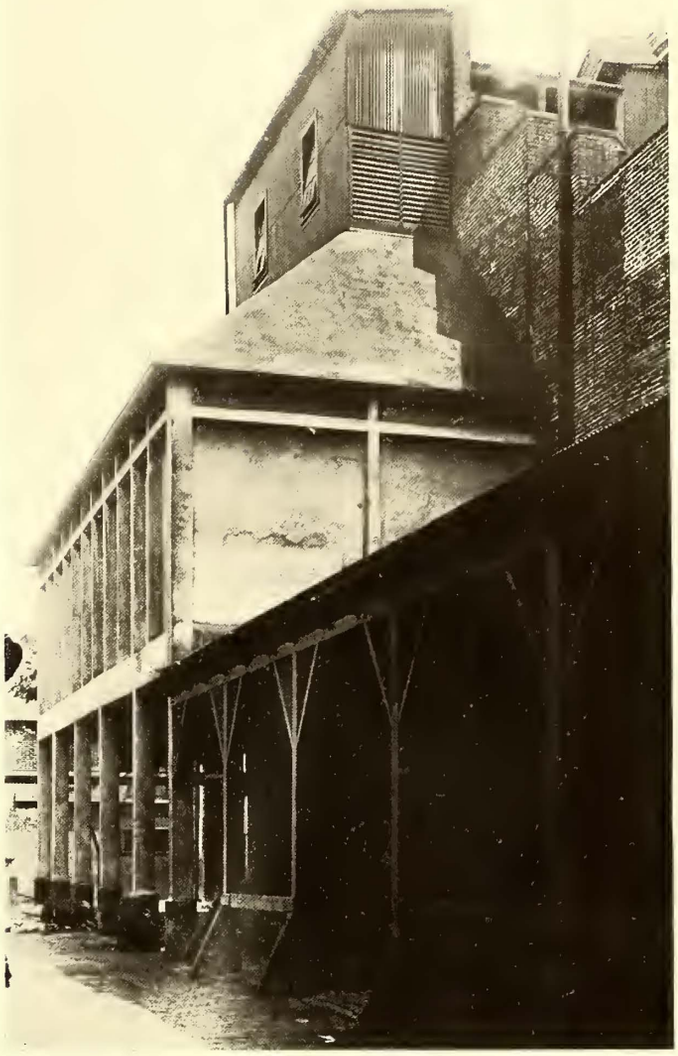
PERSPECTIVE VIEW OF NEW DELAWARE AVENUE A. C. GENERATING STATION

REAR VIEW OF DOUBLE-END BOILERS AT SECOND STREET AND WYOMING AVENUE STATION

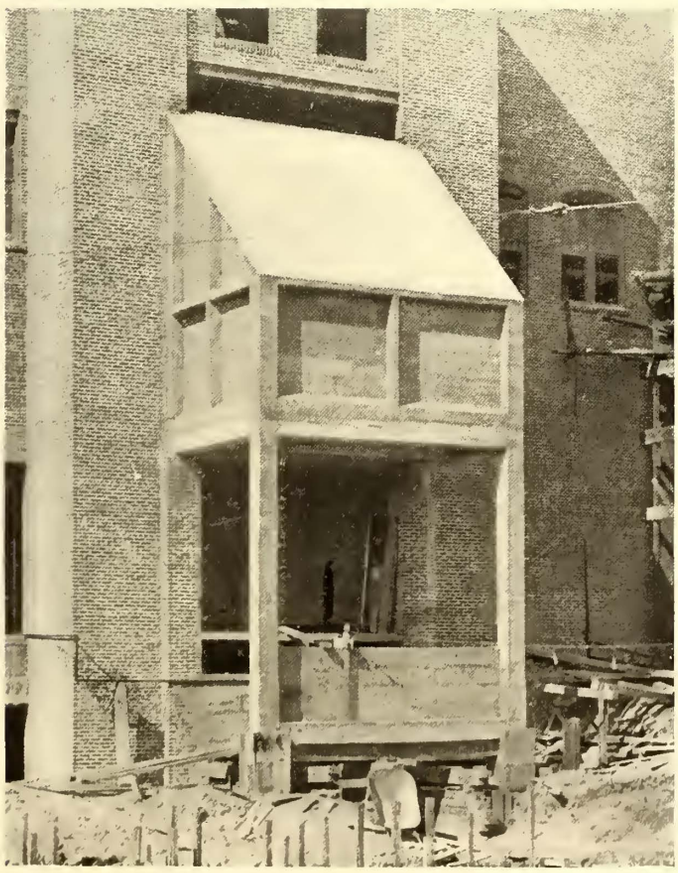
EXTERIOR GENERATING STATION AT SECOND STREET AND WYOMING AVENUE DURING CONSTRUCTION



CONCRETE BIN AT POWER HOUSE FOR STORING ASH AND CINDERS



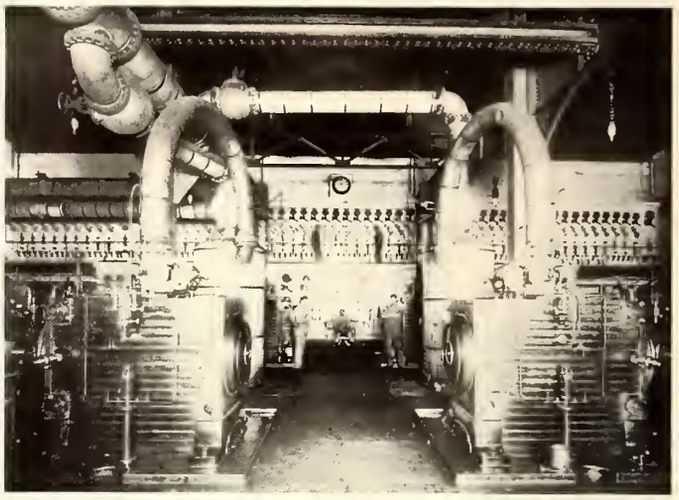
CONCRETE CINDER BIN AT THIRTEENTH AND MT. VERNON STREETS POWER HOUSE



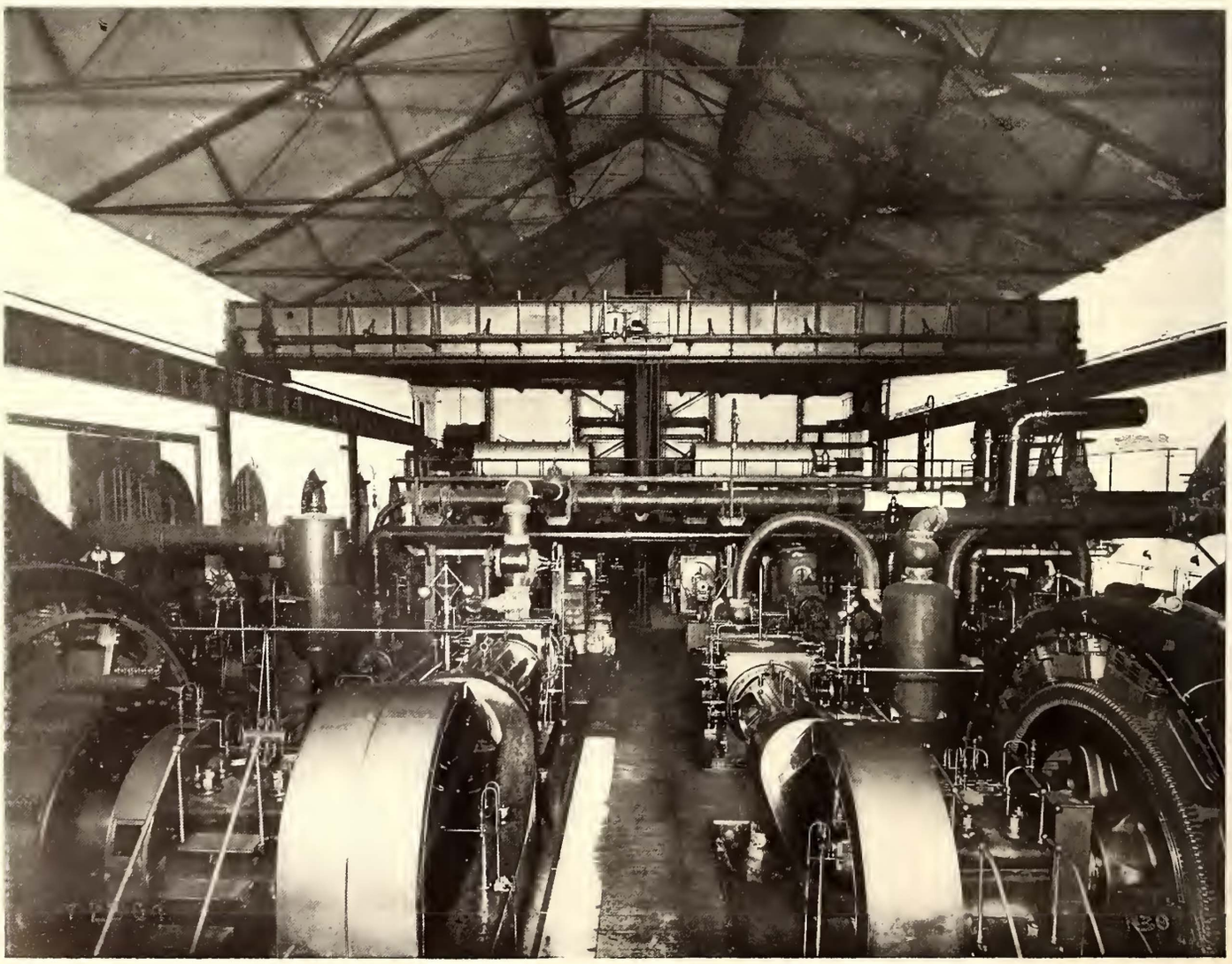
CONCRETE BIN FOR HOLDING CINDERS AND ASHES

EXTERIOR OF GENERATING STATION AT SECOND STREET AND WYOMING AVENUE

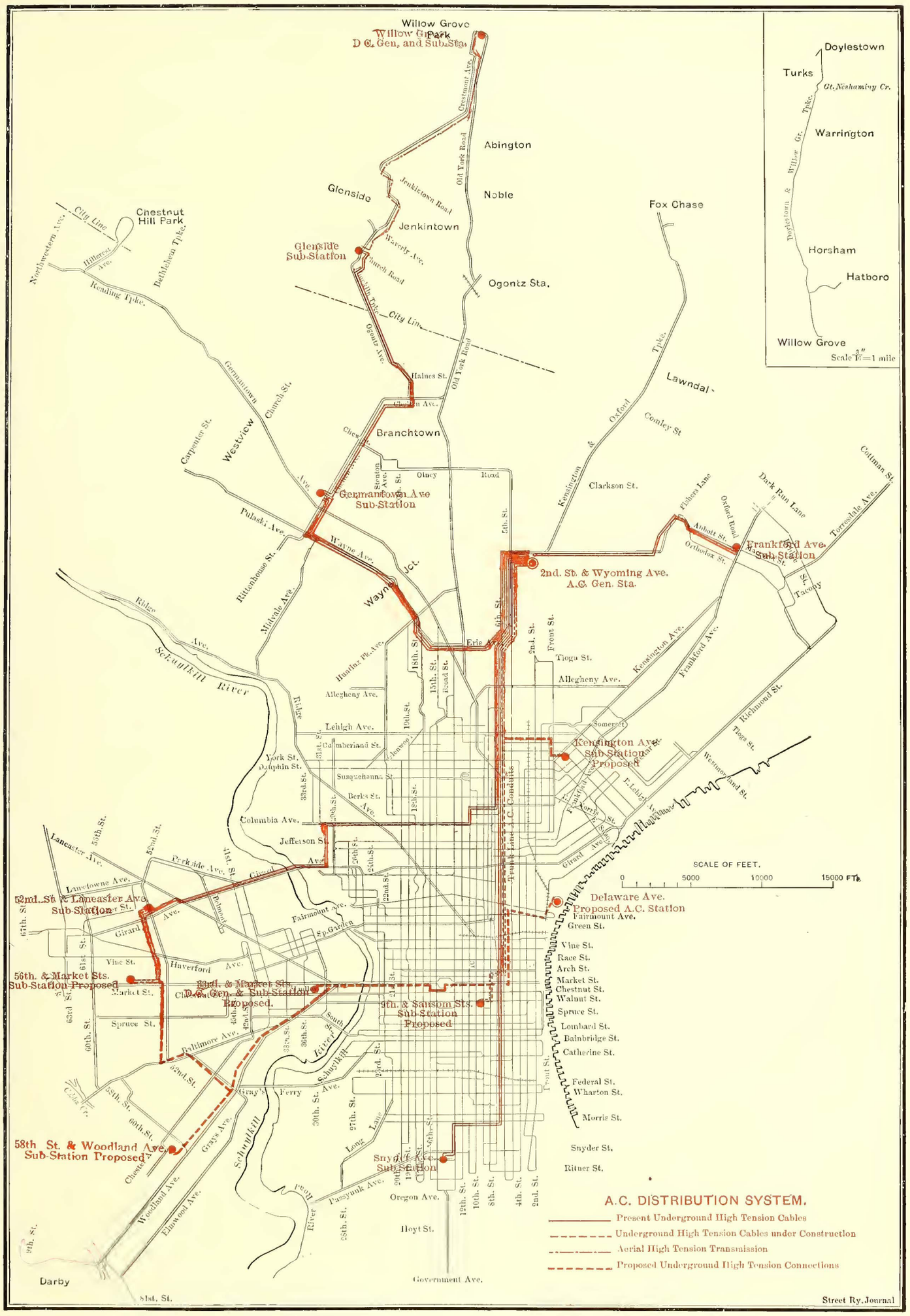
EXTERIOR D. C. GENERATING STATION AT THIRTEENTH AND MT. VERNON STREETS



INTERIOR D. C. GENERATING STATION AT THIRTEENTH AND MT. VERNON STREETS

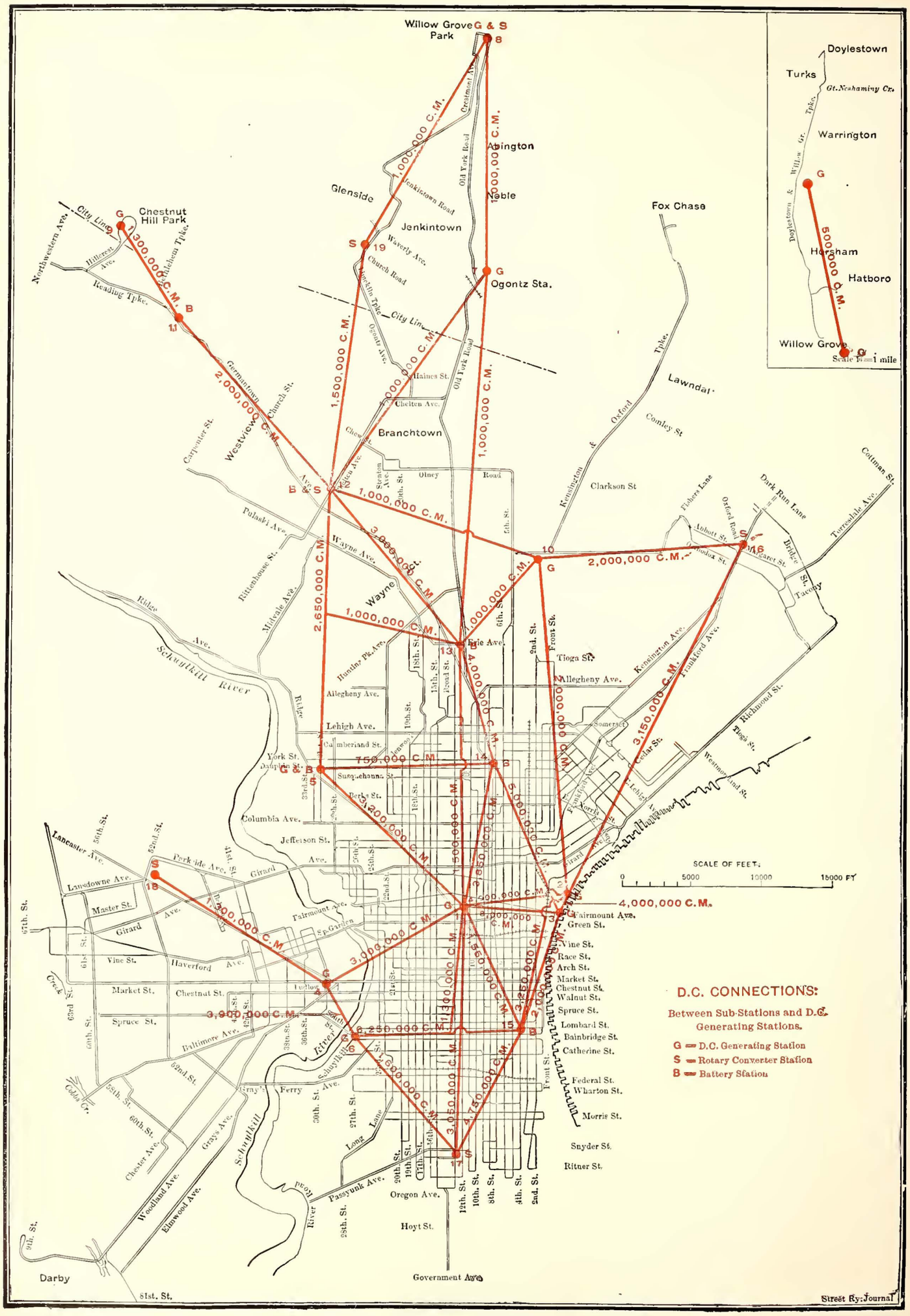


INTERIOR D. C. GENERATING STATION AT THIRTY-THIRD AND MARKET STREETS

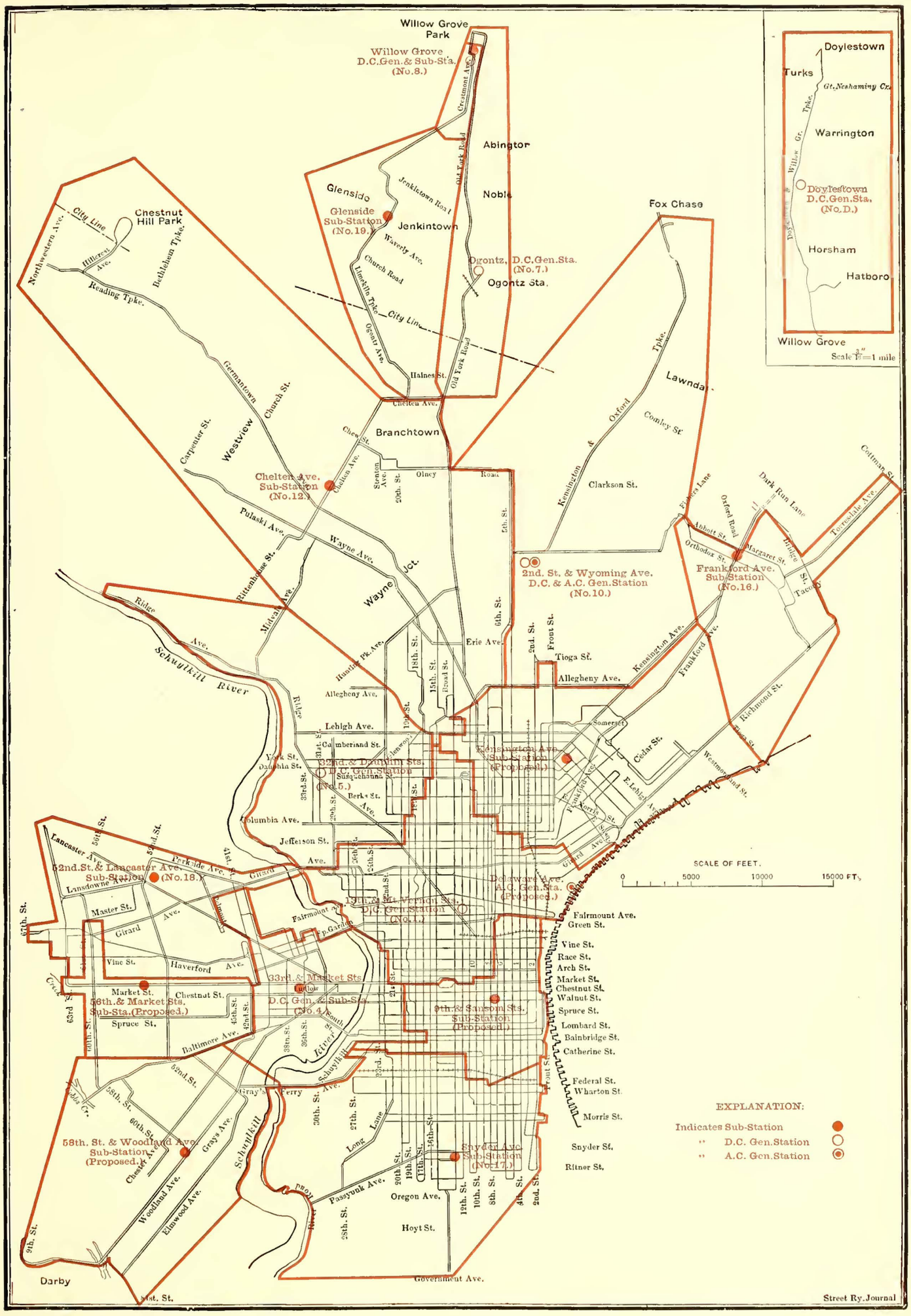


MAP SHOWING A. C. DISTRIBUTION LINES ON PHILADELPHIA RAPID TRANSIT SYSTEM

Plate XXX



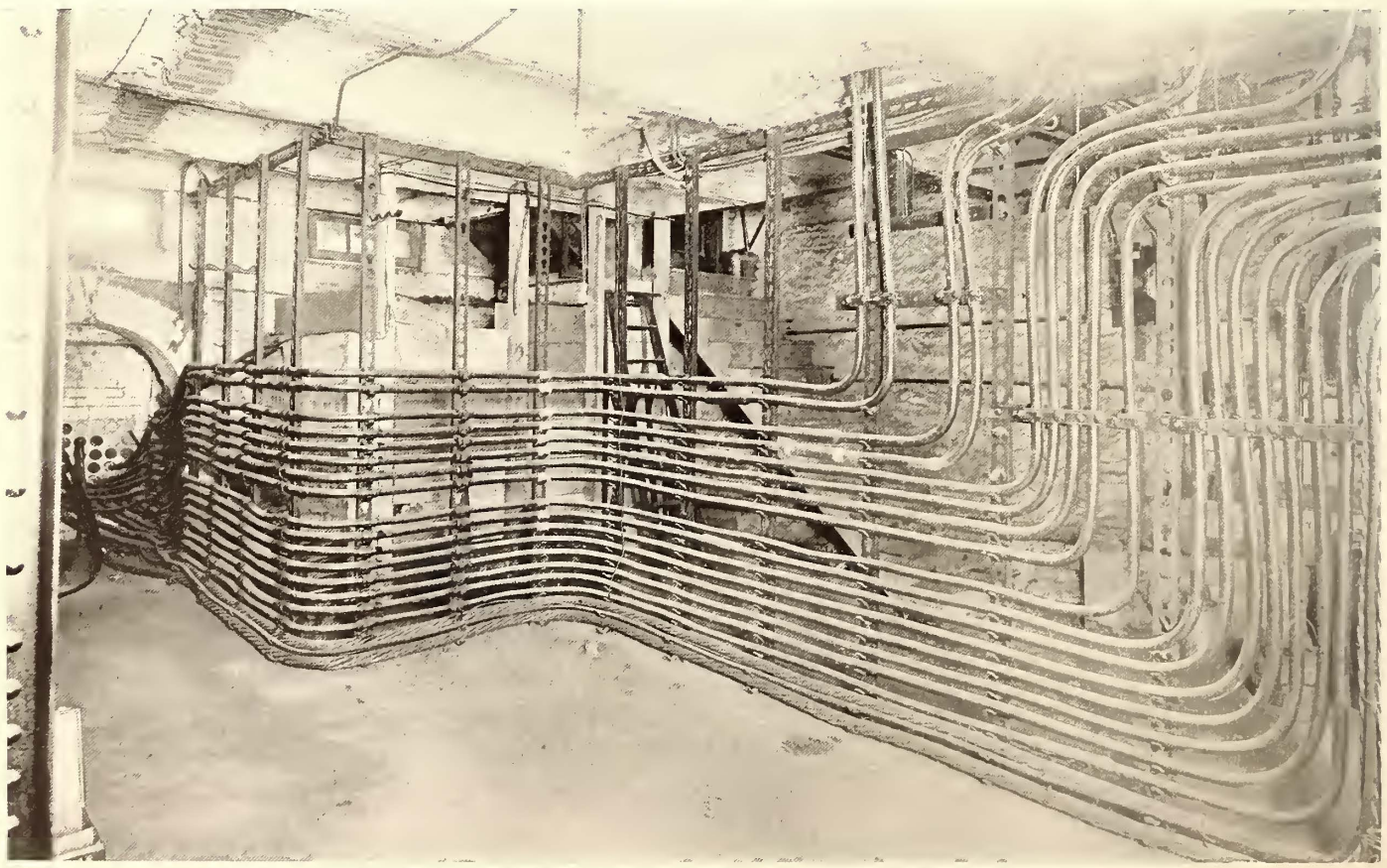
MAP SHOWING D. C. TIE LINES ON PHILADELPHIA RAPID TRANSIT SYSTEM



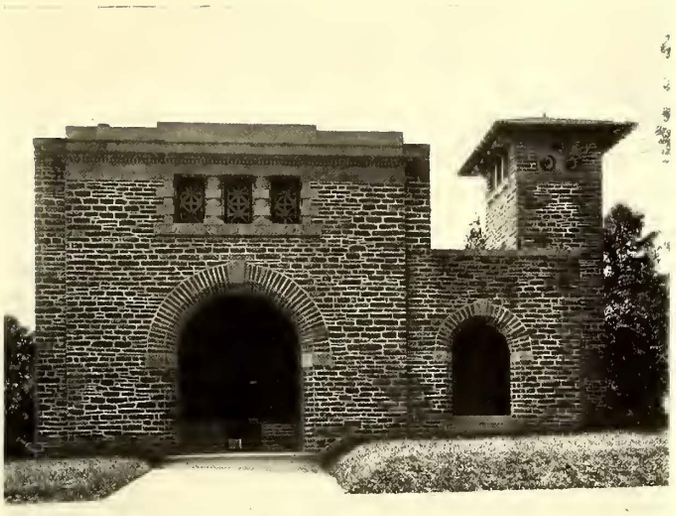
MAP SHOWING GENERATING STATIONS, SUB-STATIONS AND APPROXIMATE DISTRIBUTION AREAS, ACCORDING TO PROPOSED POWER SCHEME

EXTERIOR OGONTZ POWER HOUSE

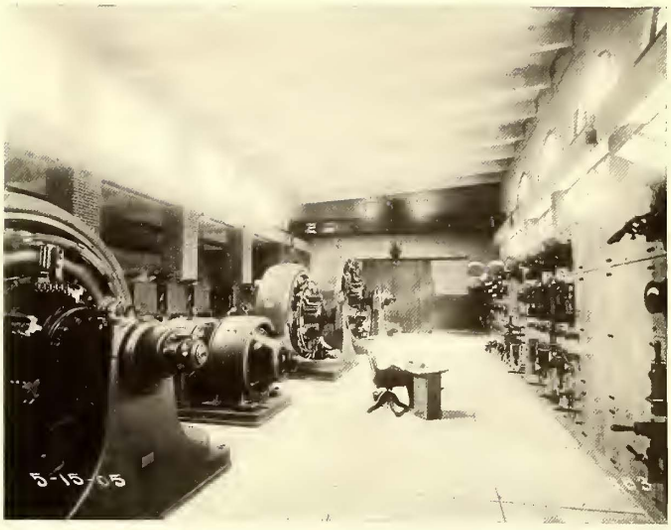
COOLING CONDENSING WATER BY FORCING IT THROUGH SPRAY NOZZLES



VIEW IN CABLE VAULTS UNDER GLENSIDE SUB-STATION, SHOWING METHOD OF SUPPORTING CABLES

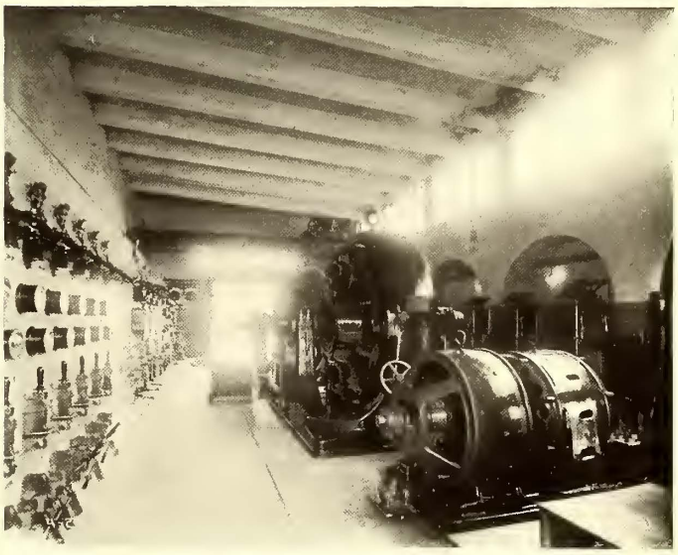


EXTERIOR GLENSIDE SUB-STATION



INTERIOR GLENSIDE SUB-STATION

EXTERIOR SUB-STATION AT FIFTY-SECOND STREET AND LANCASTER AVENUE

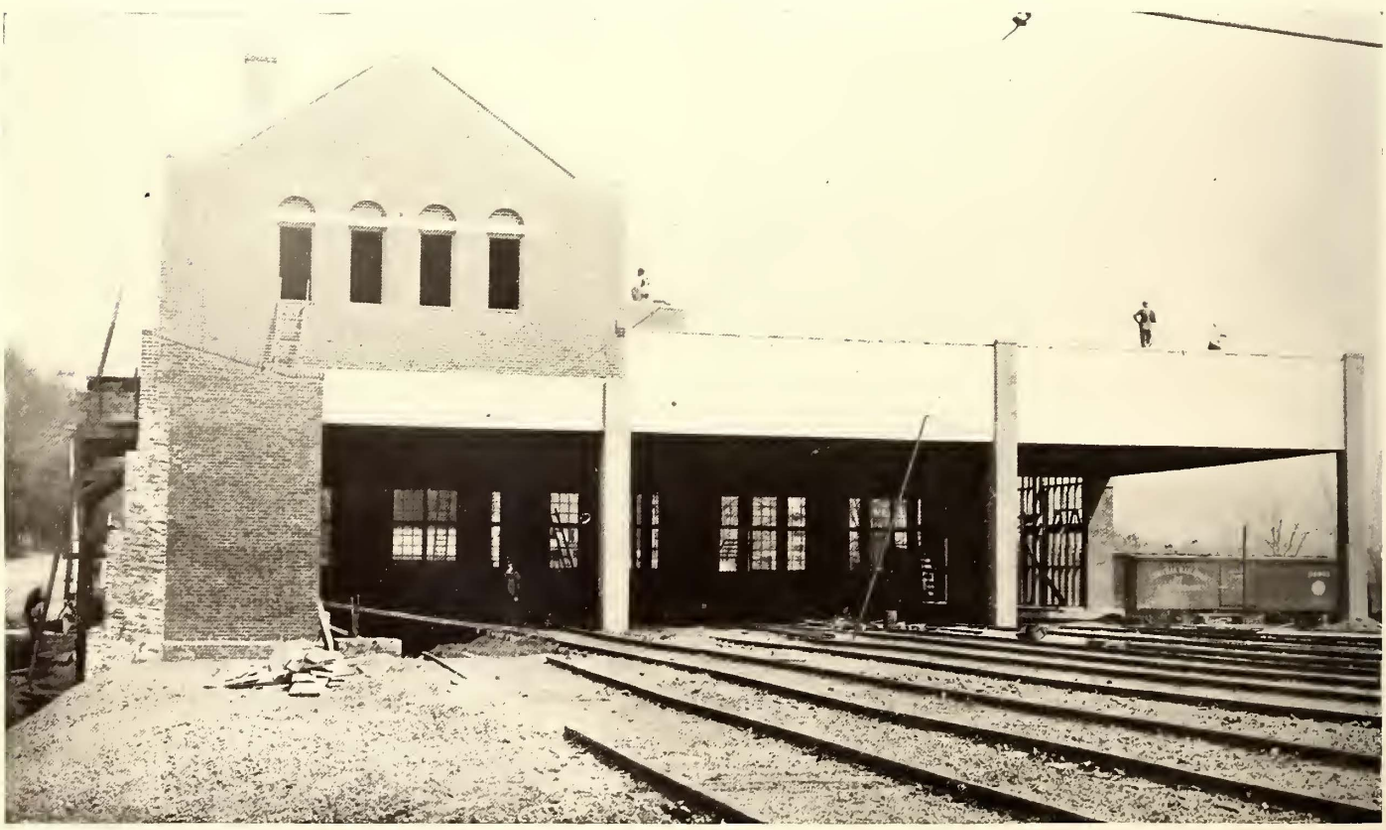


INTERIOR SUB-STATION AT FIFTY-SECOND STREET AND LANCASTER AVENUE

EXTERIOR D. C. GENERATING STATION AT WILLOW GROVE

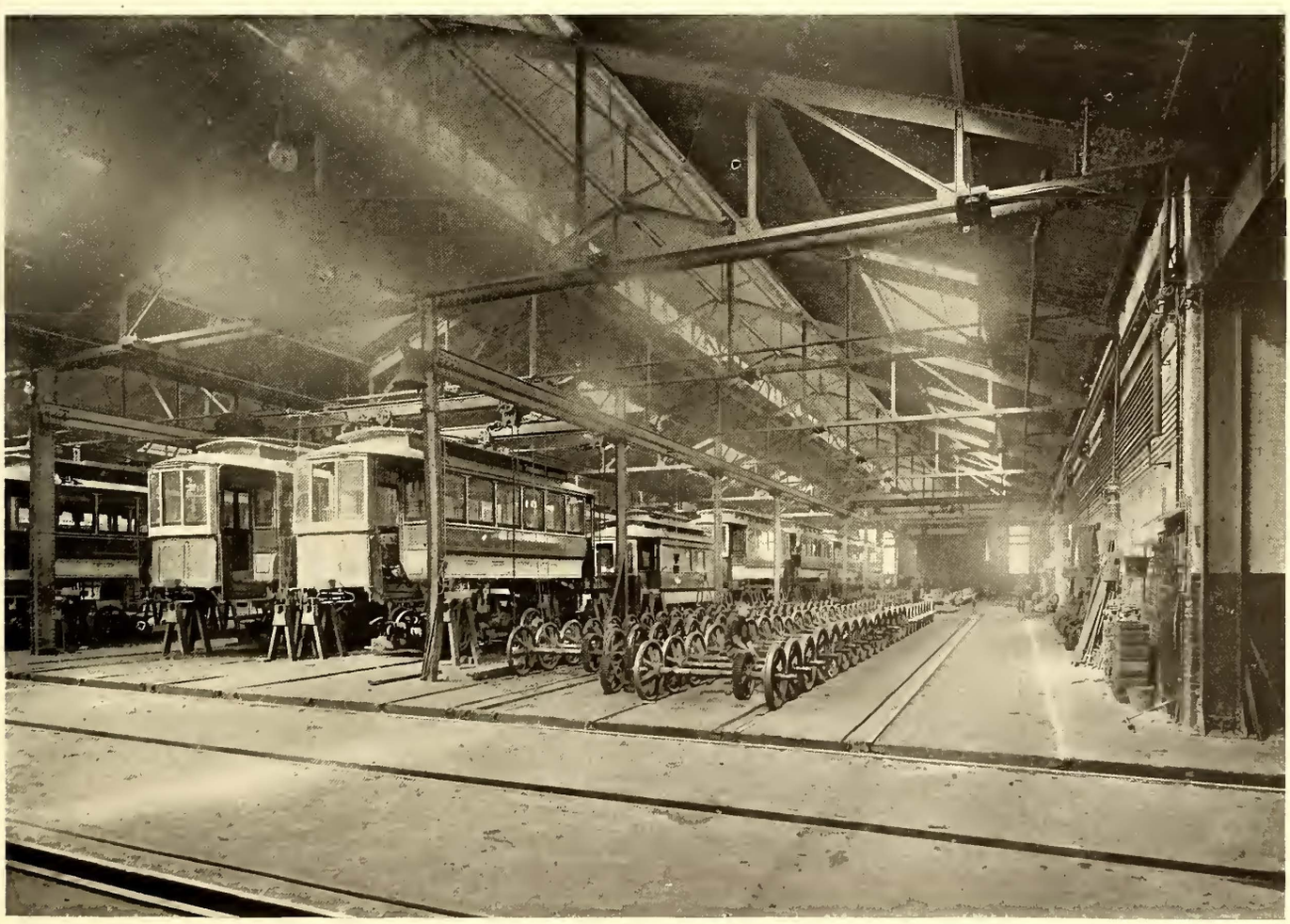
EXTERIOR GERMANTOWN AVENUE STORAGE-BATTERY SUB-STATION

TYPICAL OPERATING CAR HOUSE

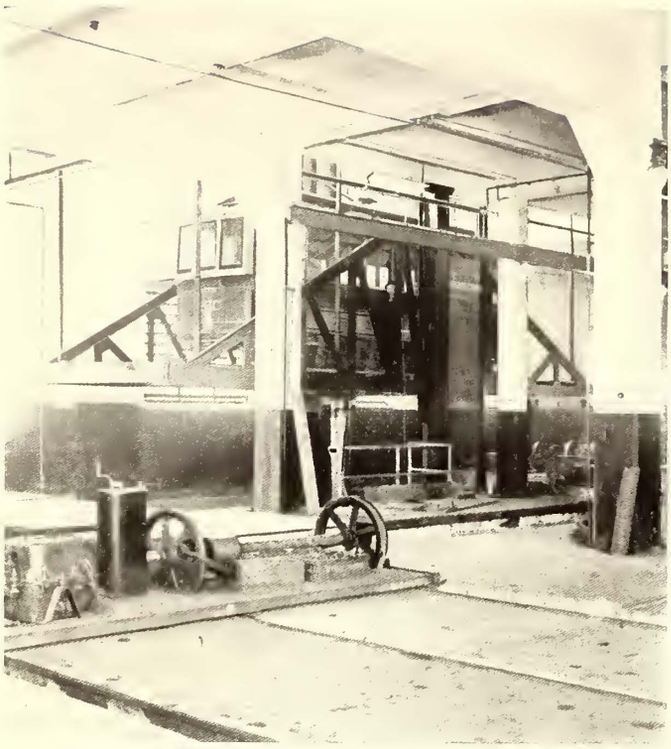


NEW OPERATING DEPOT AT WYOMING AVENUE

PAINT ROOM, NEW CONCRETE ADDITION TO KENSINGTON AVENUE SHOPS



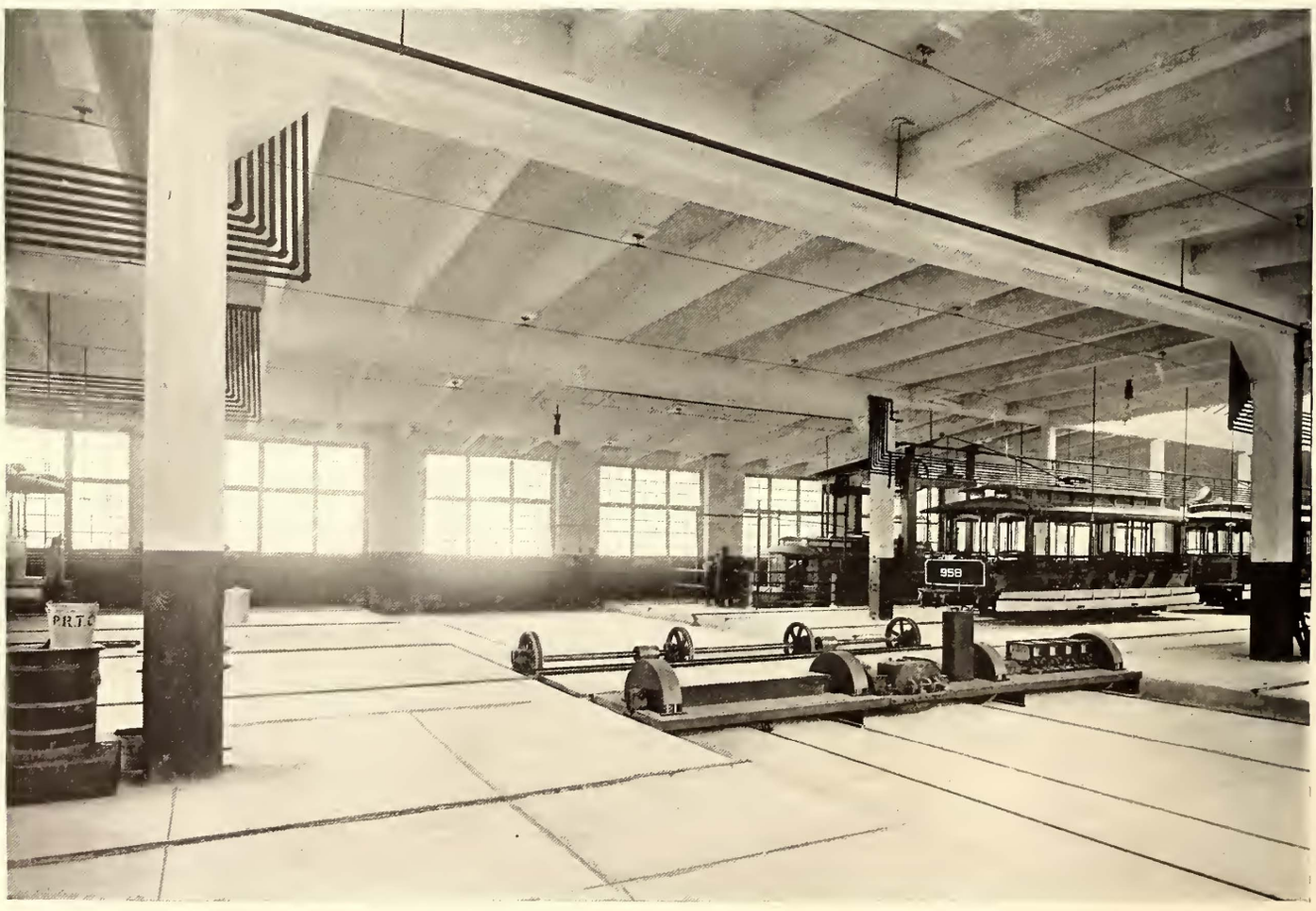
JACKING UP DEPARTMENT, KENSINGTON AVENUE SHOPS



CAR ELEVATOR IN NEW ADDITION TO KENSINGTON AVENUE SHOPS

REAR VIEW OF STORAGE BATTERY LOCOMOTIVE FOR SHIFTING TRUCKS IN SHOPS

FRONT VIEW OF STORAGE BATTERY LOCOMOTIVE FOR SHIFTING TRUCKS IN SHOPS



VIEW IN NEW CONCRETE ADDITION TO KENSINGTON AVENUE SHOPS

Market Streets. From Forty-Sixth Street to the east terminal at Sixty-Ninth Street will be fed from a new 6000-kw sub-station, which will be erected at a point near Fifty-Sixth Street.

A new sub-station will be built at Fifty-Eighth Street and Woodland Avenue with 6000-kw capacity to feed the Darby district. The three outlying sub-stations in this section will be tied together with underground tie-lines, so the entire West Philadelphia district, including the new elevated line, can be fed through any of the three sub-stations. A new 6000-kw sub-station will be built at Kensington and Cumberland Avenues to feed the Kensington district and relieve the present Delaware River direct-current generating station.

TABLE XVIII.—SHOWING NUMBER OF MEN EMPLOYED BY POWER DEPARTMENT.

STATION NUMBER.	1	2	3	4	5	6	7	8	9	10	D	11	12	13	14	15	16	17	18	19
Engineer in Charge	1	1	1	1	1	1	1	1	1	1	1	..	..	..	..	..	..	..	..	..
Assistant Engineer	2	2	2	2	2	1	2	1	1	2	1	..	..	..	..	..	..	..	..	..
First Oiler	1	1	1	1	1	1	1	1	..	1	..	..	..	..	..	..	..	..	..	..
Oilers	5	5	9	9	3	2	6	1	..	5	..	..	..	..	..	..	..	..	..	..
Switchboard Men	3	3	3	3	3	3	3	2	2	4	..	1	1	1	1	1	1	1	1	1
Generator Men	3	3	3	3	..	..	..	1	..	3	..	1	4	2	2	2	2	3	2	2
Pumpmen	1	3	..	..	..	1	..	..	..	2	..	..	..	..	..	..	..	..	..	..
Water Tender	3	3	3	3	3	3	3	..	..	3	..	..	..	..	..	..	..	..	..	.
Firemen	14	6	6	14	3	2	3	4	2	6	2	..	..	..	..	..	..	..	..	..
Firemen's Helpers	..	..	5	..	2	2	2	3	1	6	..	..	..	..	..	..	..	..	..	..
Boilermen	1	1	1	1	1	..	1	..	..	1	..	..	..	..	..	..	..	..	..	..
Coalmen	1	1	3	1	..	1	..	1	..	1	..	..	..	..	..	..	..	..	..	..
Ashmen	2	3	..	2	..	..	..	..	..	7	..	..	..	..	..	..	..	..	..	..
Boiler Cleaners	3	2	3	3	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Janitors	1	1	1	1	1	1	1	1	1	1	..	..	..	..	..	..	..	..	..	..
Engine Room Laborers	..	1	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..
Boiler Room Laborers	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Screen Men	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..
Laundry Men	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
	41	37	43	44	21	18	25	16	8	46	4	2	5	3	2	3	3	4	3	3

NOTE.—Nos. 8 and 9, operated in summer only. No. 10, new A. C. Station. No. D, small country station. No. 8, generating station and sub-station combined. Nos. 11, 13, 14 and 15, battery sub-stations. No. 12, rotary and battery sub-station. Nos. 16, 17, 18 and 19, rotary sub-stations without batteries.

SUMMARY OF TABLE XVIII.

OPERATING MEN:		Boiler Maker and Helpers	4
Generator Stations	303	Rigger and Helpers	2
Sub-Stations	28	Pipe Coverer and Helpers	2
	331	Conductors and Motormen (Ashes and Freight)	10
		Storekeeper, Watchmen, etc	11
		Laborers	12
REPAIR MEN (All Stations):		Electricians and Helpers	20
Steam Fitters and Helpers	20		100
Machinists and Helpers	6		
Brick Layers and Helpers	10		
Carpenters and Helpers	3	Total	431

POWER STATIONS OF THE PHILADELPHIA RAPID TRANSIT COMPANY.

