LATEST PRACTICE IN ROLLING STOCK DESIGN AND EQUIPMENT

The earlier interurban railway builders showed a wide difference of opinion as to the most desirable types of cars for interurban service. Limited service had not been attempted at that time and the work to be performed was substantially the same on the majority of roads, i. e., that of taking care of the country trade and the business from town to town. Of course the population tributary to the road was considered somewhat in determining the sizes of car, but in the main, the service on various roads was very similar. Ideas on the best type of car as on many other subjects seem to vary with the locality. For example, the roads around Columbus and through the central portions of Ohio adopted extremely long cars. The greater portion of the rolling stock in this section measure 60 ft. and weigh from 40 to 60 tons. The operators went on the theory that it was better to run a less frequent service and to provide ample seating facilities for all the people that might want to ride. Roads out of Cincinnati and Cleveland went to the other extreme and while, as a rule, they had better territory than the roads in the central portion of the State, yet cars above 45 ft. in length were unknown in these cities up to four years ago. Motor equipment did not run above 200 hp to the car and car weights were usually under 30 tons. The theory of these operators was that it was better to give more frequent headway or run double-headers during certain portions of the day, or even to crowd passengers at times, than to run large cars practically empty during certain portions of the day.

While at the present time there are undoubtedly roads in Ohio that have business sufficient to warrant the use of 60-ft. cars, there are a number of successful operators who believe that the low net earnings and financial embarrassments of some of the roads in Ohio can be attributed to the unwarranted use of ultra heavy, power-consuming rolling stock.

The earlier roads bought numerous combination cars, usually having but two compartments, the baggage compartment being designed to handle the express and freight business which was just commencing to develop. Smokers were accommodated by placing folding side seats or camp stools in the compartment with the trunks and market produce. A year or two later as the freight and express business increased to a point where better facilities were necessary, the majority of roads put on exclusive express cars, and the combination car declined in favor as against the straight passenger coach with a special smoking compartment.

Within the past two or three years there has come the limited car, stopping only at towns and competing with the steam roads for the long distance and town to town business. For a time the operators debated as to the best type of car for this service and different ideas were put into practice. Some of the roads figured that they did not want to carry baggage on these cars because of the delays in handling and the space consumed by the baggage. Others found that a goodly portion of the patronage on the limited cars was made up of traveling men desiring to make quick jumps from town to town, to whom the electric service was of no advantage unless they could take their trunks and sample cases along with them. Hence the necessity for a baggage compartment. At the same time the smoking public demanded accommodations, and on the long through-trips they were not satisfied to sit on the hard benches of a combination car. These contingencies resulted in the building of the three-compartment car. The great popularity of the limiteds and the necessity for higher speeds, together with the demand for smoking and baggage facilities, necessitated the designing of a longer and heavier car, so that the 55 to 60-ft. car is now making its appearance on roads which had tabooed it a few years ago.

The present popularity of the larger type of car is shown by the fact that out of the seventeen roads in Ohio investigated, thirteen have cars of 50-ft. length or over (three of them having cars 60 ft. or over), and on nine of these roads three-compartment cars are used for local as well as limited service. On some of the roads the smaller cars are kept for the local runs and the longer for the limiteds. To take care of the increased business and limited service, the Western Ohio Railway is taking all of its cars apart and adding a baggage compartment. The cars were originally 48 ft. 10 ins. over all, and they are being increased to 52 ft. 10 ins. The floor framing is strengthened by inserting four I-beams the whole length of the car, all the work being done in the company's own shop at Wapakoneta. The cost of the work is about $255 per car, including refinishing, and this gives the road practically a new car. A view of one of these lengthened cars is shown on Plate XL.

It is the aim of every traction manager to secure as wide a car as possible in order to provide comfortable seats wide enough for two passengers, but the aims in this direction are frequently thwarted by local conditions. City companies have less need for wide cars and the "devil strips" are usually altogether too narrow to suit the ideas of interurban managers. Cincinnati and Dayton have many "devil strips" only 3½ ft. wide, so that the cars of the Interurban Railway & Terminal Company and Cincinnati, Milford & Loveland are only 8 ft. 1 in. and 8 ft. 3 ins. respectively. The Dayton, Covington & Piqua cars are likewise 8 ft. 3 ins. By entering on another street in Dayton, the Dayton & Troy was able to get a car 9 ft. wide. The Toledo, Port Clinton & Lakeside entering Toledo has some cars 9 ft. wide, but two of them cannot pass on the same street, which is sometimes inconvenient. For 4-ft. "devil strips" found in the majority of cities an 8-ft. 6-in. car is looked upon as standard, although some cars exceed this width.

Increased weights of cars and higher speeds necessitate greater strength of floor framing. The large majority of cars now being built for interurban service in Ohio have two or three, and in some cases four I-beams extending the full length of the car with channels or plates for side sills. The latest cars for the Lake Shore Electric have four 6-in. I-beams and two 7¾-in. x ⅝-in. steel plates, bolted between oak sills, one of them 5 ins. x 8 ins. and the other 2 ins. x 6 ins. Other cars of equal strength have been built for several Ohio roads.

Some interesting cars of a distinctive type have been built for the limited service on the Ft. Wayne, Van Wert & Lima, and Lima & Toledo lines. They are 62 ft. over all and weigh 45 tons. They have rear platforms 9 ft. long with cosy-corner leather seats on the platform, a passenger compartment 27½ ft. long fitted with sixteen high-back plush seats, a smoking compartment fitted with eight leather upholstered chairs and a couch, and a baggage compartment 9 ft. 2 ins. in length in connection with the motorman's cab. These cars were illustrated and described in the STREET RAILWAY JOURNAL for June 16, 1906.

The best location for the toilet room is an open question with certain managers. It is somewhat more obscure when placed at the rear of the car and it cuts up the car less than when placed between the compartments or in the forward portion of the main compartment, but many managers prefer the central location because the trucks do not become dirtied and there is

TABLE III.—SUMMARY OF LATEST STANDARDS IN ROLLING STOCK ON ROADS TREATED (See also Following Page).

NAMES OF COMPANIES.	No. of Latest Standard Cars.	Service for Which Intended.	Make of Car Body.	Length of Body.	Length Over All.	Length of Platform.	Width Over All.	Height of Steps in Ins.	Height of Riser from Platform to Car Floor.	Single or Double End Operation.	Weight of Car Complete in Tons.	Number of Compartments.	Number of Seats.	Seats Stationary or Reversible.	Covering of Seats.	Seating Capacity.	Color of Body.
NORTHERN OHIO GROUP.																	
Cleveland & Southwestern	30	Interurban and limited	Niles and St. Louis	46' 6"	51'	4' 6"	8' 9"	16 -16 -16	6"	S	35	3	24	S	Plush and leather	48	Green.
Lake Shore Electric	20	Interurban and limited	Niles and Brill	47' 1"	52'	4' 7½"	8' 7"	17 -16	6"	S	35	3	28	S	Leather	54	Big 4 orange.
Eastern Ohio	10	Interurban	Kuhlman, St. Louis	37'	47'	6'	8' 6"		6"	S	30	2	24	R	Cane	48	Red.
Toledo & Indiana	10	Interurban and limited	Stephenson and Jewett	40'	52'	6'	8' 6"	16 -10 -10	5"	S	25	2	27	S	Pantasote	54	Big 4 orange.
Toledo & Western	6	Interurban	Jewett and Niles	40'	47'	4' 6"	8' 6"	18 -10 -10	4"	S	26	2	19	R	Cane	40	Pullman green.
Toledo, Pt. Clinton & Lakeside	10	Interurban and limited	Kuhlman and Niles	42'	50'	4'	8' 9"		5"	S	23	2	27	S	Plush and leather	54	Pullman green.
Stark Electric	11	Interurban	Kuhlman and Niles	40' 6"	50' 6"	4'	8' 9"	19 -16 -12	5"	D	34	2	28	R	Cane	56	Pullman green.
Canton-Akron	9	Interurban	St. Louis and Jewett	52'	57'	5'	8' 6"			S	40	3	32	R	Plush and leather	64	Pullman green.
CENTRAL AND SOUTHERN OHIO GROUP.																	
Western Ohio	19	Limited and local	Niles and Kuhlman	48'	52' 10"	4'	8' 9½"		5"	D	31	3	22	R	Cane	44	Pullman green.
Ft. Wayne, Van Wert & Lima	10	Local	Cincinnati	46'	55'	6'	8' 6½"	14 -12 -10	6"	S	41	3	28	S	Plush and leather	56	Pullman green.
	2	Limited	Cincinnati	50'	61'	6'	8' 6½"		6"	S	48	3	32	R	Plush and leather	64	Pullman green.
Dayton & Troy	8	Local and limited	Barney and Smith	38'	50'	6'	9' 3"	18 -14 -12	0"	D	34	3	27	R	Pantasote	54	Big 4 orange.
Dayton, Covington & Piqua	8	Interurban	Barney and Smith	34'	42'	4'	8' 6"			D	22	2	21	R	Plush	42	Maroon and yellow.
Scioto Valley	14	Interurban	Am. Car and Fdy. Co	51'	60'	5'	8' 6"		6"	D	44	2	35	R	Cane	71	Pullman green.
Cincinnati & Columbus	8	Interurban	Jewett	52'	60'	5'	8' 6"	15 -17	6"	S	38	3	25	S	Plush and leather	51	Dark green and yellow
Cincinnati, Milford & Loveland	8	Interurban	Cincinnati	30' 9"	46' 9"	4'	8' 3"	18 -10 -12	5"	D	29	2	20	R	Cane	40	Dark blue.
Interurban Ry. & T. Cincinnati	30	Interurban	St. Louis	34'	44'	4'	8' 1"		5"	S	25	2	26	R	Plush	52	Pullman green.
Cincinnati, Georgetown & Portsmouth	12	Interurban	St. Louis	40'	50'	5'	8' 10"			S	31	2	27	R	Cane	54	Orange.
INDIANA GROUP.																	
Indiana Union	20	Interurban	Cincinnati	41' 0½"	53' 5½"	5'			6"	S	38	2	29	R	Plush	58	Pullman green.
Indianapolis & Northwestern	20	Interurban	Jewett and Laconia	53 6"	60' 8½"		8' 8"	11 -11	5"	S	41	2	31	R	Plush and leather	62	
Indianapolis & Cincinnati		Interurban						13 -13	6¼"	S					Plush	54	Maroon.
Indianapolis, Columbus & Southern	8	Interurban	Jewett	42' 11"	53' 7½"	R 4' 8" F 5' 2"		11 -11	4½"	S	35	2	29	R	Plush and rattan	58	Pullman green.
Terre Haute Tr. & Lgt	4	Interurban		48' 7"	51' 6"	6'	8' 5"	10½-10½-10½	0"	D	32½	3	27		Cane	61	
Kokomo, Marion & Western		Interurban	Jewett	34'	43'		8' 8"		0"	S		2	31		Plush and rattan	46	Pullman green.
Ft. Wayne & Wabash Valley	7	Interurban	Cincinnati	46' 6"	55'	R 6' 4"	8' 8"	13 -13	6"	S	20	3	27	R	Plush and leather	54	Pullman green.
MICHIGAN GROUP.																	
Rapid Railway System, Detroit	125	Interurban	Cincinnati	41' 10½"	52' 7½"	R 4' 10½" F 4½" 2"	8' 8½"	12 -12	6"	S	32	2	26	R	Plush and leather	53	Pennsylvania red.
Detroit, Ypsilanti, A. A. & J.	12	Interurban	Barney and Smith	41' 9½"	51' 9½"	8'	8' 9"	10½-10½-10½	0"	S	32	2	30	R	Plush	60	Brown.

less opportunity for a dishonest passenger to secrete himself in the closet and escape paying his fare, a trick which is frequently worked where the toilet room is in the rear. There is a growing tendency to carry water flushers and to improve the sanitary conditions by the use of rubber or enameled sheet metal for floor and sides, so that the car cleaners can turn the hose into the toilet room and wash it out thoroughly. The carrying of disinfectants in toilet rooms is also becoming common practice with the best roads.

The designing of steps so that they will not extend out too far beyond the side of the car and at the same time keep the rear platform wide enough for safety is quite a problem. The use of heavier equipment has raised the cars to such an extent that a third step is often desirable, the 18-in. or 19-in step used by a number of roads being a source of annoyance to ladies, especially where mounting in the country where tracks are elevated. The Dayton & Troy Electric has equipped all its cars with a folding step which is dropped at each stopping point. The Stark Electric provides each car with a small stool or box and the conductor is supposed to place it on the ground at each stop, the same as is done by a Pullman porter.