Feed Pumps.	Feed Water Heaters.	Condensers.	Economizers.	Mechanical Stokers.	Mechanical or Forced Draught.	Coal and Ash Conveyors.	Capacity of Coal Bunker in Tons.
2—Duplex Buffalo, 16x9x24"...	3—5'6"x19', Hoppes open..	None.....	None.....	None.....	Steam blowers, Eynon-Evans	2 Ash elevators... 1 Coal elevator... 1 Coal conveyor.. Link belt machinery.	1,500
2—Worthington duplex, 10x16x 8½x10".....	1—Kensington, 3'x13"..... 1—Goubert, 3'x16', closed..	1—Blake, 16x32x21..... 2—Blake, 12x25x18..... All jet condensers.	4—Broomell-Schmidt & Stacey.....	None.....	Mechanical and steam blowers	1 Coal elevator... 3 Coal conveyors. Link belt machinery.	100
2—Barr duplex, 16"x9"x24".....	3—Hoppes, open.....	1—Allis-Corliss, 14"x30", with duplex plunger pump. Jet condensers..	None.....	Box stokers	Steam blowers, McClave.....	.....	30
2—Scranton duplex, 16"x9½"x 24".....	2—Hoppes, 5'x19', open...	2—4,000 hp Surf. Wheeler 2—110 hp. DeLaval Tur. Pumps..... 2—Edws. air pumps trip... 1—2,000 hp. Surf Wheeler. 1—Cent. Pump..... 1—Box Dup air pump, 22" runner	None.....	None.....	Steam blowers, Eynon-Evans	2 Ash elevators... 1 Coal elevator... 1 Coal conveyor.. Link belt machinery.	1,600
2—Worthington duplex, 10x16x 10".....	3—Goubert, closed.....	3—Schutte syphon condensers.....	None.....	Noue.....	Steam blowers, McClave.....	1 Ash elevator... 1 Coal elevator... 1 Coal conveyor.. Link belt machinery.	700
1—Barr duplex, 12"x7½"x12"....	1—Hoppes, open.....	6—Wood Cent. Pumps.....					
1—Scranton duplex, 12x7x8"....	2—Kensington, closed.....	2—Blake, 12"x25"x18", with jet condensers.....	None.....	None.....	Steam blowers, McClave.....	Noue.....	None
1—Worthington, 8x6x9".....	1—Hoppes, open.....						
2—Barr duplex, 18x6x12".....	4—Kensington, closed.....	1—Wetherill-Corliss plunger pump 14"x16", jet condensers.....	None.....	None.....	Steam blowers, McClave.....	None.....	None
		1—Triplex Deening pump, 12"x14", motor driven....	None.....	None.....	Steam blowers, Eynon-Evans		
2—Snow duplex, 8"x6"x10".....	3—Wethcrill, closed.....	None.....	Nonc.....	None.....	.....		
2—Blake duplex, 7½x4½x10"....	1—Goubert, closed.....	1—Wetherill-Corliss plunger pump, 14"x16", jet condensers.....	None.....	None.....		None.	
2—Heissler triple exp., 6-plung.. 2—Scranton duplex, 7½x12x12"..	1—Hoppes, open.....	1—Alberger barometric.... 6—Alberger cent. barometric	None.....	Box stokers	Forced draught, fans.....	1 Coal elevator... 1 Coal conveyor.. 2 Ash elevators... Link belt machinery.	2,000
2—Worthington duplex, 6x4x6".	1—Kensington.....	1—Worthington jet condenser, 9"x5"x12".....	None.....	None.....	.....	None.....	None
2—Duplex, 16x9x24".....	.....	.....		None.....	None.....	2 Coal elevators.. 2 Coal conveyors. Link belt machinery.	3,500 First Portion 12,000 Comp. Sta.

The distance from Second Street and Wyoming Avenue to the sub-station at Fifty-Second Street and Lancaster Avenue is 47,000 ft., which is the longest alternating-current transmission. This is an underground alternating-current line.

The system selected for the new power scheme is 13,200 volts, three-phase, 25-cycle generation, transmitted at the initial voltage to the sub-stations, where it is transferred and converted in the usual way.

The location of all the generating stations of the company are indicated on the maps, and the equipment of each is given in detail in Table XVI.

There are in all eleven generating stations, having a combined generating capacity installed of 33,600-kw direct current and non-condensing stations have been changed to condensing by installing water-cooling devices.

TABLE XVII.—SHOWING EQUIPMENT OF ALL ROTARY AND STORAGE BATTERY SUB-STATIONS OF THE PHILADELPHIA RAPID TRANSIT CO.

Sub-Station No.	Location of Station.	Rotaries.	Transformers.	Additional Equipment.	Storage Batteries Equipment.	Amp. Hour Capacity, 8-Hour Rate.
11	Abington Ave., Gtm.	.....	.....	.....	250 Chloride cells...	960 amp. hours
12	Chelten Ave.	2—500 kw. G. E. 2—100 kw. West.	2—550 kw., G. E., 3-phase..... 6—375 kw. West., single-phase,	2 fans, driven by induction motors; A. C. starting switches for G. E. rotaries; G. E. oil switches operated by 110-volt storage battery; 1 air compressor.	250 Chloride cells... Battery not run in parallel with rotaries.	1,280 amp. hours
13	Erie Ave.	.....	.....		261 Chloride cells...	1,280 amp. hours
14	Ninth and Dauphin Sts.	.....	.....	.....	260 Chloride cells...	1,920 amp. hours
15	Fifth and Lombard Sts.	.....	.....	.....	260 Chloride cells...	2,400 amp. hours
16	Frankford and Arrott Sts.	2—500 kw. G. E. 2—1,000 kw. (future)	2—550 kw., 3-phase G. E ...	2 fans, driven by induction motors; A.C. starting switches for G. E. rotaries; G. E. oil switches operated by 110-volt storage battery; 1 air compressor..	None	
17	Thirteenth St. and Snyder Ave.	3—1,000 kw. West 2—500 kw. G. E.	9—375 kw. West. single-phase 2—550 kw. G. E. 3-phase....	2 fans driven by induction motors; A.C. starting switches for G. E. rotaries; G. E. oil switches operated by 110-volt storage battery; 1 air compressor;	None	
18	Fifty-Second and Lancaster Sts.	3—1,000 kw. West. rotaries... 3—1,000 kw. (future)	9—375 kw. West. single-phase	2 fans with induction motors; G. E. oil switches operated by 110-volt battery; 1 air compressor; 1 West. motor generator for starting rotaries; motor is 3-phase, 75 hp., induction; generator is 45 kw. D. C.; 2-37½ kw. single-phase West. transformers for induction motor.....	None	
19	Glenside	1—1,000 kw. West 2—500 kw. West 3—1,000 kw. (future)	3—375 kw. West. single-phase 6—175 kw. West. single-phase	2 fans, driven by induction motors; G. E. oil switches operated by 110-volt battery; 1 air compressor; 1 West. motor generator, motor is 3-phase, 75 hp. induction type; generator is 45 kw. D.C. for starting rotaries; 2-37½ kw. single-phase West. transformers for induction motors.....	None	
8	Willow Grove	2—500 kw. West 1—1,000 kw. (future)	6—175 kw. West. single-phase	2 fans, driven by induction motors; G. E. oil switches operated by 110-volt battery; 1 air compressor; each rotary has a 3-phase induction motor mounted on its shaft for starting; 3-25 kw. single-phase transformers supply the motors.....	None	
5	Thirty-Second and Dauphin Sts.	.....	.....	.....	270 Chloride cells, operated with generators.....	3,200 amp. hours

LOW-PRESSURE TURBINES

The Philadelphia Rapid Transit Company is about to install at one of its power houses two low-pressure Curtis steam turbine units, manufactured by the General Electric Company, Schenectady, N. Y. These turbines will utilize the energy inherent in the steam between exhaust pressure (atmospheric) of the reciprocating non-condensing engines and the condenser vacuum. Briefly, these turbines consist of a specially designed Curtis steam turbine adapted to receive steam from the low-pressure side of a non-condensing reciprocating engine. Each turbo-generator will be of 800-kw capacity, and will generate direct current, the generators

8000-kw alternating current, which with the 3000-kw additional alternating current now being installed will give a total of 44,600-kw in generating capacity. There are ten sub-stations, having at present a combined capacity of 14,000-kw in rotary converters. There are also six storage-battery plants, having a total capacity of 5200 amp.-hours.

With the exception of the Second Street and Wyoming Avenue station, now in operation, and the new Delaware Avenue station, now under construction, all the generating stations are equipped with direct-current generators, most of which are connected to slow-speed engines, although a few high-speed engines are still in use. The boilers are mostly of the water-tube type, made by the Babcock & Wilcox Company, Thayer & Company and the Parker Engine Company. Four of the stations were originally designed to run non-condensing and seven to run condensing. Two of the in effect floating on the line and automatically taking care of their part of the load. No governing mechanism will be employed, but the turbines operating in parallel with the engines will adjust themselves to the load as called upon to do so. Steam will be taken into the turbine at a pressure of 15 lbs. absolute, and exhaust into the condenser at about 1 lb. absolute, passing through the turbine in four stages. Interpolated poles on the generator will insure perfect commutation, direct current being developed at 575 volts.

Of the eleven generating stations, the more important ones are situated at Thirteenth and Mt. Vernon Streets, Beach and Green Streets, Thirty-Third and Market Streets, and Second Street and Wyoming Avenue.

POWER HOUSE AT THIRTEENTH AND MT. VERNON STREETS

This station is equipped with five 1500-kw Westinghouse

direct-current generators, directly connected to Wetherill-Corliss engines. This building is fireproof in construction. There is nothing particularly novel about the engine room, except perhaps in the arrangement of the switchboard. The station feeds a central and important part of the city, consequently has a large number of feeders running from it. The switchboard is arranged with upper and lower bus-bars. The lower bus-bar is continuous throughout the whole board, and in ordinary operation all feeders leading from this station are connected to the lower bus-bar. The upper bus-bar is divided into five sections, any of which can be connected together if desired. From four of these stations heavy tie-line cables connect to four other power houses, so that the load may be given to or taken from the other stations as occasion may require. By means of these tie-lines the company is enabled to keep its engines loaded at all times of the day.

The boiler room of this station is equipped with nineteen 375-hp B. & W. boilers and one 400-hp Parker boiler. The coal is delivered by wagons, and after passing over the scales is dumped into a hopper and carried by a Link Belt coal elevator into a suspended iron bin, from which it is delivered to the floor of the boiler room by spouts. The ashes pass beneath the boiler into ash pockets, and are drawn off into cars in runways below the boiler-room floor. These cars carry the ashes to two automatic ash elevators situated at one end of the boiler room. These elevators are new and somewhat novel, in that they require no handling except the starting on the up trip. They were made by the Morse-Williams Elevator Company. The ashes are dumped into a bucket and the elevator is started by pulling a hand rope in the ordinary manner. After starting, the elevator requires no attention. The bucket, carrying about 1000 lbs. of ashes, goes to the top of the elevator automatically, dumps the ashes into an ash bin, rights itself and returns to the starting point at the bottom of the elevator shaft. The ashes are then drawn from the ash pocket into cars made for this particular purpose, carrying 20 tons each.

POWER HOUSE AT BEACH AND GREEN STREETS

The Beach and Green Streets power house is equipped with three 1500-kw General Electric generators, direct connected to E. P. Allis twin tandem-compound engines; also one 500-kw General Electric generator, direct connected to E. P. Allis single-cylinder engine. This station is also equipped with two engine-driven boosters and one motor-driven booster for use on certain long feeders which run from this station. The boosters were supplied by the Crocker-Wheeler Company.

The boiler room is on the second floor, and is equipped with twelve B. & W. boilers and two Thayer boilers. This boiler room is the only one in the direct-current stations equipped with stokers. The station is run condensing. The condensing system consists of one E. P. Allis direct-driven pump, which draws the water through condensers for all the engines. This system has proven particularly reliable and satisfactory.

POWER HOUSE AT THIRTY-THIRD AND MARKET STREETS

The Thirty-Third and Market Streets power house was originally a non-condensing station, and has recently been changed to a condensing station by installing cooling towers on the boiler-room roof. The equipment consists of four 1500-kw Westinghouse generators, two of which are direct connected to Wetherill-Corliss engines, and two to Pennsylvania Iron Works Corliss engines. There are also two 800-kw generators connected to Pennsylvania Iron Works tandem-compound engines. These generators all deliver direct current.

The exhaust from the engines is led to three surface condensers of the Wheeler Admiralty rectangular type. Water for cooling the condensers is taken from the city mains, and after passing through the condensers, as much as is needed is taken automatically for boiler-feed purposes at an average temperature of 120 degs. F. The balance is forced to cooling towers by centrifugal pumps driven by De Laval steam turbines. These cooling towers are equipped with two fans each, driven by 40-hp motors. The average cooling in the summer time is about 16 degs. The condensing apparatus was installed by the Wheeler Condenser & Engineering Company.

Coal is delivered by wagons, and after passing the scales is dumped into the hopper and conveyed into a 1600-ton suspended coal bin, similar to the one at Thirteenth and Mt. Vernon Streets. The ashes are taken from the ash pits beneath the boilers and conveyed to ash pockets by automatic elevators in the same manner as described for the Thirteenth and Mt. Vernon Streets plant.

The switchboard in this power house is double-decked, the upper deck being for feeder panels and the lower deck for generator panels. The instruments are mounted on Tennessee marble, oil finish, and the board is equipped throughout with aluminum bus-bars.

The other direct-current stations are not of sufficient novelty to require detail descriptions.

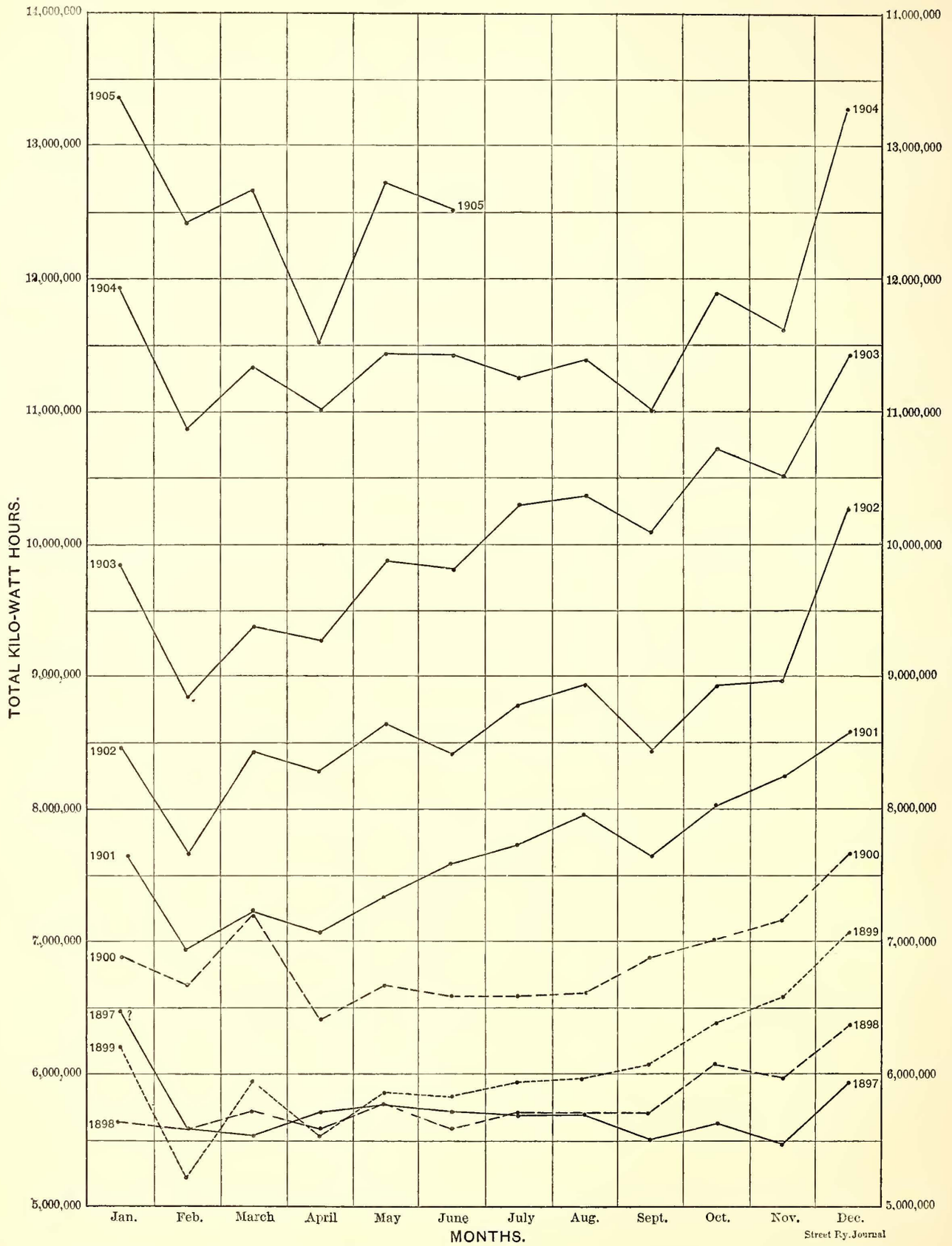
A. C. STATION AT SECOND STREET AND WYOMING AVENUE

At present, alternating current for the Philadelphia Rapid Transit system is generated

TABLE XIX.—SHOWING AREAS PER HORSE-POWER AND OTHER DETAILS OF ALL OF THE POWER STATIONS OF THE PHILADELPHIA RAPID TRANSIT COMPANY

Station No.	Location.	Size Plant in Kw.	Size Engine Room, Sq. Ft.	Size Boiler Room Sq. Ft.	Rated Hp. of Boilers, Comp. Plant.	Sq. Ft. Boiler Room, Per Hp.	Size Boiler Units Hp.	Size Grates Sq. Ft.	Hp. Per Sq. Ft. Grate.	Water HS. Grate S.	Bunker Capacity. Tons.	Size Chimneys, Ft.	Notes.
1	Thirteenth and Mt. Vernon Sts.....	7,500	14,466	82½x170—14,025	7,500	1.87	375, 12 tubes high 16 tubes wide	9'8"x 7'0"— 68	5.5	55.	1,500	2—11'3" Diam., 170' high, steel lined..	Stacks inside B. R. Water tube boilers.
2	Delaware Ave. (old Sta. D. C.).....	3,800	12,657	83½x200—16,650	6,000	2.77	250, 7 tubes high 16 tubes wide	7'6"x 9'0"— 67½	3.8	38.	150	.....	Induced draft. Water tube boilers.
	Delaware Ave. (new sta. A. C.).....	55,500	28,080	115x340—39,500	51,200	.77	800, 18 tubes high 20 tubes wide	9'8"x10' —160	5.	50.	12,000	8—14' Diam., 225' high.....	Stacks carried on steel framework of building. Water tube boilers.
3	Beach St., foot of Green St.....	5,000	10,934	78½x142—11,147	5,000	2.23	250, 9 tubes high 14 tubes wide	7'0"x 8'6"— 59½	4.2	42.	150	2— 7'x7' 125' high.....	Stacks inside B. R. Water tube boilers.
4	Thirty-Third and Market Sts.....	7,600	12,633	79 x147—11,613	6,500	1.78	375, 12 tubes high 16 tubes wide	9'8"x 7'0"— 68	5.5	55.	1,600	2—10'3" Diam., 172' high, steel lined..	Stacks outside B. R. Water tube boilers.
5	Thirty-Second and Dauphin Sts	2,200	6,287	42 x130— 5,460	2,400	2.27	300	7'0"x 7'3"— 51	6.	53.	800	1— 8' Diam, 175' high.....	Stacks inside B. R. "Berry boilers."
6	Twenty-Seventh and South Sts.....	1,700	4,865	— 6,210	1,500	4.14	250, 7 tubes high 16 tubes wide	7'6"x 9'0"—67.5	3.7	37.	No bunkers		
7	Ogontz.....	2,400	5,968	36 x125— 4,500	2,250	2.00	250	7' x 6 — 42	6.5	53.5	No bunkers	1— 8' Diam., 150' high.....	Stacks inside B.R. Water tube boilers.
8	Willow Grove.....	1,500	5,400	50 x 90— 4,500	1,300	3.50	110	25	5.	.....	No bunkers	1— 9' Diam., 130' high, steel lined..	Stacks inside B.R. "Berry boilers."
							125	36	4.1			1— 7'x7' 100' high.....	Stacks outside B.R. Return tubular boilers.
10	Second and Wyoming Ave., A. C.....	12,300	16,625	53 x266—14,098	11,600	1.25	700	147.4	4.74	51.85	2,000	1—16' Diam., 220' high, steel lined..	Stacks inside B. R. Water tube boilers.
							600	130	4.62	51.4			Stoker.

at one large station located on Wyoming Avenue at Second Street, and extending south to the Wingohocking Creek, and between the Newtown branch of the Philadelphia & Reading Railway and



CURVES SHOWING COMBINED OUTPUT OF ALL POWER HOUSES OF PHILADELPHIA RAPID TRANSIT COMPANY

boilers in all, each with a normal rating of 640 hp. Each battery had an independent iron stack erected above the boilers. Below the boilers, extending the length of the building, was constructed a tunnel, through which the cinders were removed. The boilers were operated by forced draft, the air being driven by a 10-ft. Sturtevant blower through a chamber built in connection with the cinder tunnel. The coal handling and stoking were done entirely by hand.

Third Street. The power house is known locally as station No. 10.

This station was originally intended as a temporary plant only, and practically the entire structure was a wooden frame building.

The original plant, built in 1903, included a boiler room 56 ft. wide and 105 ft. long, with three batteries of Parker boilers, six

The engine room was 70 ft. wide and 105 ft. long, and in it

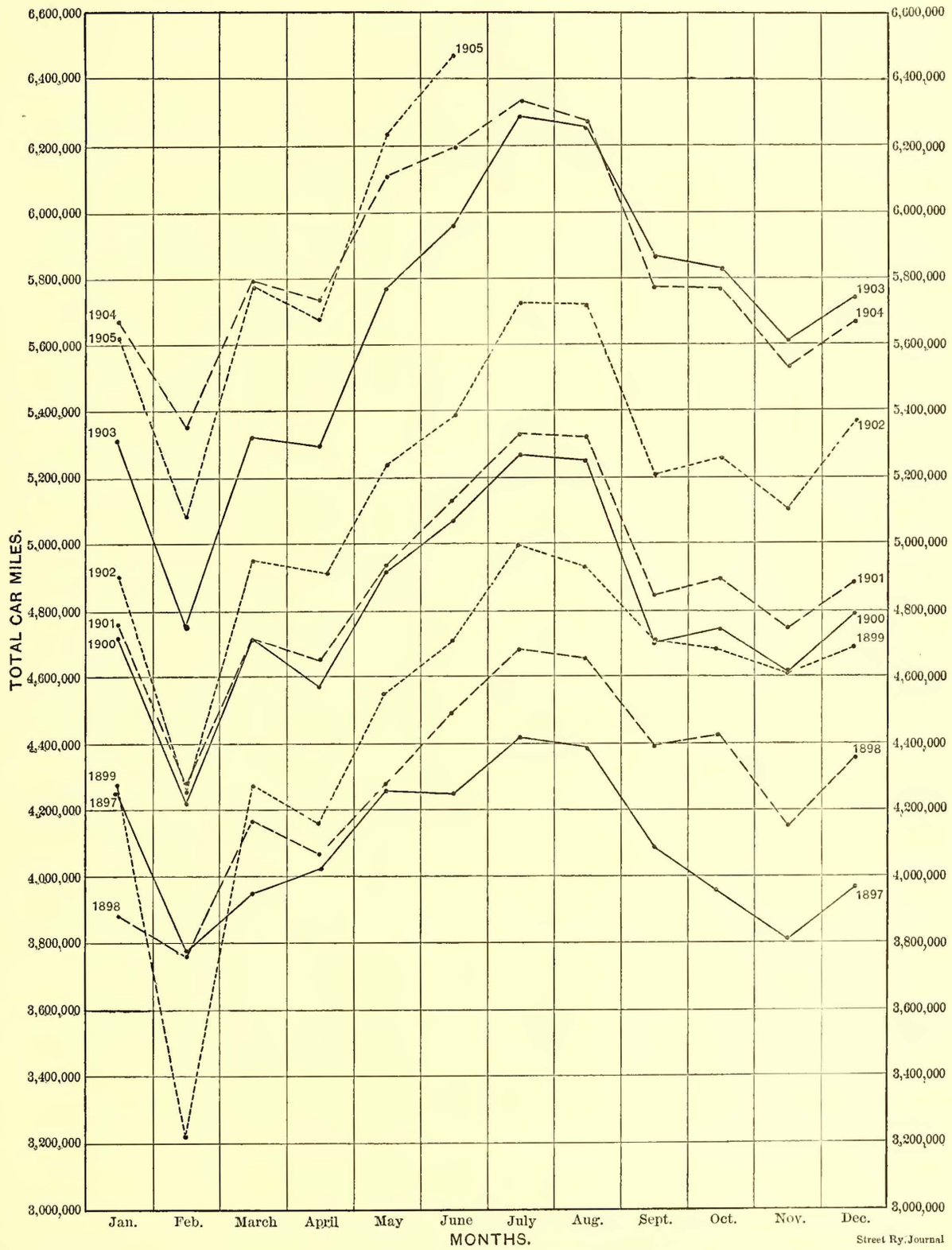
were installed two 28-in. x 54-in. x 48-in. cross-compound Wetherill engines, each driving a 1000-kw General Electric generator and one 23-in. and 40-in. x 20-in. Westinghouse automatic compound engine, driving a 400-kw Westinghouse generator.

The decision to make the plant permanent and to add to its capacity meant practically rebuilding the structure without interfering with its operation. The station as it now appears is practically completed, and comprises a boiler room 54 ft. wide and 267 ft. long, and an engine room 70 ft. wide and 242 ft. long.

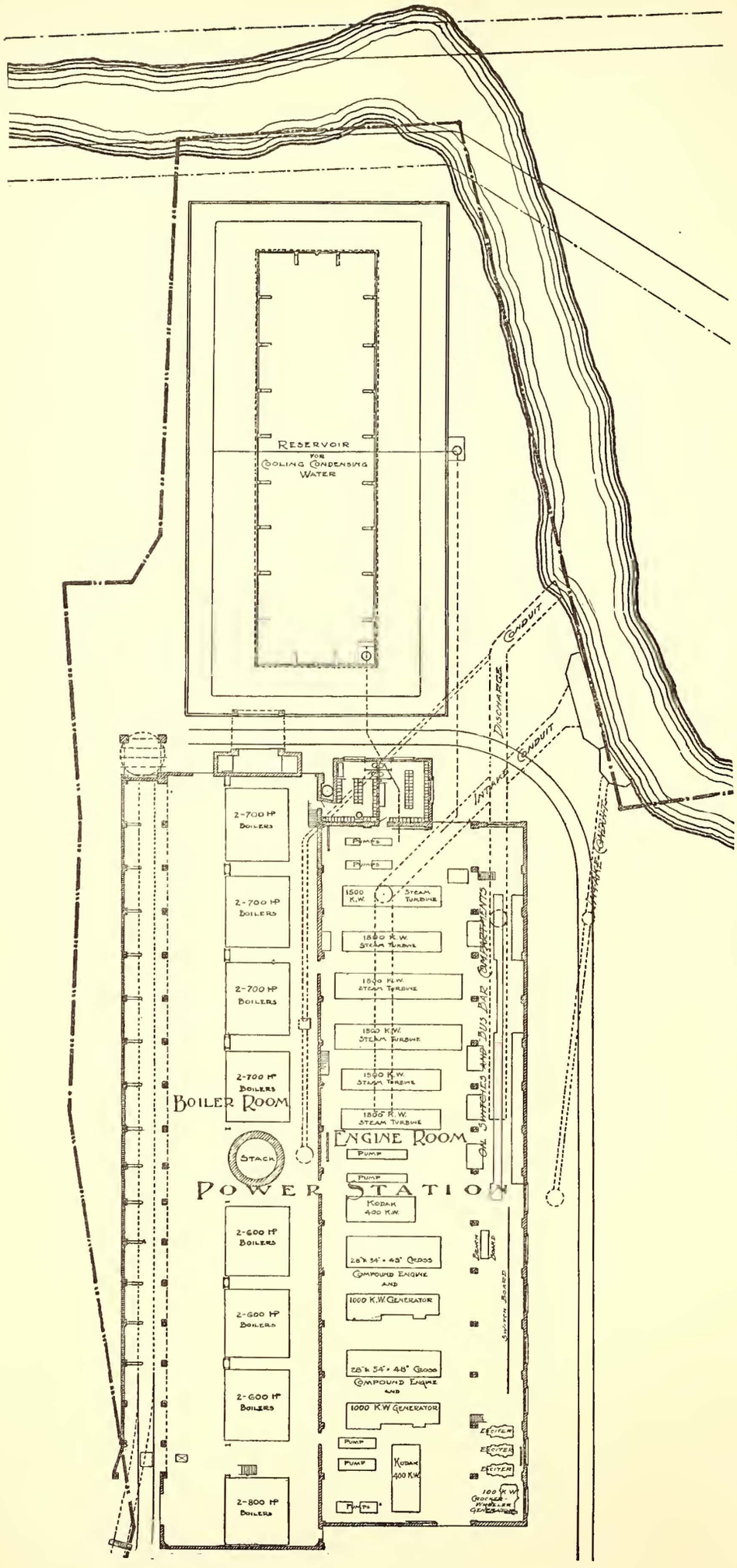
In the boiler room the six old boilers were rebuilt, and are rated at 600 hp each. South of these four new batteries of two boilers each were installed, each boiler having a normal rating of 700 hp. An extension to the north has been built to accommodate an additional battery of the same capacity. The new 700-hp boilers are double-end boilers; that is, they are fired from both ends. They are equipped with automatic stokers. The total area of the boiler room is 14,098 sq. ft., making about 1.25 sq. ft. per horse-power.

Between the old and new boilers a brick-lined steel stack 14 ft. in diameter and 220 ft. high has been erected. An extension has been built to the east to enclose the railroad siding.

In the extension to the south of the engine room the installation consists of six 1500-kw Westinghouse-Parsons steam turbines and



CURVES SHOWING TOTAL CAR-MILES BY MONTHS SINCE 1897 FOR PHILADELPHIA RAPID TRANSIT SYSTEM



GENERAL PLAN OF GENERATING STATION AT SECOND STREET AND WYOMING AVENUE

four dry-vacuum pumps. In the extension to the north is a 23-in. and 40-in. x 20-in. Westinghouse automatic compound engine driving a 400-kw Westinghouse generator, two Heisler and two Scranton boiler feed-pumps, three steam-driven exciter sets and a Reeves automatic engine driving a 100-kw Crocker-Wheeler generator.

The total output of the engine room is 11,990 kw. The area of the entire station is 31,358 sq. ft., or 2.63 sq. ft. per kilowatt output. For the engine room alone there are 1.42 sq. ft. per kilowatt capacity.

In this connection, attention is directed to Table XIX. on page 511, which gives the square-foot area in relation to boiler and engine-room output for several of the Philadelphia stations. It will be noted that station No. 10, at Second Street and Wyoming Avenue, and also station No. 2, which includes the new turbine plant at Delaware Avenue (described later in this article), show remarkable figures in regard to both engine and boiler horse-power developed per square foot of area. This noteworthy economy of floor space has been obtained by the use of turbines and double-end boilers. Attention is also called to the large grate surface, which is demanded on account of the class of fuel that is being burned at these plants.

The overhead traveling crane is 51-ft. span, and between the columns supporting the west crane runway and the west wall (a space of about 16 ft.) are located the switchboard and the oil switch and bus-bar compartments, these compartments being similar in construction to those in the sub-station, described elsewhere.

In the basement under the south extension is the condensing apparatus, water for which is supplied from the creek through a 3-ft. 6-in. x 4-ft. conduit, the discharge conduit being of the same size leading to the creek south of the intake chamber.

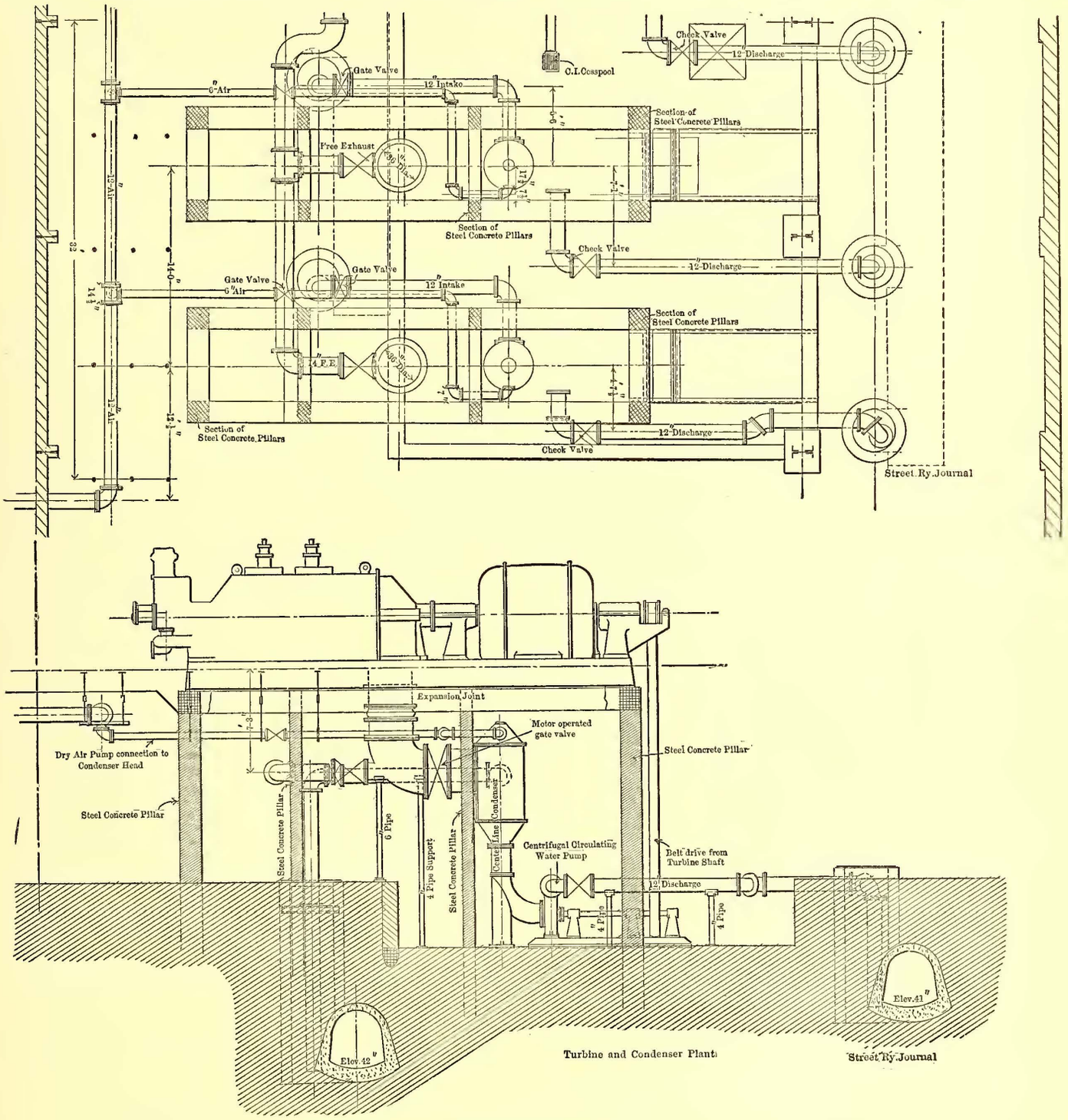
It was the original intention to install but four steam turbines in the extension, and when two more were installed it was found necessary to supplement the supply of cooling water secured through the conduit, and for this purpose the hot water coming from the condensers is piped to the rear of the power house, and cooled by being discharged through spray nozzles into a reservoir 40 ft. wide, 144 ft. long and 11 ft. deep, where it is stored for use in the condensing system.

DETAILS OF EQUIPMENT AT STATION NO. 10

The plant at Second Street and Wyoming Avenue is typical of many others throughout the country in which the rapid advancement of modern engineering practice has brought about the extensive revision of plans even before the station as originally laid out has been but partly completed. In several respects, the station is of more than ordinary interest; in the change from steam engines to steam turbines for the second half of the plant with its present extensions; introduction of a new type of condensing plant; the use of reinforced concrete pillars for turbine foundations; the adoption of a comparatively new type of boiler-superheater unit, and the generation of 13,000-volt current directly at line potential.

As originally planned, the plant was intended for reciprocating engine units, two of which were installed before it was decided to alter plans to provide for steam turbines. The plant was designed for the use of saturated steam, but the original boiler equipment is now being modified to accommodate an internal type superheater, thus conforming with the new extensions.

The plan on page 514 shows in outline the station as it will appear when completed, which will be within the present year. At the present time, however, only four turbine units are in operation, Nos. 3, 4, 5 and 6, with Nos. 1 and 2 engines. The extraordinary compactness of a steam turbine equipment is well brought out in this plant. Two engine units totaling 2000 kw occupy more space than five turbine units totaling 7500 kw, and nearly as much as the entire 9000 kw of turbine machinery, allowing the necessary floor space for the respective units. To some extent this compactness may be accredited to the location of condensers beneath the turbine, so that no extra floor space is necessary for them. This is a distinctive feature of the Parsons type of turbine.



PLAN AND SECTION SHOWING GENERAL ARRANGEMENT OF TURBINES AND CONDENSING PLANT AT SECOND STREET AND WYOMING AVENUE POWER STATION

In this station the outside longitudinal bay of the engine room, 12 ft. in width, is entirely reserved for the controlling apparatus. Operating switchboard, meter board and motor switches are on the main floor, high-tension switches on the second floor, and cable work in the basement. Unlike the usual type of large steam plants, where a double row of boilers is employed, the entire steam-generating capacity is arranged in a single row. The units are, however, exceptionally large in capacity, 600 hp to 700 hp, each with two units in a battery, and the settings are considerably higher than usual, measuring 24½ ft. from the floor level. This largely increases the general compactness of the boiler room.

The Wyoming Avenue station was originally planned to serve city surface lines, the area served extending in some cases as far as 10 miles from the station. This necessitates high-tension alternating-current transmission with low-tension d. c. distribution from rotary-converter sub-station. The transmission lines average 7 miles in length, the longest run being 15 miles. In the present system, current is generated high potential for direct transmission without the use of transformers at the main station. This idea has been embodied in the entire power equipment. The station not only supplies current direct to the various sub-stations, but may also be operated in conjunction with a. c. power plants located in other parts of the city, so the load may be shifted from one plant to another, thereby avoiding possible interruptions to the service, or in normal operation securing the most efficient distribution of load.

TURBINE EQUIPMENT AT STATION NO. 10

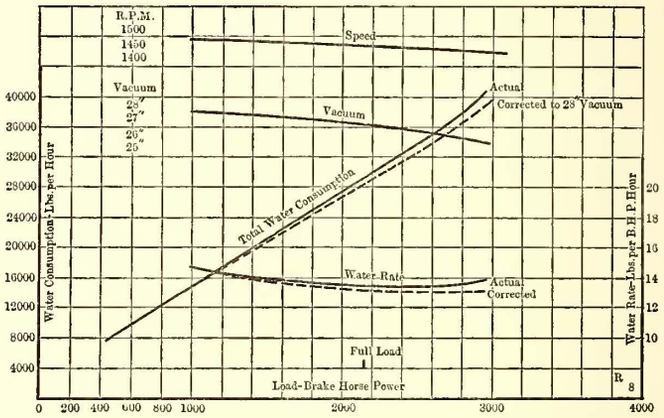
The turbine units are each of 1500-kw rated capacity and of standard Westinghouse construction. The drawings on page 515 show the unit, condenser and circulating water tunnels. Turbine and generator are mounted upon a single bed-plate of box girder construction supported at the four corners, at the center and at two intermediate points by reinforced concrete pillars. These pillars are 20 ft. in height, and are suitably tied together in the concrete body which forms the floor of the unit, and is integral with the concrete flooring. This arrangement gives great rigidity to the general concrete structure. The bed-plates of the turbine units are set down well into the concrete floor, bringing the foot of the equipment nearly to the floor level.

This concrete structure provides a remarkably free basement for the condensers, which are installed directly beneath the turbines in the spaces between the various pillars. Each turbine with its condenser is a unit independent in all respects of the remaining units. The advantages of the arrangement are obvious, not only in the facility and independence of operation, but also in the avoidance of long and troublesome exhaust pipes, with the dependent frictional loss. The condensing equipment consists of one 3500-hp Alberger barometric condenser and auxiliaries used in connection with the reciprocating engines; four 1500-kw Alberger dry-vacuum centrifugal condensers in connection with steam turbines and using natural water supply; two 1500-kw Alberger dry-vacuum centrifugal condensers on steam turbines and using water from cooling reservoir.

As the construction of the turbine units conforms in general to that used by the builders, a detailed description is not necessary. An important point, however, is the use of two independent admission valves, alike in construction, similarly operated from a single governor, yet differing in their functions. The Parsons type of steam turbine increases in efficiency as the load is increased, even if loaded far beyond its capacity. As it is extremely desirable that the turbine should give its best economy when operating on loads within its normal rating, some little efficiency at overloads can well be sacrificed if necessary to accommodate the heavy overloads that occur in traction stations. The function of the primary admission valve is therefore apparent. The secondary valve controls the steam admission during normal loading, within which the turbine possesses its best economy. At a predetermined overload the secondary valve comes into play and sustains the load by admitting more steam at a given speed. The increased power is obtained by the action of this secondary valve admitting high-pressure steam to the lower stages of the turbine where the diameters are greater. Normally, the unit runs at 1500 r. p. m. It is controlled by a sensitive governor, through which any speed regulation can be obtained down to 1½ per cent and 2 per cent. The units not only operate in parallel, but also with two Corliss engine type units, so that less sensitive speed regulation is desirable.

An effective detail of construction is the small motor-driven speed-changing device with which each turbine is equipped. The principle is similar to that which has not infrequently been applied to steam engines in a. c. practice. This apparatus consists essentially of a movable load on the governor spring, the variations being accomplished by a small motor controlled by a double-throw switch mounted upon the switchboard. The attendant synchronizes all machines from this point after they have been brought up to speed and the throttle opened, and also effects the proper distribution of load between the various generating units according to the indications of the meters before him.

The oiling system for each turbine is independent of the others, and upon the closed-circulation principle. As the bearings are proportioned to support the rotating parts without the necessity of forced lubrication, a small plunger pump positively driven through gearing from the main turbine shaft, is sufficient to maintain circulation, the pressure for which is from 5 lbs. to 10 lbs. per square inch. The oil used is a high-grade mineral oil that, under similar conditions, has been used continuously for six months or over in other turbine plants. It enters the bearing shells at the point of least pressure, at the top, and, after thoroughly flushing the journals, returns to a pipe cooler in the bed-plate of the unit, from whence it is again returned to the bearings. Each turbine is equipped with a safety stop mounted at the end of the turbine shaft. It is a small centrifugal governor, which may be set to operate at a definite overspeed, a small trip valve communicating with a quick-closing throttle in the main line. Thus any injury to the governor mechanism cannot result in the destruction of the machine. Should any emeregncy arise making it desirable to shut down quickly, the operator may trip this valve by hand without having to close the main throttle valve.



EFFICIENCY TESTS ON WESTINGHOUSE-PARSONS TURBINES

The accompanying diagram on this page shows the average results of the four turbines installed. Dry saturated steam was used at a constant pressure of 150 ft. per square inch. The vacuum could not be held up to the normal 28 ins. on the heavier loads, but in spite of this the guaranteed economies were exceeded by a good margin. The minimum water rate was secured at slightly over full-load rating, and was about 13.35 lbs. per b. h. p. hr. Had the vacuum been held up to 28 ins., as will be the case in service, the economy would have been much better, as indicated by the dotted line—less than 13 lbs. per b. h. p. hr. at about full load, corresponding to about 18.3 lbs. per kw-hour with saturated steam. The correction for vacuum is based upon comprehensive

tests upon a machine of similar size and design, which showed a decrease in water rate of about 3 per cent per 1-in. increase in vacuum at full load. The average speed variation between half load and 50 per cent overload was 2.68 per cent; from no load to full load, 2.45 per cent. At about 13.7 per cent over speed the automatic stops released and shut down their respective machines.

DETAILS OF CONSTRUCTION OF STATION NO. 10

The character of the ground made it necessary to take the foundations for the columns and piers to rock, and support the walls on girders. These girders, as well as those supporting the boiler walls, are of reinforced concrete. Reinforced concrete has a prominent part in the construction work in connection with the station, and its adaptability to many uses is well shown. In addition to the girders referred to, the cinder bin, the condensing-water reservoir, the drainage sewer and the entire floor construction of the engine room, with the supports for the turbines, are of this type of construction. The columns supporting the turbines are about 16 ft. high, and are 18 ins. x 18 ins. and 12 ins. x 18 ins. in section, reinforced with steel rods.

Above the main floor level the building is of skeleton steel construction, with brick walls and cinder concrete roof, finished with slag and gravel.

The reservoir south of the power house is also of reinforced concrete construction. The walls are 11 ft. high, and are 8 ins. thick, with buttresses spaced 16 ft. center to center, reinforced to withstand the pressure from the earth outside banked up at an angle of 30 degs. Around the four sides of the reservoir are sloping wood platforms carrying two lines of piping fitted with nozzles through which is sprayed the hot water that is caught by these sloping platforms and carried to the reservoir.

The sewer leading past the station and conveying sewage from Wyoming Avenue is of reinforced concrete with flat bottom and semi-circular top, supported at intervals of 16 ft. on piers resting on "simplex" concrete piles driven to rock.

NEW TURBINE STATION ON DELAWARE AVENUE

The property on which the new station is to be erected extends from Delaware Avenue on the east to Beach Street on the west, a distance of 200 ft., with a frontage of 435 ft. on Beach Street and 415 ft. on Delaware Avenue. On the opposite side of Delaware Avenue, with a frontage of 82 ft. and a depth of 400 ft., is pier No. 41, which is also the property of the company.

The site of the station is at present partially occupied by an old station, and the first section of the new station is being erected north of this. Upon the completion of this first section, the old station will be demolished and the new station completed, as shown by the plan on page 518.