Interurban cars on the roads visited in Indiana and Michigan vary in length from 51 ft. 6 ins. to 61 ft. 6 ins. over bumpers. The longest cars are those in limited service over the tracks of the Indiana Union Traction Company and the Fort Wayne & Wabash Valley Traction Company between Fort Wayne and Indianapolis. Most companies in these districts appear to favor a car about 53 ft. long for local interurban service. However, the cars of the Indianapolis & Northwestern Traction Company, which are 60 ft. 8¾ ins. over bumpers, have been in use three years and have been found well adapted to ordinary interurban service. New cars recently purchased by the company are of practically the same length. The new cars recently put in service by the Fort Wayne & Wabash Valley Traction Company are 55 ft. long. The older cars of the Detroit, Ypsilanti, Ann Arbor & Jackson Railway are being lengthened in the shops of the company to an over-all length of 51 ft. 9⅝ ins., which is the length of new cars purchased by the company. The usual width of cars over sills is about 8 ft. 6 ins. This brings the width over all to about 8 ft. 8 ins. or 8 ft. 10 ins. The cars of the Terre Haute Traction & Light Company, which are 8 ft. 5 ins. over sills, were the narrowest found. The width of 8 ft. 6 ins. over sills is generally conceded to be too narrow, but has been adopted because of the width of the devil strip in cities. Although the Winona Interurban Railway Company, operating between Winona and Goshen, Ind., was not one of the roads visited for the purposes of this investigation, it might be mentioned that in the construction of the cars for this road quite a

departure from usual practice was made. They measure 9 ft. 4 ins. over all, and this width and the manner in which the sides of the car are constructed give the interior of the car a width only 3 ins. narrower than a standard Pullman car. The extra width was permissible by reason of the fact that the cars do not at the present time enter any city where the tracks are double. As for the future, it is believed by the management that within a few years the devil strip in cities will be widened to accommodate wider interurban cars.

All of the passenger cars of the roads visited in Indiana and Michigan have two compartments and some of them have three. The limited cars of the Indiana Union Traction Company and the reguliar cars of the Detroit, Ypsilanti, Ann Arbor & Jackson Railway are the only ones not having baggage compartments. With one exception the construction of all of the cars is patterned much after steam coaches. They have the steam-coach type of hood and the side windows raise instead of dropping. The one exception is the interurban car of the Terre Haute Traction & Light Company. The construction of this car follows closely that of the usual type of car for heavy city service. The roof is of the monitor type, the side windows drop, the letter board is absent and the ceiling is lower than usually found in interurban cars.

The cars of the Terre Haute Traction & Light Company are intended for double-end operation. The interurban cars of all of the other systems are intended to be operated in one direction only. The platforms of cars are usually about 5 ft. long. In some cases, as on the cars of the Indiana Union Traction Company, the front platform, which is used exclusively for a motorman's cab, is a few inches shorter than the rear platform.

There is a tendency to build the floors of the platforms at the same level as the car floors. The new limited cars used between Fort Wayne and Indianapolis are constructed in this manner, as are also the cars of the Detroit, Ypsilanti, Ann Arbor & Jackson Railway. This construction permits the sills to be run through from bumper to bumper. In many cases the rear platform alone is dropped. This drop is usually about 6 ins. The bottom of the sills of the cars is usually from 40 ins. to 43 ins. above the rail. With a drop platform this necessitates two steps of from 11 ins. to 13 ins., the lower step being about 17 ins. above the rail. When the platform is not dropped, three steps are often used.

The rear platforms of the interurban cars of the Detroit United Railways are open. They are constructed similar to open platforms of city cars and are provided with a safety gate on one side.

The older cars of the Detroit, Ypsilanti, Ann Arbor & Jackson Railway also have open rear platforms. On this system, however, closed vestibules are preferred, and all new cars are being purchased with closed vestibules, and the platforms on the older cars are being enclosed.

The height over all of cars in these States is usually about 13 ft. The Detroit, Ypsilanti, Ann Arbor & Jackson cars measure 12 ft. 11 7/8 ins. to the top of the trolley plank; the new cars of the Fort Wayne & Wabash Valley Traction Com-

TABLE III.—SUMMARY OF LATEST STANDARDS IN ROLLING STOCK ON ROADS TREATED.—*Continued* (See also Following Page).

NAMES OF COMPANIES.	Type of Trucks.	Wheel Base.	Truck Centers.	Wheels. Material of Wheels.	Wheels. Diameter in Ins.	Wheels. Width of Tread in Ins.	Wheels. Width of Flange in Ins.	Wheels. Depth of Flange in Ins.	Wheels. Weight in Lbs.	Wheels. Life in Miles.	Axles. Diameter of Axles in Ins.	Axles. Material.	Axles. Size of Journal in Ins.	Method of Lubricating.
Northern Ohio Group.														
Cleveland & Southwestern	Baldwin	6' & 7'	29'	Forged steel	36	3½	1½	1 1-16	650	200,000	5½ and 6	Forged steel	5 x 9	Oil and waste.
Lake Shore Electric	Baldwin and Brill	7' 6"	28' 6"	Steel tire, forged steel	37½	3	1½		700	.....	6	Forged steel	4½ x 8	Oil and waste.
Eastern Ohio	Peckham	6' 6"	24'	Cast iron	33	3½	1½		450	.....	4½ to 5½	Forged steel	4½ x 8½	Grease and waste.
Toledo & Indiana	Peckham	6' 6"	29'	Cast iron	33	3½	1½		500	50,000	5	Rolled steel	5 x 8	Oil and waste.
Toledo & Western	Peckham and Dorner	6' 6"	27'	Cast iron	33	3½	1 3-16		500	35,000	4½	Rolled steel	3½ x 8	Oil and waste.
Toledo, Pt. Clinton & Lakeside	Peckham	6' 6"	27'	Cast iron	36	3	1½		800	.....	5½	Rolled steel	.....	Oil and waste.
Stark Electric	Peckham and Dorner	6' 6"	21' 6"	Steel tire	36	3½	1		600	*60,000	5½	Rolled steel	4½ x 7	Oil and waste.
Canton-Akron	St. Louis	6'	34'	Steel tire	35	3	1½	1	750	200,000	5½	Open hearth steel	4½ x 8	Oil and waste.
Central and Southern Ohio Group.														
Western Ohio	Peckham	8'	28'	Rolled steel	36	3	1½	1 5-16	....	*60,000	5	Rolled steel	4½ x 8	Oil and waste.
Ft. Wayne, Van Wert & Lima	Baldwin and Taylor	8' 6"	32' 37'	Steel tire	37½	3½	1½	1	....	120,000	6½	Rolled steel	4½ x 8	Oil and wool waste.
Dayton & Troy	Barney and Smith	7'	26'	Steel tire	37 & 39	3½	1½	1	900	350,000	5	Open hearth steel	4½ x 8	Oil and waste.
Dayton, Covington & Piqua	Barney and Smith	6'	23'	Steel tire	34	3	1		585	.....	5	Cold steel	4½ x 7	Oil and wicking.
Scioto Valley	Brill	6' 6"	37'	Steel tire	36	4½	1½	1 1-16	....	350,000	6½	Forged steel	4½ x 9	Oil and waste.
Cincinnati & Columbus	Peckham		35'	Steel tire	36	..	..	..	....	.....	..	.....	.....	.....
Cincinnati, Milford & Loveland	Taylor special	4' 6"	27'	Cast iron	33	3½	1½	1	....	55,000	6½	.....	4½ x 8	Oil and waste.
Interurban Ry. & T. Cincinnati	St. Louis	4' 6"	23'	Steel tire	33	3½	1½	1 1-16	....	*80,000	4½	Forged steel	3½ x 9	Oil and wool waste.
Cincinnati, Georgetown & Portsmouth	St. Louis	6'	26'	Cast iron	33	4½	1½	1½	800	.....	6	.....	4 x 7	Oil and waste.
Indiana Group.														
Indiana Union	Baldwin	8'	29' 6"	Steel tire	37½	2½	1½	1	....	.....	5½	.....	.....	Oil and waste.
Indianapolis & Northwestern	Peckham	6' 6"	41'	Steel tire	34	2½	1 3-16	1	700	160,000	6	Steel	4½ x 8	Oil and waste.
Indianapolis & Cincinnati	Baldwin	6' 5"	33' 2"		33	2½			....	.....	5½	Steel	5 x 9	Oil and waste.
Indianapolis, Columbus & Southern	Peckham	6' 6"	31' 1"	Steel tire	33	2½	1½	1 3-16	750	.....	5½	.....	4 x 8½	Oil and waste.
Terre Haute Tr. & Lgt	Baldwin	6' 3"	27' 1"	Solid steel	33	3	1½	1	590	.....	5½	.....	.....	Oil and waste.
Kokomo, Marion & Western	Peckham	6' 9"	24' 7"	Steel tire	..	2½	1½	1	....	.....	5	.....	.....	Oil and waste.
Ft. Wayne & Wabash Valley	Baldwin	6' 8"	32' 4"	Steel tire	37½	3	1	1	....	.....	6½	.....	3½x10	Oil and waste.
													5 x 9	
Michigan Group.														
Rapid Railway System, Detroit	Baldwin	6' 6"	28' 2½"	Rolled steel	36	3	1½	1	....	.....	5½	.....	4½ x 8	Oil and waste.
Detroit, Ypsilanti, A. A. & J.	Peckham	6' 10"	30' 10"	Cast iron	36	..	1	1	650	40,000	5½	Steel	4½ x 7	Oil and waste.

* Before first trueing.

TABLE III.—SUMMARY OF LATEST STANDARDS IN ROLLING STOCK ON ROADS TREATED.—*Concluded.*

NAMES OF COMPANIES.	Brakes.			Brake Shoes.						Type of Drawbar or Coupler.
	Make of Brake.	Type.	How Hung.	Composition.	Inserts Used.	Braking Pressure.	Weight Original in Lbs.	Weight Discarded in Lbs.	Life in Miles.	
Northern Ohio Group.										
Cleveland & Southwestern	Christensen, Westinghouse	Straight	Inside	Gray iron	No	90% weight of car	..	..	....	No drawbars.
Lake Shore Electric	Westinghouse	Straight	Inside	Gray iron	Yes	90% weight of car	..	..	....	Van Dorn.
Eastern Ohio	Christensen	Straight	Inside	Soft iron	No	Air, 80 lbs	..	..	....	
Toledo & Indiana	Christensen	Straight	Inside	Gray iron	Yes		..	..	....	Van Dorn.
Toledo & Western	Christensen	Straight	Outside	Gray iron	No	95% weight of car	38	12	....	Jewett radiating.
Toledo, Pt. Clinton & Lakeside	Westinghouse	Straight	Inside	Cast iron	No		..	..	....	Niles.
Stark Electric	Westinghouse and Christensen	Straight	Inside and outside	Soft iron	No	40,000 lbs	45	15	6,000	M. C. B.
Canton-Akron	Christensen	Straight	Inside	Gray iron	No	9,000 lbs. per shoe	41	15	....	
Central and Southern Ohio Group.										
Western Ohio	Christensen	Straight	Outside	Gray iron	No		..	..	....	Home made.
Ft. Wayne, Van Wert & Lima	Westinghouse	Straight	Inside		Yes	Air, 75 lbs	33½	12	2,500	Van Dorn.
Dayton & Troy	Christensen	Straight	Inside	Gray iron	No	8,000 lbs. per shoe	36	15	....	
Dayton, Covington & Piqua	Christensen	Straight	Inside	Gray iron	No		24	10	7,100	Barney and Smith.
Scioto Valley	Westinghouse	Straight and automatic	Outside	Gray iron	Yes		26	8	5,600	Van Dorn.
Cincinnati & Columbus	Westinghouse	Straight	Inside	Gray iron	No	40,000 lbs	29	11	....	Cincinnati Car Co.
Cincinnati, Milford & Loveland	Christensen	Straight	Outside				..	..	....	
Interurban Ry. & T. Cincinnati	Westinghouse	Straight	Outside	Gray iron	Yes	48,000 lbs	27	10	3,000	
Cincinnati, Georgetown & Portsmouth	Christensen and Westinghouse	Straight	Outside				..	..	....	
Indiana Group.										
Indiana Union	Christensen	Straight	Inside			90% weight of car	33	..	....	Van Dorn.
Indianapolis & Northwestern	Westinghouse	Straight	Inside	Gray Iron	No	10,000 lbs. per shoe.	27	12	1,050	Van Dorn.
Indianapolis & Cincinnati						90% weight of car	28	..	....	Van Dorn.
Indianapolis, Columbus & Southern					Yes	90% weight of car	24	16	....	St. Louis.
Terre Haute Tr. & Lgt.	Westinghouse	Automatic	Inside		No		35	..	....	Van Dorn.
Kokomo, Marion & Western		Straight	Inside	Composition filled			35	..	....	Home made.
Ft. Wayne & Wabash Valley	Westinghouse	Straight	Inside	Composition filled			26	8	3,500	
Michigan Group.										
Rapid Railway System, Detroit		Straight	Inside	Medium hard cast iron	No	90% weight of car	32	14	....	Van Dorn.
Detroit, Ypsilanti, A. A. & J.	Westinghouse	Straight	Inside	Cast iron	No		28	..	....	

pany, 13 ft. 1 in.; those of the Terre Haute Traction & Light Company, 12 ft.; and those of the Indiana Union Traction Company, 13 ft. 6 ins. to the top of the roof.

There is very little relation between the total weights of the cars as given and the seating capacity. This is partly accounted for by the fact that the baggage compartment in some of the cars reduces the number of seats. The heaviest cars found, which were those of the Indianapolis & Northwestern Traction system, weigh 82,000 lbs. The weight of the new cars of the Fort Wayne & Wabash Valley Traction Company is estimated at 80,000 lbs.

It is interesting to note that the weight of interurban cars, as usually constructed, is about equally divided between the body and the trucks and motors. Of the total weight of 76,000 lbs. for the Indiana Union Traction Company's car the body weighs 38,000 lbs.

The floor framing is either of wood construction entirely, or, as is more customary, the center sills consist of I-beams sandwiched between wood fillers. The side sills are also sometimes of compound construction. The cars of the Indianapolis & Northwestern system have solid wood center, and intermediate sills and side sills consisting of two pieces of yellow pine with a ½-in. plate sandwiched between. The cars of the Indiana Union Traction Company have compound center sills, solid intermediate sills, and the wood side sills reinforced by a steel plate. The center and intermediate sills of the Terre Haute Traction & Light Company's car are of compound I-beam construction, and the side sills are reinforced by an 8-in. x 8-in. steel angle-bar.

In Indiana and Michigan the rear of the car is the usual location of the toilet room. Frequently the most serious objection to this location, the restricting of the passageway at this point, is avoided by placing the rear door to one side of the car and omitting a seat opposite the toilet. One objection to placing the toilet room in the forward portion of the car is that the view ahead is restricted. Usually the toilet room is fitted with a dry hopper, but the interurban car of the Terre Haute Traction & Light Company is provided with a hopper flushed with water, a tank being provided in the roof of the car. The new car of the Winona Interurban Railway, in addition to being fitted with a hopper flushed with water, is lined with enameled steel, which adds to the sanitation. The same is true of the new cars of the Detroit United Railways.

SEATS

On a majority of latest cars in Ohio the seats are being made stationary, this, of course, only being possible on single-end cars. While the reversible type of seat allowing a party of passengers to face each other is admittedly very convenient for the passengers, it affords a chance for the selfish passenger to occupy more than his share of the room, obliging others to stand. Besides with the high head-roll seats which usually have considerable rake, it is impossible to place them back to back without reducing the seating capacity of the car. Sentiment is about equally divided

on the subject of seat coverings. Leather or pantasote is being used in the latest smoking compartments and several roads are using one or the other throughout. The cane seat is preferred by many on account of its cleanliness and durability and is largely used for local service. While high-back roll-top plush upholstered seats are preferred by a number of roads for the long-distance service, several roads combine the two, placing plush seats in the main passenger compartment and leather seats in the smoking. Chair seats, which were used by a number of roads in their limited service a year or so ago, are being given up because of the reduction in seating capacity of the car.

The passenger compartments in Indiana and Michigan are usually equipped with reversible or walkover seats. Wicker chairs are frequently found in the smokers of limited cars. The seats in the passenger compartment, with one exception, are covered with plush. Rattan or leather serves as a covering for the seats in the smoker.

A few years ago the interior of cars was usually finished with cherry. Within the last few years mahogany has largely been used for the interior finish. At the present time there is a tendency to change to a dark oak finish. The cars of the Indianapolis, Columbus & Southern Traction Company are finished in oak, as are also those of the Kokomo, Marion & Western Traction Company, and the Detroit, Ypsilanti, Ann Arbor & Jackson Railway.

CAR COLORS

Painting of cars is no small item in the maintenance account. Many Ohio roads are following the example of the steam roads in respect to colors and are adopting the Pullman type of green, which is thought by many to be the most durable color. Ten roads out of seventeen in Ohio considered for this article are using this finish. The Toledo & Western formerly finished its cars dark red, but now uses the green. It reports a saving of about $25 on the finishing of the car, and the finish is said to be 25 per cent more durable. The Western Ohio has made a similar change.

A number of roads believe it to be a good advertisement to have a distinctive color. The Toledo & Indiana, Lake Shore Electric and Dayton & Troy favor the "Big Four" orange with brown trimmings for this reason. This finish is also said to be very durable as compared with some other colors. The Cleveland & Southwestern is known everywhere as the "Green Line" by reason of its light green finish. The Cincinnati, Milford & Loveland uses a dark blue and is known as the "Royal Blue Line" in Cincinnati. Several of the Everett-Moore lines out of Cleveland and Detroit use Pennsylvania red with gold trimmings.

Pullman green has also been adopted by several companies in Indiana as a body color for cars. This color is used by the Indiana Union Traction Company, the Fort Wayne & Wabash Valley Traction Company, the Indianapolis, Columbus & Southern Traction Company and the Kokomo, Marion & Western Traction Company. Its lasting qualities and the attractive appearance which it gives the car are arguments in its favor.

The cars of the Indianapolis & Cincinnati Traction Company are painted a maroon, and the Indianapolis & Cincinnati Traction Company is advertised as the "Red Line" in all of the company's literature. Brown

TABLE IV.—SUMMARY OF STANDARD ELECTRIC EQUIPMENT AND CONTROL ON CARS (See also Following Page).

NAMES OF COMPANIES.	Type of Motors.	No. of Motors to Car.	Single or Double End Operation.	Type of Controller.	Type of Rheostats (Grid or Panel).	Trailer and Train Operation.	Method of Lubricating Motor Bearings.	Method of Lubricating Armature Bearings.	Trolley Poles. Length.	Trolley Poles. Pressure Maintained at Wheel in Lbs.	Trolley Wheels. Diameter in Ins.	Trolley Wheels. Life of, in Miles.	Trolley Catcher or Retriever.
Northern Ohio Group.													
Cleveland & Southwestern	West. 112, 93, 76, 56	4	S	Type M, L-4	Grid	No	Oil cups	Oil cups	12'	28	5½	3,500	R
Lake Shore Electric	G.E. 57, West. 76, 121	4	S	Type M	Grid	Occasionally on limiteds	Oil	Oil	11' 4"	40	6	2,500	R
Eastern Ohio	Lorain 34	4	S	K-14	Grid	No	Grease	Grease	12'		6		R
Toledo & Indiana	West. 56	4	S	K-14	Grid	Passenger no; freight in trains	Packed wool waste	Packed wool waste	12'	40		2,500 on locals, 1,500 on limiteds	R
Toledo & Western	Lorain 84, West 76	4	S	Lorain, 4, K-6	Grid	Passenger no; freight in trains	Grease	Grease	12'	30	6	6,000	R
Toledo, Ft. Clinton & Lakeside	Bullock 50, 75	4	S	Bullock	Grid	Passenger no; freight in trains	Grease	Oil	12'	35	6	6,000	R
Stark Electric	West. 76, 56	4	D	K-14, L-4	Grid	Trailers for excursions	Oil	Oil	12'	28	6	4,000	R
Canton-Akron	G.E. 73	4	S	Type M	Grid	No	Oil	Oil	14'	34	6	6,611	C
Central and Southern Ohio Group.													
Western Ohio	West. 56	4	D	K-14	Grid	Passenger no; freight in trains	Oil cups	Oil cups	14'	30	6	3,000	C
Ft. Wayne, Van Wert & Lima	West. 56, 85, 121	4	S	Type M	Grid	No	Oil cups	Oil cups	11' 4"	45	6	2,500	R
Dayton & Troy	West. 76	4	D	L-4	Drum	No	Oil	Oil	14'	28-34	6	4,200 locals and 8,000 limiteds	C
Dayton, Covington & Piqua	G.E. 67	4	D	K-14	Grid	No	Grease	Grease	12'	30	6	7,000	R
Scioto Valley	G.E. 66	4	D	Type M	Grid	Both passenger and freight trains	Oil cups	Oil cups	12'		6		C
Cincinnati & Columbus	G.E. 73 hp.	4	S	Type M	Grid	No	Oil	Oil	12'	30	6		R
Cincinnati, Milford & Loveland	Bullock 50 hp.	4	D	Bullock	Grid	No	Grease	Grease	12'	18	6	7,500	R
Interurban Ry. & T. Cincinnati	West. 49, 56	4	S	K-12, K-14	Grid	No	Oil cups	Oil cups	12' 6"	32	6	4,000	R
Cincinnati, Georgetown & Portsmouth	West. 56	4	S	K-14	Grid	Freight trains	Grease	Grease	12'	20	6		R
Indiana Group.													
Indiana Union	West. 85	4	S	L-4	Grid	Trailers on special occasions	Oil and waste	Oil and waste			6		C
Indianapolis & Northwestern	G.E. 73	4	S and D	Type M	Grid	No	Oil and waste	Oil and waste	12'	30	6	5,000	R
Indianapolis & Cincinnati	West. 106A	4	S and D	Electro-pneumatic	Grid	Equipped for train operation	Oil and waste	Oil and waste	12'	30	6		R
Indianapolis, Columbus & Southern	G.E. 67H	4	S	K-14	Grid		Oil and waste	Oil and waste	12'	30	6	4,500	C
Terre Haute Tr. & Lt.	G.E. 73	4	D	Type M	Grid	Equipped for trailer operation	Oil and waste	Oil and waste	12'	30-35	6	500 to 1,500	R
Kokomo, Marion & Western	West 93	4	S	K-10	Grid	No	Oil and waste	Oil and waste	12'		6		R
Ft. Wayne & Wabash Valley	West. 121	4	S	Electro-pneumatic	Grid	No	Oil and waste	Oil and waste	13' 6"	40	6		R
Michigan Group.													
Rapid Railway System, Detroit	West. 112	4	S	Electro-pneumatic	Grid	Equipped for trailer operation	Oil and waste	Oil and waste	12'	35-40	6	4,000	R
Detroit, Ypsilanti, A. A. & J.	West. 76, 93A	4	S	L-4	Grid	No	Oil and waste	Oil and waste	12'	25-30	6		C

TABLE IV.—SUMMARY OF STANDARD ELECTRIC EQUIPMENT AND CONTROL ON CARS.—*Concluded.*

NAMES OF COMPANIES.	HEATERS.		GEARS.		Material of Gear Cases.	PINIONS.		Type of Headlights.	Type of Signal Lamps.	Type of Pilot or Fender.	Type of Sanding Device.	Type of Destination Signs.	Locations of Signs on Cars.
	Type.	Location.	Type.	Life of, in Miles.		Type.	Life in Miles.						
NORTHERN OHIO GROUP.													
Cleveland & Southwestern	Hot water	Baggage room	Solid.	300,000	Metal	Steel.	175,000		Oil	Fender	Air	Illuminated	On dash.
Lake Shore Electric	Hot water	Vestibule	Solid.		Metal	Steel.		Arc	Electric	Solid fender	Air	Illuminated	On dash.
Eastern Ohio	Hot water	Front vestibule	Split.		Metal	Steel.				Fender		Board and metal	Top deck, in front.
Toledo & Indiana	Hot water	Front vestibule	Solid.		Wood	Steel.		Arc	Oil	Grid iron fender		Small wood	Front dash.
Toledo & Western	Hot water	Front vestibule	Solid.		Wood	Steel.		Arc	Oil	Fender		Metal	Front dash.
Toledo, Pt. Clinton & Lakeside	Hot water	Front vestibule	Split.		Metal	Steel.		Arc	Electric	Fender	Air	Metal	Front dash.
Stark Electric	Hot water	Front vestibule	Solid.		Metal	Steel.		Arc		Wood pilot	Air	Wood	Front and rear dash.
Canton-Akron	Hot water	Baggage room	Solid.		Metal	Steel.		Arc	Electric	Wood pilot	Air	Illuminated	Above front windows.
CENTRAL AND SOUTHERN OHIO GROUP.													
Western Ohio	Hot water	Baggage room	Solid.		Wood			Arc	Oil	Pilot one end, fender the other		Don't use	Name on side of car.
Ft. Wayne, Van Wert & Lima	Hot water	Baggage room	Solid.		Metal	Steel.		Arc	Electric	Wood pilot	Air	Don't use	Name on side of car.
Dayton & Troy	Electric	Along sides	Solid.	300,000	Metal	Steel.	150,000	Arc	Oil	Wood pilot		Limiteds only	Front dash.
Dayton, Covington & Piqua	Electric	Under seats	Solid.		Metal	Steel.		Arc	Oil	Wood pilot		Don't use	Name on side of car.
Scioto Valley	Electric.	Under seats	Solid.		Metal	Steel.		Arc	Oil	Iron pilot		Metal	Front and rear dash.
Cincinnati & Columbus	Hot water	Front vestibule	Solid.		Metal			Arc		Wood pilot		Don't use	Name on side of car.
Cincinnati, Milford & Loveland	Electric.	Under seats	Solid.		Wood	Steel.		Arc		Fender		Don't use	Name on side of car.
Interurban Ry. & T. Cincinnati	Hot water	Front vestibule	Split.		Metal	Steel.		Arc	Oil	Fender	Air	Illuminated	Front.
Cincinnati, Georgetown & Portsmouth	Hot water	Rear end	Solid.		Metal	Steel.		Arc	Electric	Wood pilot		Metal	Front dash.
INDIANA GROUP.													
Indiana Union	Hot water	Separate compartment in smoker	Solid.		Metal	Steel.		Arc	Electric	Wood pilot	Air	Steel on front, wood on rear	Frt. and sd. near ent.
Indianapolis & Northwestern	Hot water	Front vestibule	Solid.	150,000	Metal	Steel.	100,000	Arc	Oil	Wood pilot	Air	Steel	
Indianapolis & Cincinnati	Hot water	Front vestibule	Solid.			Steel.		Arc	Oil	Wood pilot	Air	Wood on side	Front and side.
Indianapolis, Columbus & Southern	Hot water	Cab	Solid.			Steel.		Arc	Electric	Fender	Air	Painted on dash	Front and side.
Terre Haute Tr. & Lgt	Hot water	Smoker	Solid.		Metal	Steel.		Arc	Oil	Wood pilot	Air	Changeable, illuminated	On hood.
Kokomo, Marion & Western	Hot water	Front vestibule	Solid.			Steel.				Wood pilot	Air	Wood	Sides local, frt. ltds.
Ft. Wayne & Wabash Valley	Hot water	Rear of baggage compartment	Solid.			Steel.		Arc	Electric	Wood pilot	Air	Steel	Front and sides.
MICHIGAN GROUP.													
Rapid Railway System, Detroit	Hot water	Rear of passenger compartment	Solid.			Steel.		Combination	Oil	Fender		Sheet iron	Frt. and sd. near ent
Detroit, Ypsilanti, A. A. & J.	Electric.	Along truss plank	Solid.		Metal	Steel.		Arc	Electric	Fender	Lever	Sheet iron	Front and sides.