GENERAL DESIGN OF NEW DELAWARE AVENUE STATION

On account of the width of the property, the arrangement in both boiler and engine rooms is very compact. The completed boiler room occupies a space 116 ft. wide and 340 ft. long. The arrangement of the boilers across the room divides it into a number of separate firing rooms, with the boilers face to face and back to back, there being 22 ft. between faces and 18 ft. between backs. For each turbine a line of boilers is planned, two in the center and three at each end, separted by narrow alleys. Each line has a separate stack, supported on the steelwork over the center pair of boilers. It was originally intended to have a coal bunker over each firing room. This would have almost entirely shut out the light and ventilation, and the design was accordingly changed, two bunkers being provided extending the entire length of the room over each of the outside batteries. Over the boilers the stack occupies the space between the bunkers, while over the firing room the space is occupied by a ventilating skylight, supplementing the light and air obtained from the windows on Delaware Avenue. Along the fronts and backs of each line of boilers a gallery extends for the more convenient operation of the stokers.

The basement floor under the boiler room is 14 ft. below the main floor, and under each line of boilers is a gallery, with the cinder chambers in the center. In the side walls of these chambers are doors, through which, from the gallery, a poke-bar can be run to loosen up the cinders. In the bottom of the cinder chambers are chutes, through which the cinders can be discharged into cars. Under each line of boilers is a track leading to a main track running the length of the basement, by which the cinder cars are taken to the elevators leading to the cinder bin.

The engine room occupies a space 78 ft. wide and 360 ft. long, with two galleries 17 ft. wide extending the entire length of the room. The plan contemplates the installation of eight turbo units, spaced 40 ft. center to center. In the space between the turbines will be located the exciters, etc. Under the gallery on the main floor will be the oil-switch compartments. The first gallery will contain the switchboard. Over the main portion of the engine room is a three-motor traveling crane, 61 ft. span, with an auxiliary hoist. Over the oil-switch compartments is a smaller traveling crane.

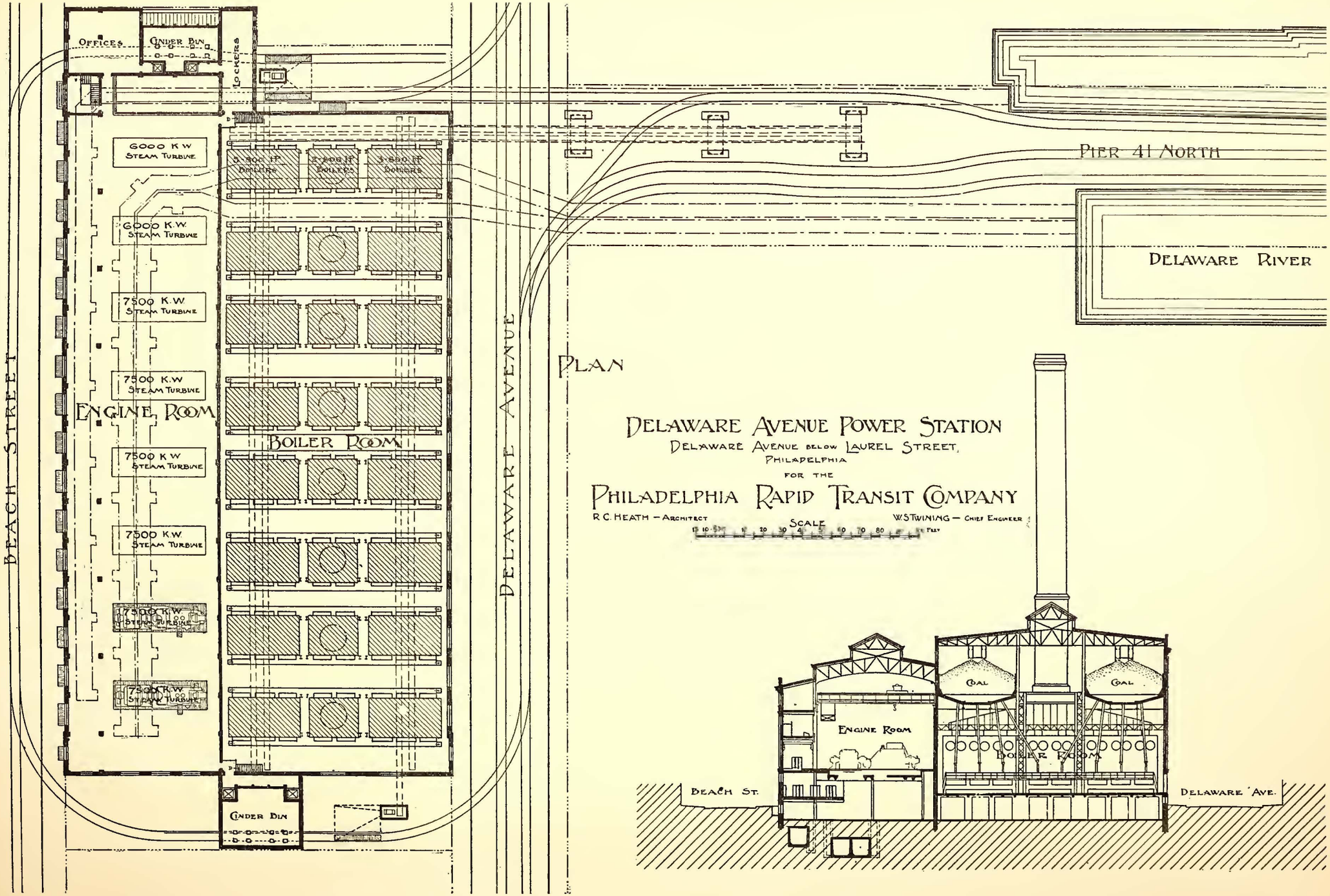
In the basement, the floor of which is 26 ft. below the main floor of the engine room, is located the condensing apparatus. A gallery, on which are located the bus-bar compartments, extends the entire length of the room.

At the north end of the engine room a steam road track extends into the building, allowing machinery and materials to be unloaded by the overhead crane. Beyond this, on the ground level, is a small shop and storeroom; on the main floor, toilet and locker rooms, and on the floor above, the offices of the engineer, etc., adjacent to the entrance and stairs from Beach Street. Adjoining the toilet rooms, and located over the trolley track from Beach Street, is the cinder bin, to which the cinders are conveyed by the two bucket elevators previously mentioned, each bucket having the same capacity as the cinder car used in the basement. The cinders are discharged by chutes into a car, by which they are taken to a dump or to some point for use.

The cooling water for the condensing apparatus is conveyed by two conduits, each 63 sq. ft. in area, from the south side of the wharf, under Delaware Avenue, under the basement floor and down the length of the engine room below the turbines, wells being constructed at the sides, from which lead the pipes running to the condensers. At the entrance to the conduits are two screens of iron bars in channel frames, the second being somewhat closer spacing than the first, both of which can be raised by an overhead hand hoist for cleaning. These screens prevent foreign matter from entering the conduits. Back of these screens is the intake chamber, and from this lead the two conduits, each having a heavy timber gate, one or both of which may be lowered, thus shutting off either conduit, so that it may be pumped out to allow any necessary repairs to be made. Should such a condition arise, water can be supplied through the other conduit, each of the two being of sufficient area to do the work alone.

The discharge conduit extends north along the Beach Street side, and then east under Delaware Avenue to the north side of the wharf.

On account of the character of the ground, the foundations presented an interesting problem, complicated by the location of the water conduits between the lines of columns. Below the upper strata, which is a hard, coarse gravel, is a soft, black mud mixed with clay, extending down an average depth of 20 ft. to coarse sand. On account of these conditions, it was decided to use piles for the foundations. Allowing a load of 20 tons per pile for wood piles, the heavy loads due to the coal bunkers and stacks made the areas of the footings such that it was found necessary to take the steel columns down below the bottom of the conduits, allowing the footings to spread out beneath them. As the bottom of these conduits is about 9 ft. below the basement floor level, and as water is encountered over the whole area at a level about 2 ft. below the floor, thus making continual pumping and shoring necessary until the piles were driven and the columns erected, the ob-



PLAN

Delaware Avenue Power Station

Delaware Avenue below Laurel Street, Philadelphia

for the

Philadelphia Rapid Transit Company

R. C. Heath — Architect

Scale

W. S. Twining — Chief Engineer

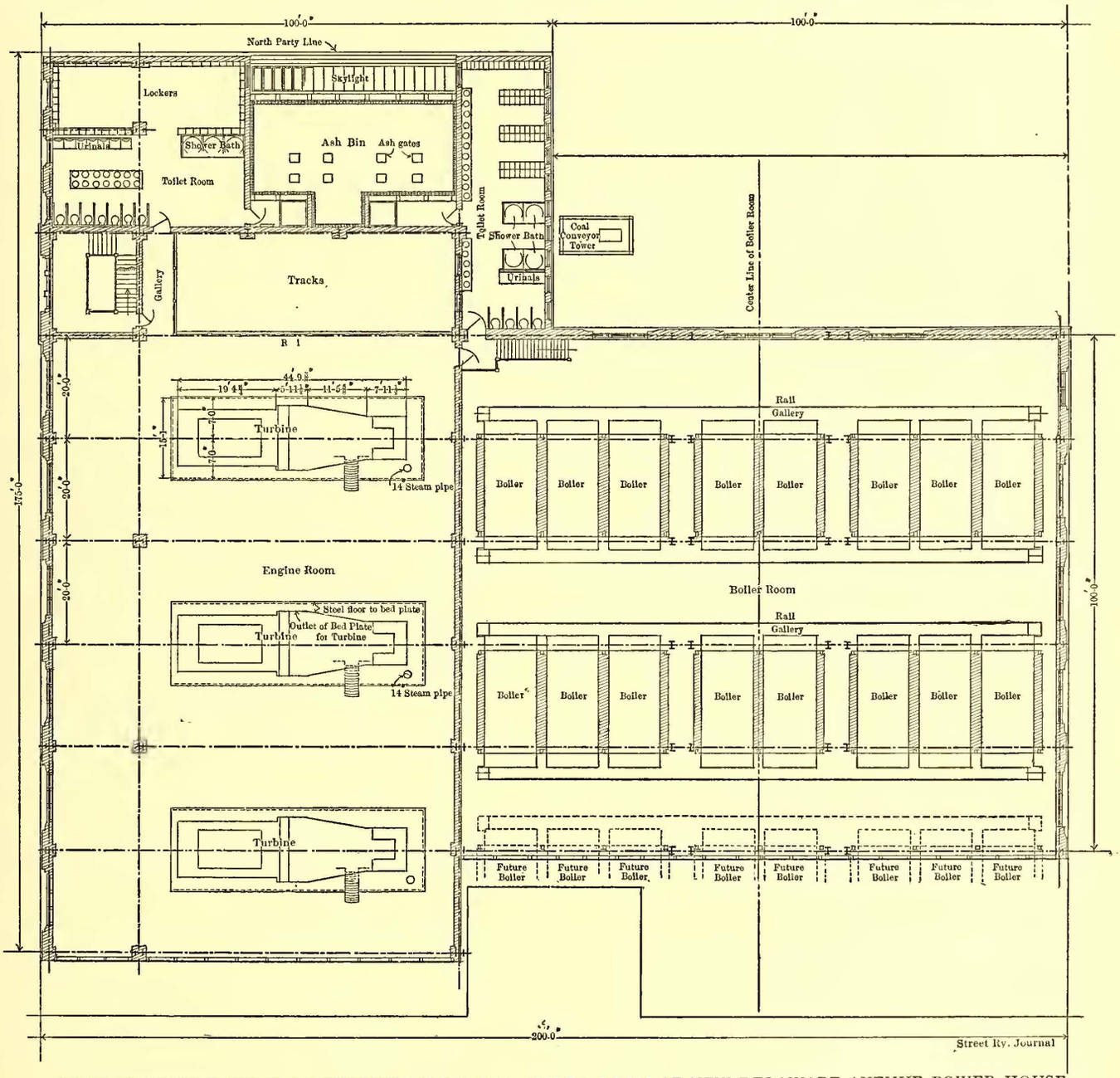
jections to footings of this character can be readily understood. This led to the adoption of Raymond concrete piles, which, being spaced 30 ins. center to center and sustaining a load per pile of 30 tons, made the areas of the footings about two-thirds the size necessary for wood piles, thus making it possible to construct the conduits between the footings, excavating below the basement floor only to the depth necessary for the concrete pile capping and the column bases. For these piles a tapering sheet-steel casing, in which is a collapsible core, is driven through the mud to hard sand; the core is then withdrawn and the shell filled with concrete.

The water conduits are square in section, the walls being of reinforced concrete. The superstructure is supported on a skeleton steel construction, the columns having combination steel I-beam grillage and reinforced concrete footings, each column supported on an independent group of piles. The walls are of red brick with terra cotta cornice. The window frames are of metal glazed with wire glass.

The main floor and the gallery floors in the engine room are of reinforced concrete slabs, between the steel beams, in which are embedded the pipes for the cables.

The entire boiler room floor, with the cinder chambers and gallery below and the piers and girders supporting the boiler columns and walls, are entirely of reinforced concrete, as are the coal bunkers and stacks. Concrete for the bunkers was considered cheaper than any other construction, because of its requiring practically no expenditure for maintenance or repairs.

To economize space, the stacks were located over the boilers and supported on the structural steel work at a point 50 ft. above the boiler room floor, finishing 175 ft. above this point, the diameter being 14 ft. inside. Reinforced concrete stacks were adopted because of economy in construction and maintenance and lightness, each stack weighing about 500 tons. They are supported on double-plate girders, between which are placed the anchor-rods, the space between the girders and in the angles forming the circular base being filled with concrete.



PLAN OF FIRST SECTION OF TURBINE ROOM AND BOILER ROOM AT NEW DELAWARE AVENUE POWER HOUSE

The roofs are of cinder concrete slabs, reinforced with steel, supported on steel trusses, the top being finished with tar and gravel roofing. The ventilating skylights over the engine and boiler rooms are of copper glazed with wire glass

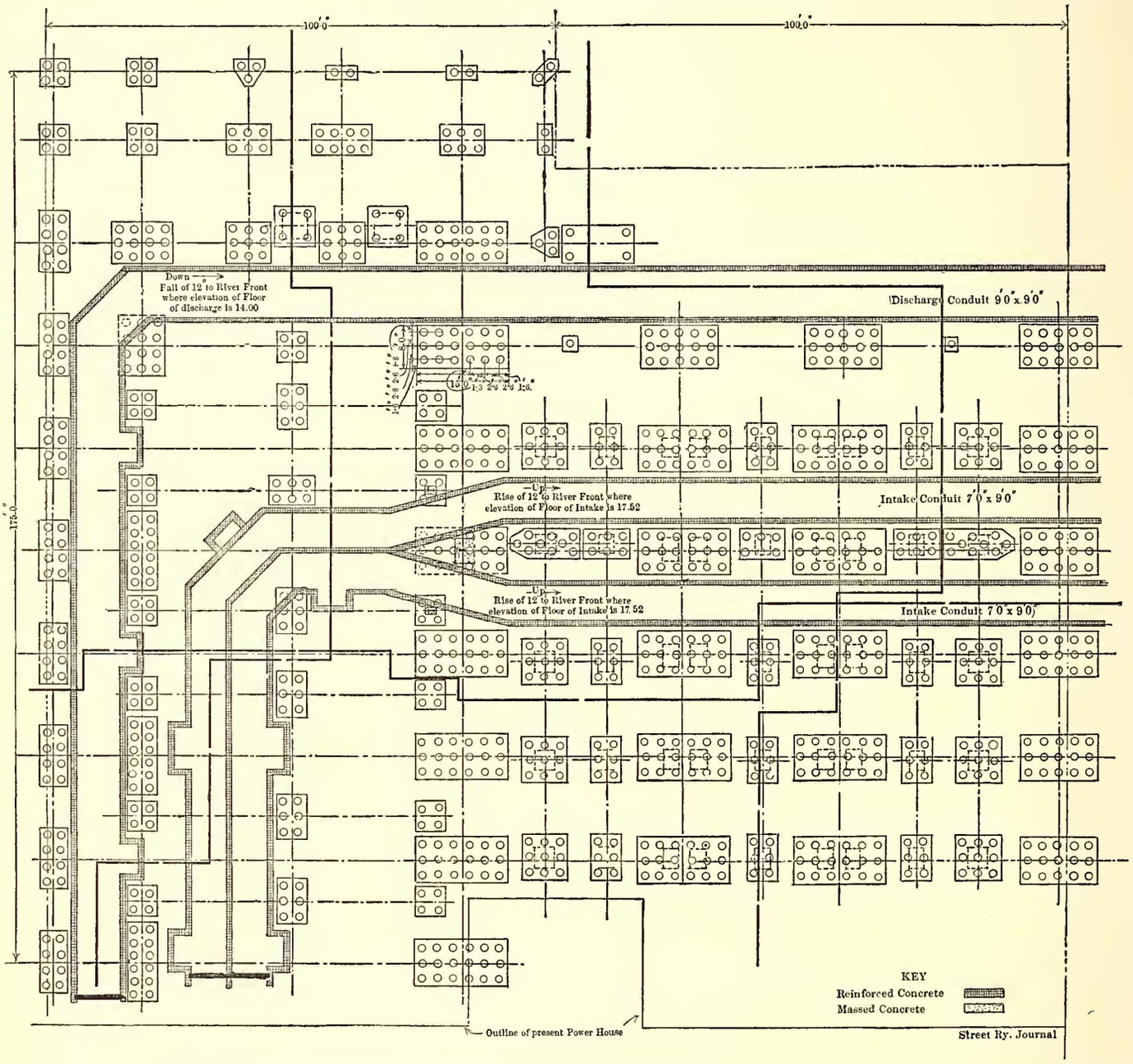
EQUIPMENT OF NEW DELAWARE AVENUE STATION

Each line of boilers contains eight Parker boilers, with a normal rating of 800 hp each, equipped with superheaters. Automatic stokers will probably be installed. No mechanical draft or economizers are contemplated.

The three units to be installed in the first section will be Westinghouse-Parsons turbines, each of 6000-kw capacity; the remaining five units will probably be 7500 kw each. Beyond this, the character of the equipment at this writing has not as yet been definitely decided.

The compactness of the entire arrangement can be seen from the following data:

Boiler room, 51,200 hp, 39,440 sq. ft., or .77 sq. ft. per hp.



PLAN OF FOUNDATIONS AND CONDENSER CONDUITS FOR FIRST SECTION OF NEW DELAWARE AVENUE POWER HOUSE

Engine room, 55,500 kw, 28,080 sq. ft., or .5 sq. ft. per kw.

Or, taking the combined areas of the boiler and engine rooms, the result shows 1.22 sq. ft. area per kilowatt for the entire station, exclusive of offices and storerooms.

HANDLING COAL

Considerable interest attaches to the methods of handling coal and ashes at the various power houses. At the Second Street and Wyoming Avenue plant, the railroad over which is received the coal for the station passes parallel to the boiler room a short distance to the east, and is about 21 ft. above the level of the basement floor. The siding begins at a point about 400 ft. north and extends into the building above the boiler-room floor. Over the firing space, about 22 ft. wide, in front of the boilers and extending the entire length of the building, is a Berquist suspension bunker with a capacity of 8 tons per lineal foot. At the north end of this bunker and under the siding tracks is a reinforced concrete bin with cast-iron pipes leading from it to a pit below the boiler-room floor, in which is the boot of a bucket elevator which carries the coal up to a conveyor over the bunker. A train of cars can be shifted into the station, and as the cars are emptied into the bin, can be shifted out on the siding to the north. The coal passes from the bin to the elevator, thence to the bunker by means of the conveyor. Pipes lead from the bottom of the bunker to the stokers.

The coal-elevating and conveying apparatus is of the Link Belt Engineering Company's type. The total elevation of coal is about 90 ft.

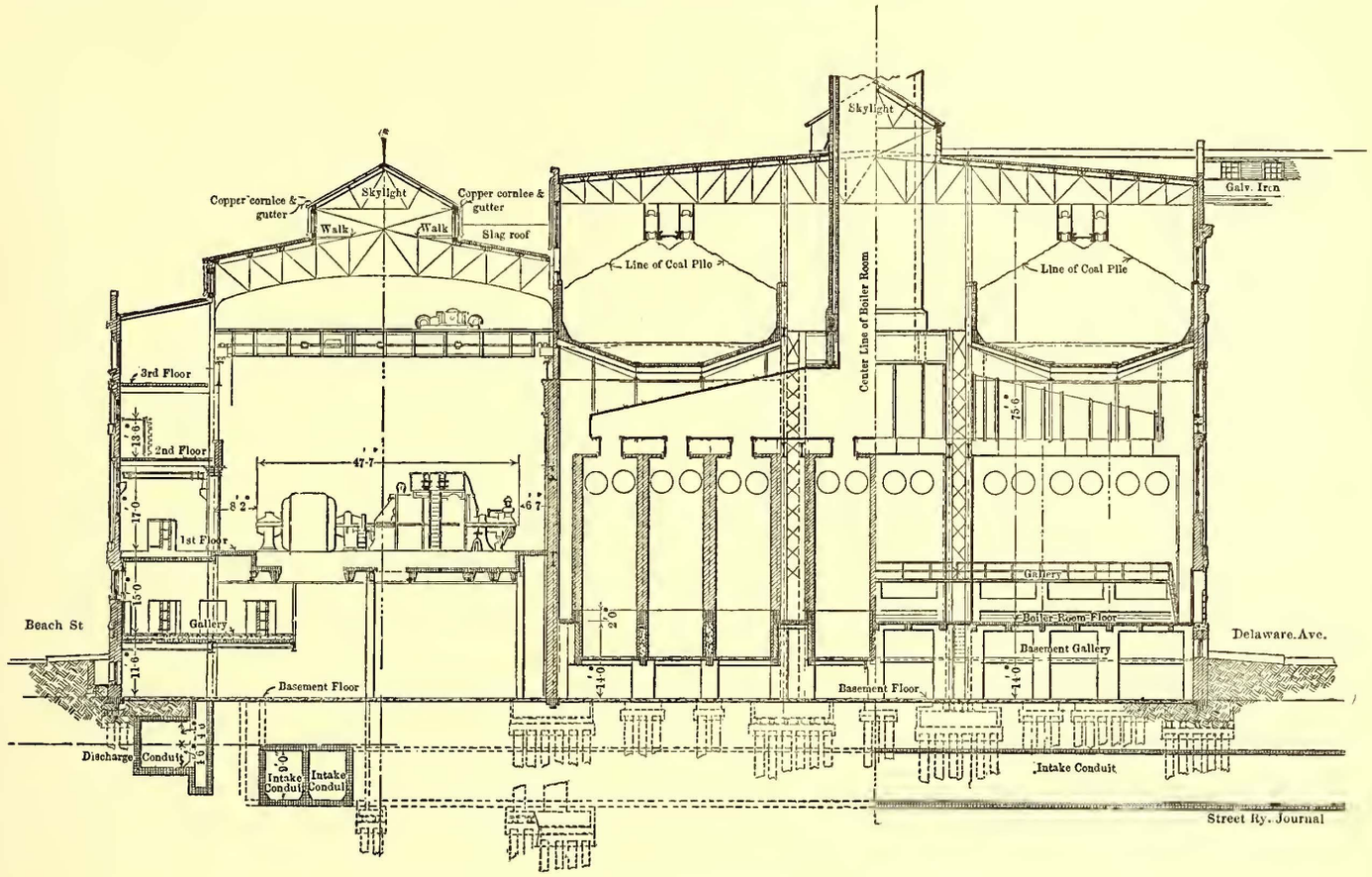
The Berquist bunker is built as part of the structure, and serves not only its purpose of economically storing the coal, but also of bracing the building. The capacity of the bunker is 1800 tons.

The boilers, located on one side only of the house, are spaced 28 ft. center to center. Between these the center row of columns are spaced from which the bunker is suspended; on the wall side the columns are only 14 ft. apart for special reasons, due to the wall and foundation. However, the bunker girders are 28 ft., and the intermediate columns are relieved of the bunker load by

an ingenious connection, plainly seen in the photographic engraving on Plate XXV.

As the boilers are hand-fired, the coal is drawn off from the bunker on the floor as required. The delivery pipes for the coal are fastened to the lower part of the bunker by a special Berquist valve, so constructed that when the boiler tubes have to be cleaned the valve can be readily closed, retaining the coal in the bin, and the pipes can be taken out, affording ready access to the boiler tubes. The delivery pipes are stopped just far enough above the floor to have a constant supply of coal on hand ready for use without littering the floor with unsightly heaps of coal.

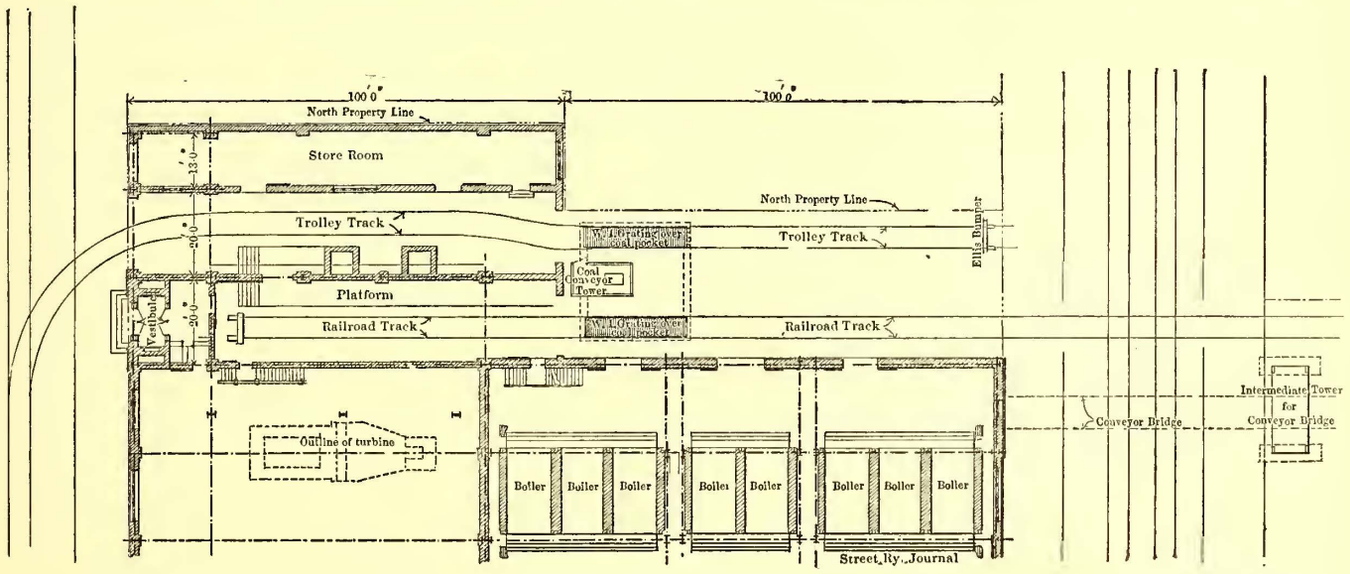
The coal-storing and handling scheme at the Second Street and Wyoming Avenue power house is almost identical to those used by the Philadelphia Rapid Transit Company in its power houses at Thirteenth and Mt. Vernon Streets, and Thirty-Third and Market Streets. The steel work for the coal-handling scheme of the three houses was designed by A. Samuel Berquist, C. E., Brooklyn, N. Y., patentee of the Berquist bunker, and was erected by the American Bridge Company.



CROSS SECTION OF NEW DELAWARE AVENUE POWER HOUSE

Below the whole line of boilers and passing through the base of the stack is a tunnel for the operation of the cinder cars. At the south end of the tunnel the cinders are discharged into a bucket elevator, by means of which they are taken up and dumped into the cinder bin. This is built over the trolley track to enable a car to be run under it and be loaded with the contents of the bin.

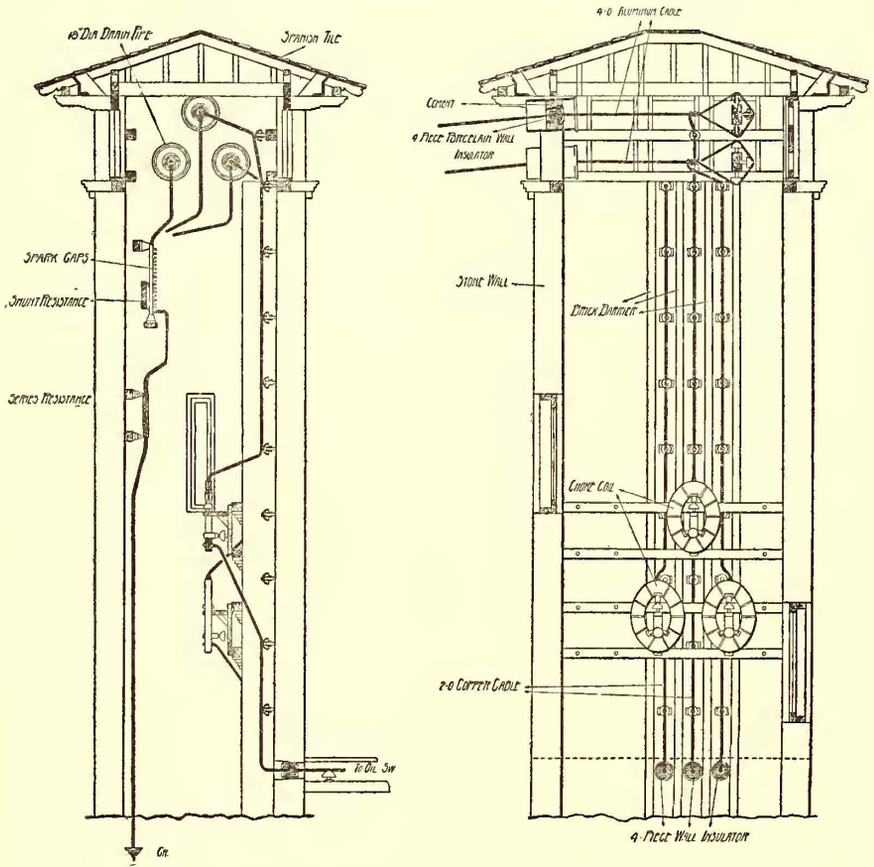
At the new Delaware Avenue power house the company has a wharf which is used entirely for receiving and handling the coal, which will come by rail. For this purpose three tracks lead from



PARTIAL PLAN OF NEW DELAWARE AVENUE STATION, SHOWING LOCATION OF COAL-HANDLING ARRANGEMENTS IN RELATION TO BOILER AND TURBINE ROOMS

the Belt Line tracks in Delaware Avenue and extend the entire length of the wharf. Midway between Delaware Avenue and the end of the wharf, for convenience in unloading and shifting the cars, is located the elevator tower, in which two elevators convey the coal to the conveyor bridge over Delaware Avenue to cross conveyors, one over the center of each bunker. In addition to this, two other elevator towers will be erected, one north and one south of the boiler room and adjoining the tracks, it being the idea to bring coal to these points in the company's own cars from a reserve supply should the supply by rail be at any time cut off. From these two elevators the coal is conveyed to the bunkers by separate conveyors, one over each bunker.

North of the station, at Second Street and Wyoming Avenue, a double trestle is being erected for the storage of about 65,000 tons of coal. The tracks are 30 ft. apart. For supplying coal from this point to other stations, two trolley tracks at grade, or about 25 ft. below the trestle tracks, are being installed. Coal



DETAILS OF HIGH-TENSION WIRING IN TERMINAL TOWER AT GLENSIDE SUB-STATION

will be loaded on cars on these tracks from the trestle by a small locomotive crane with a clam-shell bucket. The piers supporting the trestle rest on "Simplex" concrete piles driven to rock.

HANDLING CINDERS

For convenience and economy in handling the cinders at the various power stations, four of the plants have already been equipped with reinforced concrete cinder bins.

The cinders are discharged from below the boilers into cars, each having a capacity of about 1 cu. yd., which empty their contents into a bucket elevator, the bucket having the same capacity as a car. The elevators, driven by motors, convey the cinders to an overhead bin, elevated enough to allow the large car used for hauling coal and cinders to pass beneath it. The cinders are discharged from the bin into this car through cast-iron hoppers and are taken to some point for use in concrete work or in grading.

The construction of these bins is entirely of concrete, reinforced with steel rods, the concrete withstanding the action of the cinders better than any other material. The walls are 5 ins. or 6 ins. thick, braced on the outside by vertical and horizontal beams, the bottom in some cases being inclined to facilitate the movement of the cinders toward the hoppers.

In the case of the bin at the Beach and Green Streets power station, the boilers are on the second floor, and the cinders are taken by cars to the bridge extending across the upper part of the bin, below the monitor, and discharged. In this case, of course, elevators are not necessary.

The capacity of the bins already constructed and in contemplation at the different power houses is as follows: Thirty-Second and Dauphin Streets, 80 cu. yds.; Thirteenth and Mt. Vernon Streets, 500 cu. yds.; Beach and Green Streets, 160 cu. yds.; Second Street and Wyoming Avenue, 150 cu. yds.; Delaware Avenue (contemplated), 500 cu. yds.

The cost of the bin at Second Street and Wyoming Avenue amounted to about $17 per cubic yard, and the bin at Beach and Green Streets $12.50 per cubic yard of capacity. In the former figure the elevators and motors are not included, and in the latter the bin was erected on old steel work, the cost of which is not included.

COOLING CONDENSING WATER

An ingenious method of securing cold water for condensing purposes is employed at several of the power stations where there is not a sufficient water supply to insure cool condensing water at times of heavy load, and where the conditions hardly warrant the installation of cooling towers.

At a small station located at Ogontz, the condensing water is taken from Tacony Creek. The flow of water in this creek is so low during the summer months that it becomes necessary to use some method of cooling the water. This is done by pumping the water through a series of ten spray nozzles placed at intervals of about 15 ft. along the banks of the creek. The water is pumped through these nozzles under a pressure of 15 lbs. to 30 lbs., and returns directly to the creek. The result is rather pretty fountain effect, giving a cooling of about 30 degs. to 35 degs.

At Thirty-Second and Dauphin Streets, the same type of nozzles is used, but the water is sprayed into a cement tank built in between two car houses. The cooling in this case, owing to the confined space, is not so great as at Ogontz, but it is amply sufficient for the purpose. This station was originally non-condensing, but is now equipped with jet condensers in connection with the cooling device described.

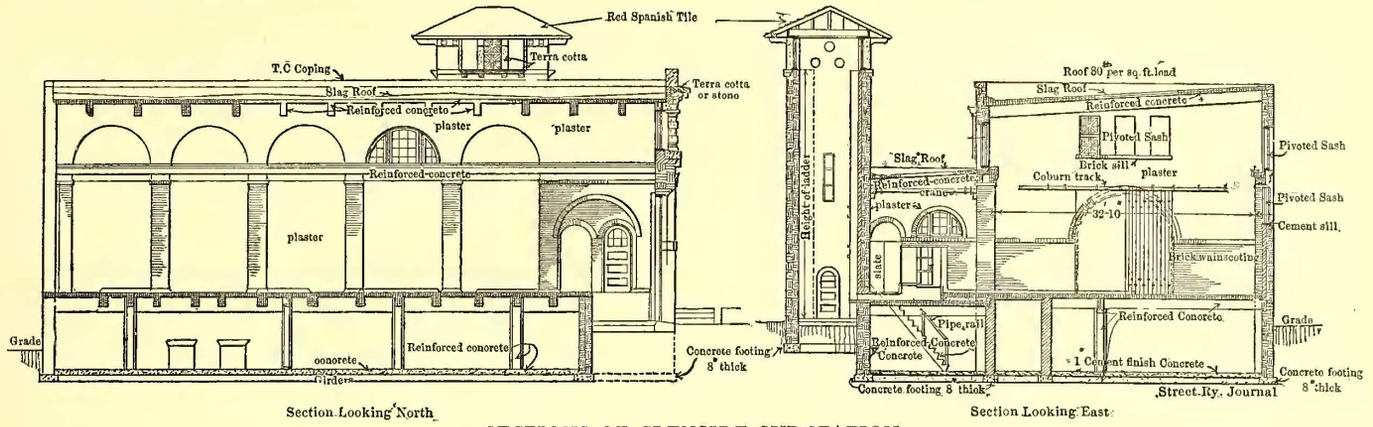
SUB-STATIONS

At the present time six sub-stations have been completed. The location and capacities of these are indicated in Table XVII. on page 510. Two other sub-stations are in course of erection, as follows: One at Eighth and Sansom Streets with four 1500-kw rotaries and an ultimate capacity of eight 1500-kw rotaries, and one at Fifty-Eighth Street and Woodland Avenue with two 1000-kw rotaries and an ultimate capacity of six 1000-kw rotaries. Two other sub-stations will be erected within a year, one on Market Street west of Fifty-Fifth Street, and one on Cumberland Street near Kensington Avenue.

The design of two of these stations was, to a certain extent, fixed by the character of the buildings to which they were added as extensions. Two others were modifications of existing buildings. Those at Glenside, Fifty-Second Street and Lancaster Avenue, and the one in course of erection at Fifty-Eighth Street and Woodland Avenue, are very similar in design, and may be considered typical for their size.

The Glenside station differs from the other two in the cable tower, necessary because of the overhead cables north to Willow Grove. The details of this tower are made clear in the accompanying drawing, page 522.

The completed station at Fifty-Second Street and Lancaster with a hand hoist. The main building, containing the transformers, converters and switchboard, is 30 ft. wide and 20 ft. high, with a 15-ton three-motor traveling crane. In the basement for cooling the transformers is a brick air chamber, through which air is forced by two Sturtevant blowers.

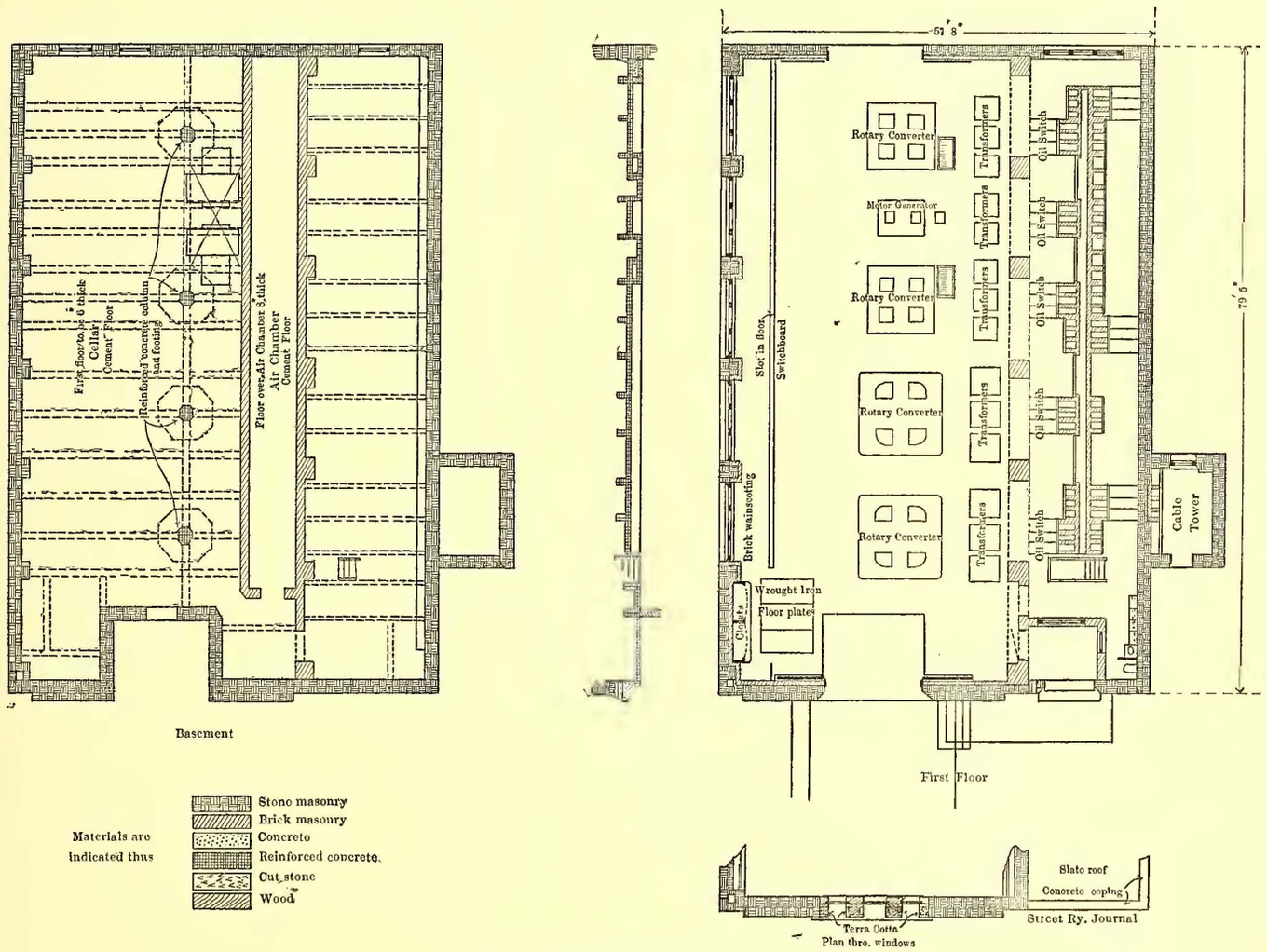


SECTIONS OF GLENSIDE SUB-STATION

Avenue will include six 1000-kw rotary converters, of which three have been installed. These are placed in a line with a motor generator in the center. In a parallel line on the south side is the d. c. switchboard; on the north side are the transformers, and

CONSTRUCTION

The building is entirely fireproof, the outside walls being of brick and terra cotta, the roof and floors of reinforced concrete, and the window frames of metal, glazed with wire glass. The



PLANS OF GLENSIDE SUB-STATION

back of these are the oil-switch and bus-bar compartments, all being on the same floor. The oil-switch and bus-bar compartments are located in a space 9 ft. 7½ ins. wide, with a comparatively low roof, separated from the main body of the building by a series of piers and arches supporting the crane runway and the wall above. Over these compartments is a 1-ton traveling crane

especially interesting feature about the construction is the use of reinforced concrete in the floors and roof. The floor under the transformers is a slab, 8 ins. thick, supported on the walls of the air chamber below. The unusual thickness is necessary because of openings under the transformers, which take up the greater part of the area.

The balance of the floor of the main building is supported by reinforced concrete columns, one under the center of each converter, spaced 15 ft. center to center, 16 ins. square, reinforced with four 1-in. diameter steel rods, with ties spaced 12 ins. center to center, the column resting on a reinforced concrete footing.

Each column was designed to carry the weight of the converter, with certain percentage added for vibration, amounting in all, in the case of the 1000-kw machines, to 127,000 lbs., the weight of the floor being taken as a total load of 350 lbs. per square foot. Each column supports transverse and longitudinal beams intersecting over the center of the column, the transverse beams spanning to the wall at each side and the longitudinal beams spanning from column to column and carrying the floor beams, spaced about 5 ft center to center. This plan brings the heavy load directly on the concrete column, and is a radical modification of the usual practice of supporting machine loads by solid concrete or masonry foundations. The economy of the construction in space and cost can be readily seen and the design has given perfect satisfaction. The floor slabs are 6 ins. thick, and embedded in the concrete are the pipes carrying the cables from the converters to the switchboard. During construction, these pipes are laid on the wood centering for the concrete; the reinforcing rods are then placed in position below them and the concrete is then deposited and tamped into position.

In connection with the oil-switch and bus-bar compartments, it being necessary to construct below the floor duct ways or passages for the cables leading from these compartments and to the transformers, an independent floor, with a 6-in. slab, with beams spaced 4 ft. 4 ins. center to center, all of reinforced concrete, was first constructed, finishing 14 ins. below the main floor level. These duct ways were then formed with 4-in. walls of brick and covered with slate, finishing level with the main floor. The floor space not so occupied was then filled up with cinder concrete and finished with cement level with the slate. The roof over the space occupied by these compartments and over the main building is of concrete, with a 4-in. thick slab, supported on beams spaced 5 ft. 6 ins. center to center, having a span of 31 ft., all of concrete, the beams being reinforced with four rods each, 1 in. in diameter, to carry a live load of 30 lbs. per square foot and the dead load from the concrete.

The oil-switch and bus-bar compartments are constructed of a red pressed brick, with 4-in. walls, in which are built the rods which secure in place the channels at the top. This top and the shelves are of Alberene stone. In the first station erected, these compartments were constructed of concrete, but on account of the excessive cost of the centering and the finish after the centering was removed, this was abandoned and brick adopted.

The walls are wainscoted, with red brick matching the oil-switch compartments. Above this they are finished with plaster. The ceiling is simply whitewashed, no other finish being necessary on account of the smooth surface due to the rise of surfaced centering.

STORAGE BATTERIES

The storage-battery plants of the Philadelphia system have been fully described in past issues of the STREET RAILWAY JOURNAL. (See STREET RAILWAY JOURNAL for November, 1896, page 741; November, 1897, page 758; and April, 1901, page 421.) There are six of these plants, the capacities of each being given in Table XVII. on page 510. The batteries for the most part are located at points where the tie-lines to two or more power stations cross. They float on the line and act as cushions to relieve the generating stations of the effects of fluctuating peaks. The batteries are charged at semi-regular intervals or when they run low. The charging is usually done at night.

CAR HOUSES, REPAIR SHOPS AND ROLLING STOCK

There are ten storage houses and eighteen operating depots on the Philadelphia system. The houses for storage are plain, unpretentious structures for affording protection to cars which are not in service. They are located at any convenient point and have no special features of interest. The operating houses are located at the ends of the different routes, and in all cases contain a sufficient number of tracks for the storage of cars during the night at the end of the day's runs. Attached to the building in each instance is a building for the accommodation of the conductors and motormen, containing a room where the men make up their accounts of fares, transfers, etc., and rooms for the use of the superintendent and receiver, also lockers and toilet rooms. In most cases a small shop is also included in which minor repairs are made, such as would not make it necessary to send the car to the repair shops.

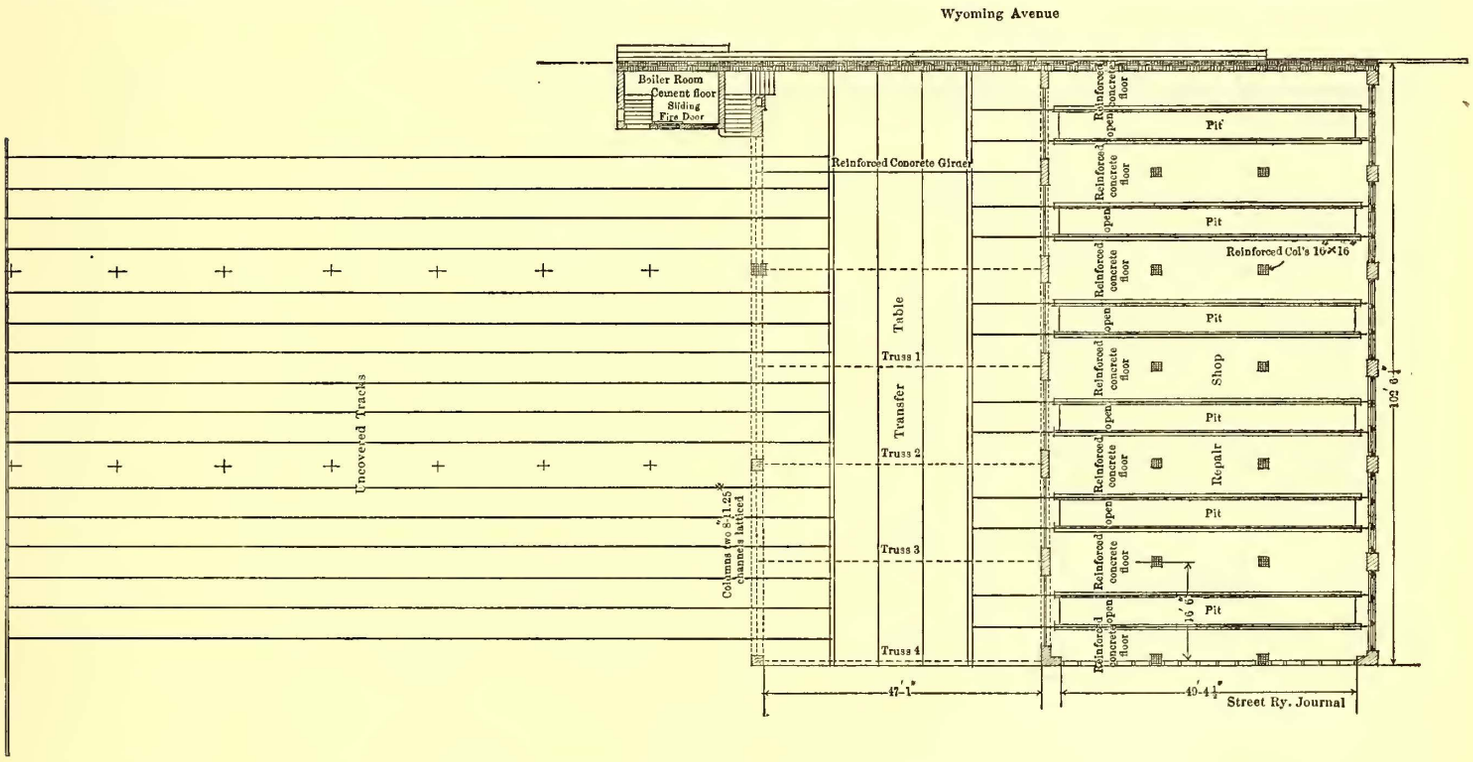
The house at Wyoming Avenue is the latest one erected, and the shop layout is the result of the experience in the other houses. The house contains nine tracks, with the entrance at the west end from Third Street. As this is the operating end of the lines using Cumberland Street. Both of these are old buildings, and the buildings, as well as many of the shop methods and devices, have been described in detail in the columns of the STREET RAILWAY JOURNAL.

Of considerable interest to those interested in general shop design is the addition recently built to the Kensington Avenue plant, for a complete description of which see STREET RAILWAY JOURNAL for Sept. 3, 1904, page 310. This addition, which is a two-story building, is built entirely of reinforced concrete construction, and is 90 ft. x 389 ft.

ROLLING STOCK

It will be seen from Table XX. on the following page, showing number and types of cars in use in Philadelphia, that the company has a wide assortment of rolling stock, this being the result of taking over so many independent companies, each of which had its own ideas as to the best type of car.

Since the last consolidation the company has adopted one standard car that will be used for both winter and summer service in



PLAN OF NEW OPERATING DEPOT AT WYOMING AVENUE

the house, there is an office for the use of the superintendent and the depot clerks. This office is on the second floor. On the first or house floor level there is a shop with six tracks, each track long enough for one car. Between the shop and the house tracks is a transfer table by which cars to be inspected or repaired may be transferred from the house tracks to the shop. This shop is intended for minor repairs only, such as can be completed in a short time without the use of machine tools. The entire second floor over the transfer table and shop is of reinforced concrete construction, the girders over the transfer table, carrying the second story walls, being about 50 ft. clear span.

REPAIR SHOPS

There are two large repair shops for doing the overhauling and repair work for the entire equipment. One of these is at Eighth and Dauphin Streets, and the other at Kensington Avenue and the future. This is a 38-ft. car, over all measurements, of the Brill semi-convertible type, mounted on Brill double trucks. The newer cars are all equipped with Christensen air brakes and have four motors. Various types of motors are in use, Westinghouse No. 3, GE 800 and GE 70 A motors predominating. The company has recently purchased 100 Curtis D-2 trucks.

Practically all of the closed cars are now fitted with electric heaters. The standard panel heaters of the Consolidated Car Heating Company are used in cars with panels, and that company's new design of cross-seat heaters with lead wires at one end in cross-seat cars.

The type of open car most frequently seen on the streets in Philadelphia is a ten-bench car, although there are a large number of single-truck open cars in service. The following is a complete statement of the rolling stock and equipment in use on June 30, 1905:

TABLE XX.—SHOWING ROLLING STOCK EQUIPMENT, PHILADELPHIA RAPID TRANSIT COMPANY

CLOSED.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
		Ft.			
35	St. Louis	20	Bemis	2—G. E. 800	Hand
278	"	20	Peckham	2—G. E. 800	"
3	"	20	Bemis	2—West. 3	"
27	Jackson & Sharp	20	"	2—G. E. 800	"
66	"	20	Peckham	2—G. E. 800	"
1	"	20	Bemis	2—West. 3	"
17	"	20	McGuire	2—G. E. 800	"
1	"	20	Peckham	2—West. 3	"
19	Pullman	20	"	2—G. E. 800	"
9	"	20	McGuire	2—G. E. 800	"
12	"	20	Bemis	2—G. E. 800	"
3	Brill	20	Peckham	2—G. E. 800	"
1	"	20	"	2—West. 3	"
2	"	20	Bemis	2—G. E. 800	"
14	"	20	"	2—West. 3	"
1	"	20	Brill	2—G. E. 800	"
1	"	20	McGuire	2—G. E. 800	"
164	"	28	Brill 27 G	4—West. 3	Christensen
117	"	28	" 27 G	4—G. E. 800	"
136	"	28	" 27 G	4—West. 12A	"
88	"	28	" 27 G	4—Lorain	"
81	"	28	" 27 G	4—G. E. 70A	"
1	"	28	Curtis	4—G. E. 800	"
5	"	28	"	4—West. 3	"
9	"	28	"	4—Lorain	"
1	"	28	"	2—Lorain	"
94	American	20	Bemis	2—G. E. 800	Hand
6	"	20	McGuire	2—G. E. 800	"
63	Laclede	24	Brill Max. Trac.	2—West. 56	Christensen
142	"	24	"	2—Lorain	"
2	"	24	"	2—West. 3	"
6	"	24	Curtis	2—West. 56	"
41	"	24	"	2—Lorain	"
3	"	24	"	2—West. 3	"
351	"	20	Bemis	2—West.	Hand
1	"	20	Peckham	2—West.	"
1	"	20	"	2—G. E. 800	"
114	"	20	Bemis	2—G. E. 800	"
1	Electric Traction Co.	20	McGuire	2—G. E. 800	"
1	"	20	Peckham	2—G. E. 800	"
25	Philadelphia Traction Co.	20	Bemis	2—West. 3	"
4	"	20	"	2—G. E. 800	"
1	"	20	Peckham	2—G. E. 800	"
2	"	24	Bemis D. T.	2—West. 3	"
3	"	24	Brill Max. Trac.	2—Lorain	Christensen
26	Union Traction Co.	20	Peckham	2—G. E. 800	Hand
1,974					

OPEN.

4	Brill	30	Bemis	2—G. E. 800	Hand
1	"	30	Brill	2—G. E. 800	"
40	"	30	Peckham	2—G. E. 800	"
150	"	34	Brill Max. Trac.	2—West. 56	Christensen
10	"	34	"	2—Lorain	"
111	American	30	McGuire	2—G. E. 800	Hand
107	"	30	Peckham	2—G. E. 800	"
13	"	30	Bemis	2—G. E. 800	"
443	St. Louis	30	Peckham	2—G. E. 800	"
5	"	30	"	2—West. 3	"
40	Lamokin	30	"	2—G. E. 800	"
209	Laclede	30	"	2—G. E. 800	"
89	"	30	Bemis	2—G. E. 800	"
2	"	30	"	2—West. 3	"
10	Barney & Smith	30	Peckham	2—G. E. 800	"
1	Jackson & Sharp	30	"	2—G. E. 800	"
1,235					

MISCELLANEOUS EQUIPMENT.

3	Lamokin	16	McGuire	G. E. 800	Hand
2	Union Traction Co.	16	Peckham	G. E. 800	"
1	People's Traction Co.	16	"	G. E. 800	"
3	"	16	Brill	G. E. 800	"
1	St. Louis	16	"	G. E. 800	"
1	Electric Traction Co.	16	McGuire	G. E. 800	"
7	Philadelphia Traction Co.	16	Bemis	West. 3	"
18					

MONEY CARS.

1	Union Traction Co.	16	McGuire	G. E. 800	Hand
1	"	16	Peckham	G. E. 800	"
2					

PARLOR CARS.

1	Laclede	20	Peckham	West. 3	Hand
1	St. Louis	20	St. Louis	G. E. 800	"
2					

TESTING CARS.

1	Philadelphia Traction Co.	20	Bemis	West. 3	Hand
1	Jackson & Sharp	16	Peckham	G. E. 800	"
2					

MAIL CARS.

No.	Maker.	Length.	Trucks.	Motors.	Brakes.
		Ft.			
4	Union Traction Co.	16	Peckham	G. E. 800	Hand
10	"	16	McGuire	G. E. 800	"
14					

TOWER CARS.

1	Union Traction Co.	20	Peckham	G. E. 800	Hand
1	"	20	McGuire	G. E. 800	"
2					

FREIGHT CARS.

4	Middletown Car Works	40	Peckham	4—Lorain	Christensen
6	"	34	"	4—Lorain	"
1	Union Traction Co.	28	"	4—Lorain	Hand
19	"	28	"	G. E. 800	"
1	"	28	"	G. E. 1200	"
1	"	28	McGuire	No motors	"
3	"	28	Robinson	No motors	"
1	"	28	McGuire	No motors	"
2	Allison Car Works	35	Allison	No motors	"
2	Brill	28	McGuire	G. E. 800	"
1	"	28	"	West. 3	"
1	Philadelphia R. T. Co.	28	Peckham	Lorain	"
1	"	28	"	G. E. 800	"
2	Electric Traction Co.	28	"	G. E.	"
1	"	28	Bemis	G. E.	"
4	"	28	McGuire	G. E.	"
2	People's Traction Co.	28	Peckham	G. E.	"
6	Philadelphia Traction Co.	28	Bemis	West. 3	"
1	"	28	McGuire	West. 3	"
1	"	28	Bemis	G. E. 800	"
60					

SPRINKLERS.

11	Kensington Engine Works	28	Peckham	G. E. 800	Hand
4	"	28	"	Lorain	"
1	Philadelphia Traction Co.	20	Phila. Trac. Co.	West. 3	"
16					

PLOWS.

24	Philadelphia Traction Co.	..	Phila. Trac. Co.	West. 3	Hand
23	Union Traction Co.	..	Union Trac. Co.	West. 3	"
2	"	..	"	West. 56	"
30	Brill	..	Brill	West. 56	"
20	"	..	"	Lorain	"
2	Peckham (Rotary)	..	Peckham	2—G. E. 800	"
				2—G.E. 1200	"
101					

SWEEPERS.

17	Lewis & Fowler	..	Lewis & Fowler	G. E. 800	Hand
5	Brill	..	Brill	G. E. 800	"
57	Union Traction Co.	..	Union Trac. Co.	West. 3	"
79					

SAND CARS.

10	Union Traction Co.	16	Bemis	G. E. 800	Hand
40	"	16	Brill	G. E. 800	"
4	"	16	McGuire	G. E. 800	"
1	Philadelphia R. T. Co.	16	"	West. 3	"
4	Philadelphia Traction Co.	16	Bemis	West. 3	"
59					

RAIL CAR.

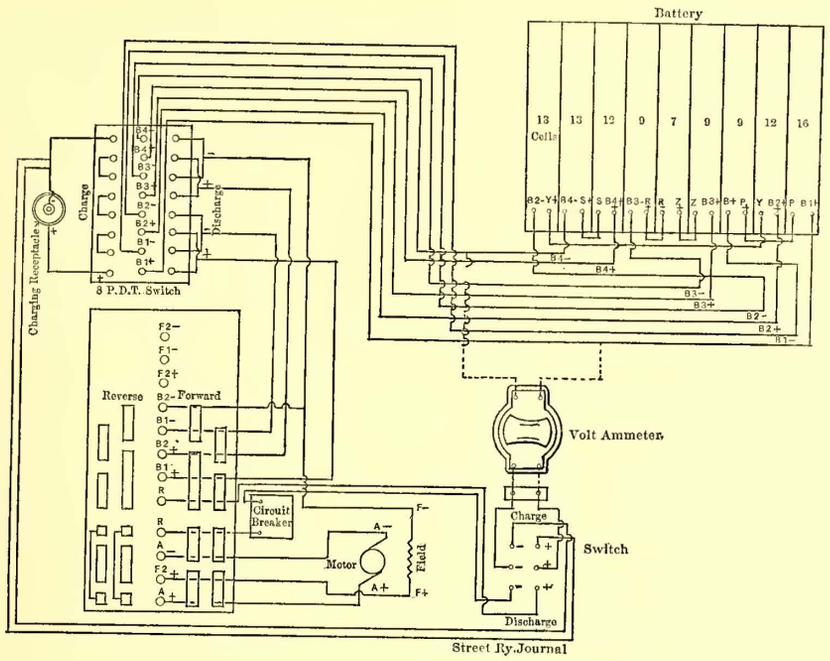
1	Philadelphia R. T. Co.	75	Brill	4—Lorain	Christensen
1					

SUMMARY.

Closed cars	1,974	Tower cars	2
Open cars	1,235	Freight cars	60
Miscellaneous equipment	18	Sprinklers	16
Money cars	2	Ploughs	101
Parlor cars	2	Sweepers	79
Testing cars	2	Sand cars	59
Mail cars	14	Rail cars	1
		Total	3,565

SHIFTING TRUCKS

For shifting trucks around the shops a novel storage-battery locomotive is used. There are two of these in service at the Kensington shops. The locomotives were built by the Baldwin Locomotive Works. Each is equipped with one Westinghouse 10-hp 220-volt motor, No. 61. This motor is mounted on one axle, and the two axles are connected together by roller-bearing chain supplied by the Link Belt Engineering Company. The wheels are 24 ins. in diameter, and the total height of the locomotive complete is 32 ins. It has 100 cells of Electric Storage Battery Company's type MV-7 chloride accumulators arranged in four banks of 25 each, so placed as to be used in series-multiple during discharge, but all to be connected in series during charge. The controller is the Westinghouse No. 145 type, altered to suit the requirements, so that it has five points, the middle point being the off position. The first point either side of the off position connects four banks of 25 cells in multiple. The second point either side of the central connects two banks of 25 cells in series and two in multiple. One side of the central off position is forward and the other side is reverse. The total weight of the complete locomotive is about 7500 lbs.



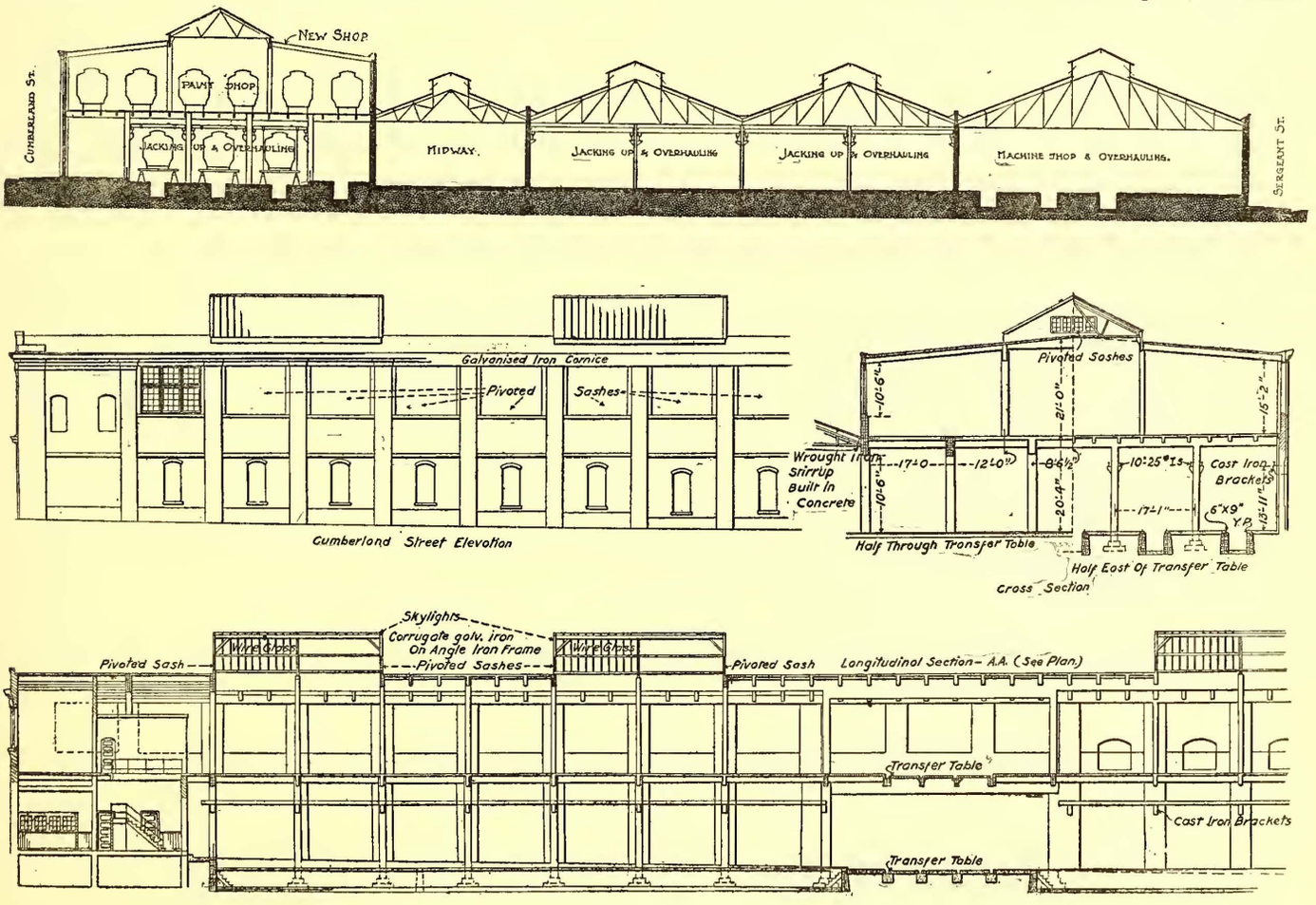
WIRING DIAGRAM FOR STORAGE-BATTERY LOCOMOTIVES USED FOR SHIFTING TRUCKS IN SHOPS

CAR SIGNS

The Philadelphia signs for designating routes on cars are illustrated on Plate XXXIX. The sign mounted on the hood, as shown, has two designations, one of which is obscured, depending upon the direction of travel, by a swinging flap that can be turned upward or downward, as the case requires. The side sign is a four-face block, any one face of which can be made to show outward by turning a small hand wheel inside of the car.

TEST CAR

The company keeps in service the year round a car especially equipped for testing the electric equipment on all rolling stock. The car contains one Herrick testing set; a voltmeter with graduations reading from 1 to 600 for making drop-volt tests; an ammeter reading from 1 to 750 for testing circuit breakers, and other instruments. During the out-of-season period, when one set of



SECTIONS THROUGH NEW CONCRETE ADDITION TO KENSINGTON AVENUE SHOPS

cars is in the storage houses, the test car is stationed at the storage depots and the attendant goes over each car one by one, testing out fields, armatures, cables, circuit breakers, air-brake compressors and other parts of the electrical equipment. If defects are discovered, notation is made on the proper blank form, and this blank is sent to the repair shop so that when the particular car is taken to the shop for overhauling, the master mechanic is informed as to just what repairs are necessary.

If a car comes in from service with any portion of the electrical equipment out of order, the test car is sent for and the exact trouble is at once located.

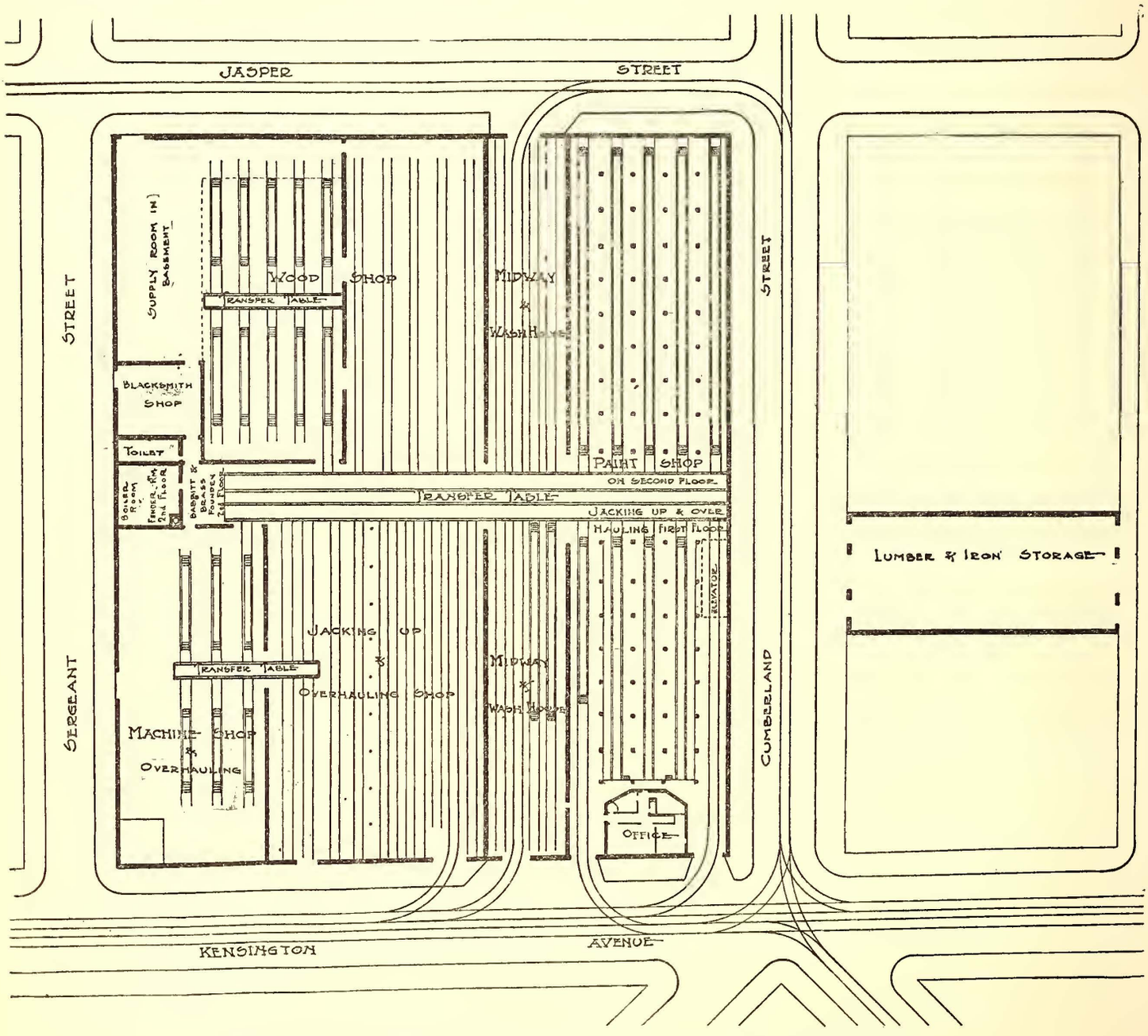
The car has flexible leads terminating in a small switchboard within the car, the other ends of these leads being used to connect up the equipment to be tested. In going over a car, the first step is to try out the circuit breakers. A helper connects one of the flexible leads to each side of the breaker, and the operator in the test car, by means of a small series controller, slowly cuts out resistance until the breaker actuates, when the ammeter will give the reading as to the load for which the breaker is set.

The cables of the car under test are next tried for leaks or poor insulation, this being done in the usual way by using the voltmeter.

Attention is then given to the resistance of rheostats, the measurements being taken by drop-volt test. In the same way fields, armatures and ground connections are gone over and the readings are noted. A car can be thoroughly tried out in this way in about 10 minutes. A very material reduction, not only in the number of crippled cars, but also in the cost of car maintenance, has been effected through the systematic testing accomplished by means of this car. The car is in charge of H. Branson.

MECHANICAL AND ELECTRICAL INSPECTION DEPARTMENT

The company has lately established a mechanical and electrical inspection department. It is the duty of the inspectors to carefully examine every car at the various depots once a week, with the end in view of discovering mechanical and electrical defects before they cause actual breakdowns. Each car is thoroughly gone over for low bearings, truck, wheel, brake and other mechanical troubles. This department also investigates the more frequent causes of troubles, and in its weekly reports to the general manager makes suggestions and recommendations as to ways of reducing the number of causes for which cars have to be taken from service. The institution of this careful inspection, whereby defects are discovered before they become serious, has resulted in greatly reducing the number of cars sent to the shop for repairs.

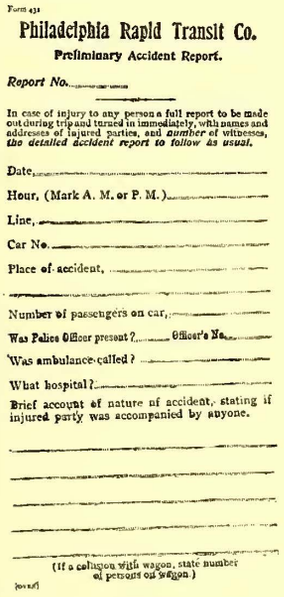


GROUND PLAN OF NEW CONCRETE ADDITION TO KENSINGTON AVENUE SHOPS

CLAIM AND OTHER DEPARTMENTS

In reviewing the work of the claim adjusting department of the Philadelphia Rapid Transit Company it will be in order first to outline the details of the machinery of the department by means of which the routine work is conducted, and then to describe the general policy of the company with respect to the handling of accidents and accident claims.

The claim department of the Philadelphia Rapid Transit Company is in charge of a general claim agent, who reports directly to the second vice-president and general manager. Those who report to the general claim agent are: the chief clerk, with an office force consisting of seven stenographers and eight filing



Philadelphia Rapid Transit Co.

Preliminary Accident Report.

Report No.

In case of injury to any person a full report to be made out during trip and turned in immediately, with names and addresses of injured parties, and number of witnesses, the detailed accident report to follow as usual.

Date,

Hour, (Mark A. M. or P. M.)

Line,

Car No.

Place of accident,

Number of passengers on car,

Was Police Officer present?, Officer's No.

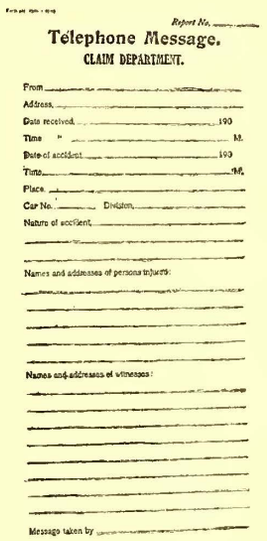
Was ambulance called?

What hospital?

Brief account of nature of accident, stating if injured party was accompanied by anyone.

(If a collision with wagon, state number of persons on wagon.)

FORM 431.—CONDUCTORS' PRELIMINARY ACCIDENT REPORT



Report No.

Telephone Message.

CLAIM DEPARTMENT.

From

Address,

Date received, 190

Time M.

Date of accident, 190

Time M.

Place,

Car No. Division,

Nature of accident,

Names and addresses of persons injured:

Names and addresses of witnesses:

Message taken by

FORM 327.—BLANK FOR TAKING DOWN TELEPHONE MESSAGE CONCERNING ACCIDENT

and record clerks; the chief detective and detective force, and an assistant general claim agent. Those who report through the assistant general claim agent are the chief adjuster, with a staff of nine adjusters; the chief inspector with a staff of ten inspectors, and the chief investigator with a staff of sixteen investigators. The distinction made by the company between adjusters, inspectors and investigators is as follows: The force of adjusters attends to the settling of cases before any claim is brought or before the claim is taken to court; the inspectors are engaged on those cases on which suit has been commenced; the investigators, as their name implies, investigate current work; that is, cases that have not yet been brought to court, and report on them to the chief investigator, who in turn reports on them to the chief adjuster.

As on other large street railway properties, effective work on the part of the claim department is dependent in very large measure upon the thoroughness of the reports concerning accidents furnished by the conductors and the promptness with which these reports reach the proper hands in the claim department for suitable action. In these days, when the policy of rendering of just compensation for injuries and damages unwittingly inflicted by public-service corporations is general, justice and fair dealing must run a swift race to keep ahead of the accident doctor and the ambulance-chasing lawyer.

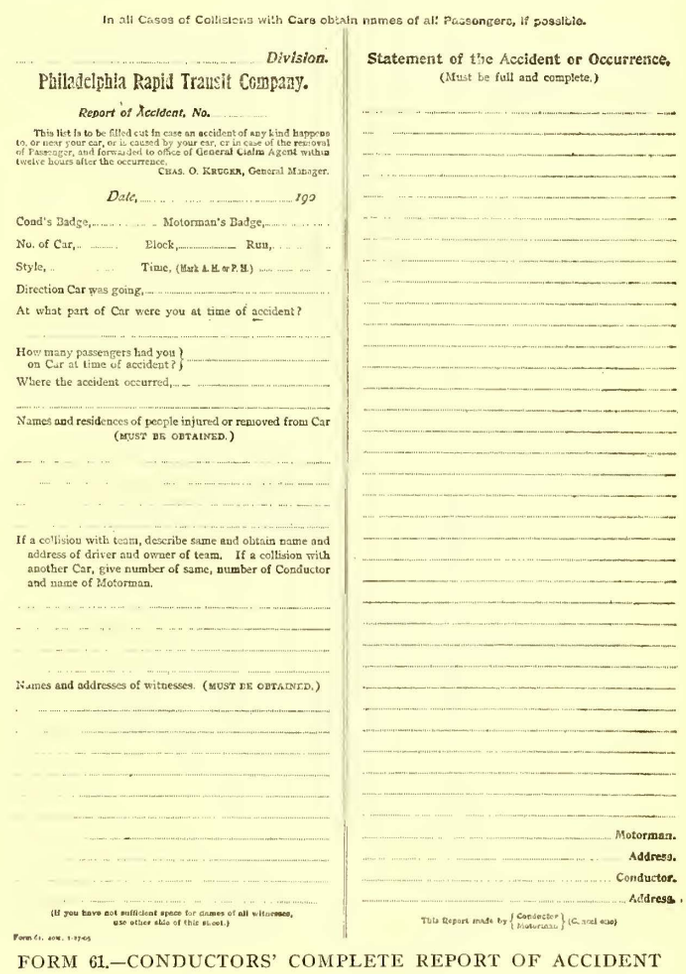
On the Philadelphia system emphasis is laid on the issue of instructions to employees in regard to accidents by covering this subject in the first and second rules in the book of rules and regulations for the guidance of conductors and motormen. The prevention of accidents is covered in Rule I., of which the following is an epitome: The safety of the public is the first consideration in the operation of a street railway, therefore the utmost care must be exercised at all times to prevent accidents. The motorman should always be on the alert to avoid danger, and his attention should never be diverted from his duties. He should keep his eye constantly on the track before him, to prevent accidents or injuries to persons who may not at the moment be able to get out of the way of the car. The conductor's first duty in the safe operation of the car is to allow ample time for passengers to get on or off the car before pulling the bell. If the passenger is old or feeble, time should be allowed for him to be seated, as a fall on the car can be of as much consequence as a fall off. In fine, the conductor should realize that he is the conductor of the car, and that implies that he is a safe and competent person to "conduct" the car, or otherwise he should not hold his position.

Rule II. of the instructions to employees covers so comprehensively the question as to what to do in case of accident as to warrant its reproduction in full here. It reads as follows:

ACCIDENTS—IN CASE OF

Every disturbance on, or occasioned by the cars, every collision or accident to individuals or to animals, vehicles, or other property—if such occurrence is caused by the cars, by their operation, or by the act or operation of any employee when engaged in duties for the company—must be reported.

In the matter of accidents to individuals, it must never be assumed that "no harm has been done," no matter what the individuals say themselves. The assumption must always be that "harm has been done," and the report must be as promptly and accurately filled, and the names of witnesses, etc., taken with as great care as if actual and visible injury had been inflicted. Much loss has been occasioned by the neglect of employees to properly report



In all Cases of Collisions with Cars obtain names of all Passengers, if possible.

Division.

Philadelphia Rapid Transit Company.

Report of Accident, No.

This list is to be filled out in case an accident of any kind happens to, or near your car, or is caused by your car, or in case of the removal of Passenger, and forwarded to office of General Claim Agent within twelve hours after the occurrence.

CHAS. O. KRUGER, General Manager.

Date, 190

Cond'r's Badge, Motorman's Badge,

No. of Car, Block, Run,

Style, Time, (Mark A. M. or P. M.)

Direction Car was going,

At what part of Car were you at time of accident?

How many passengers had you on Car at time of accident?

Where the accident occurred,

Names and residences of people injured or removed from Car (MUST BE OBTAINED.)

If a collision with team, describe same and obtain name and address of driver and owner of team. If a collision with another Car, give number of same, number of Conductor and name of Motorman.

Names and addresses of witnesses. (MUST BE OBTAINED.)

(If you have not sufficient space for names of all witnesses, use other side of this sheet.)

Statement of the Accident or Occurrence.

(Must be full and complete.)

Motorman.

Address.

Conductor.

Address.

This Report made by { Conductor / Motorman } (Or, next case)

FORM 61.—CONDUCTORS' COMPLETE REPORT OF ACCIDENT

cases of accidents which seemed trivial at the time of occurrence, but which developed into important and expensive cases. The invariable rule must be to report every accident to individuals with full and equal care.

1. Upon the occurrence of an accident, the first duty is to render assistance to the person or persons involved in it.

2. The next duty is to obtain the full and correct name and address of the person or persons injured, or the drivers or owners of animals, vehicles, or property injured or damaged.

3. The next duty is to obtain the full and correct names and names and addresses of all eye witnesses. If they refuse or seem unwilling to give their names, tell them it is the strict rule of the company, and that your failure to obtain names of witnesses will look as if you had not tried to obey the rules of the company.

4. The next duty is to make out the report. State clearly just what occurred as you saw it. State fully the nature of injury to persons or property, give your reasons why you could not prevent the accident, and state what you did to prevent it. State whether person injured was lame, deaf, intoxicated or of defective vision, and give his or her approximate age. If property was injured, describe condition of property. State any act done by the person injured, or whose property was injured, or any circumstances connected with such person which in the slightest degree contributed to the injury. State what, if anything, was said by the person injured immediately after the accident. State if the person injured was alone or with whom, and give such further information as you may deem important.

5. Under no consideration must the matter be discussed with,

Form 255. 10m. 5-05.

Philadelphia Rapid Transit Company,

CLAIM DEPARTMENT.

No. ..... Case of. .....

INDIVIDUALITY OF WITNESSES.

Name, ... Age, ... White. Black.

Male. Female. Nationality, ... Occupation, ...

Permanent. Transient. Bright. Dull. Willing. Unwilling.

Remarks, ...

Name, ... Age, ... White. Black.

Male. Female. Nationality, ... Occupation, ...

Permanent. Transient. Bright. Dull. Willing. Unwilling.

Remarks, ...

Name, ... Age, ... White. Black.

Male. Female. Nationality, ... Occupation, ...

Permanent. Transient. Bright. Dull, Willing. Unwilling.

Remarks, ...

Name, ... Age, ... White. Black.

Male. Female. Nationality, ... Occupation, ...

Permanent. Transient. Bright. Dull. Willing. Unwilling.

Remarks, ...

Respectfully submitted,

..... *Inspector.*

FORM 295.—BLANK FOR STATING CHARACTERISTICS OF WITNESSES

or any information given to, anyone outside the officers of the company. Representatives of the accident department that are entitled to the information you may have concerning an accident must show to you their card of authority, which must be endorsed by the general manager and claim agent.

In practice, the conductors make out a preliminary report of the occurrence at the time of the accident, using for this purpose Form 431, reproduced on preceding page. On the back of this form are blank spaces for filling in names and addresses of persons injured, and for the names and addresses of witnesses. This form is furnished to the conductors in pads of twenty-five, and each conductor is required to have in his pocket one of these pads when on

Form 296. 10,000. 5-05.

Philadelphia Rapid Transit Co.,

CLAIM BLANK.

Case of ..... No. .....

(Must be filled out and then Signed by the Claimant.)

Philadelphia, Pa., ... 190

Date of accident, (Give day of week, date of month and hour.) .....

Place of accident, (State exactly) .....

Nature of accident, (State in detail just what happened.) .....

Name and address of attending physician, ...

Nature of injuries, ...

Names and addresses of all witnesses, ...

Total amount of claim, ...

Witness: Signature, ...

Address, ...

FORM 296.—BLANK FOR TAKING SWORN STATEMENT OF CLAIMANT CONCERNING ACCIDENT

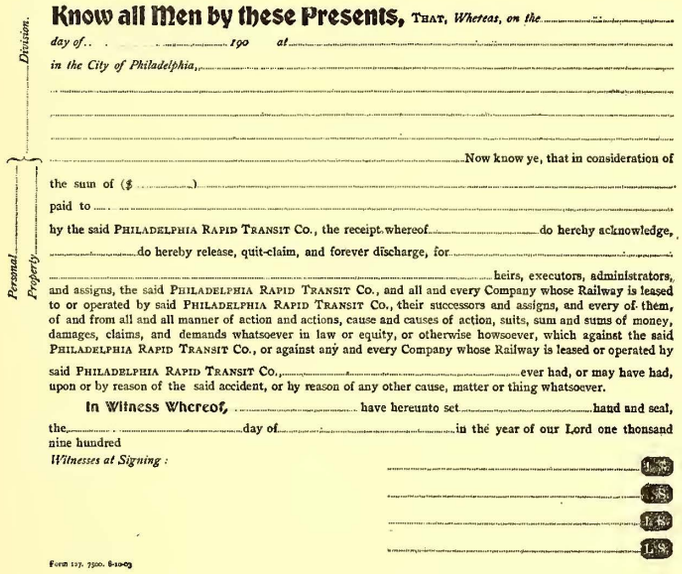
duty. This preliminary report is turned into the car depot at the first opportunity.

When the conductor is relieved from duty he is required to go immediately to the employees' room at his car house and write out a more comprehensive report, giving all of the details in regard to the occurrence, using for this purpose Form 61. The fuller reports are all forwarded to the claim department from all the depots at 2 o'clock each morning, but the depot superintendent or inspector in charge has instructions that as soon as the conductor's preliminary report is received, if the accident involves personal injury, this preliminary report must be repeated at once over the telephone to the chief adjuster or chief investigator, at the office of the claim department. This telephone message is taken down by a stenographer in the claim department from the telephone receiver, on Form 327. It is thus provided that the machinery of the claim department will be in motion within thirty minutes after the accident, on all cases involving personal injury.

Inspectors who may witness the accident, or who arrive on the scene soon after, have instructions to secure statements of witnesses on the spot, giving all the details of the occurrence. These statements are written by the inspector on blank forms prepared for the purpose, and the witnesses are requested to sign these statements. The inspector also makes a report of the accident in accordance with the facts he is able to gather.

When the detail accident reports previously referred to are received in the early morning hours at the claim department, they are immediately placed in the hands of an expert examiner, who

goes through the individual reports carefully and classifies them. Two copies of each report are then made. One copy goes to the office of the general superintendent for the information of the operating department, and one copy goes to the employees' record files. The originals are numbered consecutively (this number then becomes the reference and filing number of the case), and the papers are routed to the attaches of the claim department delegated to handle the particular class. It thus comes about that by 8 o'clock



Know all Men by these Presents, THAT, *Whereas, on the* ..... *day of* ..... *190* ..... *at* ..... *in the City of Philadelphia,* .....

Division.

Personal Property.

.....Now know ye, that in consideration of the sum of ($ .....) paid to ..... by the said PHILADELPHIA RAPID TRANSIT CO., the receipt whereof ..... do hereby acknowledge, ... do hereby release, quit-claim, and forever discharge, for ..... heirs, executors, administrators, and assigns, the said PHILADELPHIA RAPID TRANSIT CO., and all and every Company whose Railway is leased to or operated by said PHILADELPHIA RAPID TRANSIT CO., their successors and assigns, and every of them, of and from all and all manner of action and actions, cause and causes of action, suits, sum and sums of money, damages, claims, and demands whatsoever in law or equity, or otherwise howsoever, which against the said PHILADELPHIA RAPID TRANSIT CO., or against any and every Company whose Railway is leased or operated by said PHILADELPHIA RAPID TRANSIT CO., ... ever had, or may have had, upon or by reason of the said accident, or by reason of any other cause, matter or thing whatsoever.

In Witness Whereof, ... have hereunto set ..... hand and seal, the ..... day of ..... in the year of our Lord one thousand nine hundred

Witnesses at Signing:

..... L.S.

..... L.S.

..... L.S.

..... L.S.

Form 127. 7500. 8-1903

FORM 127.—RELEASE

every morning each adjuster and investigator finds upon his desk his assignment for the day's work, these assignments in the main consisting of the accidents that occurred the previous day.

In the handling of these accident reports the first step is for the adjuster or inspector, as the case may be, to see the person injured. The practice in Philadelphia is to tender the services of a doctor, and the company will furnish a reputable physician if the party desires it. If the injured person prefers his own doctor, the company asks the privilege of sending one of its doctors, in company with the injured person's physician, it being the duty of the company's doctor to find out the physical condition and give aid when requested, but these doctors do no settling or adjusting with respect to financial compensation. The doctors so employed by the company are all physicians in private practice. They are of high standing in their profession, and do not give all of their time to the company's business, but are called by telephone to treat individual cases when their services are needed.

The adjusters, when they start out in the morning, are supplied with a certain amount of cash, the amount depending upon the cases they are to handle during the day. The individual adjusters have authority to settle cases for cash and take releases by payments of from $1 to $500. They work under the general director of the chief adjuster, but they have instructions if special conditions arise to act on their own discretion in the settling of cases. The adjusters replenish their supply of cash by turning into the treasurer the releases and vouchers for expenses. All employees of the claim department, with the exception of the office force, are under bonds in a surety company.

The form of release used by the company has been devised with especial care. A simple form has been adopted, and the company has been singularly successful in establishing the validity of releases. The releases are printed on bank safety paper, which is proof against erasions or alterations. (See Form 127.)

If the adjuster or investigator is unable to effect a settlement of the case, he requests the injured person to fill out a blank (see Form 296), giving the claimant's version of the case, names and addresses of witnesses, and total amount of claim. To have the claim considered, the claimant must sign this statement, and the company then sends a notary public to the address of the person, and the statement is sworn to. This form is considered a very important one, inasmuch as it aids in securing a correct statement of the claimant's version of the case while all the facts are still fresh in his mind.

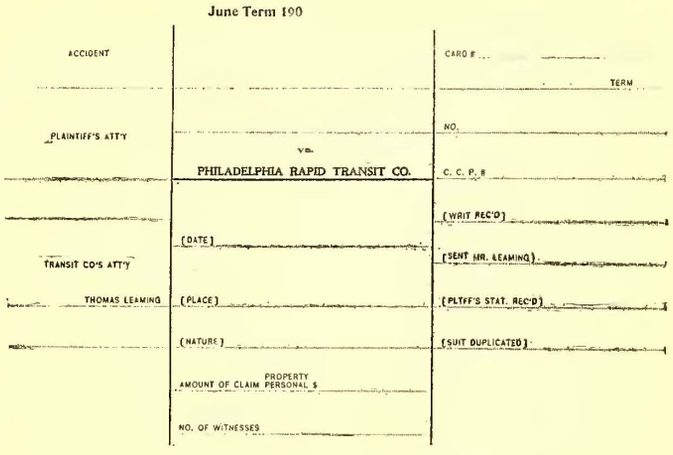
It should be stated here that practically all the blank forms, letter heads, etc., used by the claim department are of the same size, 8¼ ins. by 10½ ins., which has been adopted as standard. This uniformity introduces conveniences in filing.

As to the system of filing papers, the original reports from the conductors in regard to the accidents are numbered consecutively, and are filed in filing boxes, each box holding seventy-five cases. All papers referring to each case are, of course, attached to the original report, and bear the corresponding case number.

As an index to these filing cases, a large book is kept, which is known as the accident register or index. The column headings at the top of the pages in this book call for entries, giving the file number, date of accident, name of division, car number, block number, conductor's badge number, motorman's badge number, closed or open car, time of day, direction in which car was moving, place of accident, name of injured party, address of injured party, nature of injury, date of settlement, amount paid for personal injury, amount paid for property injury, amount collected for damage to cars.

If suit is brought on a case, all the papers referring to that case are transferred from the original filing boxes to a separate file known as "suits pending." It is known, therefore, that the papers for any accident that ever happened on the road are in either one of two files. This is thought to possess advantages over the more common practice of having separate files for various classes of accidents. The files are kept in fireproof vaults.

About two years ago the claim department began keeping very elaborate records of accidents, classified in various ways. A table setting forth these classifications, together with the number of accidents of each class, is presented on page 533. The records with reference to the system of classifying are kept by the card system, the cards used for this purpose being reproduced on page 532. A card index is also maintained, giving the name of each doctor with whom the claim department has had dealings, together with the accident cases which he has attended. Another card index of lawyers' names is kept in the same way. The value of all these records will be at once apparent as furnishing progressive data and averages that are of the utmost importance in the intelligent handling of future cases.



COURT DOCKET CARD INDEX

Such cases as are to be taken into court are referred to the company's general counsel, under whose direction they are referred to assistant counsel for preparation and trial. A number of methods in the nature of aids for expediting and facilitating the work of preparing and trying cases have been worked out, and

some of these merit particular mention. For instance, it is often of prime assistance to the trial lawyer if he knows something of the individuality and character of the company's witnesses in a given case. To supply this information, the claim department fills out Form 295 (see page 530), and sends this with the other papers in each case to the general counsel.