has been adopted by the Detroit, Ypsilanti, Ann Arbor & Jackson Railway. Pullman green was formerly used, but peculiar atmospheric conditions or some other cause prevented this color holding up. Brown was adopted after a series of tests, in which it was found that this color lasted better.

TRUCKS

With a reduction in curves on high-speed lines there has come a chance for trucks of longer wheel base, giving steadier riding qualities to the car. The Ft. Wayne, Van Wert & Lima, Lake Shore Electric and Cleveland & Southwestern, on their latest cars are using the heaviest type of M. C. B. trucks with 7-ft. wheel base.

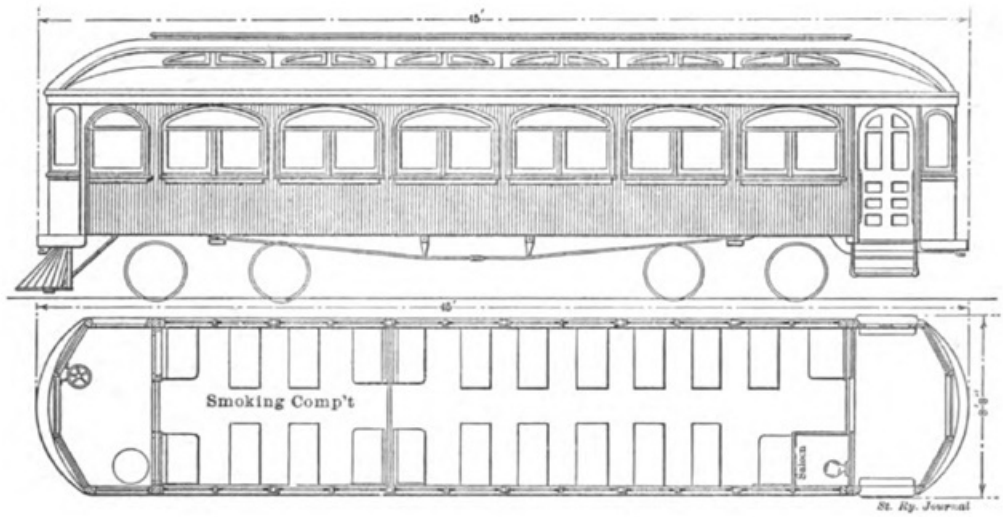
The interurban cars of all the roads examined in Indiana and Michigan are mounted on trucks of the M. C. B. type. Both forward and rear trucks are usually of the same type, as all four axles carry motors.

Within the last few years the weight of trucks has been gradually increased and each truck, exclusive of motors, will now weigh from 10,000 lbs. to 12,000 lbs. The trucks under the cars of the Indiana Union Traction Company weigh 10,500 lbs. each. A few years ago the wheel base of trucks for interurban cars was usually found to be 6 ft. The use of larger sizes of motors, however, necessitated lengthening the truck, and at the present time either 6 ft. 6 ins. or 6 ft. 10 ins. is the usual length of wheel base. The lengthened wheel base has introduced no difficulties in taking curves, but it has been necessary to design the under side of the car so as to provide for the greater swing of the truck.

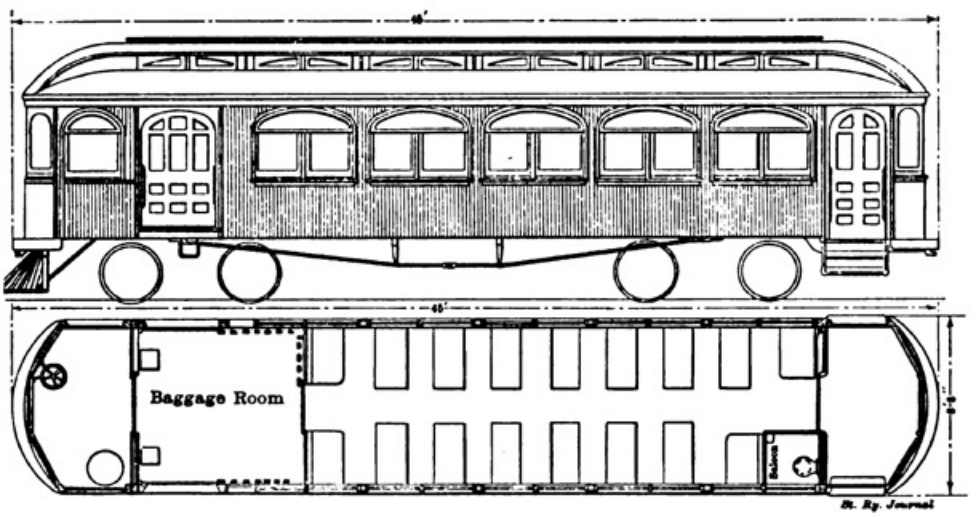
WHEELS

With the increase of speeds there has come a tendency on the Ohio roads to increase the diameter of wheels. With the larger wheel it is not necessary to increase the gear ratio to obtain the higher speeds, and it is believed it gives an easier and steadier riding effect. The 36-in. wheel is now looked upon as standard by the high-speed roads, while a few of them have gone beyond this, the Ft. Wayne, Van Wert & Lima and Lake Shore Electric using a 37¼-in. wheel, and the Dayton & Troy going to the extreme of 39-in. wheels for its limited cars.

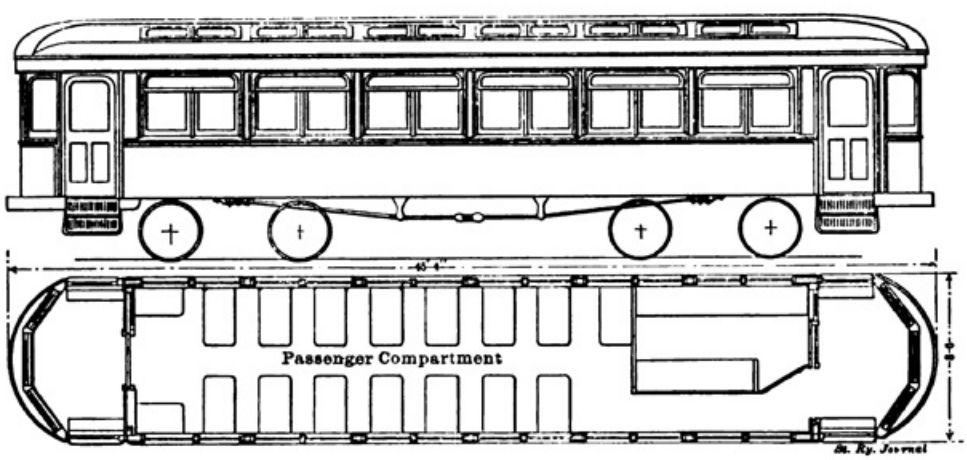
But few roads in Ohio have used steel wheels long enough to determine their exact life. The Dayton & Troy removed some wheels with 2½-in. steel tires after 250,000 miles, and it is believed that the 3½-in. tires will give 350,000 miles or better, and the 4-in tire probably 500,000 miles. The actual life depends a great deal upon the methods of treating the wheels and the diameter to which they are turned. Some roads are turning wheels down to within a quarter of an inch of the tire depth, while others believe that ½ in. or ⅝-in. margin is safer from an operating standpoint. Whether to allow wheels to run until they are all out of shape, or "take the stitch in time" and trim them frequently is also a debated question. The Dayton & Troy ran part of its wheels 40,000 miles and turned off ¼ in., while others ran 60,000 miles



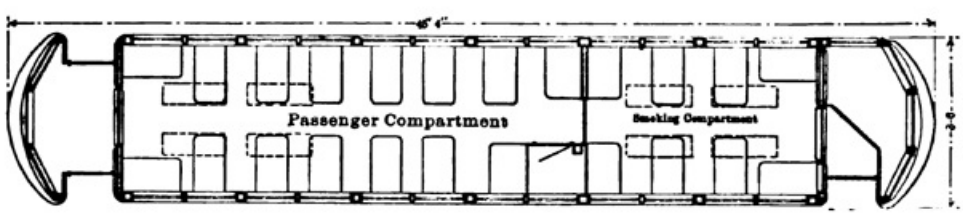
KOKOMO, MARION & WESTERN CAR



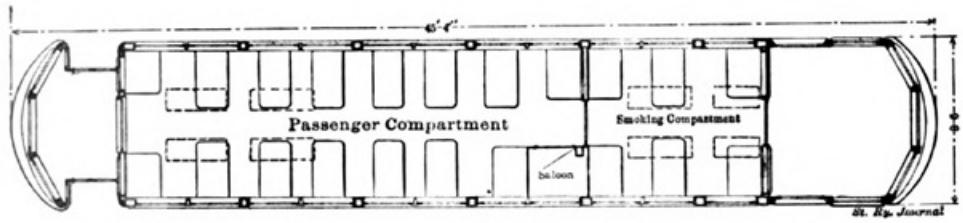
KOKOMO, MARION & WESTERN COMBINATION CAR