As an aid to the trial lawyer in presenting accident cases to juries, the claim department frequently prepares rather elaborate plan drawings showing in detail the layout of the locality in which the particular accident occurred. The drawings are made on long sheets of heavy linen paper, and show street and track intersections, location of curbs and sidewalks, building lines, etc., together with all dimensions and distances, that will serve to explain the situation. These drawings are usually made in different colors, and all lettering and dimensions are indicated in large size, so that as the trial lawyer displays the chart in front of the jury box, each member of the jury and the court can readily follow and understand the explanations as given by the lawyer. These charts are constructed from original surveys made after the accident has happened, and all distances are determined and verified by actual measurements made on the spot, and are not taken from records. The surveyors and draftsmen who do this work are always put on the stand, and are able to testify from their own knowledge as to the accuracy of the charts. Drawings of this kind have been found invaluable in properly presenting cases to juries.

The camera is also used systematically and effectively in the preparation and trial of cases. Frequently photographs showing the scene of the accident, the car involved in the occurrence, and any other features that would throw light on the case, are prepared, and, if the case goes to trial, are presented to the jury. The camera has been employed with conspicuous success in the ferreting out and exposing of fraudulent claims, and the detective force of the company makes extensive use of this means for breaking down false claims and bringing fraudulent claimants to justice.

A number of photographs are reproduced on Plate XL. as showing concrete examples of the effective use of the camera.

In the case of Patrick Crossen, the man was struck by a car and knocked down. He claimed spinal injury and total disability, and on the stand at the trial testified he had done absolutely no work since the accident. On cross-examination, the original photographs were laid before the jury, and by them the company was able to establish that the plaintiff had been engaged regularly before the trial at his occupation of shoveling dirt. The jury lost no time in finding for the company.

In the case of a driver of a brewery wagon, who was hit by a car, the plaintiff claimed injury to his back and total disability. The photographs taken soon after the accident showed the man engaged at his regular occupation of handling beer barrels. The introduction of the photographs at the trial resulted in a verdict for the company.

As another instance of a similar nature, may be cited the case of a young foreigner, who claimed heavy damages for alleged

	Date of Settlement	No. of Settlements	Cost	Average	Male		Female		Open		Closed	
					No.	Cost	No.	Cost	No.	Cost	No.	Cost
	July											
	Aug											

CARD INDEX FOR CLASSIFYING SETTLEMENTS ACCORDING TO SEX, AND WITH REGARD TO OPEN AND CLOSED CARS

DATE OF SETTLEMENT	NO. OF SETTMT	COST	AVGE.	IRISH		ITALIAN		HEBREW		NEGRO		AMERICAN		Other Foreigners		Unreported		Attorney's Fees					
				No	COST	No	COST	No.	COST	No.	COST	No.	COST	No.	COST	No	COST	No	COST	No	COST	No.	COST	No.	COST
JULY																							
AUG.																							

CARD INDEX FOR CLASSIFYING SETTLEMENTS ACCORDING TO NATIONALITIES OF CLAIMANTS

DATE OF SETTLEMENT	NO. OF Settlement	COST	Average		DATE OF SETTLEMENT	NO OF Settlement	COST	Average
JULY					JULY			
AUG.					AUG.			

CARD INDEX FOR KEEPING RECORD OF SETTLEMENTS ACCORDING TO COSTS

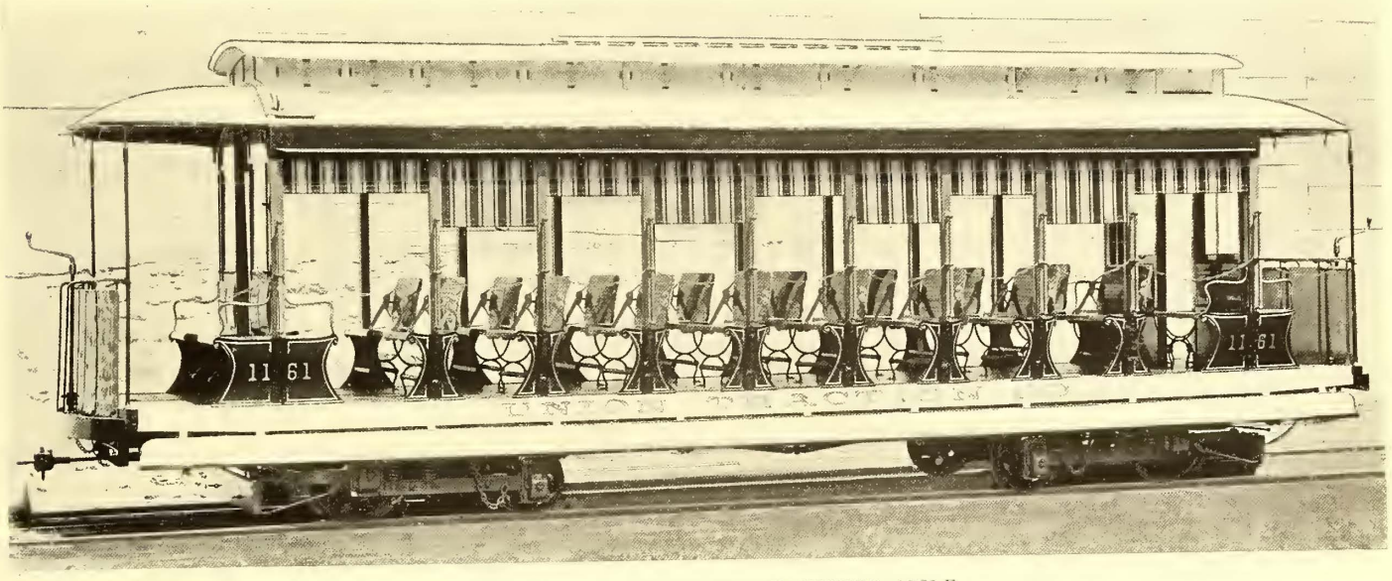
Doctor _____ of _____

Report No.	Claimant	Date	Address

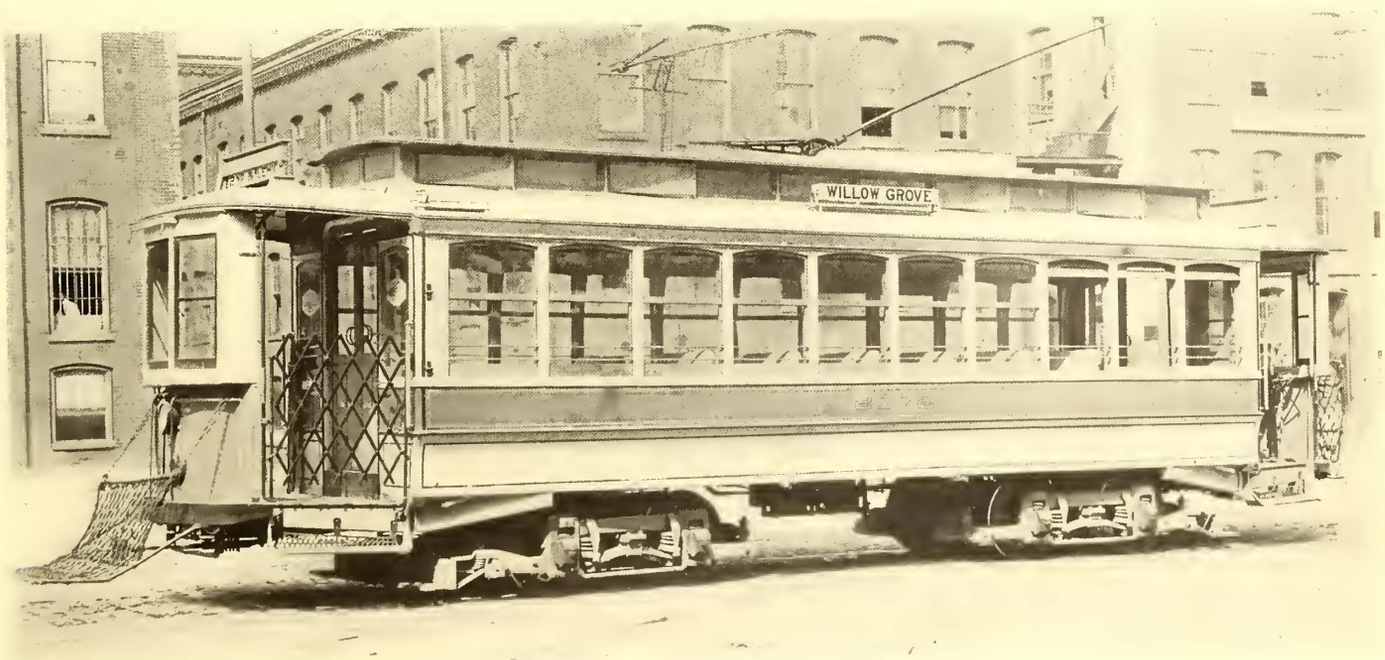
CARD INDEX FOR KEEPING RECORDS OF PHYSICIANS

INTERIOR OF CENTER AISLE OPEN CAR

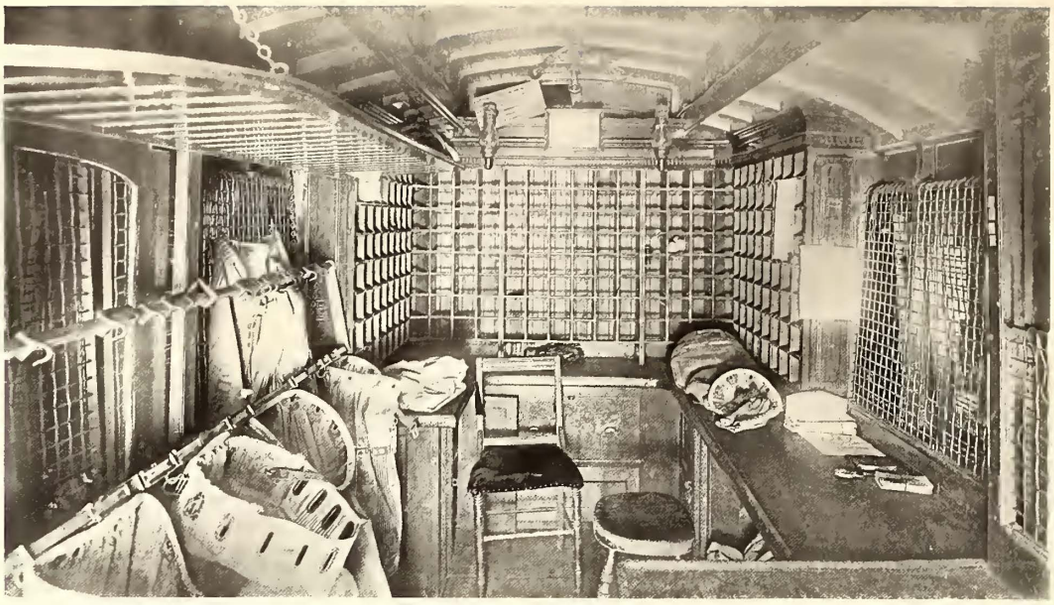
INTERIOR OF STANDARD SEMI-CONVERTIBLE CAR



EXTERIOR OF OPEN CAR WITH CENTER AISLE



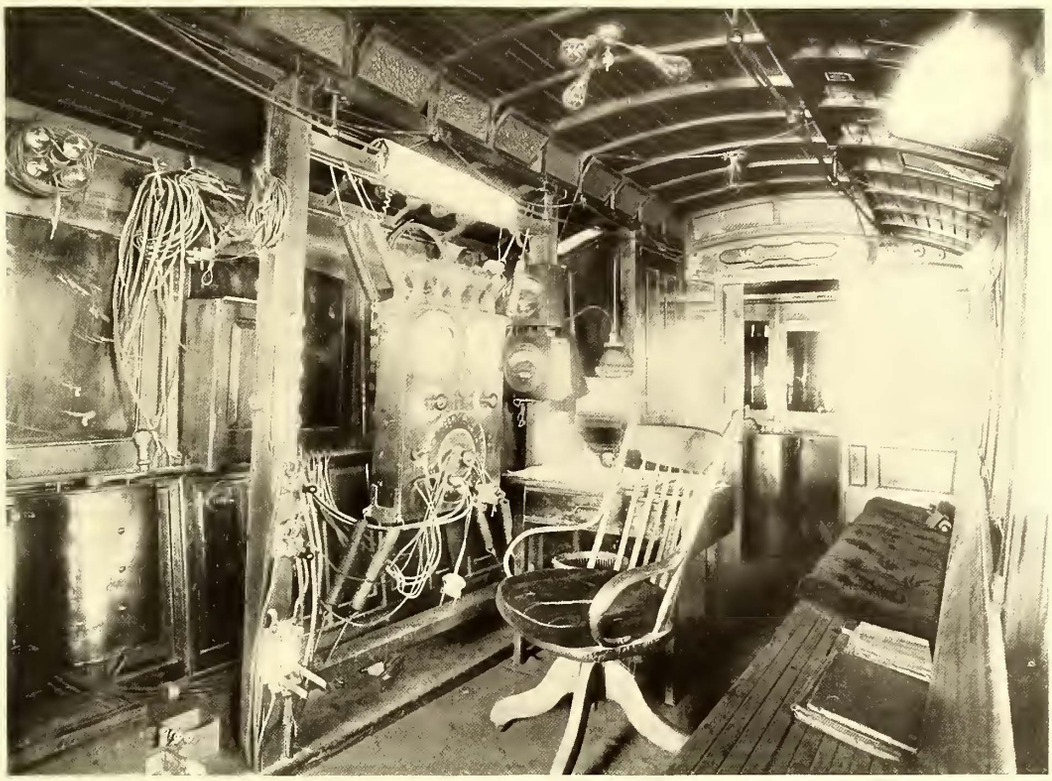
EXTERIOR OF STANDARD SEMI-CONVERTIBLE CAR



INTERIOR OF MAIL CAR

DUMPING SNOW INTO MELTING PITS

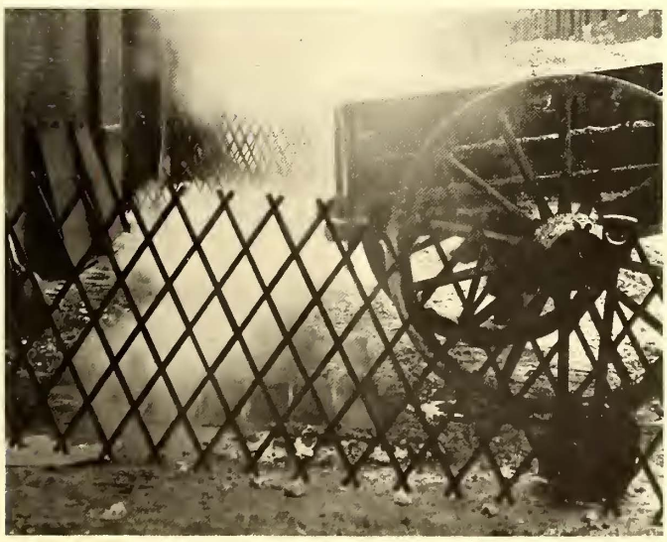
GENERAL STOREROOM, EIGHTH AND DAUPHIN STREETS



INTERIOR OF TESTING CAR

HOOD DESTINATION SIGN

HOOD DESTINATION SIGN, SHOWING METHOD OF CHANGING DESIGNATION BY MEANS OF MOVABLE FLAP



SNOW-MELTING PITS

DESTINATION SIGN FOR SIDE OF CAR

This Claimant Alleged Curvature of Spine and Total Paralysis.—The Photographs Showed Him Performing Feats in Gymnasium While His Claim Was Pending

This Claimant is Shown at His Regular Occupation of Handling Beer Barrels While His Claim for Injury to Back and Total Disability was Pending

A Claimant Who Alleged Spinal Injury and Total Disability

REPRODUCTIONS FROM PHOTOGRAPHS SHOWING THE VALUE OF THE CAMERA IN CLAIM ADJUSTING.—THE PHOTOGRAPHS WERE TAKEN SOON AFTER THE ACCIDENTS IN WHICH ALLEGED INJURIES HAD BEEN RECEIVED

curvature of the spine and total paralysis as the result of a street railway accident. Soon after the entry of the claim the young man was induced by a representative of the detective force to join a gymnasium, and the alleged sufferer from total paralysis was photographed while going through various difficult gymnastic stunts. It is needless to say, the photographs constituted good evidence for the defendant.

The detective department is considered one of the most valuable adjuncts to the successful operation of the claim department. The company has adopted the policy of prosecuting fraudulent claimants to the last ditch, and, when sure of its evidence, has followed would-be impostors as far as Canada, and it does not stop until the offender is landed in jail. During the past two years the department has secured over sixty convictions in accident frauds, some of them involving deep-laid conspiracies against the company's treasury. As a result of this relentless activity, this class of claimants is beginning to give Philadelphia a wide berth.

The docket of cases set for trial is arranged in card index form, this arrangement having been found to possess advantages over the more common "book" docket. Each case is entered on a separate card, a sample of which is reproduced on page 531.

The policy of the Philadelphia Rapid Transit Company with respect to the handling of accident claims may be summed up in the statement: Settle honest and meritorious claims; when the degree of the company's liability is open to question, compromise; but resist and fight to a finish all exorbitant and fraudulent claims, and follow up and prosecute fake claimants.

The claim department has authority to settle according to its own discretion the ordinary run of cases. In special cases, and when the degree of the company's liability is debatable, the general claim agent confers with the general counsel in conjunction with the general manager.

The closest co-operation is maintained between the claim department and the operating department, and a representative of the claim department attends the regular meetings of the division superintendents. The entire staff of the adjusting department is on the lookout for methods of preventing accidents, and suggestions are made freely to the general manager, and these receive the fullest consideration.

The following table gives the relative number and cost of all classes of settlements:

PERSONAL INJURY AND PROPERTY DAMAGES.

	Year Ending June 30, 1904.			Year Ending June 30, 1905.		
	Number of Settlements.	Per Cent to Total No.	Per Cent Cost to Total Cost.	Number of Settlements.	Per Cent to Total No.	Per Cent Cost to Total Cost.
PERSONAL AND PROPERTY:						
Personal injury cases	6,896	91.53	95.83	4,935	91.51	97.02
Property damage cases	638	8.47	4.17	458	8.49	2.98
Total	7,534	100.00	100.00	5,393	100.00	100.00
RATIO OF SETTLEMENTS:						
From $1 to $100	6,517	86.50	27.01	4,197	77.82	13.55
From 100 to 250	601	7.98	15.25	631	11.70	11.53
From 250 to 500	220	2.92	12.91	253	4.69	10.33
From 500 to 750	80	1.06	7.90	109	2.02	7.54
From 750 to 1,000	33	.44	4.90	41	.76	4.26
From 1,000 to 1,500	32	.42	6.31	52	.96	7.78
From 1,500 to 2,500	28	.37	8.64	39	.72	9.37
From 2,500 to 3,500	11	.12	5.58	37	.69	13.64
From 3,500 to 5,000	6	.08	4.14	21	.39	10.40
From 5,000 to 7,500	3	.04	2.83	9	.17	7.05
Exceeding $7,500	3	.04	4.53	4	.07	4.54
Total	7,534	100.00	100.00	5,393	100.00	100.00
PUBLIC AND EMPLOYEES:						
Public	7,505	99.62	99.76	5,356	99.31	99.74
Employees	29	.38	.24	37	.69	.26
Total	7,534	100.00	100.00	5,393	100.00	100.00
CARS:						
Open cars	2,271	30.13	31.35	1,233	22.86	24.95
Closed cars	5,191	68.90	68.17	4,075	75.56	74.38
Not on or by cars	72	.96	.48	85	1.58	.67
Total	7,534	100.00	100.00	5,393	100.00	100.00

PERSONAL INJURY CASES.

	Year Ending June 30, 1904.			Year Ending June 30, 1905.		
	Number of Settlements.	Per Cent to Total No.	Per Cent Cost to Total Cost.	Number of Settlements.	Per Cent to Total No.	Per Cent Cost to Total Cost.
NATURE OF INJURIES:						
Lacerations and contusions	3,586	52.00	26.26	2,297	46.55	11.31
Simple fractures, sprains and dislocations	1,233	17.88	13.18	901	18.26	10.85
Fractures	91	1.32	7.45	101	2.05	11.51
Neurasthenia	616	8.90	13.19	667	13.51	23.94
Spinal	121	1.75	8.31	160	3.24	12.07
Internal	231	3.35	10.56	281	5.69	16.51
Death, adults	11	.16	1.78	14	.28	1.08
Death, children	8	.12	.58	9	.18	.71
Loss of leg	1	.01	.03	19	.39	6.71
Loss of arm	.....	.....	.....	2	.04	1.02
Injuries to sight	16	.23	.72	4	.08	.48
Unclassified, serious	139	2.02	13.67	12	.24	1.53
Unclassified, slight	837	12.14	4.07	455	9.22	2.07
Electricity	6	.10	.20	13	.26	.30
Total	6,896	100.00	100.00	4,935	100.00	100.00
NATURE OF ACCIDENTS:						
Alighting	1,541	22.35	20.28	783	15.87	19.63
Boarding	1,256	18.21	15.08	844	17.10	15.65
Collision of cars	1,507	21.85	24.86	1,231	24.94	23.73
Vehicles struck	1,366	19.81	17.63	1,134	22.98	20.64
Pedestrians struck	421	6.10	6.64	242	4.90	10.22
Bicycles struck	21	.30	.30	3	.06	.02
Thrown from car	123	1.79	1.95	85	1.72	2.38
Ejectments	34	.49	.63	29	.59	.43
Paving	59	.86	.38	54	1.09	.61
Miscellaneous accidents	559	8.11	12.05	516	10.46	6.36
Electricity	9	.13	.20	14	.28	.30
Total	6,896	100.00	100.00	4,935	100.00	100.00
SEX:						
Male (14 years and over)	3,746	54.32	44.73	2,405	48.73	39.42
Male (under 14 years)	303	4.39	2.76	210	4.26	6.69
Female (12 years and over)	2,709	39.28	51.20	2,214	44.86	51.76
Female (under 12 years)	138	2.00	1.30	106	2.15	2.13
Total	6,896	100.00	100.00	4,935	100.00	100.00
CARS:						
Open cars	2,142	31.33	32.25	1,174	24.06	25.32
Closed cars	4,695	68.67	67.75	3,706	75.94	74.68
Total (excluding accidents by paving)	6,837	100.00	100.00	4,880	100.00	100.00
NATIONALITIES:						
Irish	1,361	19.74	16.32	624	12.64	13.37
Italian	205	2.97	2.19	95	1.92	1.22
Hebrew	743	10.77	14.04	442	8.96	10.88
Negro	322	4.67	2.31	229	4.64	4.73
American	3,393	49.20	53.82	3,056	61.93	59.64
Other Foreigners	193	2.80	3.74	149	3.02	3.08
German	679	9.85	7.58	340	6.89	7.08
Total	6,896	100.00	100.00	4,935	100.00	100.00
REPORTS:						
Reported accidents	6,007	87.11	87.45	4,299	87.11	90.39
Unreported accidents	889	12.89	12.55	636	12.89	9.60
Total	6,896	100.00	100.00	4,935	100.00	100.00
CREWS:						
Unreported (crews found)	116	13.05	19.33	84	13.21	17.53
Unreported (crews not found)	773	86.95	80.67	552	86.79	82.46
Total	889	100.00	100.00	636	100.00	100.00

PHOTOGRAPH DEPARTMENT

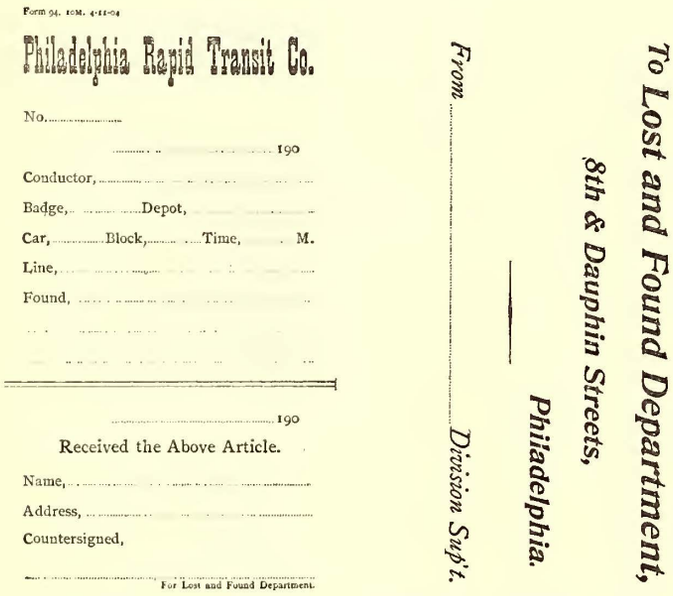
The company has found it advantageous to have its own photograph department for taking negatives and printing and developing work. This department was established about four years ago, but has rapidly increased its scope, and now constitutes an important part of the organization. The department is in charge of E. F. Harrison, who takes all the negatives required for both the engineering department and the claim department. Negatives are carefully filed and indexed, and constitute important records to which reference is constantly being made. The department has a complete photographic gallery fitted with dark room and all modern appliances for doing high-grade photographic work. An important phase of the department's work has been the taking of record and progress views in connection with the construction of the subway and elevated lines.

LOST-PROPERTY DEPARTMENT

About 5000 articles every month pass into the lost and found department. As in other large cities, this lost property forms a heterogenious assortment of articles, ranging as widely in variety as, for instance, human skulls and live puppies, and including now

and then articles that it would hardly seem as though anyone would think of carrying into a street car, to say nothing of forgetting. Employees have instructions to turn property left in the cars into their operating depot at the end of the run. To each article so found is immediately attached a tag (see Form 94), upon which is written the time, date, etc., and a description of the article. A portion of this tag comprises a receipt, which is signed by the owner when the article is claimed.

If the article is not claimed from the depot master the same day it is found, it is sent to the central lost and found department at the company's main offices early the following morning, a car making the rounds of all the depots, beginning at 5:30 in the morning, for the purpose of collecting lost articles. Each depot master enters in a special book a transcript of the tags for all the lost articles that may be turned in to him for each day. Each morning, when the lost articles for the previous day arrive at the lost and found department, a clerk first stamps each tag with a consecutive number and a transcript of the tag is entered in a book at the side of the corresponding number. The articles are then classified according to the operating depots from which they are


Form 94. 10M. 4-11-04

Philadelphia Rapid Transit Co.

No.....

..... 190

Conductor,.....

Badge,.....Depot,.....

Car,.....Block,.....Time,..... M.

Line,.....

Found,.....

..... 190

Received the Above Article.

Name,.....

Address,.....

Countersigned,

.....

For Lost and Found Department.

From.....Division Sup't.

To Lost and Found Department,
8th & Dauphin Streets,
Philadelphia.

FORM 94.—FACE AND REVERSE OF TAG ATTACHED TO FOUND ARTICLES

received, and are stored in bins, there being a bin for each depot. A separate set of bins is kept for umbrellas, as there are often as many as 1500 umbrellas on hand during a single month.

Persons making inquiries for lost articles are required to go to the lost and found department in person and identify the property. The owner signs the receipt portion of the tag, and also writes his name in the lost-property book after the description of the article, the company thus having a double receipt.

Any article that is not claimed within thirty days is returned to the employee who found it. If the article is claimed before the expiration of thirty days, the original tag, with the signed receipt attached, is sent to the proper depot, and is posted on the bulletin board, so that the employee interested may know that the goods were returned to the owner. The statistics of the department show that only about 50 per cent of the property found on the cars is ever claimed.

Although it costs several thousands of dollars a year to maintain the lost and found department, the company takes good care of everything left in the cars, and makes every effort to restore the property to the rightful owner. If there is anything about the article by which it can be identified, the owner is notified by letter to call and claim the same. The clerks in the department also watch the lost advertisements in the daily papers, and if the published descriptions correspond to anything that has been turned in, a letter is sent to the owner advising him of the fact and inviting him to call and identify his property if possible. The department is in charge of William W. Dwier. It takes a portion of the time of four men to handle the lost and found department, in addition to the time of the men at the depots.

As a precautionary measure, it is thought best to thoroughly disinfect once a week the room in which the lost property is stored.

PRINTING DEPARTMENT

The Philadelphia Rapid Transit Company operates its own printing department, which now turns out all the printed matter, including tickets, transfers, advertising posters and literature, and all the blanks and forms used by the company in its various departments. The printing department was instituted in 1880 by the Union Passenger Railway Company, and after each of the successive consolidations its scope was broadened to include the acquired properties, until now, as stated, it includes facilities for turning out the printed matter required to meet the varied needs of the entire street railway system of Philadelphia. This printed matter aggregated in bulk last year nearly 400 tons.

The printing department occupies a specially-designed portion of the storage-battery station, near the company's main offices. The press room includes 3800 sq. ft. of floor space, the room being well lighted from skylights in the roof and heated by steam pipes suspended from the roof girders. All of the presses and other machinery are operated by individual electric motors of the Crocker-Wheeler manufacture, taking 550-volt direct current from the station storage battery. The wiring for this electric-drive system is carried in conduits beneath the press room floor, the branch-offs to each machine being brought up through the floor in iron pipes.

The equipment includes the following: Two-cylinder presses, six job presses, one Kidder press of special design, which prints, numbers and perforates exchange tickets or transfers at one operation; one Sterling punching machine, two Brown & Carver cutting machines, one hand press, two New Jersey wire-stitching machines, and a complete equipment of numbering machines.

The composing room is located in one corner of the building, and is provided with about 300 fonts of job type, various sizes of body letter for book work, and a miscellaneous assortment of wood type.

The establishment also includes a storeroom for paper stock, and the varied nature of the printing called for requires that nearly four carloads, or 60 tons, of paper be carried in stock at all times.

About 50 per cent of the work passing through this department consists of transfers and exchange tickets. As previously stated, these are now printed on a special press built by the Kidder Press Company from plans suggested by the superintendent of the printing department. This machine is capable of turning out 1,000,000 tickets a day. The tickets are printed thirty to a sheet, and the machine prints these on both sides of the web, numbers each ticket twice on one side and perforates and counts them during one process. Until the introduction of this machine, the tickets had to be put through a cylinder press twice, in order to print both sides, and then they had to be numbered and perforated. One man and a boy are now doing the work that formerly required seven men.

As outlined on page 482 of this issue, the layout of the street railway lines and the number of intersections require a multiplicity of different forms of transfers and exchange tickets. Each transfer and exchange ticket bears the run number under which it is to be issued, and, in addition, the transfers and tickets for each run number are numbered consecutively. Transfers and tickets are bound in pads of 100, wire stitched at the end, with a cardboard backing. It will be readily understood that this complicated system of tickets requires great care in making sure that tickets properly numbered as to runs, and bearing consecutive numbers are supplied at the proper time to all the various operating depots. Accuracy and care are all the more necessary, inasmuch as each

exchange ticket has a cash value of 8 cents, and the accounting between the company and its conductors with reference to these transfers and tickets is carried on entirely by means of the system of numbering, so that it is very essential that nothing but perfectly-printed and numbered pads be issued.

The responsibility for issuing the tickets in proper form, and also for seeing that the necessary number of transfers and tickets of each series are supplied to the proper depots as required, devolves upon the superintendent of the printing department. By an ingenious and comparatively simple system of records, the department is able to keep track of the number of each form of transfers and exchanges and the numerical series furnished to each depot. Every week each operating depot turns into the printing department a memorandum, giving the last ticket number issued for each run number operating from the particular depot. The superintendent of printing examines these returns, and, by noting the numbers that are running short, he is able to take steps for replenishing the stock. This system does not require that a large number of tickets of any form or series be carried in stock, and the waste is therefore reduced to a minimum. About 174,000,000 of tickets, involving 127 tons of paper, were printed during the last fiscal year with practically no serious errors and with minimum waste.

The printing of the forms and blanks used in the routine work of the various departments comprises an important part of the work of the printing department. There are now about 400 different forms used by the company.

The method of keeping track of these forms and duplicating them when necessary is interesting. Sample books are kept containing samples of each form, classified according to the departments using them. In a separate book ruled with the heading as

Form No.____

Date	Quantity	Date	Quantity	Date	Quantity	Date	Quantity	Date	Quantity	Date	Quantity

COLUMN HEADINGS IN RECORD BOOKS USED BY PRINTING DEPARTMENT FOR KEEPING RECORD OF BLANK FORMS PRINTED FOR EACH DEPARTMENT

shown herewith is recorded the quantities of each form printed. As will be seen, this book gives the form number and the dates and quantities printed. Each form printed bears in one corner the form number, the number printed and the date of the last run, as for instance, "Form 68, 6 m. 6-26-05."

As to the financial results of this department, it may be said that the company believes it is saving about 30 per cent on its printing bills over and above what it would cost to have the work done outside. In addition, it is getting better work, and its printing is done under its own supervision. On the single item of tickets, the records show that the total cost of transfers and exchanges, including paper, printing, clerical work for keeping records, and distribution to the various depots, is now about 7½ cents a thousand, which is from 2 cents to 3 cents cheaper than the work could be secured on the outside. It cost about $4,000 to fix up the building for the use of the printing department, and the equipment cost about $20,000 additional. The expense of running and maintaining the printing department is about $30,000 per annum. The department is in charge of J. S. Skinner, superintendent of printing.

TESTING LABORATORY

An important feature of the machinery of the purchasing department is a complete chemical testing laboratory. This laboratory was established about six years ago on a very small scale, primarily to test babbitt metal. From this small beginning the testing department has grown rapidly, and is now considered one of the most important on the road. The chief purpose of the laboratory as at present organized is to furnish data from which the purchasing agent is enabled to draw up specifications for a wide variety of supplies, such as babbit metal, oil, grease, paint, metals, etc., and, after materials have been received, to see that they are up to specifications. By this means the company is able to make its own chemical determinations, and is in a position to avoid paying fancy prices for fancy brands, and is also enabled to keep close check on materials and supplies purchased. It is now the practice to send samples of materials purchased to the laboratory before any of the material is used, for the purpose of demonstrating whether or not the goods are as specified. This usually involves a delay of not over forty-eight hours, as the determinations can be made within that time.

The laboratory occupies the second story of one of the storage-battery houses near the general offices of the company. The equipment of the laboratory includes the following:

A gas-burning combustion furnace for analyzing iron and steel samples.

Two ventilating hoods, formed with tile floor, wooden sides, roofs and glass sliding doors, and equipped with motor-driven fans. In these hoods are carried on various tests of metals, etc., in which obnoxious vapors are given off, the ventilating features being designed to carry off through a flue all unpleasant or dangerous vapors and gases.

Apparatus for making flash and fire tests of oils.

A Doolittle's torsion viscosimeter, for determining the viscosity of oils.

Small gas oven and drying and heating apparatus.

Condensers in connection with distilling and extraction apparatus.

Electrolytic apparatus, for analysis of metals.

Crushing and pulverizing apparatus, for reducing coal, metals, etc.

Calorimeter, for determining calorific values of coals.

In addition to the foregoing, there is a large assortment of apparatus and furnishings that go to make up a well-equipped laboratory, including several working tables, a water vacuum pump, sink with running water, numberless glass tubes, jars and bottles, crucibles, mortars, scales, chemicals, etc.

There is also a standard voltmeter, for calibrating all the voltmeters used on the road.

As an indication of the variety of work carried out at this laboratory, the following partial list is given of analyses made during the past few months for the purpose of securing data for working up specifications.

Solder, gasoline, pipe covering, motor grease, turpentine, coal oil, linseed oil, engine cylinder deposit, journal oil, brass of various kinds as trolley ears, wire, grab handles and car trimmings, overhead material, etc., zinc, babbit metal and alloys, pig iron and manufactured iron products, signal oil, sulphuric acid for storage batteries, shellac, lead, putty, tool steel, paints, cement, boiler compounds, boiler scale and feed-water, track salt, etc.

The cost of installing the laboratory complete, exclusive of the building, was something less than $1,000. As to the financial results, it may be said that the expense of maintaining the laboratory, including the chemist's salary, is not over $2,000 per year. During the last fiscal year over 800 separate analyses were made, involving on the average three different determinations to each analysis. This shows an average of about $2.50 for each analysis, or 75 cents for each determination. An outside chemist would probably charge about $3 per determination. As to the economy, a single instance may be cited. The company is now buying babbit metal at 3 cents per pound less than the same brand can be purchased under trade name, the metal being based on specifications drawn in accordance with data secured in the laboratory. This price for babbitt means a saving to the company of at least $2,100 a year in this one item alone. It

is estimated the laboratory department enables the purchasing agent to effect a saving of from $7,000 to $10,000 per annum in the purchasing of material and supplies.

SNOW FIGHTING ORGANIZATION AND METHODS

For the purpose of removing snow from the streets, the city is divided into districts and thoroughly organized gangs are assigned to each district. The details for a redistribution of the snow-fighting forces and methods of fighting snow for the coming winter are now receiving attention, but at this writing are not ready for publication.

The company is somewhat hampered in handling this problem by not having suitable snow dumps. To overcome this there have been used successfully melting pits, which are located at the power houses, and consist of open wells filled with hot water, heated by exhaust steam in a specially constructed heater. The snow is dumped from the wagons directly into these pits and is melted by coming in contact with the hot water. The melted snow is then run off into the sewers. Experience with these melting pits does not indicate a reduction in cost over carting the snow away and dumping it. The indirect advantage of the method, however, is considerable, as it requires less wagons on the street and reduces the street congestion.

The company owns 105 snow-plows, all of which are of the single-truck, nose and shear type. The distinguishing feature of the Philadelphia plows is the shape of the shear and nose, which are made unusually high, and are curved over at the top to an unusual degree. This form serves to break up the snow by rolling it over on itself.

LAUNDRY FOR WASTE AND RAGS

The company operates its own laundry for cleaning waste, commutator cloths, etc. This is located at the Beach and Green Streets power house.

The laundry machinery is driven by a 9-amp. 500-volt GE motor. In the laundry the company has the following apparatus: One 20-in. turbine washer, built by the Oil & Waste Saving Machine Company, Rochester, N. Y.; one 20-in. belt-driven whizzer, built by the Troy Laundry Company, Troy, N. Y.; one boiling tank, 3 ft. in diameter and 4 ft. high, piped up with steam and cold water, built by the railway company; two brass barrel washing machines, size 2 ft. 6 ins. in diameter by 4 ft. 6 ins. long inside measurement, built by the Wilson Laundry Company, Columbia, Pa.

Adjoining the washing room is the drying oven. This is built of brick with fireproof doors. To guard against fire, water and steam fire sprays are also installed. The drying room has three tiers of shelves, under which are two heating coils, made of 1½-in. black pipe, of which there are 12 lengths, 12 ft. long, in the two coils. The steam going through the coils is trapped, thereby insuring dry steam circulation. The temperature of the drying room is kept at about 135 degs. night and day.

The shelves of the drying tables are 3 ft. 3 ins. wide by 12 ft. long, and are made of heavy galvanized wire screening ½-in. mesh. They are built in sections, each being 2 ft. x 3 ft. x 3 ins. The waste is spread out over these shelves very thinly and dried. Experience has shown that too heavy a layer of wet waste on these shelves is liable to catch fire from spontaneous combustion.

In the drying room above the shelves are a series of pipe rods let into the wall, on which the commutator rags are dried. The wash room and the drying room are both well ventilated, excellent ventilation being very necessary, as the humidity in these two rooms otherwise would become unbearable.

The motor room is partitioned off from the wash room, and is sufficiently large to be used as a stock room, in which the laundryman keeps each month's supply of soda, soap and cheesecloth for commutator rags. Here he also stores the dry-finished waste and rags from which he fills the waste cans and bundles the commutator rags for the various power houses and sub-stations.

A strict account is kept of the work done in the laundry from month to month, and the cost is charged up pro rata to all the stations having laundry work done. The expense of operating each station is kept separate, and a very interesting report is sent out annually by the superintendent of motive power to each engineer in charge, bearing on this expense.

The method of carrying out the work of this department is as follows:

A wagon is detailed to collect from the various power houses each day's quantity of dirty waste and dirty commutator rags which have previously been placed in waste cans and bundles, with the number thereon. These the driver delivers to the laundry, and in return takes back to the said power house or station a similar number and quantity of commutator rags and waste that have been washed. The laundryman then takes the waste from the cans and puts it into the turbine waste-saving machine. In this machine the waste is revolved at a high rate of speed, a portion of the exhaust steam from the turbine passing through the waste as it is being revolved. The action of this steam is to cut all of the oil and grease out of the waste, and the steam naturally condenses and carries the oil with it out through a trap and pipe connection at the bottom of the turbine, where it is caught in a bucket and dumped into a "perfection" filter, which separates and cleans the oil. This turbine holds 30 lbs. of wet oil-soaked waste when filled, and it takes from 30 minutes' to 40 minutes' whizzing to extract all of the oil and dross from each charge. The turbine does not take all of the dirt out of the waste, but after being put through this process there still remains a gritty sediment. To force this out, the laundryman puts the cleaned waste into one of the Columbia washers. The amount of waste constituting one wash in the Columbia washer is 60 lbs., for which he uses 4 lbs. of sal soda and 7 lbs. of soft soap. This quantity of waste is kept revolving and reversing slowly in the washer for about 35 minutes or 40 minutes, when it is finally rinsed out clean with fresh cold water and put into the whizzer, where the water is all forced out of it by centrifugal motion. After this process, the waste is spread out in the drying room to dry.

The commutator rags are not put into the oil and waste-saving turbine at all, because the rags come into the laundry as black as ink and are filled with carbon and copper dust. The rags are therefore thrown into the boiler, where they are boiled in ever-changing, clean boiling water, without soda or soap, for about 45 minutes. After this they are taken out, put into a Columbia washer, and washed and rinsed clean by a mixture of 6 lbs. of sal soda and 6 lbs. of soft soap to every 200 rags. These are also whizzed dry and then hung in the drying room.

As to the amount of oil saved by the waste machine, it is worth noting that the dirty waste, previous to being sent to the laundry by the various power houses, is squeezed in a screw press by a janitor, and such oil as can be extracted that way is kept; but even with this precaution the laundry redeems every month between seven and eight barrels of good oil.

It may be interesting to state that four years ago the superintendent of motive power tried the washing of waste and rags as an experiment; to-day it is an absolute necessity. Five years ago the consumption of new waste in the station at Beach and Green Streets alone was 15 bales per year, but for the past two years it has been only 1 bale per year. This year it will be a trifle over 1 bale. The item of commutator rags is also a very important one, there being about 2500 rags washed weekly in the laundry. The quantity of waste washed in the laundry averages 1500 lbs. for seven days' run. There is but one man in the laundry, and he is paid $1.75 per day.

MATERIAL AND SUPPLIES ACCOUNTING

It is the practice for each department of the company on the first day of each month in advance to make up requisitions for material and supplies required. This reduces the amount of stores on hand and cuts down the stock of dead material. The

requisitions are sent to the purchasing agent and are passed to the general manager for approval. They are then returned to the purchasing agent, who obtains quotations or places orders for the materials as the case may be. A considerable portion of the supplies are purchased on standard specifications made up from data secured in the testing laboratory. Four copies are made of all orders for goods. The original is sent to the firm from which the material is purchased. The second copies are filed numerically and indexed alphabetically. The third copy is forwarded to the department that ordered the goods. The fourth copy is kept as a price card index and is filed according to the individual items.

All bills against the Philadelphia Rapid Transit Company for supplies ordered must be made out upon bill heads furnished by the railway company with the order, and must show the order number and requisition number. Shippers are instructed to make out one set of bills for each order. All bills must be rendered in triplicate and bills, together with bill of lading, must be sent to the purchasing department the same day shipment is made.

When the bills in triplicate are received the duplicate copy is retained in the purchasing agent's department for charging against the proper account. The original and triplicate copies go to the department that ordered the material. The head of the department signs and returns the original and keeps the triplicate. The original is marked "O. K." in the order book and is sent to the auditor. The duplicates are filed under proper firm name in a file provided for the purpose.

When notice is received that shipments have arrived at the freight or express office, the company sends one of its own freight cars after the goods. A system has just been inaugurated for handling all of the supplies from the railroad stations to the proper department in the company's own freight cars. The street railway tracks in Philadelphia are a different gage from the entering railroads, and it is therefore impossible to haul the original freight cars to the store yards. The company's freight cars are 34 ft. long, mounted on double trucks and are equipped with crane, air hoist, etc. Each car has a capacity of 100,000 lbs. The conductor of the freight car obtains the destination of material from the chief clerk of the purchasing department. The conductor signs receipts for the goods to the railroad company and makes a manifest of material on a daily manifest sheet of goods received. When he delivers the shipments to any one of the departments he takes a receipt from the head of the department on his manifest. When the shipment is received at the proper department the packages are opened, examined and checked and slips are made out by the department receiving clerk showing by whom the packages were shipped and the contents. The receipts are entered in the receiving book and are held until the bills come in, when the cash value is also entered on the receipts.

Each department carries its own supplies in its own store rooms and in the distribution of accounts of materials and supplies the individual departments are charged with the goods delivered to them. Supplies for the power houses are charged to "Accrued Power Account," for line and track to "Accrued Maintenance of Way and Building Account;" general supplies, including car maintenance, to "General Supply Account;' and material for new work to "Purchase Direct" account.

In keeping its general stores the company has recently abolished the bin card system as too cumbersome and otherwise unsatisfactory. It is now the practice to give each item a separate bin number, by means of which the distribution accounts are kept, but there are no bin cards on the bins themselves. Entry of goods in and out of stores are made by means of memorandum slips which are filled in by the storekeeper and are sent to the purchasing department daily. This does away with the necessity for keeping in the storeroom accumulative records of material received and distributed.

WILLOW GROVE AND WILLOW GROVE TERMINAL

WILLOW GROVE PARK

In many respects Willow Grove Park is the finest amusement park in the world. It is situated 13 miles from the Philadelphia City Hall and at the terminus of six direct lines of cars, making it easy of access from all parts of the city of Philadelphia and its suburbs. The park covers an area of more than 100 acres, the natural beauties and picturesque surroundings making it an ideal outing spot. The natural charm and beauties of the place have been accentuated and enhanced by careful cultivation and intelligent landscape gardening.

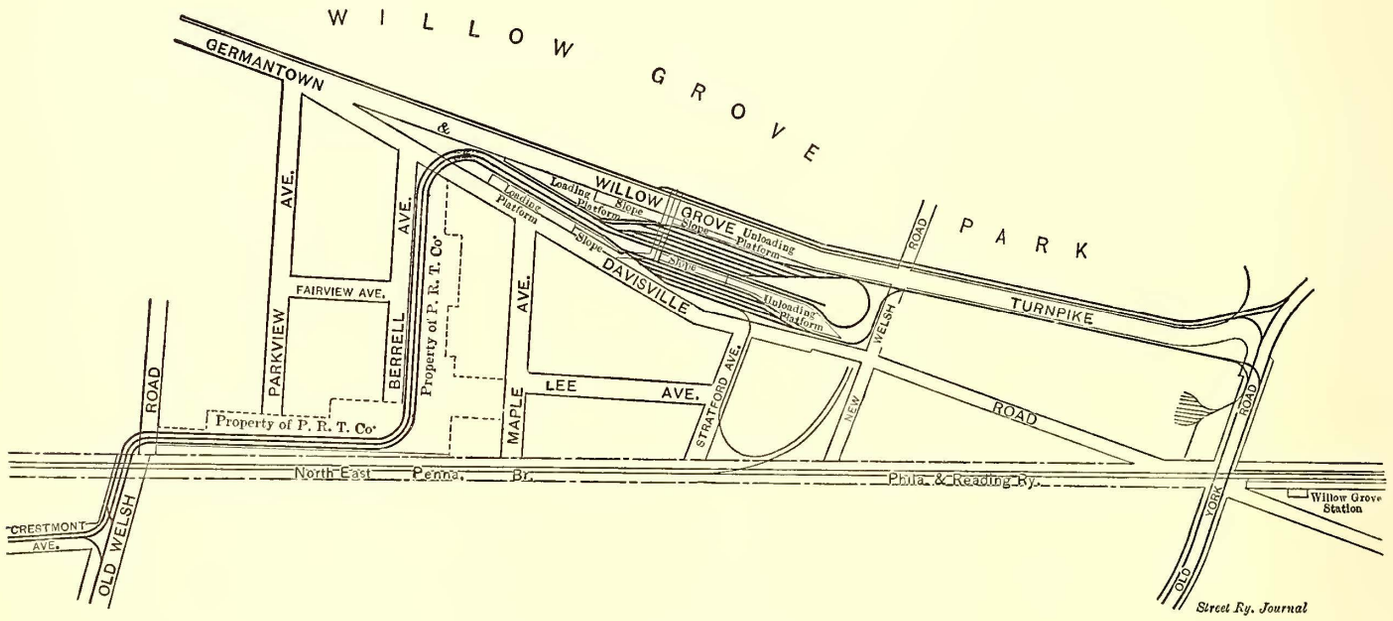
Perhaps the chief distinguishing and the most popular feature is the high quality of band and orchestral music that is provided free of charge for the enjoyment of the park patrons. For example, during the season just closed, the management engaged five of the best musical organizations in this country, these including Sousa and his Band, Victor Herbert's Orchestra, Conway's Ithaca Band, Wheelock and his United States Indian Band and Damrosch's Orchestra. The privilege of listening to the world's finest classic and popular musical compositions as rendered by these famous musical organizations was thus extended to Philadelphia's recreation seekers at absolutely no other expense than the cost of street car fare.

Vieing in popularity with the musical attractions is an electric fountain said to be the largest and finest of its kind ever built.

In addition to the music and the fountain are about 100 amusement concessions, many of which are entirely new, and all of which are of a character pleasing to the most refined taste. And here it is in order to emphasize another distinguishing characteristic of Willow Grove, and the one to which perhaps more than any other the success of the place is due, that is, the superior order and discipline that is maintained at all times. No intoxicating liquors are sold in the park, and a corps of uniformed policemen is on duty morning, noon and night, quietly but firmly to discourage the slightest signs of disorder or rowdyism. So successfully is perfect order maintained that women and children are free to come and go at any hour without the faintest chance of being subjected to experiences in any way unpleasant or annoying. There are parks in and around Philadelphia provided for those who must have an element of loudness and rowdyism in their recreation, but at Willow Grove the reception afforded to these is discouraging to repetition. The management is convinced that in this policy lies the secret of success in maintaining with profit a street railway park.

The park was first open to the public in he summer of 1896, from which time great improvements have marked each succeeding year. So rapid has been its progress and increase in popularity that at the beginning of the present year it became necessary to build another electric road to serve the travel, in addition to the several routes previously available between the city and the park. On all the routes the fare is 10 cents one way, but the park itself with the music and the fountain is free to all. No attempt is made to give free outdoor attractions other than the two mentioned, with the possible exception of fireworks displays on special occasions. Nor is any attempt made to give vaudeville or theatrical entertainments; the park in this respect differs from the resorts of a similar nature in most other large cities.

The park in itself, with its artistic settings of shrubbery, flower beds and greensward, constitutes an attraction destined to please the eye and fancy. A lake covering an area of 4 acres is one of the features popular with those who take delight in boating; an electric launch and fleet of rowboats are available for those who desire them. The night scene is remarkable for its brilliancy. Over 20,000 incandescent lights artistically placed along the avenues and lawns, and used to develop the graceful architectural lines of the buildings, serve to beautify the effect, while a multitude of arc lights give the needed illumination at important points.



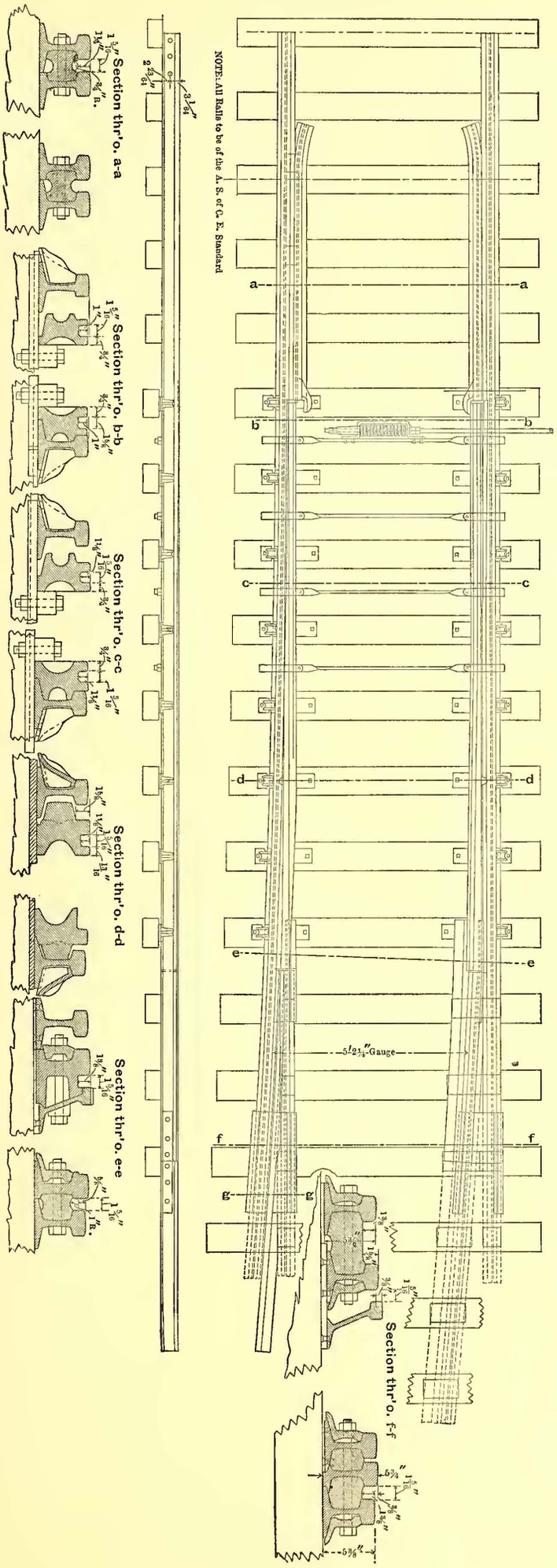
PLAN OF WILLOW GROVE TERMINAL LAYOUT

The buildings at the park are all built with the view of permanency, and most of them are painted white. Mention of the principal buildings follows:

The administration building, the headquarters from which the varied affairs of the park are directed, is a pleasing structure of brick and stone, fashioned in colonial style. Here are the executive offices and bureau of information, and in one corner is a miniature hospital. One of the commendable features of the park management is the presence of a physician, whose services are at all times at the command of the patrons gratuitously.

The mountain scenic railway is the largest attraction on the grounds, and is one of the largest and finest scenic railways in the country.

A captive flying machine is one of the newest novelties. The machine consists of a central structure 100 ft. high, with two long



SPECIAL HARDENED STEEL T-RAIL SWITCH FOR WILLOW GROVE TERMINAL

extending arms, from which are suspended by cable ten boats or "airships" in which the passengers take their novel flight, and which, as the arms revolve, are carried outward and upward in widening circles by their own momentum.

The music pavilion is a large, cheerful and comfortable open-air pavilion, with an enclosed stage at one end for the use of the musicians. Under cover there is seating capacity for 4000 people, and outside there are enough seats within sound of the music to comfortably accommodate over 15,000 people. It is not an unusual experience on a pleasant Saturday or Sunday to find 25,000 people grouped around the pavilion enjoying the music. On Labor Day of the present year 52,000 people visited Willow Grove Park.

For those who desire refreshment or meals at the park there are ample accommodations. A superior restaurant service is given at the Casino, which is a modest building, finished entirely in white, located in close proximity to the music pavilion, and having spacious porches on which over 500 people may be served with meals at one time. The company handles the restaurant privileges itself, and the Casino is noted for the superior quality of the cuisine. In addition to the Casino there are two well-equipped light lunch cafes, one in the upper part of the park, where the amusements are located, and one in the lower part, overlooking the lake and in full view of the electric fountain. A well-equipped soda fountain is located in a separate building, which affords an attractive place not only for those desiring to allay their thirst, but to those wishing a place to rest, as ample accommodations in the way of benches and comfortable chairs are at the disposal of the patrons. For those desiring to take their own lunches there are three natural groves, in the midst of which are to be found fully equipped kitchens, tables, benches, hydrants and all conveniences, especially adapted for the use of picnic parties and excursions. The use of the groves and the appurtenances is free to all.

The ladies' building is in the center of a broad lawn dotted with large shade trees, and is set apart for the exclusive use and convenience of women. Everything is free and the visitor is made to feel at home.

For the park patrons in search of light and harmless amusement there is a beautiful Midway, which in novelty and attractiveness of amusement rivals the Midways of the recent world's exhibitions at Buffalo and St. Louis, but differs somewhat from those more or less renowned affairs in that no conduct of an unruly or boisterous nature is permitted, or, in fact, attempted. Willow Grove Midway is a broad, well-paved street, upon which are found many of the latest amusement attractions, including a mirror maze, photographic gallery, coal mine, old mill, two carousels, scenic railway and the Willowgraph Theater, in which are given exhibitions of moving pictures, including an entirely new assortment of comic, magic, historical and mystic trick film novelties. The Willowgraph takes the place of the vaudeville or operatic concerts usually found in street railway parks.

The park has its own hot houses, wherein are raised the shrubbery and plants used in the landscape gardening. During the summer the force of park employees numbers about 500.

Several up-to-date methods are used for advertising this resort. These include billboard posting, small standing ads. in all the leading papers in Philadelphia and the suburbs, handbills and display cards in the cars, and an attractive booklet, copies of which are distributed freely throughout the territory from which the park travel is drawn. A feature is made of setting aside certain days for special events or societies. For instance, during the past season, days were designated as "Sunday-school Day," "Christian Endeavor Day," "America Day," "Children's Day," "Independent Order of America Day," "Grand Army Day," etc. On Christian Endeavor Day the company printed and distributed free of cost a 24-page pamphlet containing the music and words for several of the favorite Christian Endeavor hymns, and a feature was made of the music and chorus singing at the music pavilion.

The park does not yield any profit to the Philadelphia Rapid Transit Company, but during the last few years has been practi-

cally self-supporting. It was not started by the present management, and it is doubtful whether the officials of the company would recommend the creation of such a property simply for the traffic which it attracts. As the property belongs to the company, however, the wise policy has been adopted not only of keeping up its standard in every particular, but also of reserving the management to its own employees, so that by no chance can any undesirable features creep into the park operation.

NEW LINE TO WILLOW GROVE

To afford the residents of North Philadelphia and Germantown a new direct route to Willow Grove, an entirely new line was built in the spring of the present year. The line starts at Second Street and Lehigh Avenue, in Philadelphia, and runs over the new route to the park, distant from this point about 8 miles. For a considerable portion of the way the new road runs on private right of way, and for 2 miles passes through a new 100-ft. street to the city limits. Beyond the city limits the road is laid with 90-lb. A. S. C. E. T.-rail on yellow pine ties placed on rock ballast. Power is taken from the Glenside and Willow Grove sub-stations.

OTHER PARKS

The Philadelphia Rapid Transit Company, in addition to Willow Grove Park, serves Fairmount Park, Woodside Park, Chestnut Hill Park, Central Park and other smaller parks and pleasure resorts, all of which have natural or artificial attractions of various sorts and enjoy a considerable local patronage.

WILLOW GROVE TERMINAL

Prior to the present year the terminal facilities at Willow Grove Park were not entirely satisfactory. Most of the lines serving the resort approached the park over what is known as "The Old York Road," and the situation required that they make a wide detour around the park. The unloading platform was at the north end and the lay-over sidings and loading platforms at the south end, the cars leaving the park near the same point at which they entered. The cars from Doylestown did not enter the grounds, but unloaded their passengers at a point at a considerable distance from the main attractions. The construction of the new Willow Grove line early in 1905, the cars on which approached the grounds from the south, necessitated the rearrangement of the terminal facilities and the occasion was taken to lay out a comprehensive terminal that would better accommodate the travel on all the lines.

A plot of ground irregular in shape, but approximately 1200 ft. long and 195 ft. wide, was secured, and after several different terminal arrangements had been discussed, the one illustrated on page 538 was finally adopted. The terminal property is located very near the music pavilion, so that passengers are not required to walk any very great distance to and from the cars. The location also has the advantage that the topography of the property and the approaches were such that the building of bridges or trestles was avoided, and although seven different lines enter the terminal there are no grade crossing either for cars or passengers. It was also possible to lay out separate and commodious loading and unloading platforms and ample lay-over tracks.

The lines entering over the Old York Road were deflected from the former circuitous routes and are now led into the park on the eastern side of the turnpike. The new Willow Grove line is built on private right of way and enters the terminals by a nearly direct course.

The terminal property was graded so as to give room for a subterranean passageway crossing under all of the tracks at a point near the center of the property and connected to the loading and unloading platforms by inclined subway passages. The main cross passageway has a minimum head room of 8 ft. and is 36 ft. wide in the widest part. The side walls are formed of mass concrete and the roof is built of I-beams on which are laid concrete slabs with layers of waterproofing material on top.

A center line of posts and iron fence divides this main passageway in halves longitudinally, one half constituting the entrance and the other the exit passageway.

There are two unloading platforms and two loading platforms. These are connected to the main cross passageway by long slopes, each 18 ft. wide. There are no steps for passengers to ascend or descend. The floors of the inclined passageway rise on a grade of about 8 per cent. and are paved with vitrified brick. The side walls of the inclined passageways are also of mass concrete.

These passageways are used by passengers from all the cars with the exception of the lines from Doylestown, which are taken into the park over the top of the tunnels and load and unload at a separate platform, also located near the music pavilion.

As will be understood from the diagram showing the lay-out, the cars in every case pass directly to the unloading platforms and then enter the lay-over tracks where they lie until required. The cars are dispatched empty from the exit ends of the lay-over tracks and pass directly to the loading platforms. These loading platforms are arranged with fences and exit gates leading to pens, each pen constituting a berth for a particular line of cars. Over each exit gate is an illuminated sign indicating the destination of the cars stopping at the particular gate. The arrangement gives excellent control over the crowds and avoids any wild rush and scramble for seats, as passengers are admitted to the pens only in numbers as can be accommodated by the number of cars at the stand.

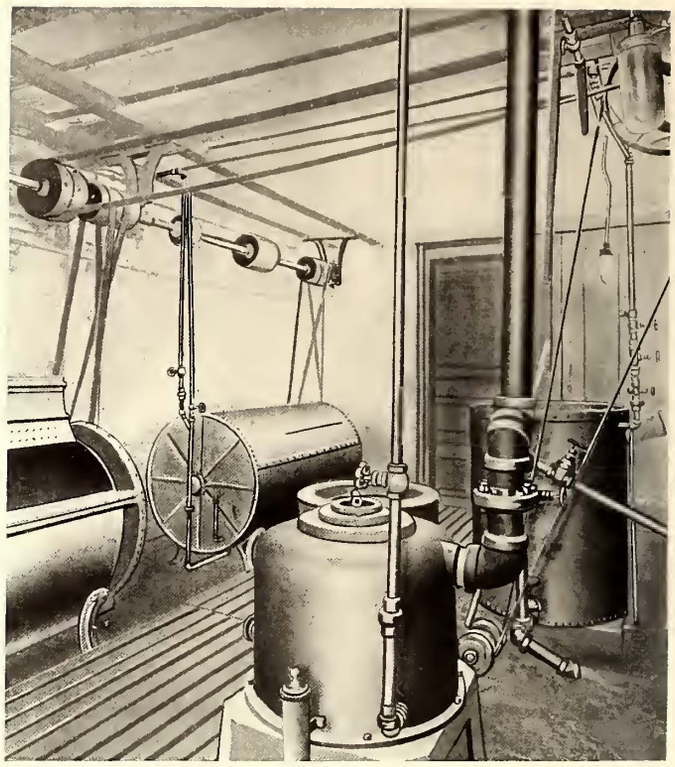
The switches leading into the lay-over tracks are of special design to meet the exacting conditions. All of the switches are made of hardened steel and are designed to accommodate M. C. B. standard car wheels. The switches at the ends of the lay-over tracks are operated by switch stands and levers from a small switch house located near the entrance, so as to enable the man at the levers to readily see the route signs on the cars as they approach. The leaving ends of the lay-over tracks are controlled by ground throw switches having the usual spring attachment, so cars can trail through without throwing the lever. The frogs are hardened steel center construction and the track is laid with 90-lb. T-rail, A. S. C. E. section. All the track layouts in the terminal were constructed and furnished by the Lorain Steel Company.

A commodious building for the use of conductors and motormen was built adjoining the lay-over tracks. The building is constructed entirely of concrete. As many as an average of 5000 people per hour have been handled at the terminal on special days.

INTERIOR OF COMPANY'S CHEMICAL TESTING LABORATORY

INTERIOR OF LOST AND FOUND DEPARTMENT, SHOWING BINS AND UMBRELLA RACKS

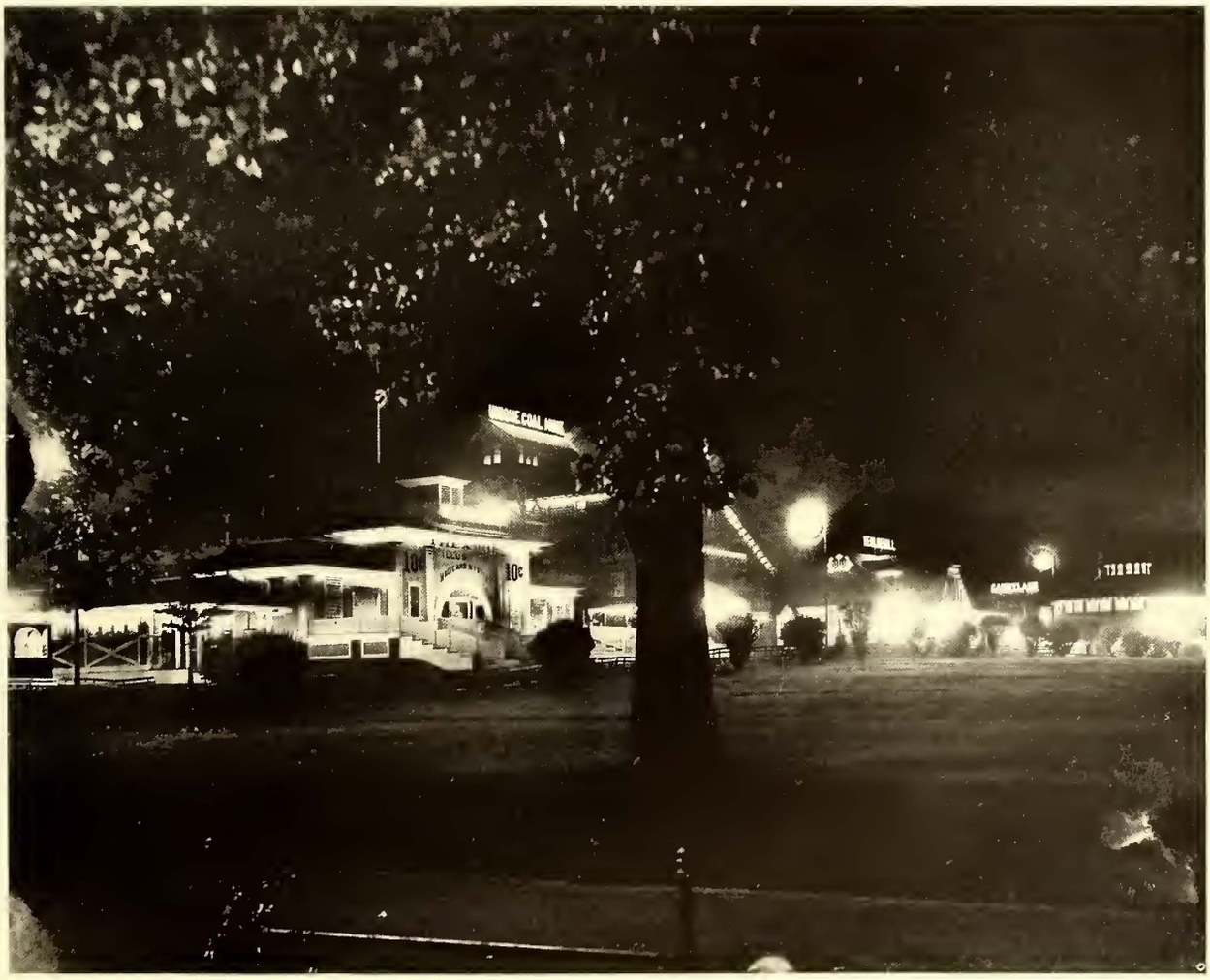
A CORNER OF THE COMPANY'S TYPE COMPOSING ROOM



LAUNDRY FOR CLEANING OILY WASTE AND COMMUTATOR RAGS

INTERIOR OF COMPANY'S PRINTING ESTABLISHMENT

PANORAMA OF LOWER END OF WILLOW GROVE, SHOWING ELECTRIC FOUNTAIN AND MUSIC PAVILION IN DISTANCE



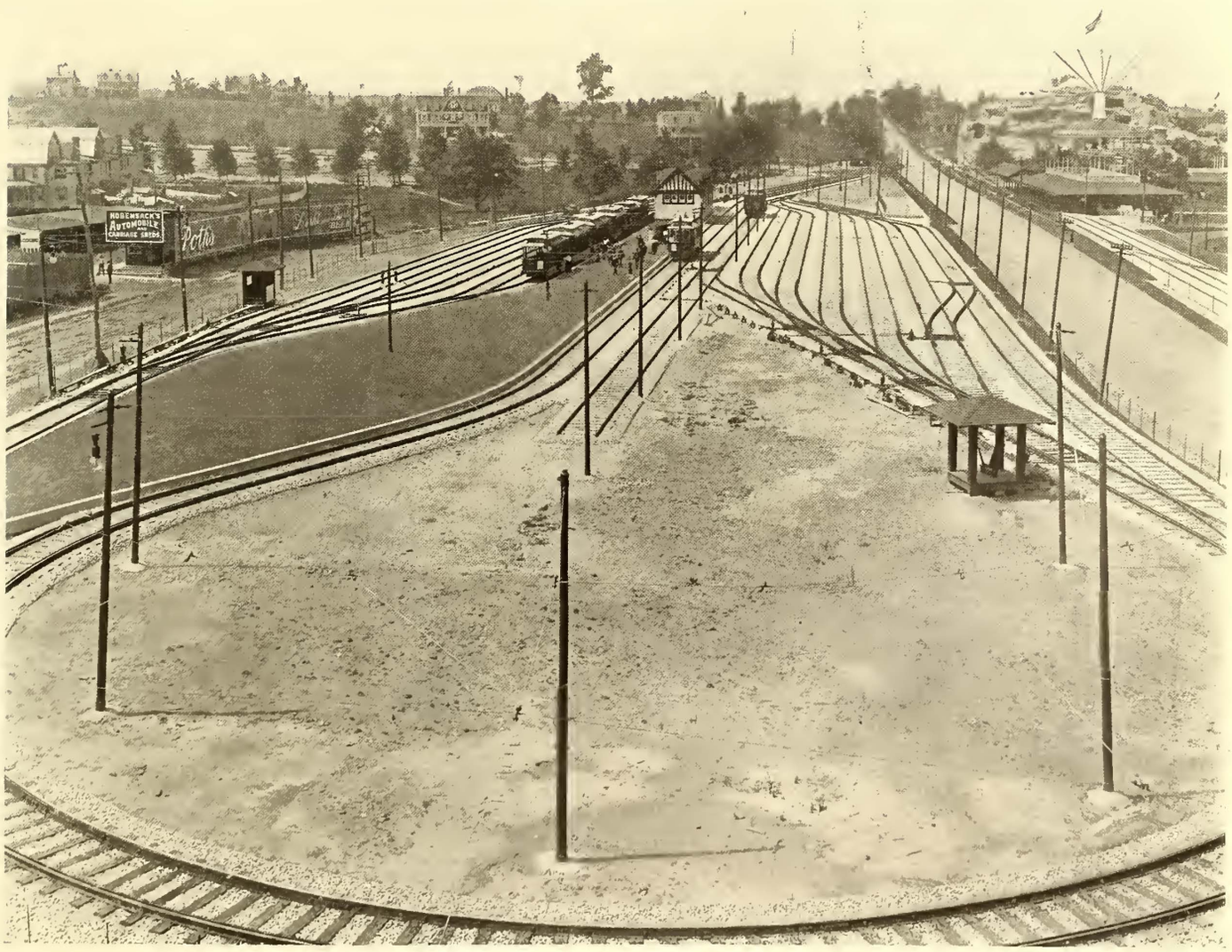
THE MIDWAY AT NIGHT, WILLOW GROVE PARK

PART OF WILLOW GROVE MIDWAY

PANORAMA OF WILLOW GROVE, SHOWING TERMINAL TRACKS AT RIGHT

WILLOW GROVE TERMINAL, SHOWING GATES AND INDICATING SIGNS ON LOADING PLATFORMS

GENERAL VIEW OF WILLOW GROVE TERMINAL

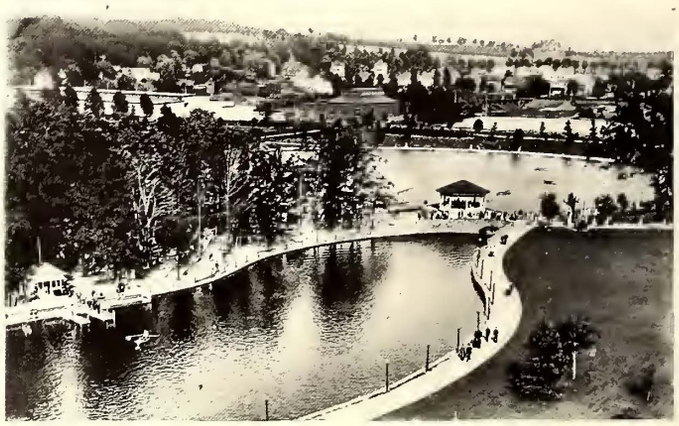


LOOP AND LAY-OVER TRACKS AT WILLOW GROVE TERMINAL

ENTRANCE TO UNDERGROUND PASSAGEWAY AT WILLOW GROVE TERMINAL

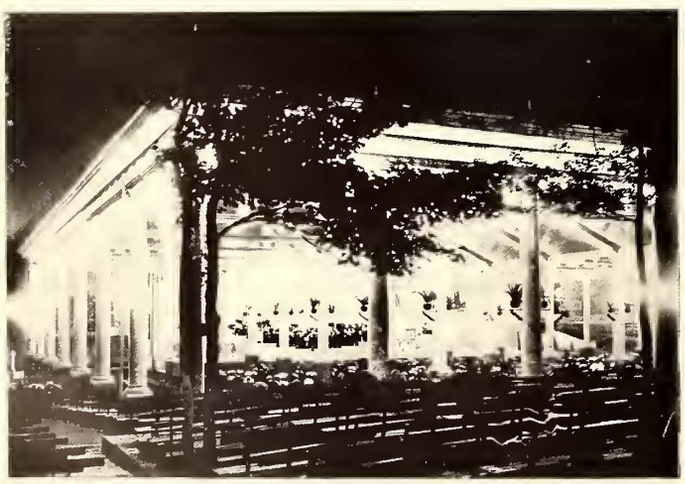
BUILDING FOR CONDUCTORS AND MOTORMEN AT WILLOW GROVE TERMINAL

HARDENED STEEL SWITCHES AT ENTRANCE TO WILLOW GROVE TERMINAL



THE TWO LAKES AT WILLOW GROVE PARK

ELECTRIC FOUNTAIN AT WILLOW GROVE

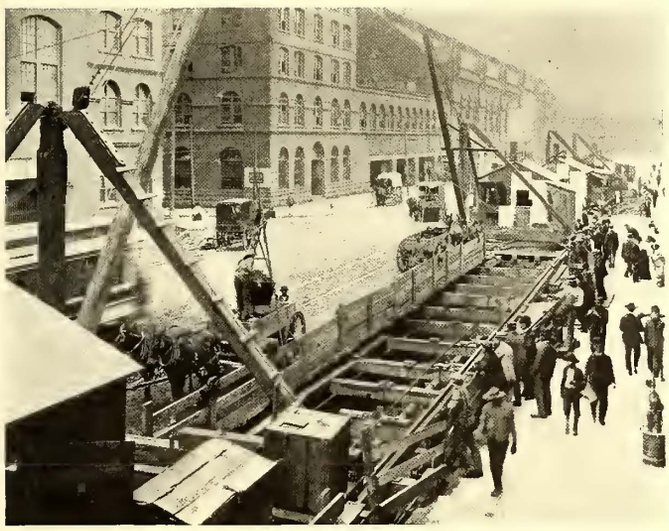


WILLOW GROVE MUSIC PAVILION

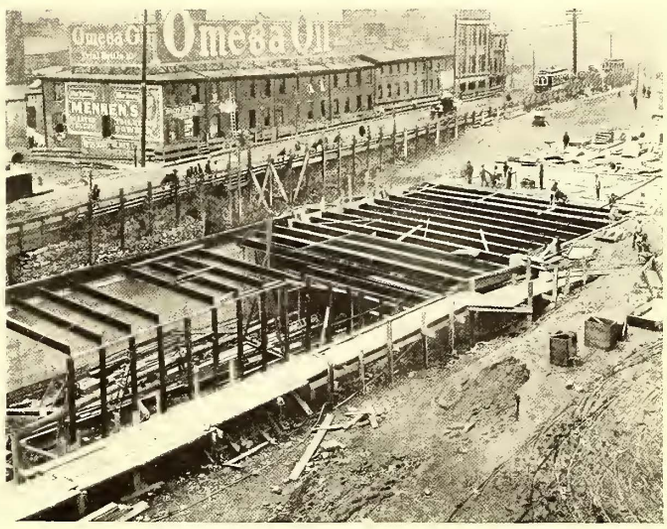
THE WILLOW GROVE CASINO

COMMENCING EXCAVATION WORK ON SUBWAY TRENCH

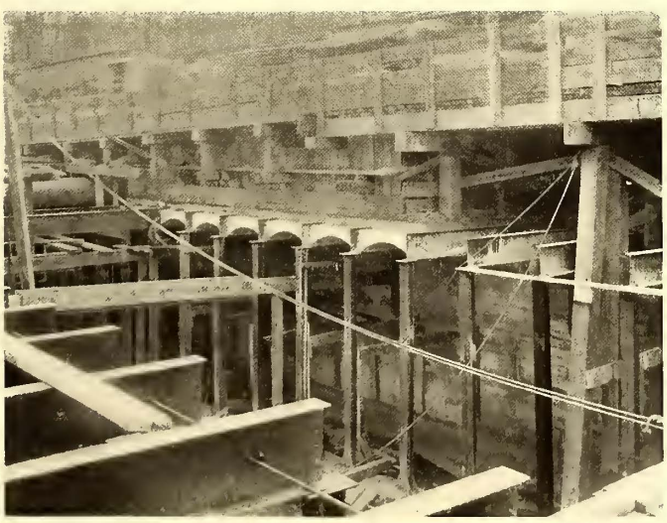
VIEW SHOWING METHOD OF SUPPORTING TEMPORARY TRACK FOR SURFACE CARS, 12-IN. CITY HALL WATER MAIN SUPPORTED AS SHOWN



SURFACE VIEW OF SUBWAY DURING CONSTRUCTION, SHOWING PLANKING OVER PART OF ROOF TO FORM PLATFORM FOR UNLOADING TEAMS

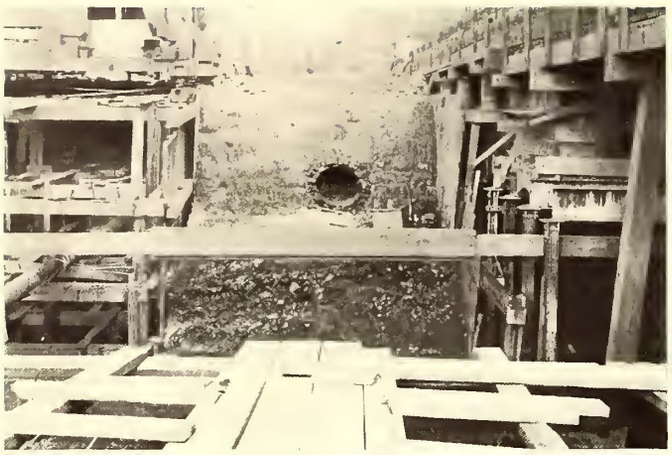


VIEW SHOWING SUBWAY ROOF CONSTRUCTION BEFORE CONCRETE WAS IN PLACE



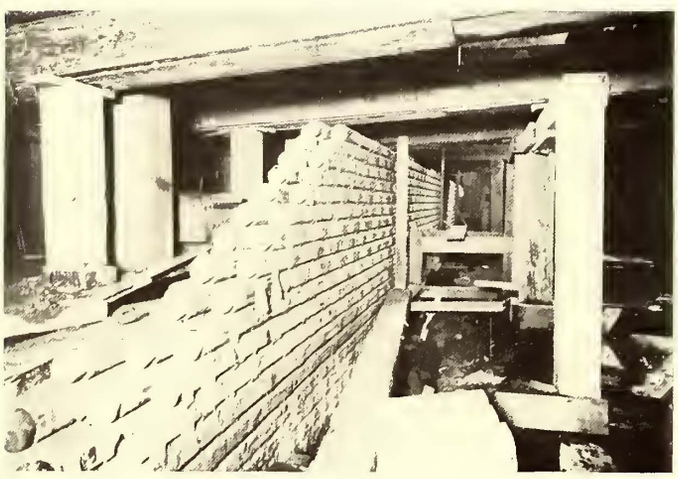
PARTIALLY COMPLETED SECTION OF SUBWAY, SHOWING GIRDERS AND ROOF AND METHOD OF CARRYING STREET TRAFFIC DURING CONSTRUCTION

VIEW SHOWING SUBWAY ROOF CONSTRUCTION



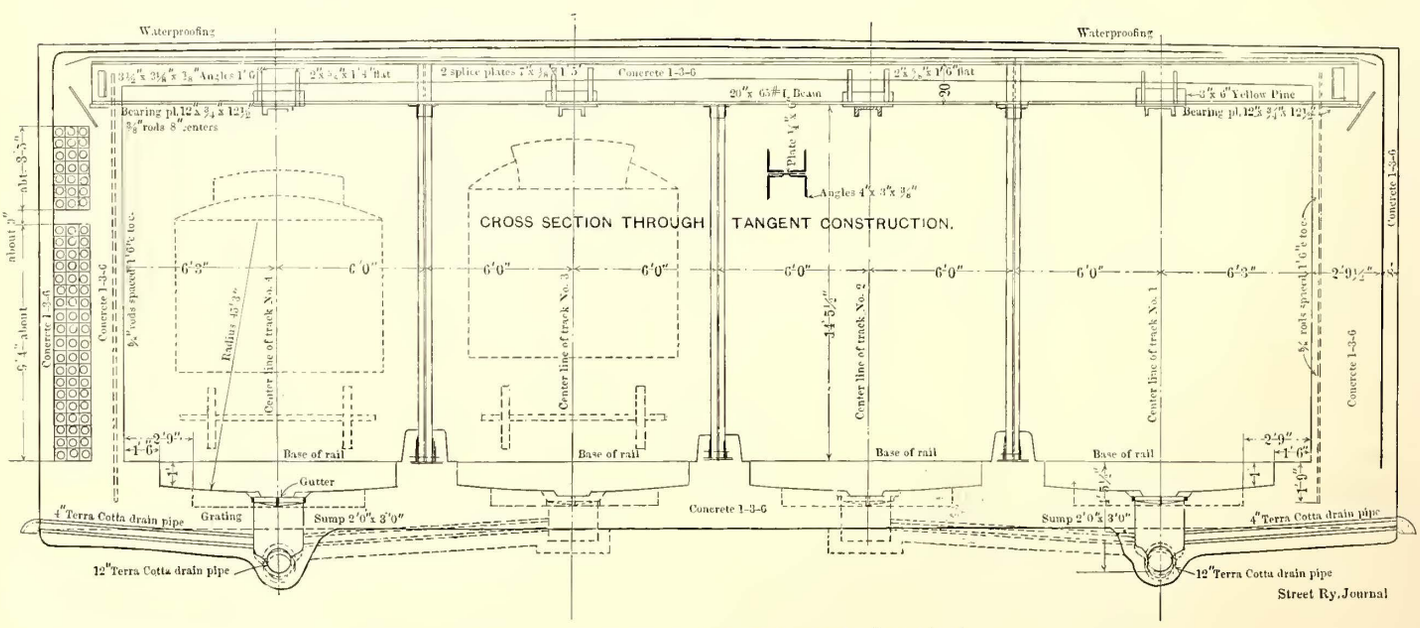
VIEW OF SUBWAY TRENCH, SHOWING CORE ENCLOSING SEWER REMAINING TO BE EXCAVATED

REINFORCED CONCRETE SEWER, BUILT TO REPLACE OLD SEWERS IN LINE OF SUBWAY UNDER MARKET STREET



TERRA COTTA DUCTS TO CARRY CABLES BELOW SUBWAY STATION

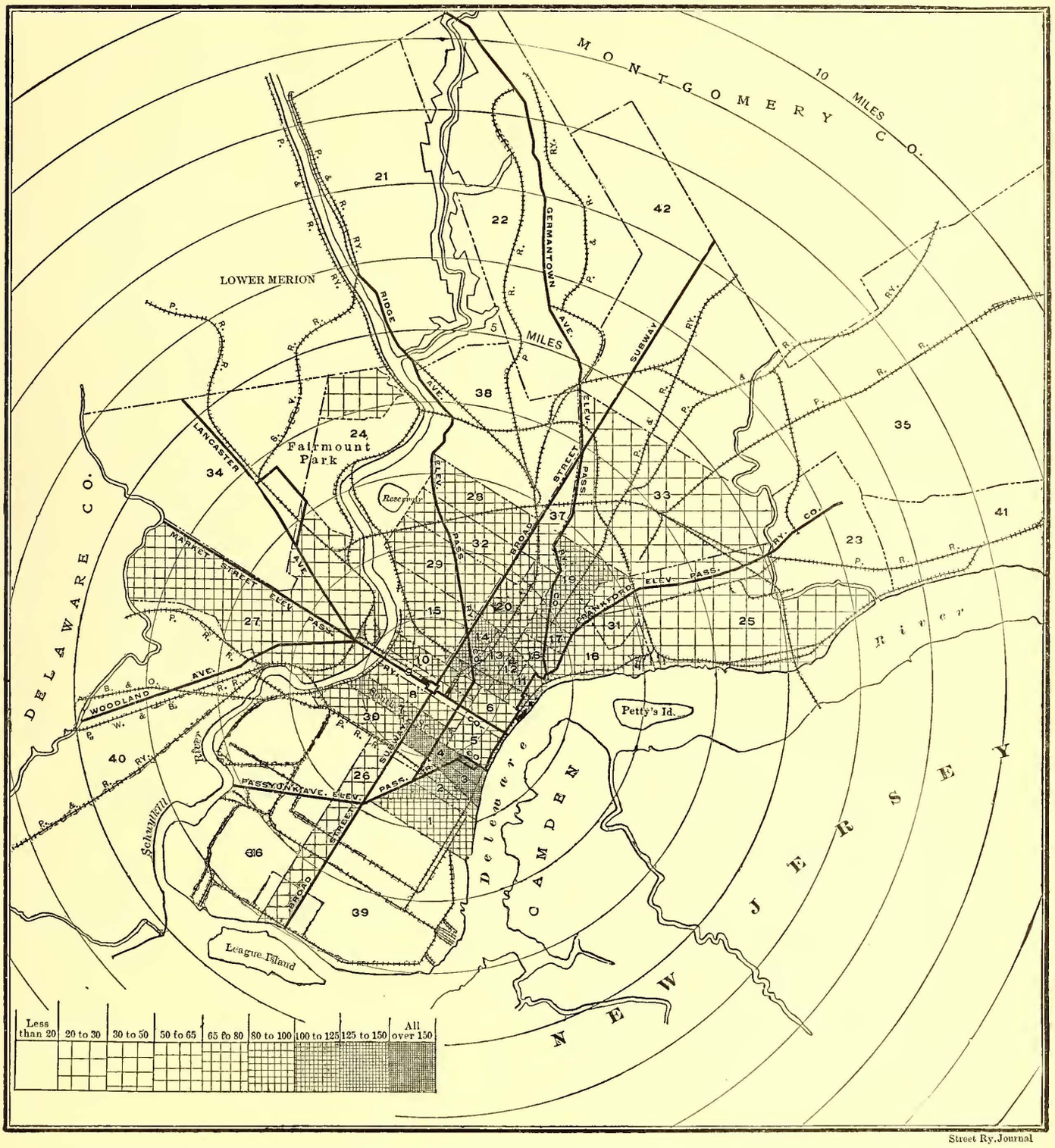
TYPICAL VIEW IN SUBWAY BEFORE TRACKS WERE LAID



TYPICAL CROSS-SECTION THROUGH SUBWAY

THE SUBWAY AND ELEVATED LINES IN PHILADELPHIA

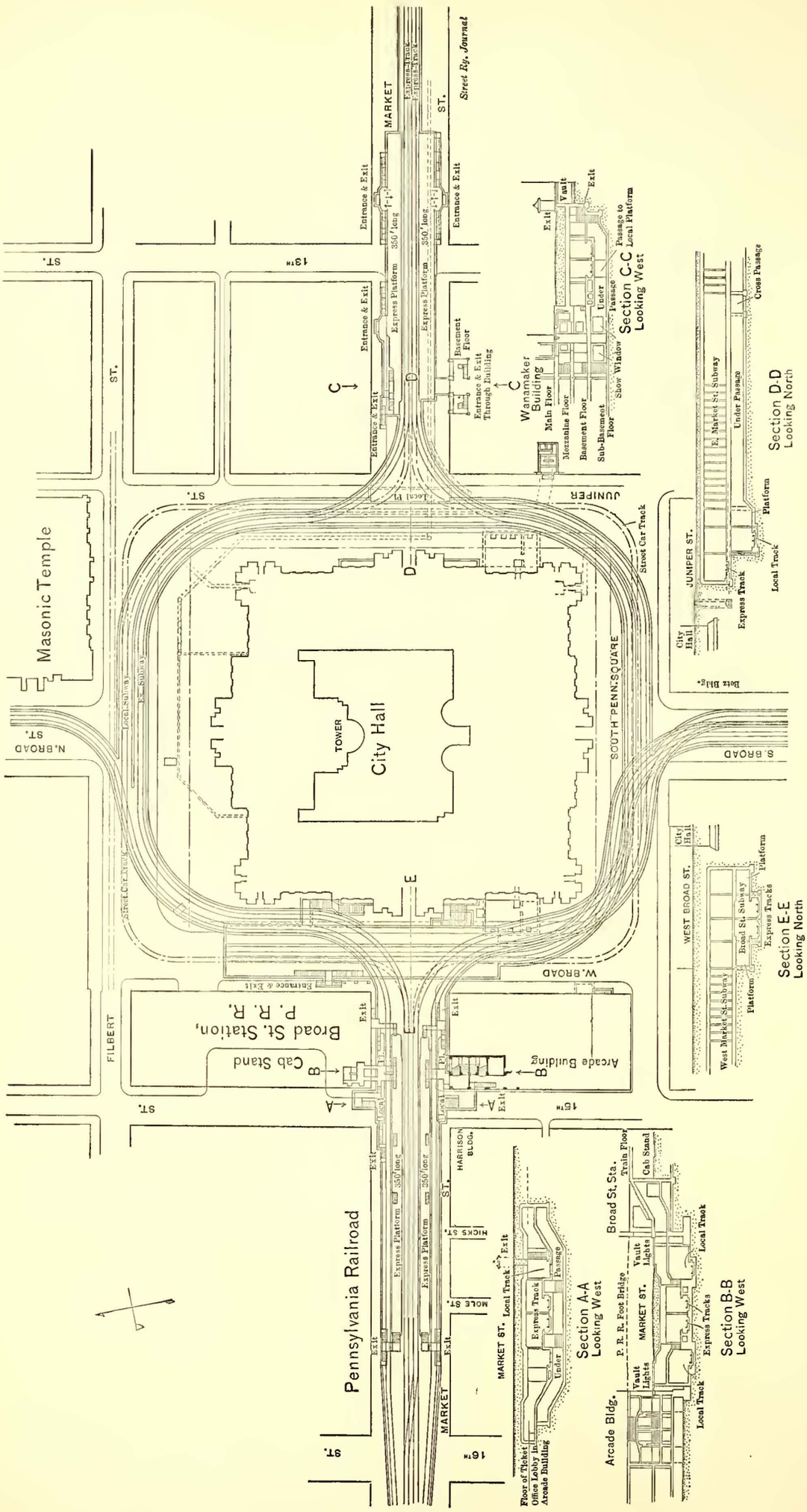
As has been briefly pointed out in the previous articles in this issue, the traffic in the central portions of the city within recent years has grown beyond the capacity of the street railway lines to handle it. For instance, cars are now being operated on Market Street on 30 sec. headway during the rush hours, and inasmuch as the maximum length of car has been reached, the present lines on this street can no longer be relied upon to meet the future increase in traffic, nor for that matter to fill the present demands.