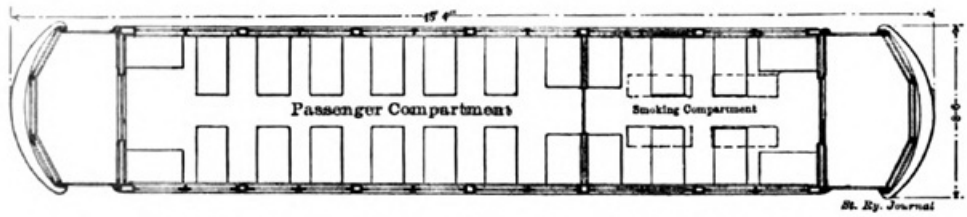
MAHONING VALLEY RAILWAY CAR



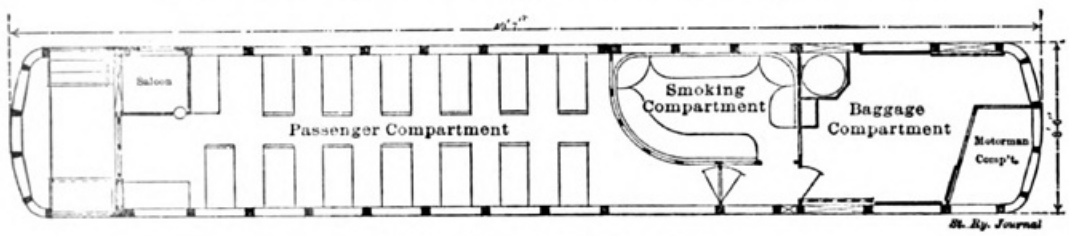
SINGLE-END CAR, WITH SMOKING AND PASSENGER COMPARTMENTS



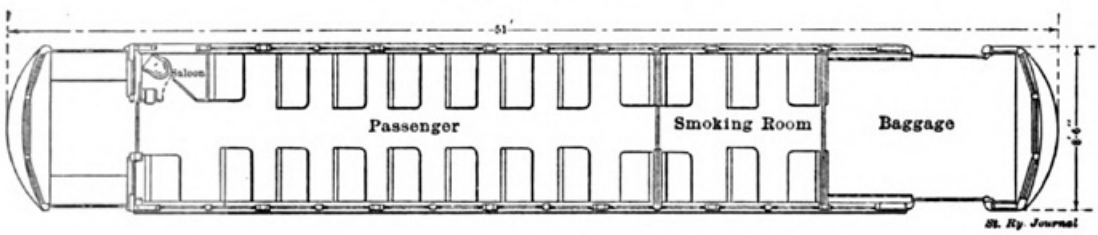
CAR WITH COMBINATION BAGGAGE, VESTIBULE, SMOKING AND PASSENGER COMPARTMENTS



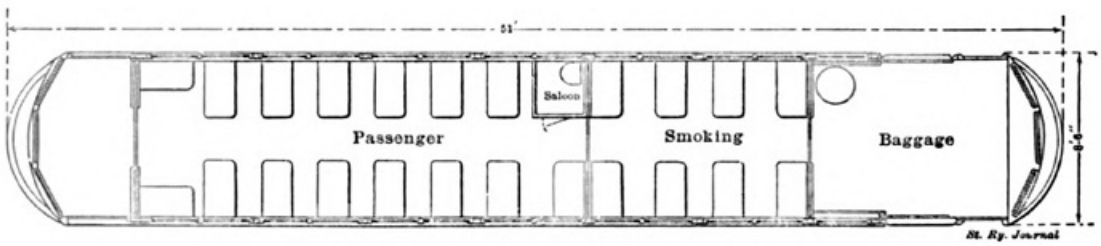
"DOUBLE-END" CAR, WITH SMOKING AND PASSENGER COMPARTMENTS



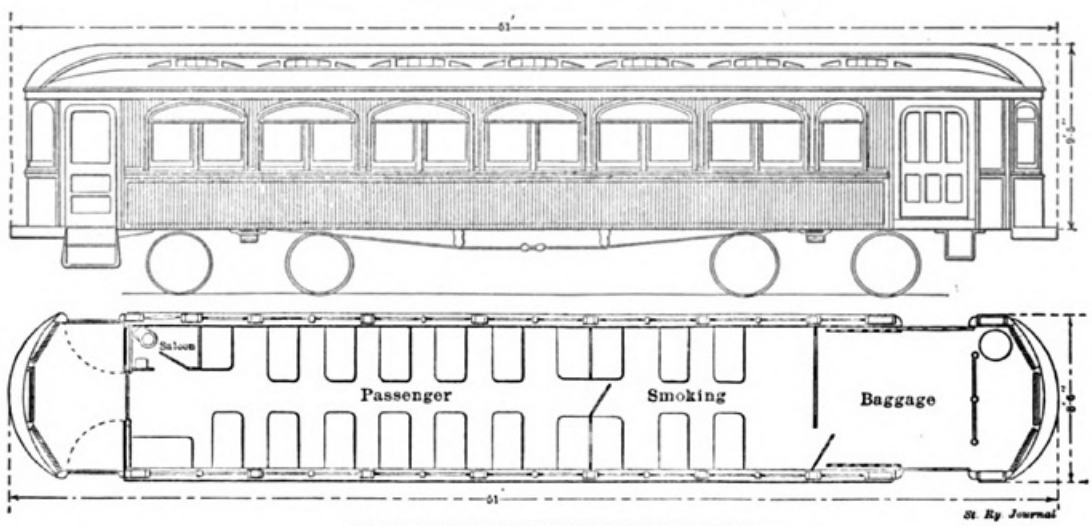
LAKE SHORE ELECTRIC CAR



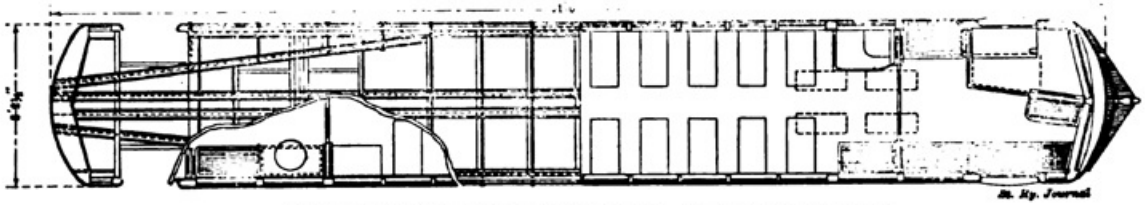
CAR WITH SHORT SMOKING COMPARTMENT



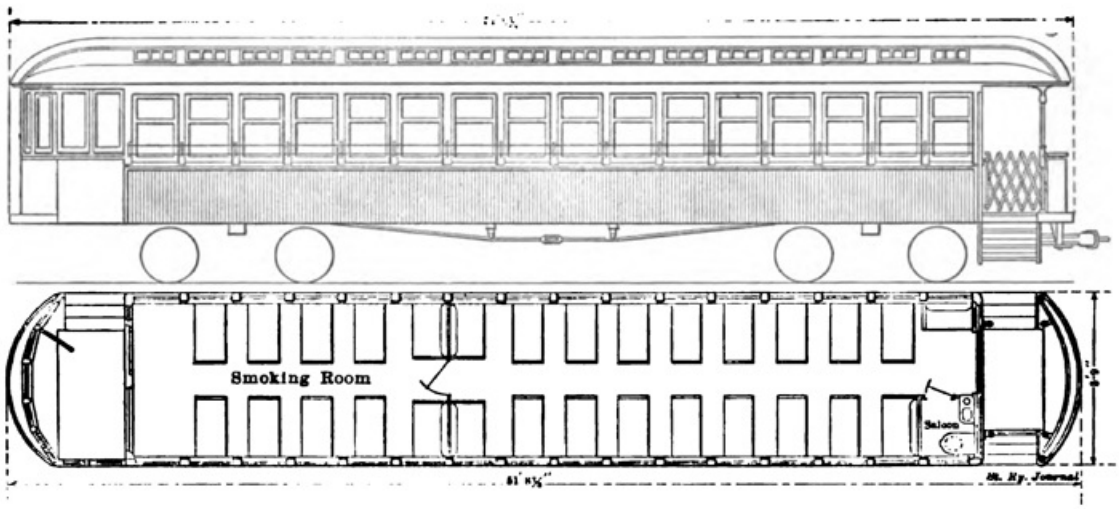
"DOUBLE-END" CAR, WITH TOILET ROOM IN CENTER



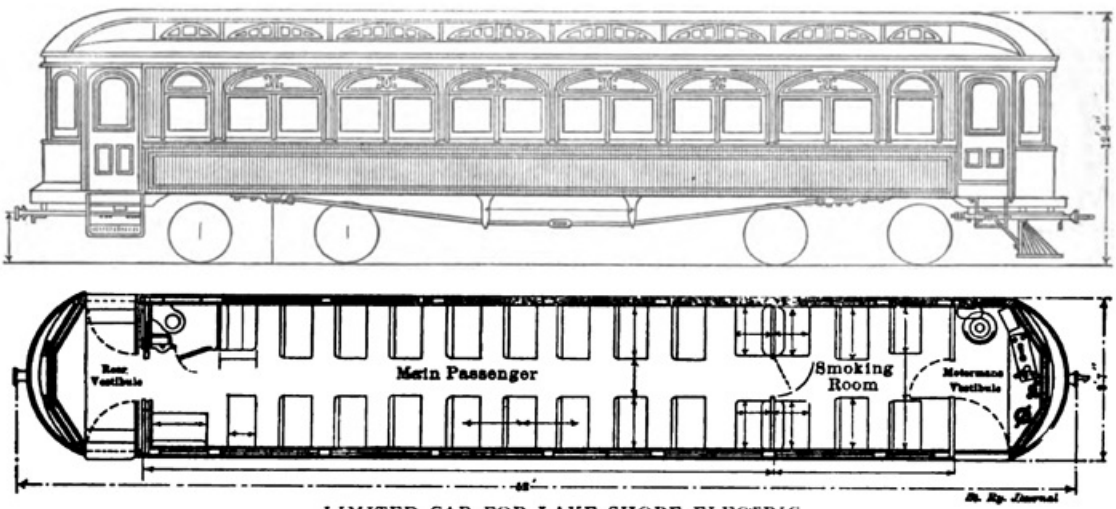
CLEVELAND & SOUTHWESTERN CAR



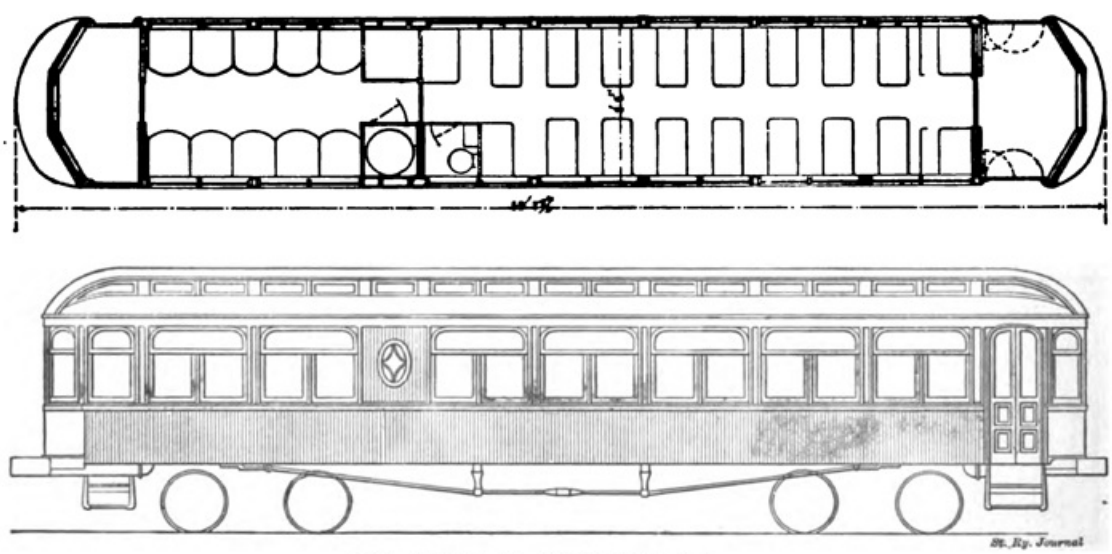
CAR OF TERRE HAUTE TRACTION & LIGHT COMPANY



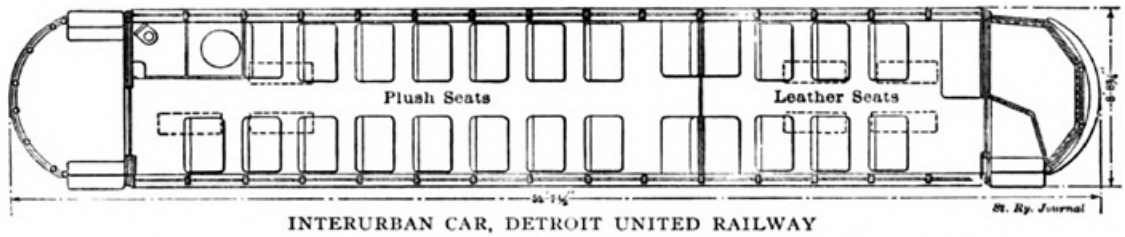
CAR FOR DETROIT, YPSILANTI, ANN ARBOR & JACKSON



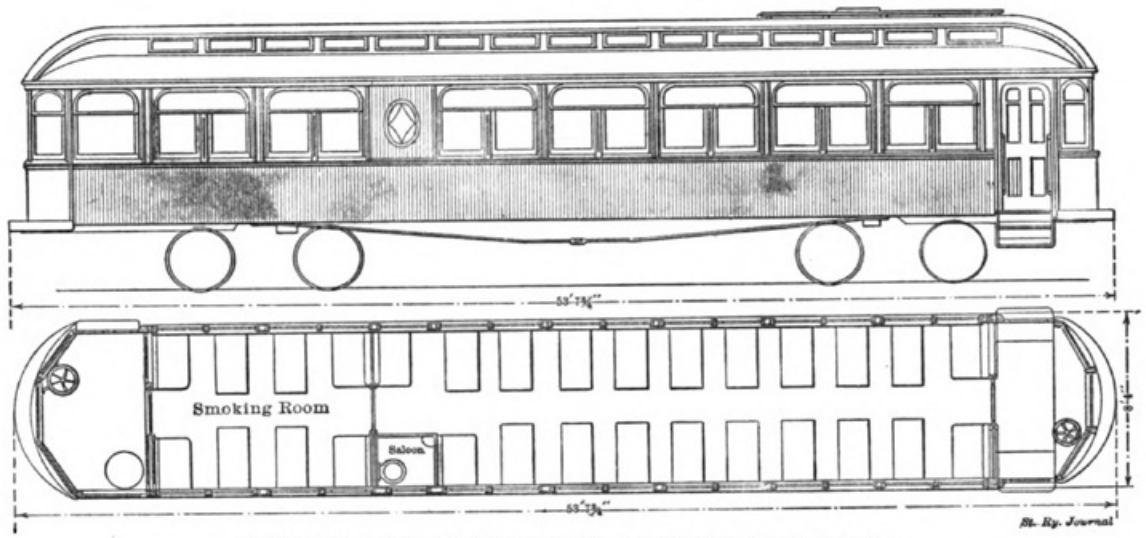
LIMITED CAR FOR LAKE SHORE ELECTRIC



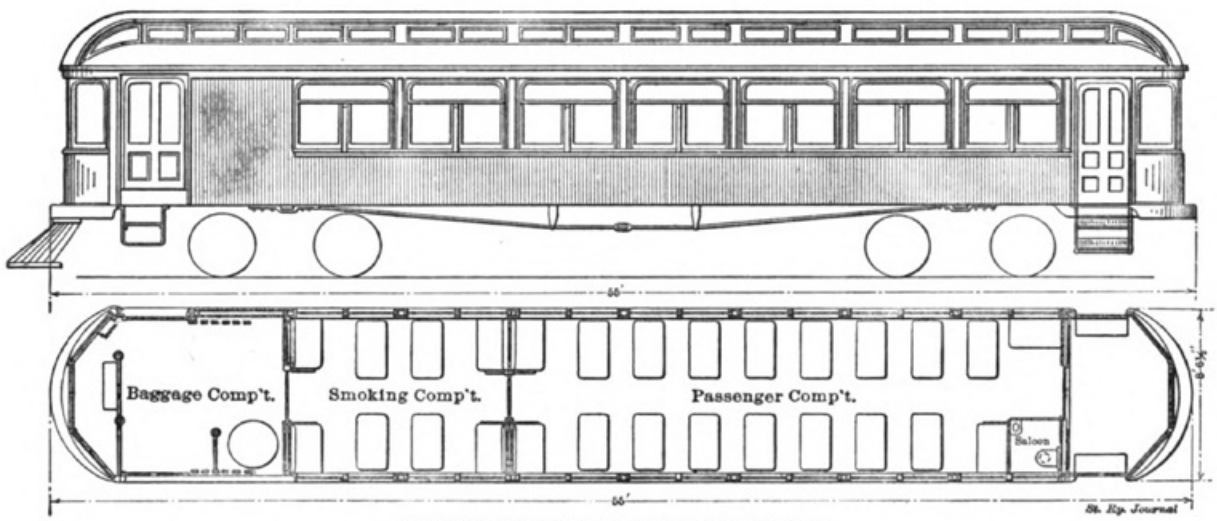
STANDARD CAR, INDIANA UNION



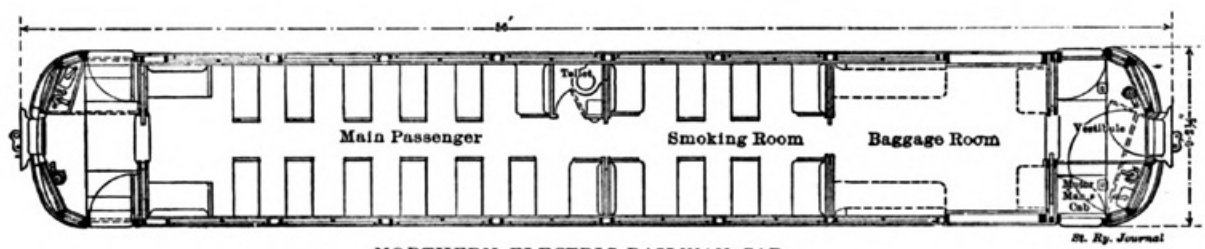
INTERURBAN CAR, DETROIT UNITED RAILWAY



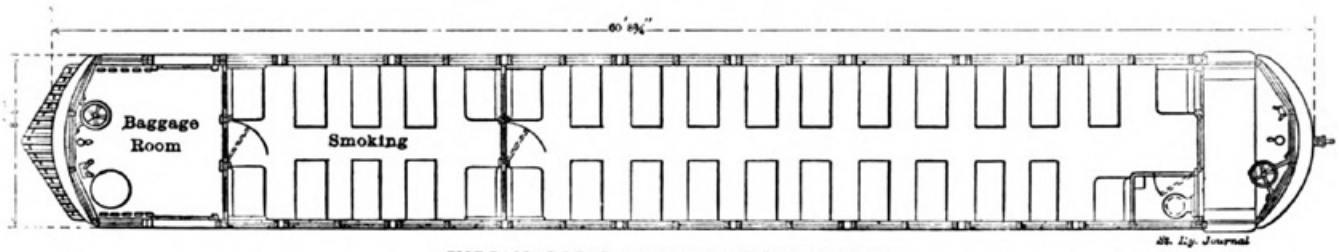
STANDARD CAR, INDIANAPOLIS, COLUMBUS & SOUTHERN