Street Ry. Journal

MAP OF PHILADELPHIA, SHOWING DENSITY OF POPULATION PER ACRE BY WARDS, AND PROPOSED ELEVATED AND SUBWAY RAPID TRANSIT LINES

In 1901 the State Legislature passed an act sanctioning the incorporation of elevated and subway rapid transit companies, and the Philadelphia Councils granted franchises for several projects, including elevated lines on Market Street, Ridge Avenue, Frankford Avenue, Passyunk Avenue and Germantown Avenue, and subways under Broad Street. By ordinance passed in 1902 the Councils authorized the building of a subway on Market Street east of the Schuylkill River, this subway to take the place of the elevated road on Market Street as contemplated in the original franchises. In October, 1902, the charter was amended to provide for the construction of a loop subway from City Hall south on Broad Street to Walnut Street, thence east



PLAN OF SUBWAYS TO BE BUILT AROUND CITY HALL

on Walnut Street to Fifth Street, thence north on Fifth Street to Arch Street, thence west on Arch Street to Broad Street, thence south on Broad Street to Filbert Street, thence on Broad Street south to City Hall.

All of these franchises were subsequently acquired by the Philadelphia Rapid Transit Company, and a broad scheme for giving genuine rapid transit facilities in conjunction with the existing surface lines was formulated.

Anxious not only to demonstrate the feasibility of the plans under discussion, but also to afford the much needed relief for the badly congested lines, the company decided to build the first section of the rapid transit route in West Market Street, commencing as a subway at the west side of the City Hall in front of the Pennsylvania Railroad Broad Street Station and running under Market Street due west to the Schuylkill River, thence by a bridge over the river and continuing as an elevated structure on Market Street to Sixty-Third Street. The line will primarily serve the newer sections of the city west of the Schuylkill River known as West Philadelphia, which is rapidly becoming one of the chief residential districts, and secondarily in conjunction with the loop subways around the City Hall and thence east to the Delaware River will relieve Market Street of its present surface congestion.

To show the need

of relief on the busy streets, the condition on that section of Market Street running east of Ninth Street may be cited as a single illustration. During the morning and evening hours 104 cars are scheduled to pass a given point in this section per hour in each direction, or 208 cars on the two tracks. The schedule headway is 34 sec. on each track and is disarranged by the obstruction of street traffic. The schedule speed in the locality referred to is about 600 ft. per minute, or 6.8 miles per hour. The speed between the termini is about 700 ft. per minute, or about 8 miles per hour.

The relief afforded by the operation of trains in the subway at points on the system where the traffic is now, or will in the future, equal the volume in the locality referred to may be considered as follows:

The volume of traffic passing an assumed point, based on the seating capacity of the present surface cars, is 3936 passengers per hour. The number of passengers passing a given point in an hour in the subway based on six-car trains seating 50 passengers each on two-minute headway is 9000 per hour, so that the relief to be afforded by the subway with two-minute headway between trains may be represented as 230 per cent; with 1½-minute headway it will equal 307 per cent.

It may be of interest to state that the number of passengers per hour during the rush hours morning and evening has been found on the elevated railways in New York and Chicago to reach as high as 6.96 times the average number of passengers per hour for the entire 24 hours. Although this is perhaps an exceptionally high figure, the average for a number of points where passengers have been counted is between three and four times the average number per hour for the entire twenty-four hours.

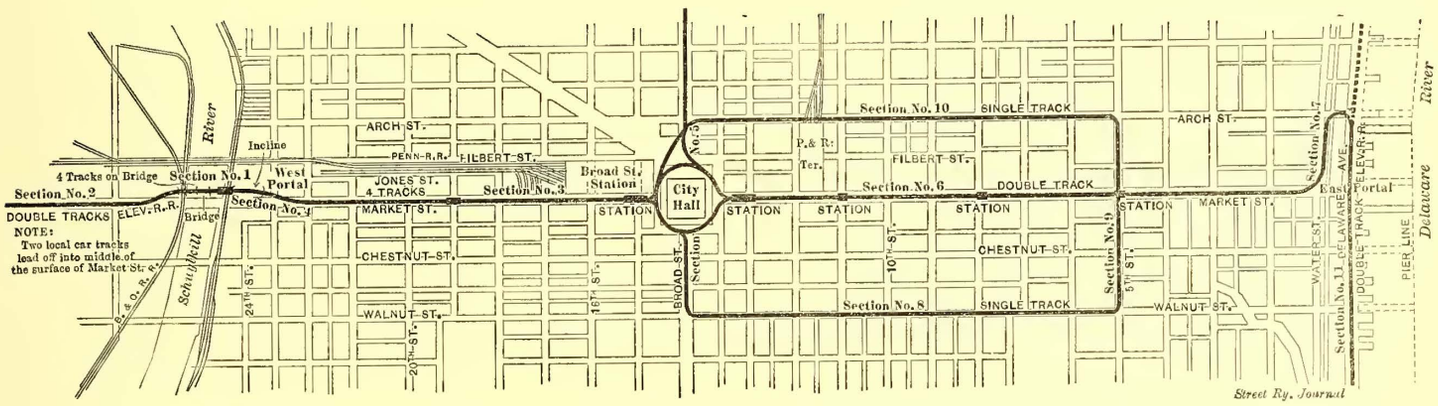
The tendency of increased facilities for travel to reduce the density of population around the business centers and increase that of the outlying districts is shown in the map on page 541, which gives the distribution of population per acre by wards. The wards in the business district have been reduced during the past few years in residential population by percentages ranging from 5.7 per cent to 44.3 per cent. The only ward that may be considered a central ward which shows an increase is the Fifteenth, located near the Schuylkill River, where the population has increased 5.2 per cent. In contrast with the depopulation of the downtown districts as residential sections, the increase in the outlying wards has been very marked, that in the Twenty-Eighth amounting to nearly 318 per cent, in the Twenty-Fifth to 224 per cent, and in the Twenty-Second to 124 per cent.

The same map shows the subway and elevated rapid transit lines contemplated and under way by which the congestion of surface street traffic in downtown districts will be relieved, and means of quick transportation provided between the rapidly growing outlying wards and the center of the city.

WEST MARKET STREET SUBWAY

The West Market Street section of the subway now nearing completion includes provision for four tracks, the two outer tracks to receive the regular surface cars from West Philadelphia and the two inner tracks to receive the trains from the elevated railway, extending west on Market Street from the Schuylkill River to a terminal west of the county line near Sixty-Third Street. As before stated, the connection between the West Market Street elevated structure and the Market Street subway is made on inclined tracks across the bridge over the Schuylkill River. According to the plans for extensions east of the City Hall terminal of the West Market Street subway, the two outer tracks for surface cars will connect by a subway loop around the business districts by Walnut, Fifth and Arch Streets, so that the cars bound east will run on the south outside track and return to the west by the north outside track. The two inner tracks reserved for trains will be connected with a subway under East Market Street extending to a point between Water and Front Streets, and thence by an incline between the two latter streets to Arch Street, where connection will be made to an elevated structure leading to and on Delaware Avenue.

The four-track subway is now practically completed from Sixteenth Street near the City Hall west to a point near the Schuyl-



PLAN OF OUTER AND INNER SUBWAY LOOPS IN DOWNTOWN DISTRICT

kill River. This section has a width of 48 ft. 6 ins. in the clear between walls and is 14 ft. 6 ins. high in the clear above the base of the rails. Three intermediate lines of columns support the roof, which is designed to carry the heaviest street traffic likely to be imposed upon it for many years to come.

The roof is formed of concrete arches supported on steel I-beams 5 ft. apart placed across the subway. The side walls are of concrete, reinforced with steel rods, and the floor is of concrete alone.

Terra cotta ducts with manholes at frequent intervals are built in the south wall, forming the conduits for feeder cables carrying current for the operation of the railway and for lighting the subway and stations.

The roof over its entire length is waterproofed with asphaltic mastic 1 in. thick. The side walls are waterproofed where necessary with layers of burlap coated with a compound consisting of the residuum from the refining of petroleum.

For the most part the line of the subway lies in earth and gravel, very little rock formation having been encountered. But a more or less serious problem was brought into the work by reason of the presence of inflowing ground water between Twenty-First and Twenty-Third Streets, the gravel bed in many places being thoroughly saturated. To take care of this sub-surface water and insure perfect underdraining for all time to come, there were laid two lines of terra cotta pipe, one under each outside track, with lateral drains passing to the exterior of the side walls every 50 ft. The main drains lead in each direction to the low point at Twenty-

Second Street, where a well or sump collects the contents of the drains. A pumping station is operated in conjunction with the sump, and the water is discharged into a sewer by electrically driven centrifugal pumps regulated automatically by floats. The conditions as to under drainage permitted the placing of these longitudinal sub-drains below the floors of the subway, and by this means any appreciable head of water against the side walls is prevented, thereby increasing the dryness of the structure and permitting the omission of the waterproofing on the parts of the side walls where they had been made thick to promote facility of construction.

Ground was broken for the subway work on April 6, 1903, at Twenty-Third Street and Market Street, to begin the reconstruction of the sewerage system which necessarily preceded the work on the subway proper. The most important feature of this work involved making provision for a large sewer main running under Market Street, which intercepted the drainage from all of the cross streets to the south. To replace this trunk main, an entirely new sewer ranging from 3 ft. to 4 ft. 9 ins. in diameter was built just outside the south wall of the subway. This sewer was built wholly of reinforced concrete with the invert lined with brick. Other less important cross and lateral sewers and water mains were deflected outside the line of the subway or, when necessary, were replaced by lines on other streets.

There were also lines of underground conduits containing telephone and lighting wires for which provision had to be made. Prior to the beginning of construction, contracts were made with the companies owning these conduits permitting the alterations and re-adjustments required by the subway construction. The conduits of the Bell Telephone Company were re-laid on Arch Street, a parallel thoroughfare, while provision was made for a portion of the conduit system of the Keystone Telephone Company in the south wall of the subway proper, the remaining portion being re-laid on the north side of Market Street in practically the original position.

The work also included the widening of Market Street on the north side west of Twenty-Second Street, raising the grade of Market Street about 12 ft. at its intersection with Twenty-Third Street, repaving the driveways and sidewalks, and also raising the grades and repaving the adjacent streets to meet the revised grade of Market Street.

The raising of the grade of Market Street was necessary to allow the subway tracks to make the ascent to the Schuylkill River bridge and pass over the tracks of the Baltimore & Ohio Railroad along the east bank of the river. The grade of the railway on the ascent was established at 5 per cent and the roof of the subway is about 9 ft. above the old surface of Market Street at its intersection with Twenty-Third Street, and about 3 ft. below the present surface of Market Street.

Contract for all of this work was carried out by the E. E. Smith Contracting Company.

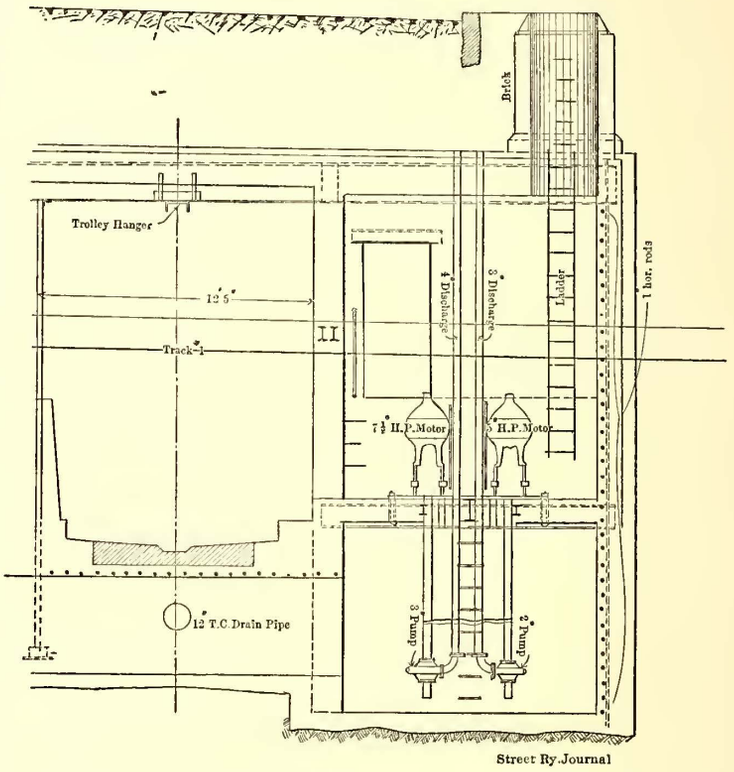
All of this work has been managed to make as little interference as possible with the street traffic, the street railway cars on West Market Street having been kept in operation without any interruption. The space between the car tracks and the nearest curb on one side of the street was always kept open for travel, the work being confined to one side of the street at a time. In general, the cut and cover method was pursued in building the subway, and the work was carried out in three stages, as follows:

(1) The south shoulder of the street was first trenched to a sufficient width to allow the building of the main sewer and a longitudinal section of the subway approximating one-quarter of the full cross section, to include one track. The street was then back-filled and repaved.

(2) When the closing up of the south side had progressed for about two blocks, the operation was repeated on the north shoulder and the floor and side wall built. The top was left uncovered on the north portion until a later period to facilitate the removal of material from the middle section or core.

(3) The middle section, or core, under the street car tracks was the last to be taken out, following the construction of the wall and floor for the north track. To support the surface tracks during the removal of the core beneath, stringers had previously been placed under the rails and a plank floor laid upon them for the full width of the track bed. Upon the plank flooring the block paving was replaced, practically maintaining the original surface conditions over the excavation. Posts placed under the stringers as the excavation advanced supported the tracks until the permanent steel roof beams could be slipped into position, the columns supporting them having previously been set in place. The weight of the tracks was then transmitted to the steel beams by means of blocking. Upon the removal of the core, the north and middle sections were roofed over, completing the full cross section of the subway. The back-fill and the repaving followed, restoring the street to its original condition.

The center line of the subway coincides with the center line of Market Street to a point 47 ft. west of Twenty-Second Street,



SECTION THROUGH PUMP CHAMBER AT TWENTY-SECOND AND MARKET STREETS, FOR LIFTING WATER FROM DRAINAGE SUMP IN SUBWAY

where it deflects to the north on reverse transition curves to meet the bridge over the Schuylkill River, the center line of the bridge being 100 ft. north of the center line of the present city bridge which carries Market Street over the river to West Philadelphia. The western end of the covered subway terminates at the portal about 137 ft. west of Twenty-Third Street, from whence the railway ascends to the bridge between retaining walls of concrete.

The stations on the West Market Street section will be located respectively at Fifteenth Street, Nineteenth Street, and at the end of the Schuylkill River bridge near Twenty-Fourth Street, the latter station designed to make connection with the Baltimore & Ohio Railroad. Stations at Nineteenth Street and Twenty-Fourth Street are intended for the regular surface cars operating on the two outer tracks of the subway. At present the Fifteenth Street station, which is just west of the City Hall, will be used temporarily as a terminal station with cross-overs until the eastern sections of the subway are completed. The stations intended for the single cars have short platforms, capable of accommodating two or three cars at a time. At the Eighteenth Street station, which will be used by both the trains and single cars, island platforms will be

built with concrete passageways above and underneath the tracks to connect the different platforms.

The roadbed in the subway will be laid with 90-lb. T-rails. The two inner tracks will each have a third rail, the exact location of which at this writing has not been decided upon. The two outer tracks for the use of the surface cars will have an overhead trolley.

It may be of interest to note the basis upon which the subway structure has been designed in order to carry the various loads imposed. In arriving at the dead-load allowance was made for the heaviest pavement liable to be placed, viz.: granite blocks on 6-inch concrete base. The weight of this pavement allowing for depth of 15 ins., which includes a 3-inch sand cushion under blocks, is 175 lbs. per square foot. The weight of the earth is taken at 110 lbs. per cubic foot, below the base of the pavement. The total dead weight resting on the top of the roof thus varies between 260 lbs. per square foot for 2 ft. cover up to 1140 lbs. for a 10-ft. cover, and proportionately for other depths. The minimum cover above the top of the roof is 4 ft., except in special cases, and the maximum, as far as the work has progressed up to this time, is between 9 and 10 feet.

The roof, including concrete steel slabs, metal girders at the stations, sidewalks, columns, etc., are proportioned by the following live loads:

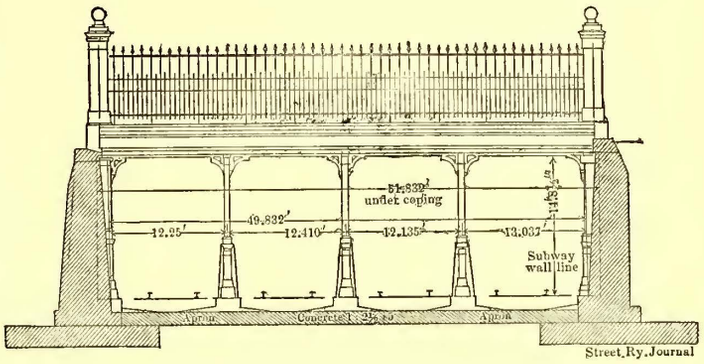
The concentrated load consists of 10 tons on each of four wheels, making 40 tons in all, 20 ft. between axles, and gage of 5 ft. This load is considered distributed by the pavement and the earth, between the pavement and the roof. In this distribution, equivalent loads for simplicity of computation are worked out so that each of the two pairs of wheels is replaced by a rectangle loaded with a load equivalent to the weight on the wheels. These rectangles are the same distance center to center as the axles, namely, 20 ft. The equivalent distributed load on the said rectangles varies from 1180 lbs. per sq. ft. for a 4-ft. cover to 200 lbs. per sq. ft. for a 16-ft. cover—the loads for intermediate covers varying, though not directly with the depth. Where the cover is 3 ft., the load is 1330 lbs per sq. ft. Special shallow construction is treated as each individual condition makes necessary. In addition to the foregoing concentrated loads, a general load of 200 lbs. per sq. ft. is applied exterior to a space 30 ft. long and 11 ft. wide, placed symmetrically to the concentrated load, the greater length parallel with the longitudinal axis of the latter.

The foregoing loads are applied so as to produce the maximum effect on any member of the construction. The concentrated load used in this work is in accordance with experience in Philadelphia covering a number of years, and is considered an adequate allowance for the heaviest loads liable to be transported about the streets.

The lateral pressure on the sidewalls consists of two parts, namely, the dead weight of the material exterior to the walls, and a superficial load taken as 200 lbs. per sq. ft. The pressure on the walls is computed by the theory of earth pressure as developed by Rankin. The co-efficient by which the pressure is determined varies in the different soils, and is based on experience in dealing with the soils in this city.

In special cases where the work approaches closely to heavy buildings, the weight of the latter are considered in determining the strength of the walls, as there is no rock above the floor of the subway except in very few places.

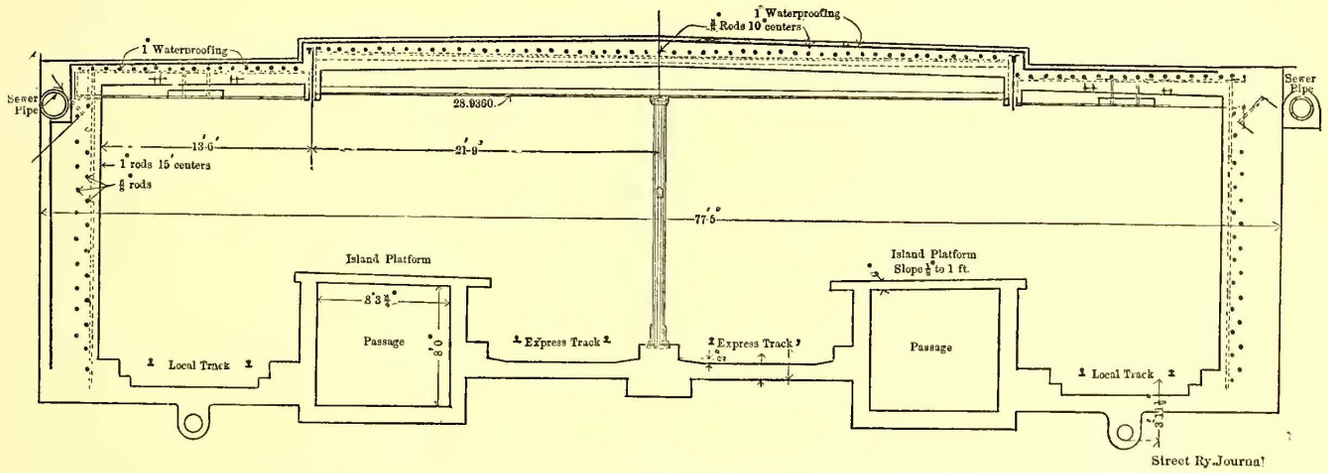
Where continuous masonry structures, such as manholes, or other street appurtenances are founded upon the roof of the subway, by which the estimated distribution of the concentrated loads would be partly vitiated, grillages will be placed in special cases to insure proper distribution to correspond with the allowed loads.



ELEVATION OF WEST PORTAL TO SUBWAY

VENTILATION

Provision has been made for ventilating the subway by building chambers along the sides with connections to the outer atmosphere so arranged that fans may be installed if found necessary. There are six of these chambers on the section between the City Hall and the Schuylkill River, and at Twenty-Second Street a ventilating stack is under construction designed to give a natural draft and provide an outlet for the foul air. At the base of the stack provision has been made for the installation of a fan if necessary. The stack is built of masonry work and is 60 ft. high and 8 ft. 4 ins. in diameter. In arranging the ventilating chambers and ducts previously mentioned, advantage was taken of the fact that the north side of the subway extends in close proximity to the Pennsylvania Railroad freight buildings along Market Street. The ventilating ducts from the air chambers are brought up against the piers of the Pennsylvania buildings in the form of masonry stacks, the stone facings of these stacks corresponding in material, workmanship and finish to the wall of the Pennsylvania Railroad buildings to which they abut. These ventilation stacks will be of concrete, reinforced with horizontal and vertical Thatcher rods, following the general construction pursued in building the subway walls.

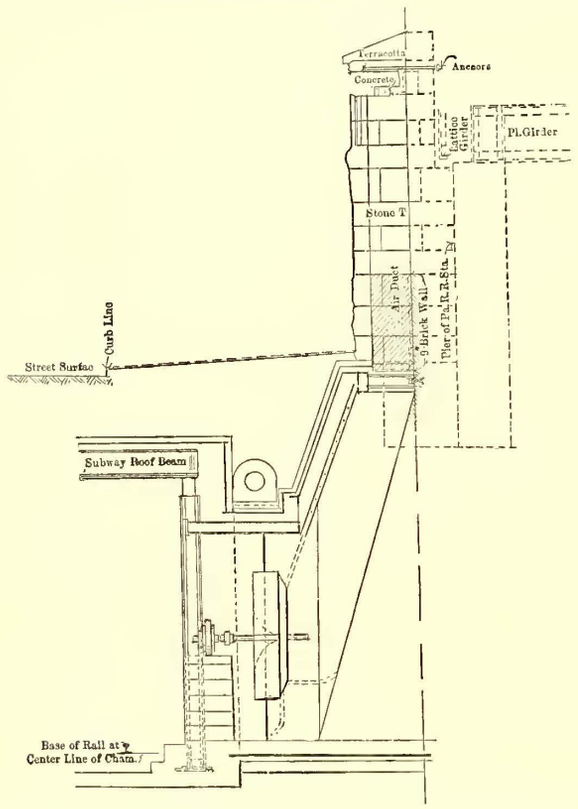


SECTION THROUGH SUBWAY STATION AT FIFTEENTH STREET, SHOWING ISLAND PLATFORMS

In arriving at a basis as to the quantity of air required to properly ventilate the subway, an estimate was first made of the number of passengers that will use the subway at one time, and the scheme of ventilation has been laid out to allow for completely renewing the air four times per hour, taking 1800 cu. ft. of fresh air per person per hour as the requirement. It is believed the system of having several comparatively small ventilating ducts connecting with the outside air will give better results than would be secured by admitting the air through fewer large openings. The distribution of the air between ventilating chambers will be accomplished mainly by the plunger-like motion of the cars. If the circulation due to the movement of cars and trains, accentuated by the 60-ft. ventilating stack at Twenty-Second Street, is not found sufficient, motor-driven fans will be placed in as many of the ventilation chambers as may be found necessary.

SCHUYLKILL RIVER BRIDGE

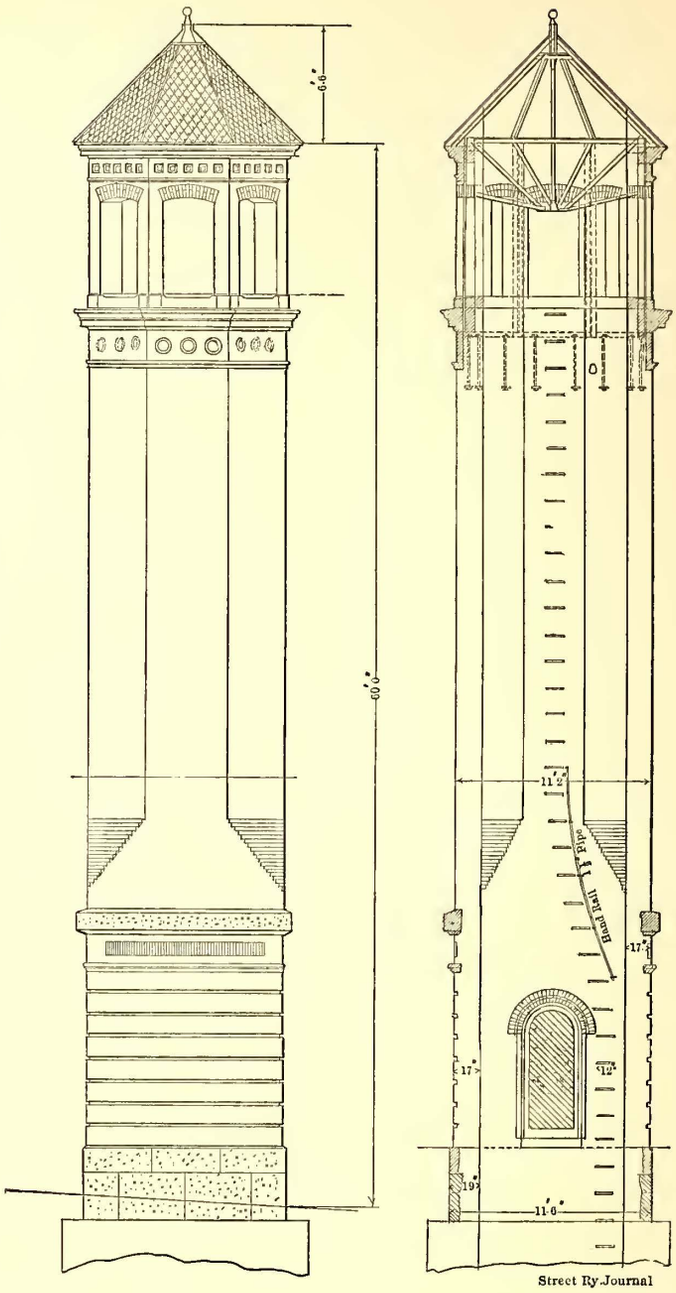
The bridge upon which the subway tracks cross the Schuylkill River called for a design somewhat out of the ordinary, inasmuch as it was necessary to carry the two inner tracks on an ascending grade of about 4 per cent from the east to the west so as to bring



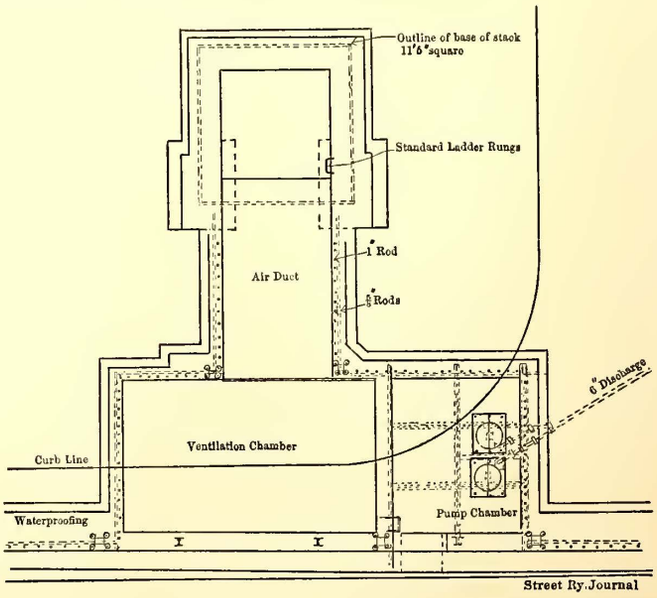
SECTION THROUGH SUBWAY VENTILATING DUCTS ALONG PENNSYLVANIA RAILROAD BUILDINGS

the trains from the subway level on the east bank to the level of the elevated structure on the west bank; and to carry the two outer tracks on a descending grade of 2.34 per cent from the west river pier to the ground surface at the west end of the bridge.

Beginning at the easterly approach, the superstructure consists of a plate girder approach span; a 98-ft. through Pratt truss; a 214-ft. truss with curved top, which is the main river span; a 90-ft. Pratt truss, and an 82-ft. plate girder approach to the west shore. The cross sections of the bridge reproduced on Plate XLIX. show the gradual divergence of the inner tracks and outer tracks at the centers of the respective spans. It will be noticed that the bridge structure begins at the eastern end just beyond the incline leading from the subway portal with the four tracks on the same level, but reaches the west end as practically a double-deck structure with the two inner tracks 22½ ft. above the side tracks designed to carry the surface cars. The piers and abutments of the bridge are of stone founded on bed rock, with the exception

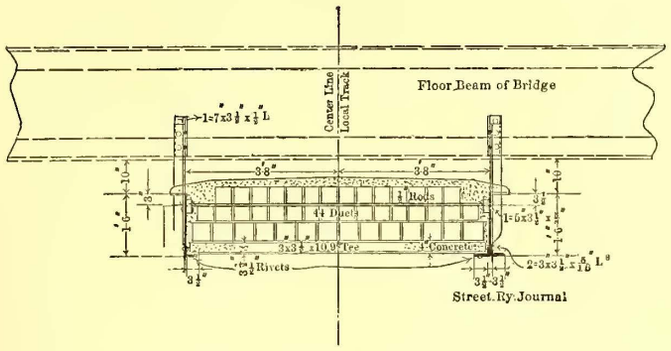


DETAILS OF SUBWAY VENTILATING STACK AT TWENTY-SECOND AND MARKET STREETS



PLAN OF VENTILATION CHAMBER AND BASE OF VENTILATING STACK

of the west abutment which rests on a pile foundation. Five pneumatic caissons were used in founding the piers. The total length of the bridge is 563 ft. and the under clearance at mean



METHOD OF CARRYING CABLE DUCTS ACROSS THE SCHUYLKILL RIVER BRIDGE

high water is 28½ ft. The bridge was built and erected by the American Bridge Company.

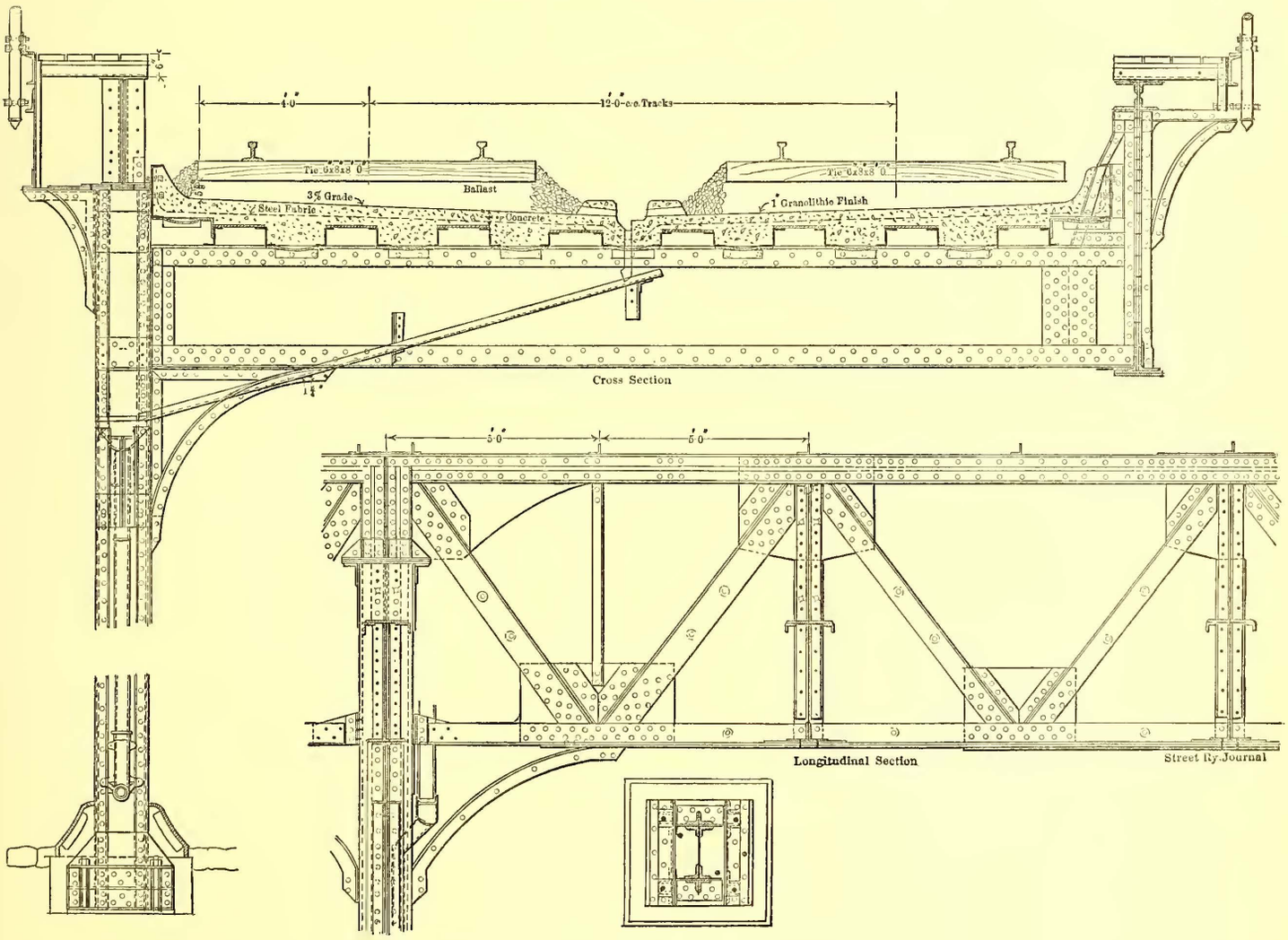
Provision is made for carrying the power and telephone cables across the bridge by continuing the bank of conduits running through the south wall of the subway under the floor system of the bridge. The conduits are supported between special steel stringers and are covered with a concrete casing, the entire structure being hung from the bridge floor system by special hangers, as shown in the detail drawing on this page. The concrete floor between the stringers supporting the lines of conduits is reinforced by wire cloth. As will be noticed from the drawings on Plate XLIX., the bank of conduits is carried under the outside tracks to the west end of span No. 3, where the conduits run into a junction house and pass from the outside tracks to the two inner tracks, the conduit for the rest of the way being supported beneath the two inner tracks, at the level of the outer tracks.

ELEVATED STRUCTURE

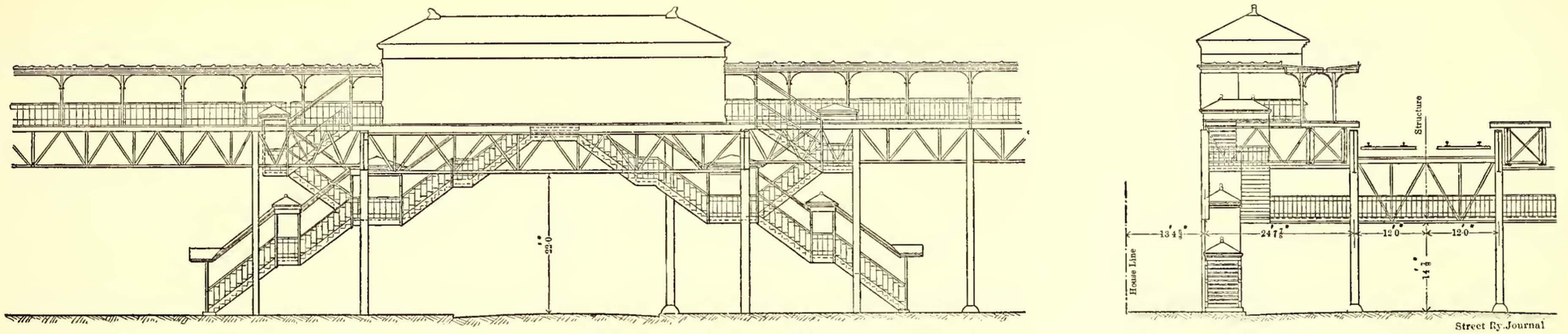
The ordinance authorizing the elevated railway called for a structure with a closed floor system, so that no drippings would fall from the elevated railway into the street. To meet this requirement, and also to reduce the noise to a minimum, the structure has been designed with a steel deck extending clear across the structure and covered with a bed of concrete under the roadbed. Where the concrete bed is deposited against vertical or inclined surfaces, the concrete is locked to such surfaces by stud bolts upon which wire is wrapped, the intention being to secure the benefit of the protection of the concrete and diminish the liability of its shaking loose and permitting water to percolate through and produce corosion.

Where the railway is on a grade of one per cent or over, there has been placed a longitudinal gutter between the tracks parallel to the grade of the structure. Where the grade is less than 1 per cent, the gutter is provided with a grade of not less than 1 per cent by local inclination between the column bents. The drainage water is delivered to collector boxes secured to the columns, from whence it is discharged below. A bed to confine the ballast transversely and maintain alignment is made by a dam between the guard in the center of the structure and the rails, and also by a facia channel on the ouside of the structure.

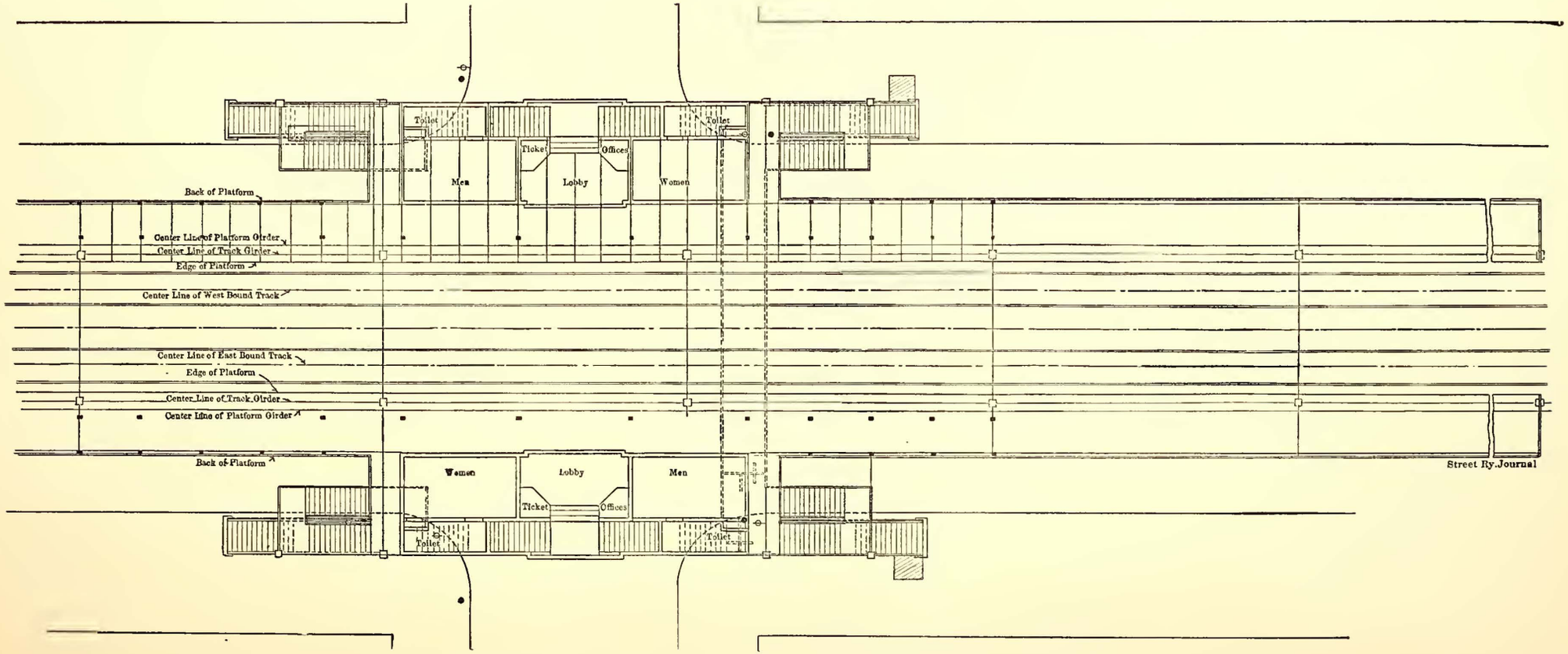
The tracks comprise the ordinary cross tie construction with a



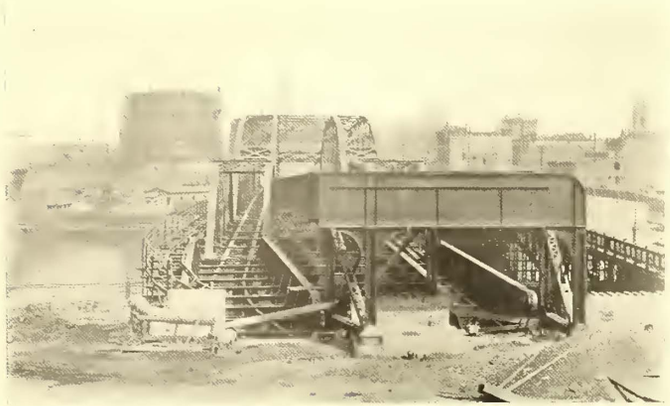
DETAILS OF ELEVATED STRUCTURE ON WEST MARKET STREET ELEVATED RAILWAY



ELEVATION AND SECTION OF TYPICAL STATION ON WEST MARKET STREET ELEVATED RAILWAY



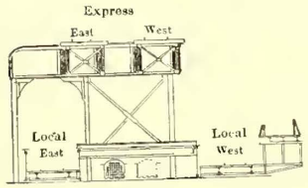
PLAN OF TYPICAL STATION ON WEST MARKET STREET ELEVATED RAILWAY



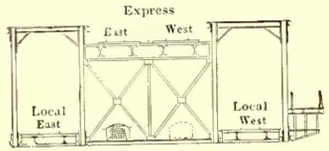
SCHUYLKILL RIVER BRIDGE, LOOKING EAST, SHOWING ELEVATED TRACKS IN CENTER AND SURFACE TRACKS AT SIDE

SCHUYLKILL RIVER BRIDGE, LOOKING NORTHEAST

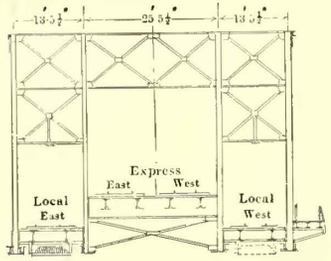
SCHUYLKILL RIVER BRIDGE, LOOKING WEST, SHOWING ELEVATED TRACKS ON INCLINE IN CENTER, AND SURFACE TRACKS AT SIDES



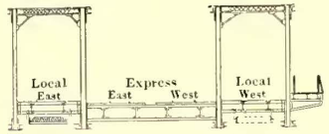
Section at Span 5



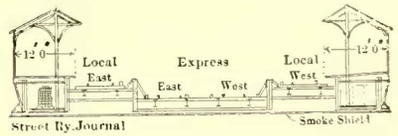
Section at Span 4



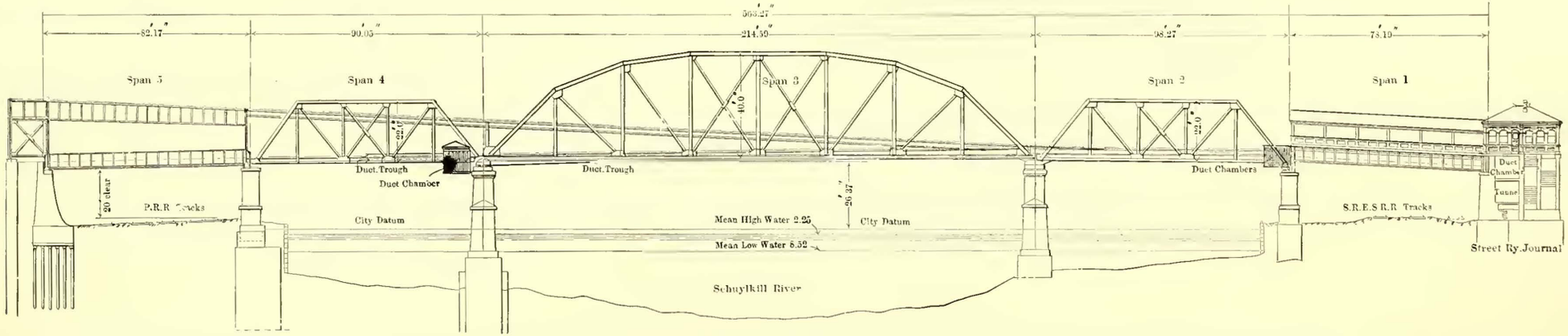
Section at Span 3



Section at Span 2

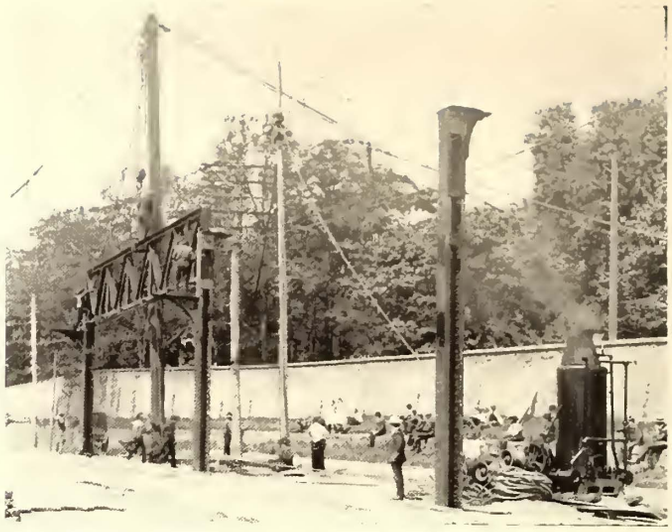


Section at Span 1



ELEVATION AND SECTIONS OF NEW SCHUYLKILL RIVER BRIDGE CONNECTING THE SUBWAY ON THE EAST END WITH THE ELEVATED STRUCTURE AND SURFACE TRACKS ON THE WEST END

VIEW OF WEST PORTAL TO SUBWAY



STARTING WORK ON WEST MARKET STREET ELEVATED STRUCTURE

VIEW TAKEN EARLY IN SEPTEMBER OF THIS YEAR, SHOWING FIRST SECTION OF ELEVATED STRUCTURE ON WEST MARKET STREET

minimum of 5 ins. of ballast under the ties, the ballast resting directly on the concrete bed. The third rail will probably be placed between the inside rails and will be fed by feeders passing through pipe apertures extending through the concrete. Where the grade is 2 per cent or over, transverse ridges are placed in the concrete bed at right angles to the track to prevent creeping.