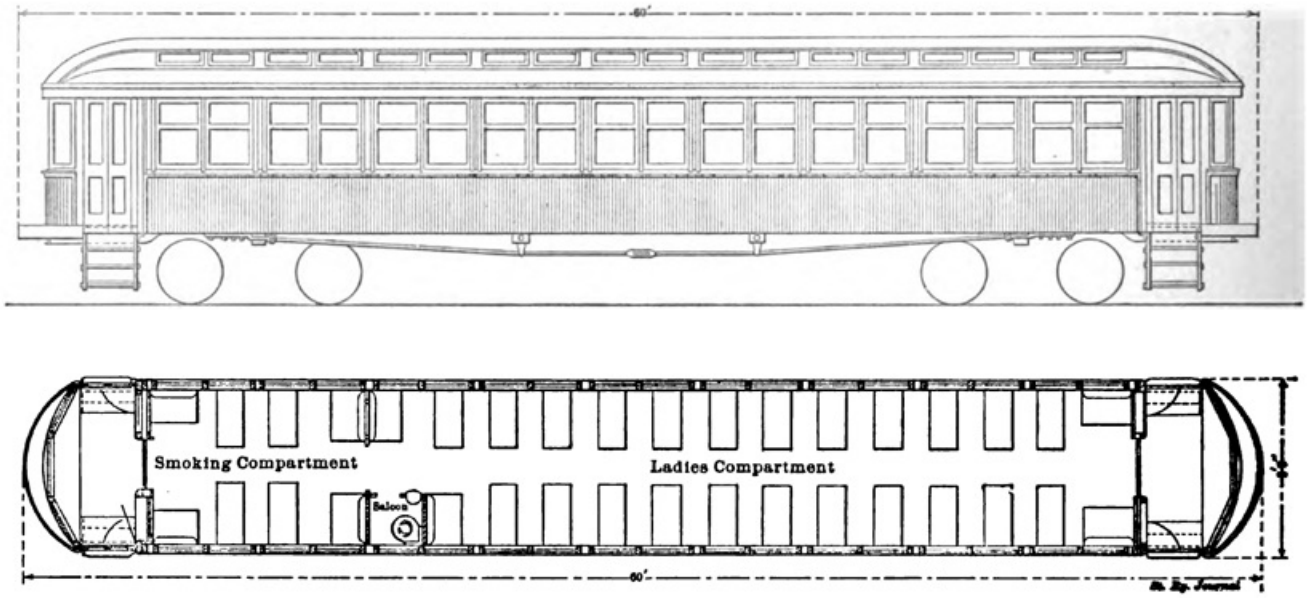
FORT WAYNE & WABASH VALLEY CAR



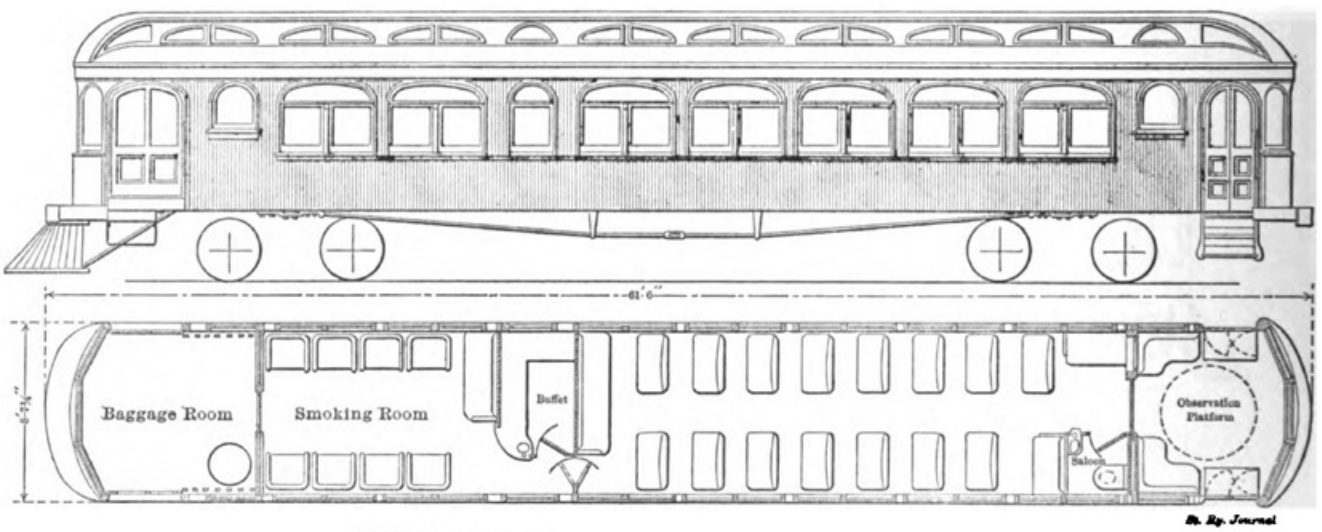
NORTHERN ELECTRIC RAILWAY CAR



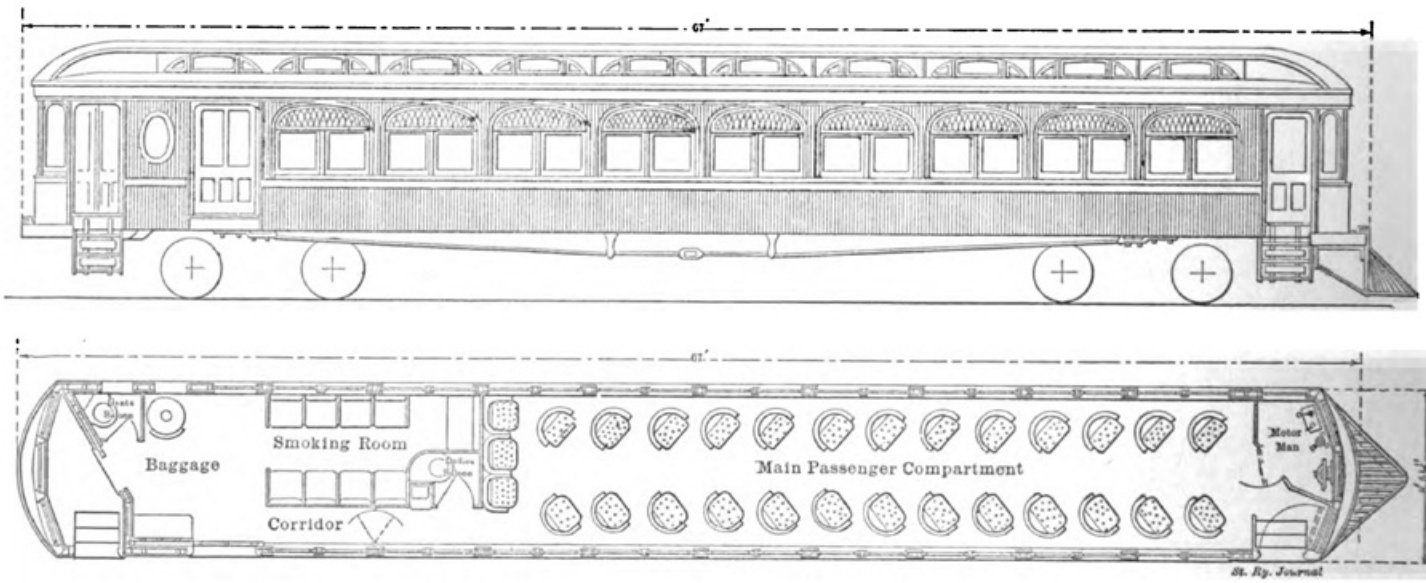
INDIANAPOLIS & NORTHWESTERN CAR



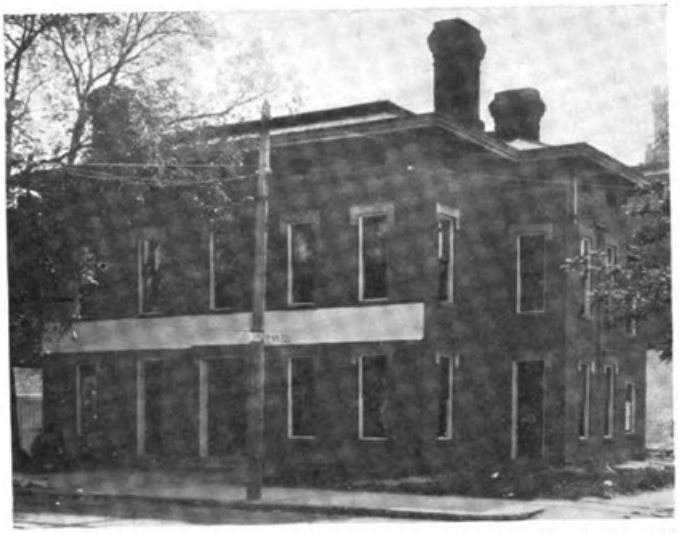
SCIOTO VALLEY CAR



COMBINATION CAR, FORT WAYNE & WABASH VALLEY



LIMITED CAR, COLUMBUS, DELAWARE & MARION

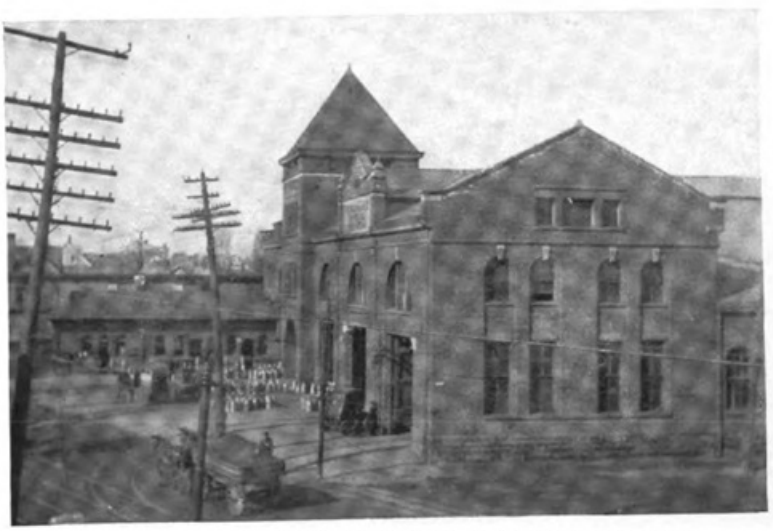


TERMINAL STATION AT MARION, COLUMBUS, DELAWARE & MARION

TRAIN SHED, INTERURBAN UNION STATION, INDIANAPOLIS

TERMINAL STATION AT COLUMBUS, SCIOTO VALLEY

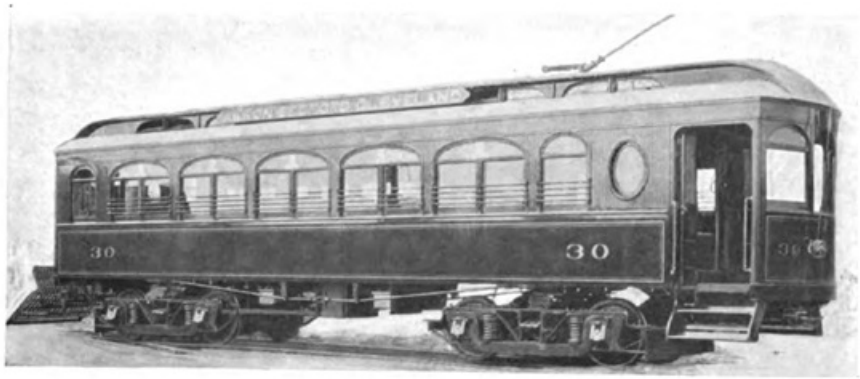
FREIGHT TERMINAL AT DAYTON, DAYTON & TROY ELECTRIC



INTERURBAN STATION, CLEVELAND & SOUTHWESTERN

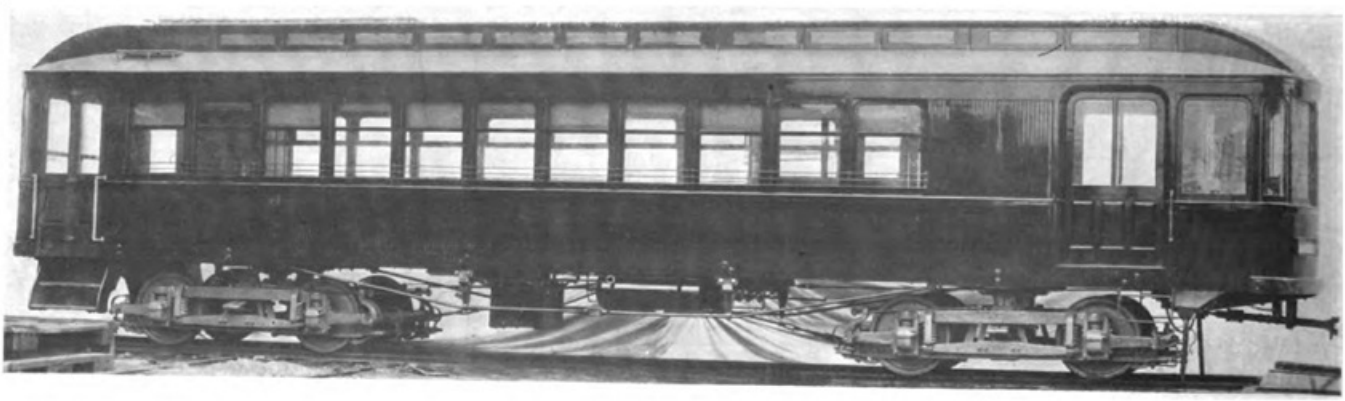
INTERURBAN, PASSENGER AND FREIGHT UNION STATION, CINCINNATI

STEEL CAR, SOUTHEASTERN OHIO



CAR NORTHERN OHIO (AKRON, BEDFORD & CLEVELAND)

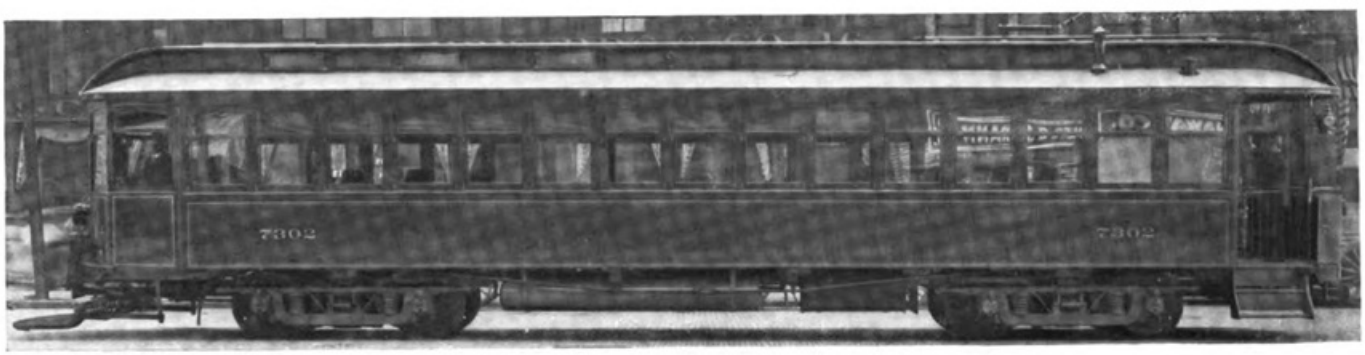
CAR, DAYTON, COVINGTON & PIQUA



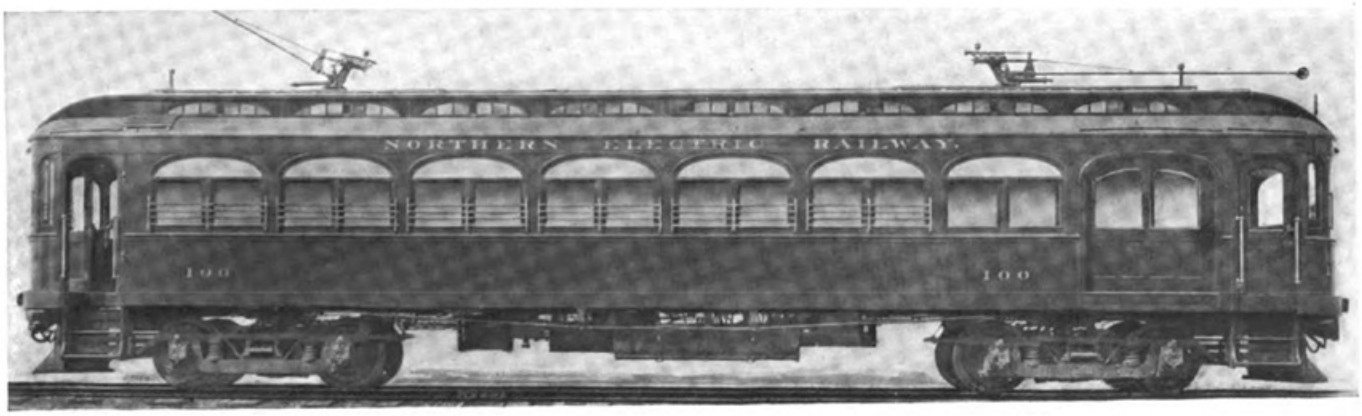
LATE CAR OF THE LAKE SHORE ELECTRIC

STANDARD CAR, COLUMBUS, NEW ALBANY & JOHNSTOWN

STANDARD CAR, COLUMBUS, NEWARK & ZANESVILLE



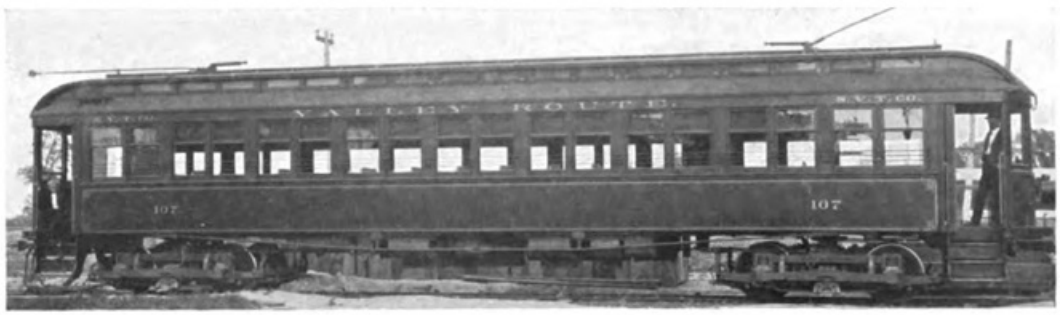
LIMITED CAR, DETROIT UNITED



CAR, NORTHERN ELECTRIC

Plate XXXVIII

STANDARD CAR, DETROIT, YPSILANTI, ANN ARBOR & JACKSON

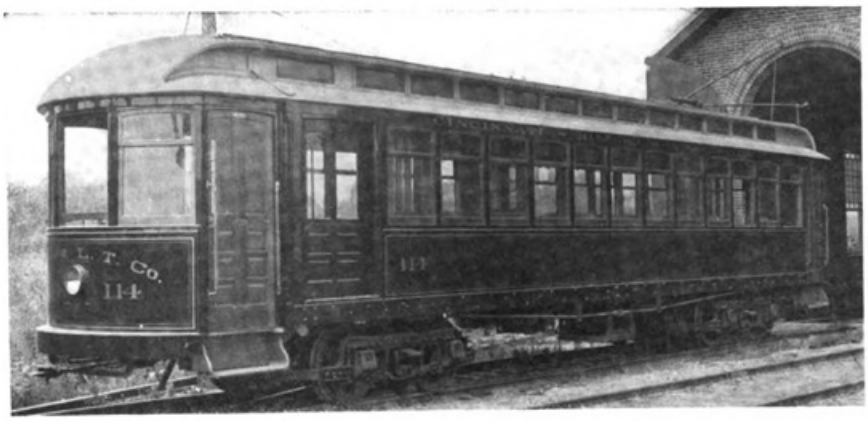


STANDARD CAR, SCIOTO VALLEY

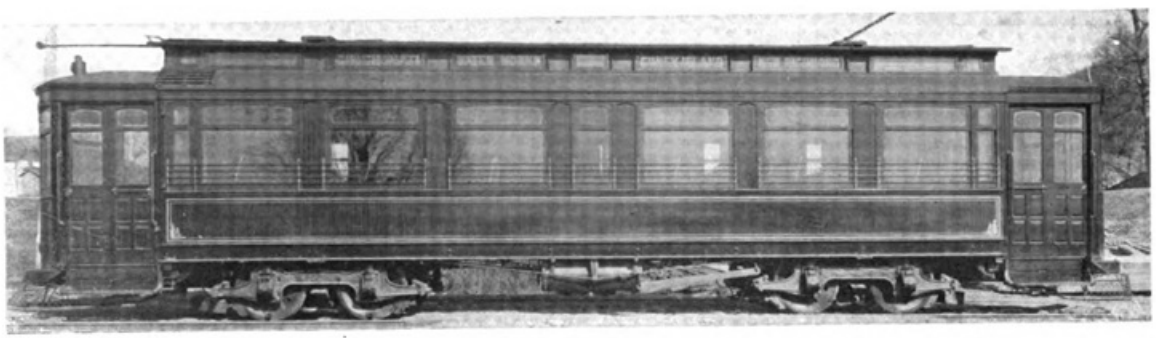
STANDARD CAR, TOLEDO, PORT CLINTON & LAKESIDE