A feature of the deck construction is a special curved plate comprising the bottoms of the steel troughs, by which such water as may percolate through the concrete is delivered to the middle, from whence it escapes through holes punched at intervals of three or four feet through the curved plate. These holes are provided with a specially designed drip on the lower side so that alkaline water will not run along the under side of the deck and destroy the paint.

Another feature of the deck construction is the use of special small angles termed "drip angles," by which such leakage as may occur at the juncture of the steel floor with the cross floor beams will be led to drop clear from the floor beams below.

Along each side of the structure a gangway will be placed supported on curved brackets. Each gangway will be provided with a pipe hand rail, with details arranged so that there will be no rattling of the pipes, the pipes being confined by a specially devised joint.

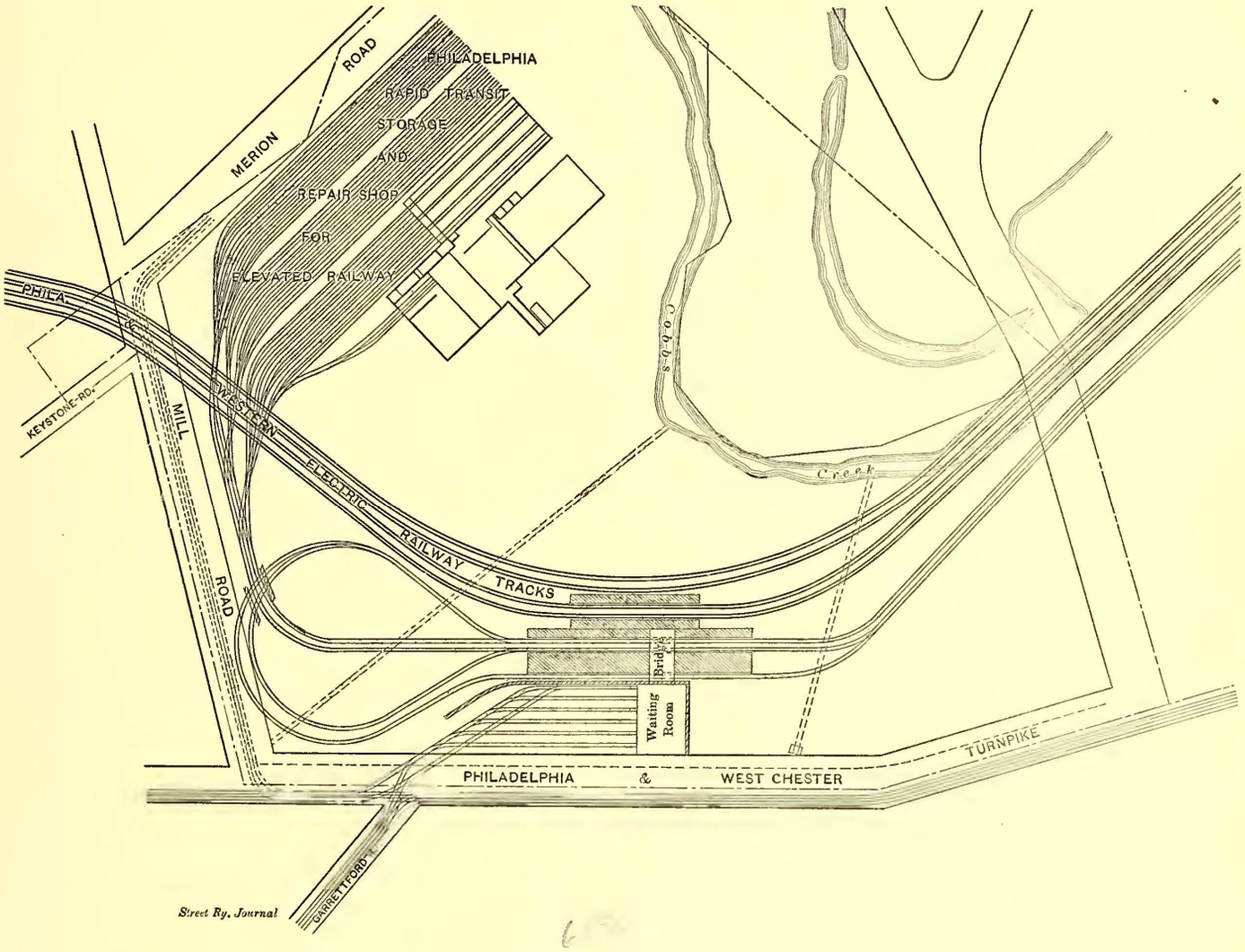
The foundations for the columns are all of concrete, with four angle bolts to each column. At the base of each column is a cast-iron fender filled with concrete, which is finished off on top to a smooth surface to drain water.

In very many cases, special designs for column foundations were necessary, owing to the presence of gas and water pipes so close to the street surface that it was necessary to provide spread footings of reinforced concrete to make the pressure per unit of area sufficiently low on soft ground. In other places it was necessary to provide grillages where pipe mains pass directly through the footings in order to carry the base of the columns around the obstructions and to a sufficient depth to secure ample foundations. All the steel work in grillages of this kind will be encased in concrete, being locked to the vertical surfaces to maintain contact and prevent corosion.

Elevated stations are located at intervals of approximately four blocks from the Schuylkill River to the Sixty-Third Street terminal. Cross passages are providied under the tracks at each station to make connection with the platforms on each side of the railway. This arrangement places the stations higher than the adjacent portions of the lines, producing in some cases accelerating and retarding grades in leaving and approaching the stations. At the stations where the railway is higher than at the other parts of the line, plate cross floor beams are replaced by lattice girders which serve also as transverse bracing to stiffen the structure.

The station platforms are carried on separate girders to avoid vibration, these girders being supported on brackets from the outer side of the columns.

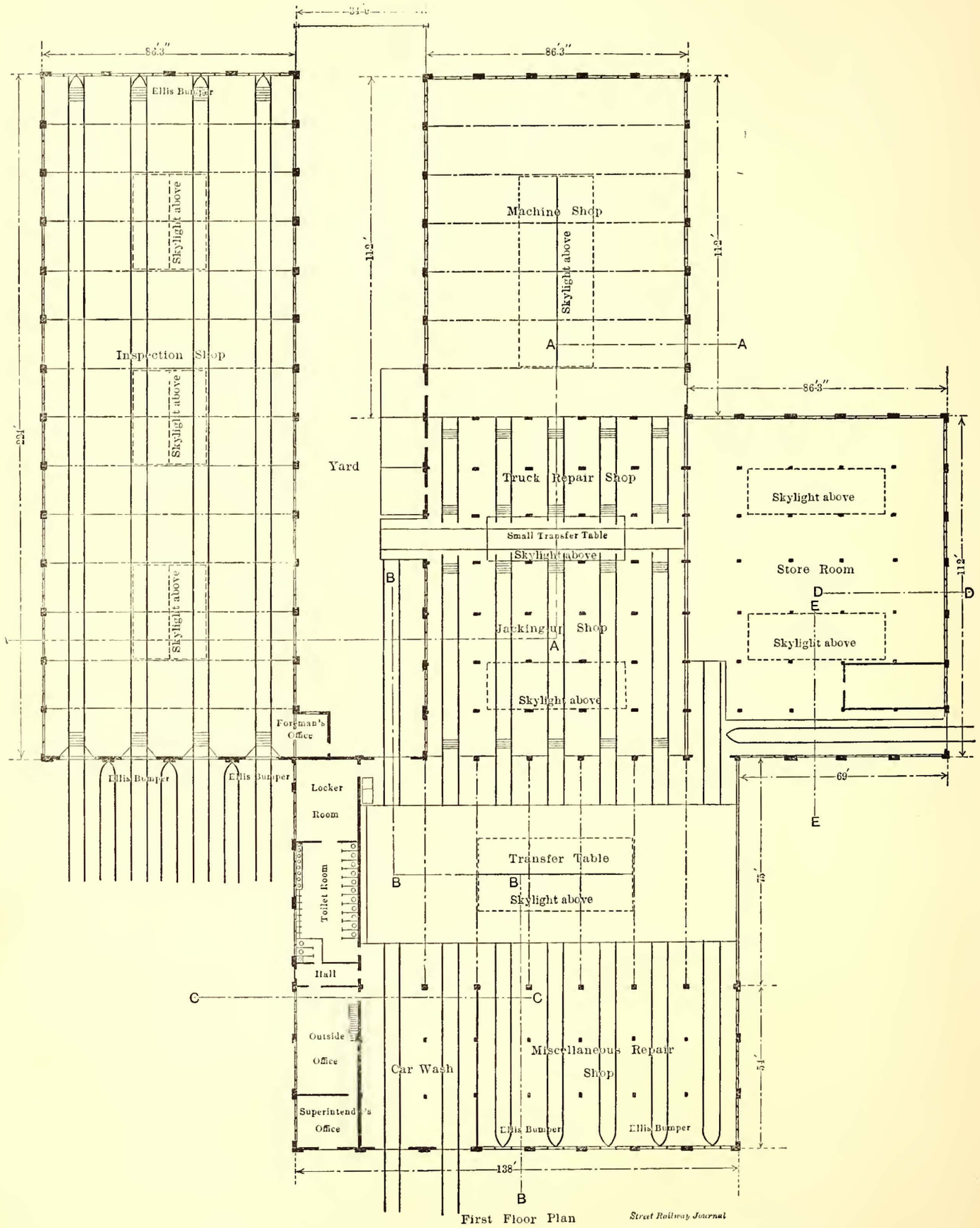
Expansion joints are placed in the elevated structure at intervals of from 200 to 250 ft. At these expansion joints steel dams support the concrete, the concrete being anchored to the vertical surfaces in the manner previously described.



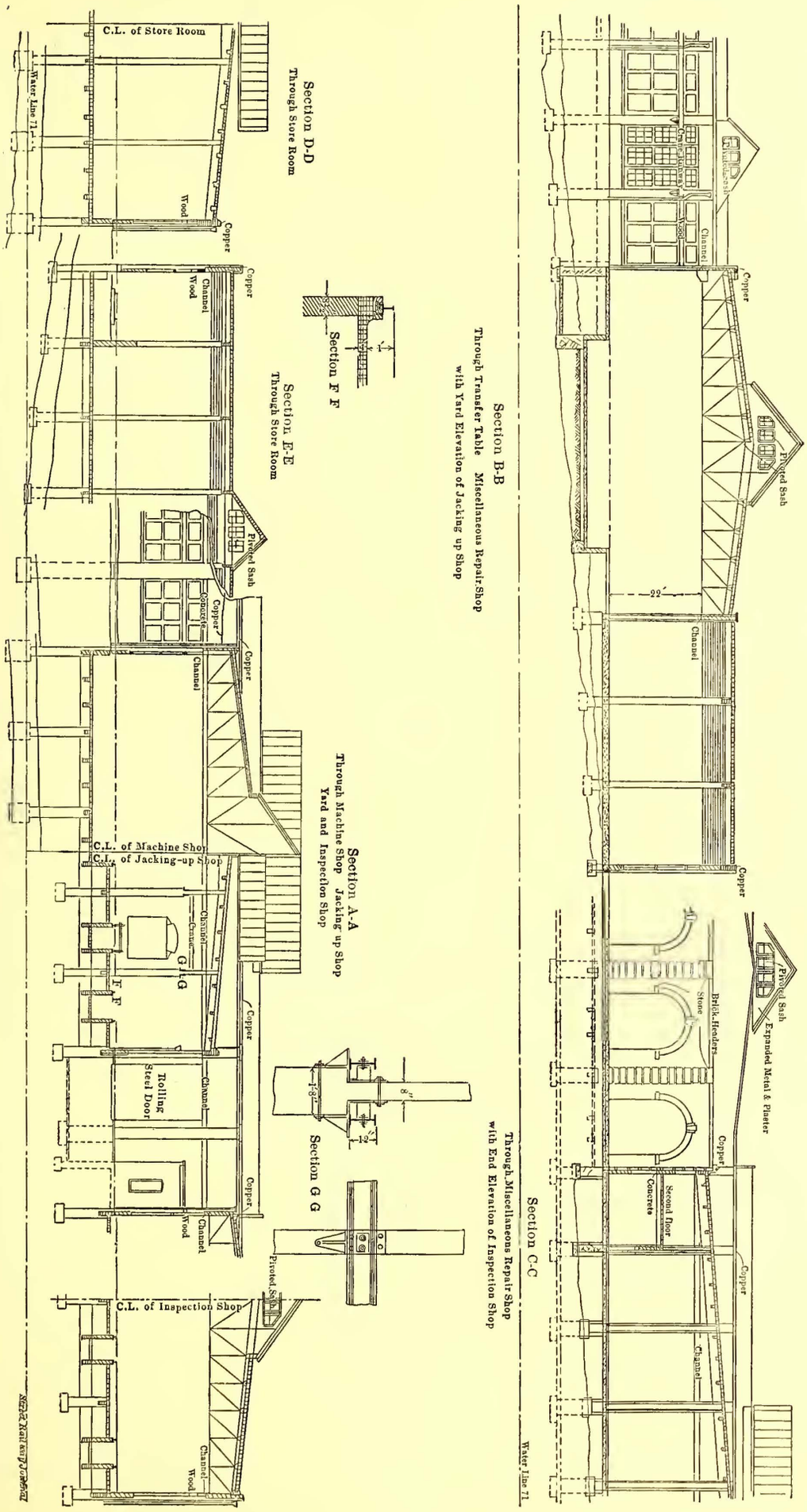
PLAN OF TERMINAL STATION AND SHOPS AT SIXTY-EIGHTH STREET FOR WEST MARKET STREET ELEVATED RAILWAY

SUBWAY AND ELEVATED RAILWAY REPAIR SHOPS

The western terminal of the Market Street elevated line is on the Philadelphia and West Chester Turnpike, less than a mile west of Sixty-Third Street. Here are to be located the repair shops, car houses, terminal station, a building for the accommodation of the employees of the road and a power station. By reason of the right of way of the Philadelphia & Western Road cutting through the center of the property, a somewhat complicated problem was presented. It was necessary to originate a scheme satisfactory to three independent roads which would avoid any crossings at grade. How the problem has been solved is shown clearly by the plan reproduced on page 549.



PLAN OF REPAIR SHOPS FOR ELEVATED RAILWAY AT WEST MARKET STREET TERMINAL



SECTIONS AND ELEVATIONS OF REPAIR SHOPS FOR ELEVATED RAILWAY AT WEST MARKET STREET TERMINAL

THE REPAIR SHOPS

The shop layout, as shown, is only a portion of the ultimate plans, and is intended to take care of the repairs of the rolling stock and equipment necessary for the operation of the first section of the subway and elevated lines. It has been planned with a view to making extensive additions. Briefly, the plan consists of an inspection shop, a jacking-up and truck repair shop, a machine shop, a miscellaneous repair shop, a storeroom with a transfer table, and offices, toilet room, locker room, etc.

In front of the inspection shop, which is the first of three to be erected, are seven storage tracks laid approximately 11 ft. center to center. Four of these are continued into the inspection shop. Into this shop, as the name implies, trains are run at intervals for inspection and for minor repairs which may be necessary. For this purpose a pit is constructed under each track for its entire length, the rails are raised 1 ft. above the floor level and a wide space between tracks has been provided.

For repair work, two entrance tracks to the repair shops proper are provided, leading to a space to be used for washing, and thence to the transfer table. Cars needing repairs to the trucks or motors are shifted to any one of the five tracks in the jacking-up shop, each track accommodating one car, where the car bodies are elevated by means of overhead traveling cranes. The trucks are withdrawn by a small electric locomotive to a small transfer table, by which they are transferred to the truck repair shop, containing five tracks, each track accommodating two trucks. These tracks are provided with overhead traveling cranes and with jib cranes attached to the columns, with air hoists for lifting the motors, etc.

For the sake of convenience, the space back of this shop is reserved for machine-tool work and for wheel work. Outside and immediately adjoining is the wheel platform for the storage of wheels before they are brought into the machine shop. On the opposite side of the

transfer table from these shops is a miscellaneous repair shop, containing five tracks, each accommodating one car, where minor repairs to car bodies, seats, etc., are to be made.

Adjoining the jacking-up and truck repair shop is the storeroom, into which will lead a steam railroad track and a track from the transfer table.

Between the inspection shop on one side and the jacking-up, truck repair and machine shops on the other side, is a yard with an overhead traveling crane. In this yard are to be deposited the scrap iron and refuse material from the shops, which can be taken by the crane to the steam road track at one end, or to the track from the transfer table at the other end.

The shops, as described, take care of all repairs except painting, which will be done on one of the tracks in the inspection shop until such time as the proposed additions are made.

The shops are located on the side of a hill, the grade at one end being about level with the tracks, and at the other end about 18 ft. below them. This made it necessary to support the walls and floors on piers and beams, the construction throughout being of reinforced concrete, except the roofs of the inspection shop, machine shop and transfer table, which are supported on steel trusses. The pit floors are carried on transverse beams, which support the pit floor beams. On these latter beams are built the brick walls of the pits which, with the beams carried by the piers between the pits, support the main floor. The tracks are spiked to wood plates which are bolted to the concrete construction.

In addition to the floors, the roofs of the jacking-up and truck repair shop, of the storeroom and of the miscellaneous repair shop, with their supporting columns, are of reinforced concrete.

The roofs of the inspection shop, machine shop and transfer table are of reinforced concrete slabs supported on the steel trusses.

All reinforced concrete work has been designed on a basis of 16,000 lbs. per square inch as the safe stress on the reinforcing rods, which are circular in section and of medium steel, and 500 lbs. per square inch as the safe extreme fibre stress for the concrete. All concrete is composed of one part Portland cement, three parts sand and five parts trap rock. All centering is surfaced, leaving the exposed face of the concrete comparatively smooth, and the corners of all beams and columns are chamfered by the insertion of a beveled strip in the angle of the centering.

All columns and trusses are spaced, longitudinally, 16 ft. center to center, and the outside walls consist of narrow brick piers at these points, casing the steel and concrete columns, with brick panel walls from floor to sill, the remaining space, which is about 80 per cent of the total, being occupied with windows. In addition to these windows, the inspection shop, machine shop and transfer table are lighted from monitor skylights, and the storeroom and jacking-up and truck repair shops from skylights of the type known as "saw tooth."

A new feature has been introduced in the transfer table. This, instead of the ordinary type running on four or six tracks, as the case may be, has two tracks, and consists of two plate girders of 45-ft. span, carrying the tracks and platform for the motor and controller. To accommodate this table, it is necessary to construct a pit, in which to operate it, 5 ft. deep, at one side of which, below the main floor, is a tunnel for the installation of wires, heating pipes, etc. This tunnel will lead to the power house, the design of which is not definitely decided, located between the shops and the terminal station, both of which buildings will be heated from it by exhaust steam.

SOME OF THE APPARATUS IN USE IN PHILADELPHIA

The Railway Journal Lubricating Company, of Chicago, has its economy lubricators and dust guards in use on two pairs of Peckham No. 25 M. C. B. trucks, operating on the Philadelphia Rapid Transit system.

The Chase-Shawmut Company, of Newburyport, Mass., states that the Philadelphia Rapid Transit Company was one of the first roads to investigate and install soldered rail-bonds, and a considerable quantity of Chase-Shawmut bonds were installed in Philadelphia in the year 1902. This company has also supplied the Philadelphia system with enclosed fuses of all dimensions for different classes of work.

The Albert & J. M. Anderson Manufacturing Company, of Boston, has made a number of shipments of line material and station switches for service in Philadelphia.

The Lagonda Manufacturing Company, of Springfield, Ohio, has installed a number of its power and turbine tube cleaners and reseating machines in the power houses of the Philadelphia Rapid Transit Company, as follows: Thirteenth and Mt. Vernon Streets station, Thirty-Third and Market Streets station, Delaware Avenue station, Beach Street station and South Street station. The Philadelphia office of the Lagonda Manufacturing Company is at 14 South Fourth Street, and is in charge of L. Bancroft Mellor, resident manager.

Williams, Brown & Earle, of Philadelphia, have installed one of their late models of continuous electric blue printing machines in the draughting room of the Philadelphia Rapid Transit Company. This machine is especially valuable for blue printing street plans, for the reason that it makes blue prints in one continuous sheet of any length without piecing.

The American Ferrofix Brazing Company, of Philadelphia, is doing considerable brazing work for the Philadelphia Rapid Transit Company. The conspicuous feature of the Ferrofix process of brazing is the saving effected by repairing broken castings, as truck frames, gear casings, etc. This process has been fully described in the columns of the STREET RAILWAY JOURNAL.

The H. P. Cameron Electrical Manufacturing Company, of Ansonia, Conn., has recently filled a number of orders for commutators for Philadelphia, including seventy-five railway commutators and 10,000 bars or segments of the GE-800 type, all of which were made up from hard-drawn copper bars. This concern has also furnished the Philadelphia Rapid Transit Company with a considerable number of Christensen air-brake commutators.

A. O. Schoonmaker, of New York City, has furnished the Philadelphia Rapid Transit Company with amber mica for street railway repair purposes.

The Speer Carbon Company, of St. Marys, Pa., states that the Philadelphia Rapid Transit Company is one of the largest users of Speer carbon brushes in the country.

The Durkin Controller Handle Company, of Philadelphia, has its controller device on a number of cars in Philadelphia.

The Sterling-Meaker Company, of Newark, N. J., has more than 2000 Meaker registers in service in Philadelphia.

The Schoen Steel Wheel Company, of Philadelphia, states that it is now filling an order for 200 rolled-steel wheels for use on the surface lines of Philadelphia.

The Standard Automatic Lubricator Company, of Philadelphia, has sold the Philadelphia Rapid Transit Company a considerable number of its automatic oilers for armature and axle bearings.

The Sterling Varnish Company, of Pittsburg, states that the Philadelphia Rapid Transit Company has for years made liberal use of the Sterling insulating products, particularly of the Sterling black plastic insulating compound.

The Falk Company, of Milwaukee, Wis., reports that it has furnished many thousand motor gears and pinions to the Philadelphia company.

The American Brake-Shoe & Foundry Company has supplied the Philadelphia system with part of its equipment of castings and brake-shoes.

The Star Brass Company, of Kalamazoo, Mich., has a great many of its trolley wheels on the street railways of Philadelphia.

L. A. Sayre & Company, of Newark, N. J., has supplied ticket punches to the Philadelphia Rapid Transit Company for several years.

The Pantasote Company, of New York, reports that "Pantasote" curtain material will be found on most of the cars in Philadelphia.

The Westinghouse Traction Brake Company reports that it has sold its governors for air brake equipments to the Philadelphia Rapid Transit Company, the type used being the Westinghouse standard Form G.

The American Rattan & Reed Manufacturing Company, of Brooklyn, N. Y., has supplied the rattan for many of the track sweepers in Philadelphia.

The Standard Paint Company, of New York, reports that it has regularly furnished the Philadelphia Rapid Transit Company large quantities of P. & B. insulating tape, P. & B. insulating electrical compounds, and S. P. C. armature and field coil varnish.

The Globe Ticket Company, of Philadelphia, has for several years furnished the tickets used for operating the various concessions at Willow Grove Park. These tickets are the Globe consecutively numbered strip tickets, put up in rolls, and are the same form of ticket as used at the St. Louis and Portland World Fairs, and at many of the leading amusement parks in this country. The Globe Ticket Company states that it has supplied the Philadelphia Rapid Transit Company with between 4,000,000 and 5,000,000 tickets each year.

J. R. McCardell & Company state that during the years previous to the formation of the Philadelphia Rapid Transit Company they had sold about thirty Trenton trolley wagons to the different electric railway companies in Philadelphia, and these wagons are still in use.

The Hope Webbing Company, of Providence, R. I., has furnished the Philadelphia Rapid Transit Company for years with tapes, webbing and sleeving for repairs to electrical apparatus. It has also made special material to meet special requirements in Philadelphia.

The Peckham Manufacturing Company, of Kingston, N. Y., reports that the Philadelphia Rapid Transit Company has in service the following Peckham trucks: About 1200 standard single trucks, several extra strong "Metropolitan Special" trucks under sprinkler cars, ten pairs of the Peckham new diamond frame freight car trucks, and two pairs of the Peckham new short-wheel base No. 25 double trucks. The Philadelphia company also has two Ruggles rotary snow-plows, made by the Peckham Manufacturing Company, and in addition has ordered another of these equipments for this fall's delivery.

The Niles-Bement-Pond Company, of New York City, has furnished for use in the shops of the Philadelphia system a car-wheel boring machine, and also one No. 5 single punching machine with interchangeable fixtures for shearing, driven by a 5-hp General Electric motor directly geared.

The Cutter Electrical & Manufacturing Company, of Philadelphia, has furnished specialties to the Philadelphia Rapid Transit Company, as follows: About sixty type "L. L." I. T. E. circuit breakers, especially adapted for street railway service. This form of instrument was developed with the special view of meeting the requirements of the Philadelphia Rapid Transit service, and is characterized by extreme simplicity of construction, yet capable of successfully withstanding severe service all day and every day. Practical use has demonstrated the merits of this device. A large number of Cutter "Reversible" or I. T. E. overhead and reverse current circuit breakers, for the protection of rotary converters, are also in use. These instruments are installed in the direct-current side of the converters for the purpose of preventing the converters from being operated reversely by the direct current, as might occur if the alternating-current supply was interrupted. These instruments are required to be very sensitive to reverse current flow, in order to disconnect the converter on a reverse flow of current equal to that required to run the converter with external load.

The Electro-Dynamic Company, of Bayonne, N. J., has recently shipped to the Philadelphia Rapid Transit Company the following inter-pole variable and constant-speed motors: Two of type "2-S," 3-hp, 550-volt, 700 r. p. m. to 1400 r. p. m. inter-pole variable speed motors, one of which is operating a radial drill. These are located in the Kensington Avenue shops. Two of type "3-S," 10-hp, 575-volt, 1200 r. p. m. inter-pole constant-speed motors, for operating elevators at the Wyoming Avenue shops. One type "3-S," 5-hp, 575-volt, 550 r. p. m. to 1650 r. p. m., inter-pole variable-speed motor. This motor is installed at the Wyoming Avenue shops.

The Electro-Dynamic Company also has on order with the Philadelphia Rapid Transit Company the following apparatus: Three type "15-S," 30-hp, 575-volt, 690 r. p. m. to 1380 r. p. m. inter-pole variable-speed motors. Three type "20-S," 40-hp, 575-volt, 630 r. p. m. to 1260 r. p. m. inter-pole variable-speed motors. Two type "50-S," 120-hp, 575-volt, 600 r. p. m. to 800 r. p. m. inter-pole variable-speed motors.

The Kalamazoo Railway Supply Company has installed the Root track scraper on a number of roads near Philadelphia, including the American Railways Company, Philadelphia, Bristol & Trenton Railway, the Williamsport Passenger Railway Company, Lewistown & Reedsville Railway Company, the Philadelphia & Easton Railway Company, the Pottsville Union Traction Company, the Camden & Trenton Railway Company and others.

The Hale & Kilburn Manufacturing Company, whose extensive works are located in Philadelphia, has supplied most of the modern seating in the cars of the Philadelphia Rapid Transit Company. Among the earliest experiments in the use of spring seating in street cars were those made on the Second & Third Streets and Fifth & Sixth Streets lines. Nearly all the cars of these two branch lines were originally equipped with Hale & Kilburn high-grade rattan spring seating, when in nearly every other city passengers were riding on the old-style board seats. Philadelphia has always since that time kept well in advance of other cities in this respect. Later on, hundreds of cars were equipped with plush-covered spring seating manufactured by the same company, and nearly all of them have now been recovered with rattan. In recent years all the new cars have been equipped with the Hale & Kilburn reversible type of rattan spring seat of neat and attractive design. There are twelve of these cross-seats in the body of the car, with four long stationary seats running longitudinally in the ends of cars. All of these seats are covered with the Hale & Kilburn canvas-lined rattan. One noticeable feature of these cross-seats is the end plate, which is so designed as to extend a few inches above the cushion, the object being to keep the occupants of the seat from encroaching upon the aisle and interfering with the free and quick movement of passengers entering and leaving the car. The rattan backs of these seats are finished around the edges with a neat bronze band.

The National Electric Company, of Milwaukee, reports that the Philadelphia Rapid Transit Company uses more than 1300 Christensen air brake equipments for the control of its cars. The compressors are of the A-B type, having a capacity of 11 cu. ft. of free air per minute. The National Electric Company has also furnished the Philadelphia system with a number of portable air compressor outfits, which are used to advantage for cleaning, riveting, etc., the compressor, reservoir and governor being mounted on a suitable truck to facilitate handling. These outfits have been found extremely useful when it is not desirable to install expensive system of piping.

The J. G. Brill Company has the following equipments on the traction lines in Philadelphia: Four hundred and seventy-five 28-ft. closed motor bodies, 156 28-ft. semi-convertible motor bodies, 160 12-double-seat cars, 28 shear-board snow-plows, 22 nose snow-plows, 5 snow sweepers, 1106 No. 27-G short-base double trucks, 550 "Eureka" maximum traction trucks.

The B. F. Sturtevant Company, of Boston, Mass., within the last two years has furnished to the Philadelphia Rapid Transit Company the following apparatus: Ten special 90-in. steel plate fans for cooling transformers, two each in the following sub-stations: 125 East Chelton Avenue, Thirteenth Street & Snyder Avenue, Frankford Avenue and Arrott Street, Fifty-Second Street and Lancaster Avenue, Willow Grove. Heating and ventilating equipment for roadway shops, consisting of a 140-in. steel plate fan, one 7000-ft. heater and complete system of galvanized steel distributing ducts with controlling dampers. Forge equipment for roadway shops, consisting of 90-in. steel plate exhauster for removing smoke, and a number of large forges for heavy work, each provided with down-draft hood. One No. 4 steel pressure blower for supplying blast to a large cupola furnace. Extension to forge equipment, Kensington Avenue and Cumberland Street, consisting of one J-1 forge with blast and exhaust connections to the Sturtevant system installed a number of years ago.

The Allis-Chalmers Company advises that in the Thirty-Second and Dauphin Streets station of the Philadelphia Rapid Transit Company are installed two Bullock engine-type railway generators that have been in continuous service since Jan., 1902. These generators have a rated output of 800 kw, but are capable of standing a 25 per cent temporary overload without overheating or harmful sparking. The speed is 85 r. p. m., and the machines are compounded to give 525 volts at no load and 575 volts at full load. The armature, which is 8 ft. in diameter, is provided with a commutator of very liberal dimensions. The brush holder yoke is supported by the magnet frame, being mounted on trunnions, so as to be automatically shifted back and forth through a small distance parallel to the shaft. In engine-type machines there is little or no end play of the armature, and the brush oscillating device is of great advantage in keeping the commutator in good condition. The armature and commutator spiders are of open construction, and the armature core is well provided with air ducts so that the ventilation is unusually good and the temperature increases correspondingly low. The insulation of these machines is very thorough, being formed in place on the armature coils, under pressure in steam-heated moulds. The generators were installed in cold weather, and, when brought into the station, were covered with frost. They were dried out for only two or three hours before being loaded, yet when thrown in parallel with generators of other make already in the station, they took their share of the load and operated with no trouble whatever. The generators are driven by horizontal cross-compound engines, and the station is provided with a storage battery which operates in parallel with the generators.

The Wheeler Condenser & Engineering Company, of New York, state that the condensing apparatus which it installed at the power station at Thirty-Third and Market Streets, Philadelphia, is one of the largest cooling tower installations in this country. The plant consists of a battery of five towers, which are placed on the roof, to each of which battery is attached two 10-ft. fans, operated by 30-hp motors. These towers cool by forced draught in summer and by natural draught in winter about 25,000 gals. of water per hour, to be used for the condensing of about 200,000 lbs. of steam. The condensers installed are of the Wheeler Admiralty rectangular type, of which there are three, to which are connected Edwards triplex suction valveless air pumps, each having three 18-in. cylinders with 12-in. stroke, and which are directly connected on the same base plate with two 40-hp Westinghouse motors. The apparatus maintains from 24 ins. to 26 ins. of vacuum in summer and 26 ins. to 27 ins. in winter.

The Electric Storage Battery Company, of Philadelphia, has installed storage batteries for traction purposes in Philadelphia as follows: First battery installed Sept., 1896, consisting of 250 13-G chloride accumulator elements, in type 13-G lead-lined wooden tanks; this battery has a capacity of 500 amps. for regulating the fluctuations on the railway load. The plant is installed at 8100 Germantown Avenue. Second battery installed Dec., 1899, at the power house at Thirty-Third and Dauphin Streets. This battery consists of 270 41-G chloride accumulator elements, in 41-G lead-lined wooden tanks, battery having a capacity of 1600 amps. for regulation. At present a specially wound motor-driven regulating shunt booster is being installed to operate in connection with this battery. Third battery installed Dec., 1899, at Ninth and Dauphin Streets. This battery consists of 260 25-G chloride accumulator elements in 41-G lead-lined wooden tanks, battery having a capacity of 960 amps. for regulation. Fourth battery installed in April, 1900, at Fifth and Lombard Streets. This battery consists of 260 31-G chloride accumulator elements in 41-G lead-lined wooden tanks, battery having a capacity of 1200 amps. for regulation. Fifth battery installed July, 1900, at Chelten Avenue, this battery consisting of 250 17-G chloride accumulator elements, in 25-G lead-lined wooden tanks, battery having a capacity of 640 amps. for regulation. Sixth battery installed July, 1900, at Erie Avenue, near Broad Street. This battery consists of 250 17-G elements, in 41-G lead-lined wooden tanks, battery having a capacity of 640 amps. for regulation. All of these batteries, with the exception of the one at Thirty-Second and Dauphin Streets, which operates in connection with the power house, were originally installed for the purpose of obtaining high voltage at points distant from the power house. Recently the battery sub-station at Chelten Avenue has had added to it some rotary converters.

The Lorain Steel Company, of Philadelphia, has furnished a large portion of the track layouts and special work in the city of Philadelphia. The company is also rolling the 137-lb. P. R. T. standard rail described elsewhere in this issue. Of special interest

is the complex track layout at the Willow Grove terminal, all of the special work for which was constructed and furnished by the Lorain Steel Company.

The General Electric Company is about to install the following apparatus for the Philadelphia Rapid Transit Company: One 2000-kw, 25-cycle, 13,200-volt a. c. Curtis steam turbine; 30 125-hp GE railway motors for operation with Sprague-General Electric multiple-unit control; 116 four-motor GE 70 equipments with K-28 control; 40 GE 70-railway motors; 260 GE 80-railway motors.

The Philadelphia Rapid Transit Company is about to install two low-pressure Curtis steam turbine units, made by the General Electric Company, and which promise to be an interesting departure in power station engineering. Each of these units consists of a specially designed Curtis steam turbine, adapted to receive steam from the low-pressure side of a non-condensing reciprocating engine, the turbo-generator in each case delivering direct current at 575 volts. No governing mechanism is required, but the turbines, operating in parallel with the engines, will adjust themselves to the load as called upon to do so. Steam will be taken into the turbines at a pressure of 15 lbs. absolute, and exhaust into the condenser at about 1 lb. absolute, passing through the turbine in four stages. The turbo-generators will in effect float on the line automatically, taking care of their part of the load.

The Locke Insulator Manufacturing Company, of Victor, N. Y., supplied the Philadelphia Rapid Transit Company the Locke No. 3 porcelain insulators for the high-voltage overhead transmission line leading from the Glenside sub-station.

The Crocker-Wheeler Company, of Ampere, N. J., sold to the Union Traction Company, predecessor to the Philadelphia Rapid Transit Company, a number of small motors for the company's printing plant, where all the transfers, exchanges, tickets, etc., needed in the operation of the system are printed. There are also in service in Philadelphia several Crocker-Wheeler boosters of the form D, two-unit type with 1000-amp. capacity at 125 volts. It is stated the engineers of the transit company were so well pleased with the brush holders of these machines that the company has purchased a number of the standard parallel type Crocker-Wheeler brush holders for equipping the generators at several of the power houses. A 100-kw form D engine-type Crocker-Wheeler generator has recently been placed in operation as an exciter in connection with Westinghouse steam turbines. The Philadelphia Rapid Transit Company has also purchased motors of the Crocker-Wheeler type to the extent of several hundred horse-power, for use in machine shops and also for driving the various amusement attractions at its parks.

At Kennett Square, in the power plant of the West Chester, Wilmington & Kennett Railway, are two 300-kw standard Crocker-Wheeler railway generators. At Lenape are two 300-kw Crocker-Wheeler generators of the same type in the power plant of the West Chester Railway Company, and a 200-kw Crocker-Wheeler generator is installed in the Downington plant of the same company.

The Alberger Condenser Company, of New York City, has carried out considerable work in connection with the Philadelphia power houses. A very interesting condensing plant will be found at the power station at Second Street and Wyoming Avenue. This consists of one 3500-hp Alberger barometric condenser and auxiliaries in connection with reciprocating engines; four 1500-kw Alberger dry vacuum centrifugal condensers, condensing on Parsons steam turbines with natural water supply, and two 1500-kw Alberger dry vacuum centrifugal condensers working on Parsons steam turbines with water from cooling bay. Another interesting condensing installation will be found at the Thirteenth and Mt. Vernon Streets power station. This plant consists of two Alberger dry vacuum surface condensing equipments working on Curtis low-pressure steam turbines with water from three Alberger double fan-draft cooling towers.

The Consolidated Car Heating Company, of New York City, has installed electric heaters in most of the cars in Philadelphia. The company's standard panel heaters are used in cars with panels, and its new design of cross-seat heaters with lead wires at one end in cross-seat cars.

The Mayer & Englund Company, of Philadelphia, has supplied the Philadelphia Rapid Transit Company with a great many of its well-known specialties. The list includes the following: About 100,000 rail-bonds and four sets of hydraulic bonding outfits; also a considerable amount of overhead line material, including insulated overhead crossings made from designs originated by the traction company. These insulated crossings are built up of sheet steel brazed and riveted together, and having a straight under-run with renewable wearing parts. Acting as agents for the International Register Company, the Mayer & Englund Company has recently taken an order for the entire equipment of the Philadelphia system with Heeren standard enamel badges for employees. This badge is a new design, claimed to be practically indestructible as far as finish and appearance are concerned. The badges are made up from molded composition layers, with german silver face and backing of pure aluminum. The various layers are pressed together under heavy pressure while hot, so as to ensure a complete molding of the layers to form one homogeneous piece. About 10,000 of the badges have been supplied. The Mayer & Englund Company has also furnished for use in Philadelphia about 350 International registers known as type R-7. The transit company is also a large user of Sterling compounds, for which the Mayer & Englund Company is agent.

The Chicago Pneumatic Tool Company, of Chicago, has equipped the repair shops of the Philadelphia Rapid Transit Company with a complete up-to-date pneumatic installation, including a large number of pneumatic tools, such as hammers, riveters, drills, etc., this installation comprising one of the largest and best pneumatic plants in connection with street railway repair work in the country.

The Gem Manufacturing Company has in operation in Philadelphia a number of portable electric plants, each consisting of a motor mounted on a truck with gearing, flexible shaft and attachment. These portable plants are used in track work for drilling, reaming and grinding, especially on crossings, curves and at joints. The resident manager for this company in Philadelphia is L. Bancroft Mellor.

The Curtain Supply Company, of Chicago, states that practically all of the open cars in Philadelphia have been equipped with curtains having this company's Acme open-car cable fixtures, while the closed cars and convertible cars have curtains equipped with the Curtain Supply Company's Acme closed-car cable fixtures and the Keeler eccentric roller top fixtures.

The E. W. Bliss Company, of Brooklyn, N. Y., advises that the Philadelphia Rapid Transit Company has used for a number of years the Bliss high-grade steel gears and pinions. The Bliss gears are made of high-grade open-hearth steel castings, the split gears being held together by eight special bolts of high tensile strength. When very heavy service, combined with high speed, is demanded, solid gears are frequently used. The Bliss high-carbon pressed pinion is the result of extensive experimenting, to produce a pinion very tough and durable that will withstand the heavy wearing strain of electric railway service. The pinions are made of special high-carbon steel, which is solidified and toughened under high pressure.

The Garton-Daniels Company, of Keokuk, Ia., has supplied lightning arresters for practically all of the lines in Philadelphia, it being the practice of the Philadelphia Rapid Transit Company to place an arrester at practically every overhead crossing, of which there are an unusually large number on the system. There are also a number of Garton-Daniels automotoneers in service on cars in Philadelphia and the suburbs.

The Keystone Electrical Instrument Company, of Philadelphia, has for some years attended to the matter of repairing and recalibrating the switchboard and portable indicating instruments in use by the Philadelphia Rapid Transit Company. This concern has also furnished the transit company with semi-portable laboratory instruments for checking alternating-current switchboard and portable instruments, and has also sold a number of switchboard-type alternating-current voltmeters and ammeters.

The George W. Lord Company, of Philadelphia, maker of water-purifying chemicals, has for several years acted as feed-water expert and chemist for the Philadelphia Rapid Transit Company, and has supplied the chemicals for use in the boilers at the various power houses where the feed-water has caused trouble.

William Wharton, Jr., & Company, Inc., has supplied a very large part of the special track work throughout the system of the Philadelphia Rapid Transit Company. Some of this work has been in use a great many years. More recent work furnished by this company can be found on some of the important extensions, like the Allegheny Avenue line, the Northeast division, the Elmwood

Avenue line, in the southwestern part of the city, and others. A number of recently furnished car house special work layouts can be found at the Lancaster Avenue car house, near Forty-Fourth Street, the Girard Avenue car house, the Thirty-First and Dauphin Streets car house, the car house at Arrott Street and Frankford Avenue, and the car house at Third Street and Wyoming Avenue, installed early this year. Among the large number of important layouts furnished by the company, one is located quite close to the convention hall, at Thirty-Third, Spruce and South Streets, at the corner of Franklin Field, the University of Pennsylvania's athletic grounds, only a half block from the street leading to the convention hall and exhibition. This layout was installed about one year ago. Of special interest is the loop at the foot of Market Street, near Delaware Avenue. This loop is of very sharp (24 ft.) radius, at the bottom of a steep grade, so that special provision had to be made to prevent derailment of the cars, by an outside guard for the wheels. To sustain the enormous traffic on this loop the entire curve was made of manganese steel. Three sets of these manganese steel rails have been furnished since Nov., 1898. The present inside rails were installed the latter part of 1903, and the present outside rails were furnished only a few months ago. Prior to 1898, manganese steel flat rails, bolted to cast-iron stringers, were used. Prior to 1895, while cable cars were still operated over the Market Street line, the outside of the curve was made of chilled cast-iron curved sections, which, at the entering end, wore out in three to four weeks. The inside rails were made of Bessemer steel, which lasted from eight to ten weeks at the entrance, and about six months in the rest of the curve. The average life of the manganese steel rails in this loop is three years. Another curve made entirely of manganese steel, installed two years ago, is located at Twelfth Street and Susquehanna Avenue. Of further interest may be the Manganese steel crossings furnished by the Wharton Company, where the Philadelphia Rapid Transit Company's lines cross steam railroad tracks of the Pennsylvania and Philadelphia & Reading roads, particularly all along Washington Avenue, Ninth Street, on the main line of the Philadelphia & Reading Railway from Fairmount Avenue north, and on American Street. In these crossings the steam railroad rails are made entirely of manganese steel, in accordance with the special design and patented construction of H. B. Nichols, engineer of way of the Philadelphia Rapid Transit Company. Several hundred of these crossings, manufactured by the Wharton Company, have been installed throughout the city, some being in use since 1899, and some sixty or more have been furnished within the last two years. At some places, where steam railroad tracks are laid with girder rails, such as at Richmond and Westmoreland Streets, Richmond and Tioga Streets and Second Street and Girard Avenue, manganese steel center crossings, made of heavy 9-in. girder rail throughout, of the latest type, and furnished by the Wharton Company early this year, can be seen. The works of William Wharton, Jr., & Company, Inc., are located in the city of Philadelphia, at Twenty-Fifth Street and Washington Avenue, and are devoted entirely to the manufacture of street railway girder rail special track work. Fourteen miles out of Philadelphia, at Jenkintown, Pa., on the Philadelphia & Reading Railway, are located the second works of the same company, devoted entirely to steam railroad and T-rail special track work.

The American Bridge Company, of New York, has furnished all the structural steel work involved in the construction of the new subway and elevated lines in Philadelphia, including the new Schuylkill River bridge. The company has also supplied the steel work for power houses and other structures erected in recent years by the Philadelphia Rapid Transit Company.

The F. B. Tait Manufacturing Company, of Decatur, Ill., has recently received an order from the Philadelphia Rapid Transit Company for 100 Curtis D-2 trucks. This type is a short wheelbase truck for medium weight cars.

The Westinghouse Machine Company and the Westinghouse Electric & Manufacturing Company received the initial order for generating apparatus in the new Delaware Avenue power station of the Philadelphia Rapid Transit Company, and have now under construction three Westinghouse-Parsons steam turbine units of 6000-kw capacity each, or three times the capacity of the largest generating units at present in operation in the power plants of the Philadelphia system. The new station is designed to accommodate, ultimately, eight units of the same capacity. The Westinghouse companies have already installed six steam turbine units, of an aggregate capacity of 9000 kw, in the remodeled power plant at Second Street and Wyoming Avenue, which plant is now delivering alternating current to the six new rotary converter sub-stations recently completed at 125 East Chelten Avenue, Frankford Avenue and Arrott Street, Thirteenth Street and Snyder Avenue, Fifty-Second Street and Lancaster Avenue, Glenside and Willow Grove. The Westinghouse Electric Company has furnished most of the converters and transformers for these new sub-stations, including thirteen rotary converters, of an aggregate capacity of 11,000 kw, forty-three air-blast transformers of an aggregate capacity of 12,375 kw, and two motor generator sets of 45-kw capacity each. The direct-current generating equipment of the old power stations includes eleven 1500-kw Westinghouse compound-wound generators of recent type, three Westinghouse automatic compound engine units of 400-kw capacity each, and several generators of about 1000-kw capacity each, of early Westinghouse design, which have been in service a dozen years or more. About one-third of the cars in service in Philadelphia are operated by Westinghouse motors.