67-FT. EXCURSION CAR, COLUMBUS, DELAWARE & MARION

STANDARD CAR, INDIANAPOLIS, COLUMBUS & SOUTHERN

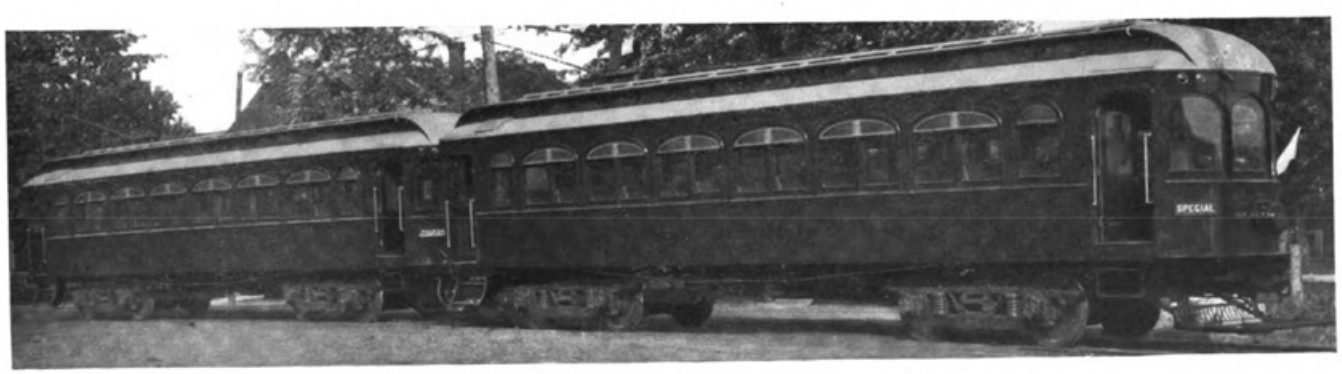


STANDARD CAR, CINCINNATI, MILFORD & LOVELAND



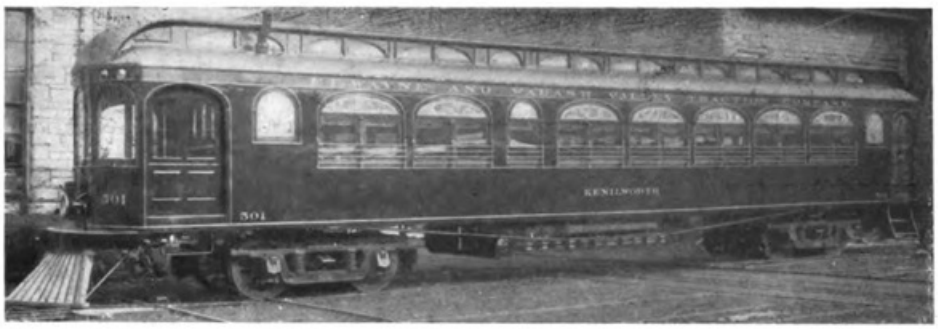
STANDARD CAR, INTERURBAN RAILWAY & TERMINAL

MOTOR AND TRAILER FOR EXPRESS AND FREIGHT SERVICE, SCIOTO VALLEY TRACTION

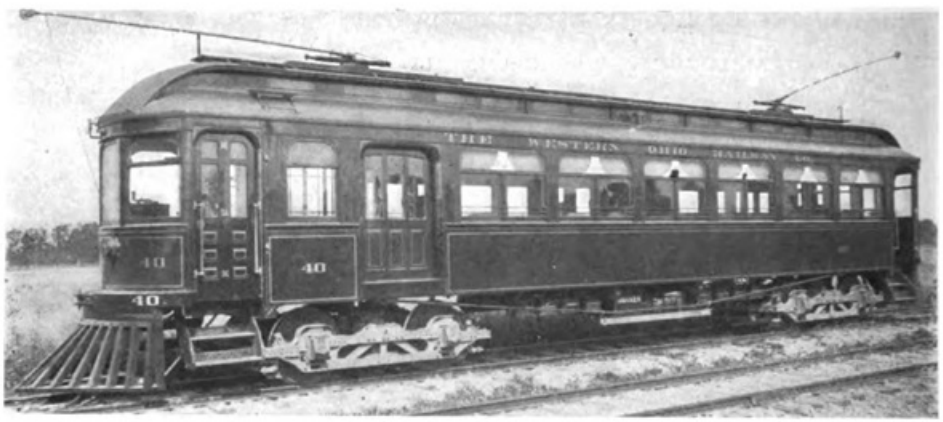


TWO-CAR LIMITED TRAIN, LAKE SHORE ELECTRIC

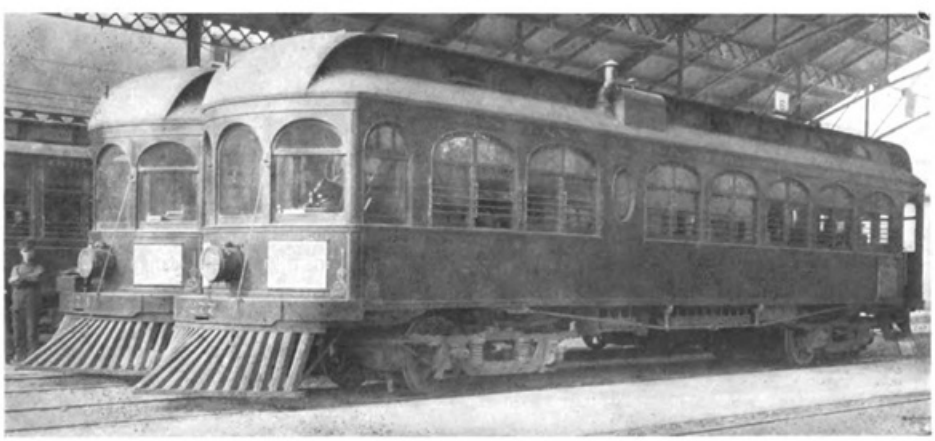
Plate XL



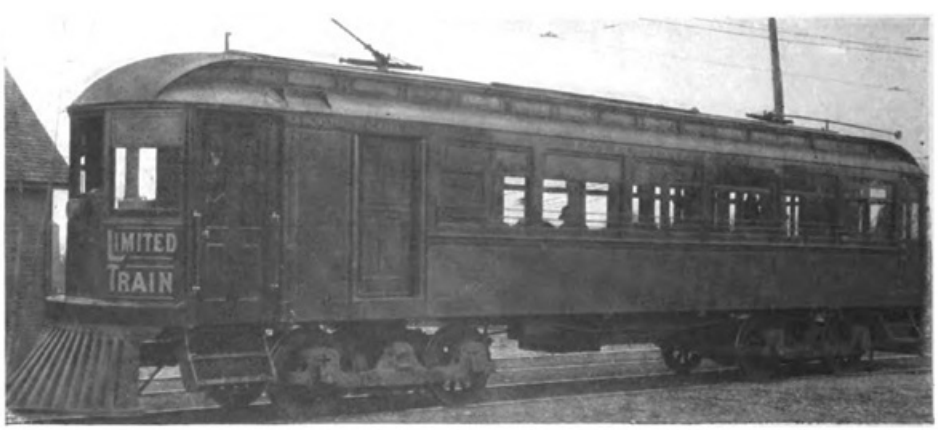
LIMITED CAR, INDIANAPOLIS-FORT WAYNE ROUTE



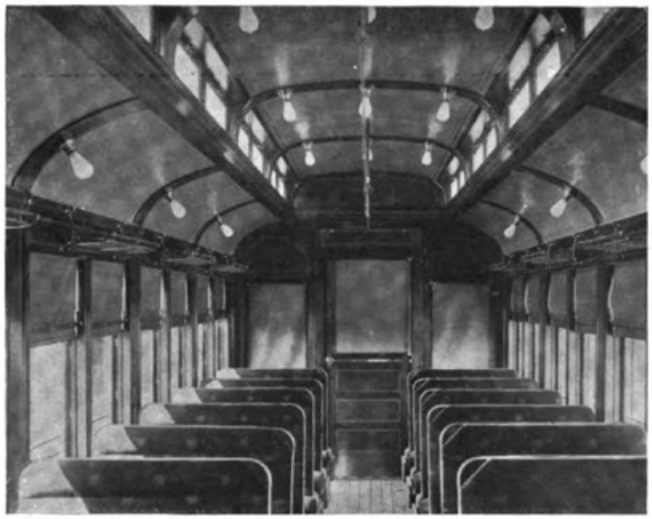
LIMITED CAR, WESTERN OHIO RAILWAY (LENGTHENED IN OWN SHOPS)



LIMITED CARS, INDIANA UNION.



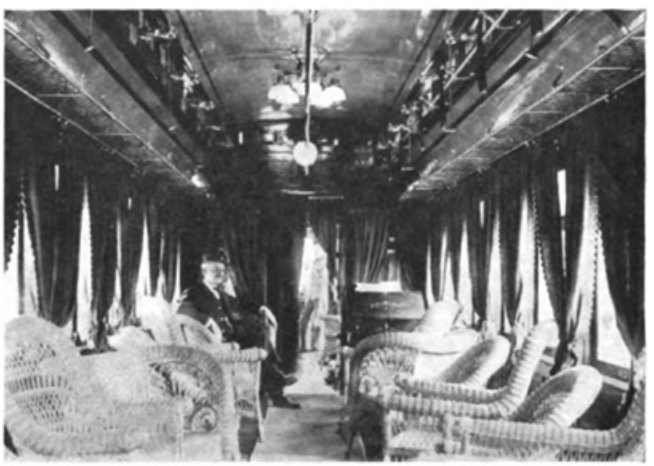
LIMITED CAR, DAYTON & TROY



INTERIOR STANDARD CAR, COLUMBUS, NEWARK & ZANESVILLE

INTERIOR 67-FT. EXCURSION CAR, COLUMBUS, DELAWARE & MARION

INTERIOR PARLOR CAR, DAYTON, COVINGTON & PIQUA



INTERIOR LIMITED PARLOR CAR, TOLEDO & INDIANA

INTERIOR PARLOR CAR, COLUMBUS, LONDON & SPRINGFIELD

INTERIOR TYPICAL INTERURBAN CAR IN THE CENTRAL WEST

Plate XLII

T. & I. Limited

Canton-Akron

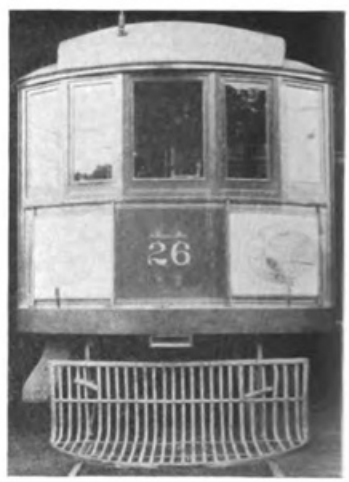
C., L. & S.

Rapid Ry. Limited

Ind., Col. & S.

Ind. Union Limited

D. & T. Limited



D., Y., A. A. & J.

Cleveland & S. W. Limited

Ft. W., V. W. & L. Limited

Scioto V. Non-Coupling

Scioto Valley Coupling

SOME END-ON VIEWS OF INTERURBAN CARS, ILLUSTRATING INDIVIDUALITY IN PILOTS, DESTINATION SIGNS, HEADLIGHTS, ETC.

and turned ½ in. It rather favors the first mentioned plan, although this necessitates more shop work. Other roads are allowing wheels to run 70,000 and 80,000 miles before turning them, and while this plan reduces the amount of shop work, it undoubtedly reduces the life of the wheel, because it is necessary to take deeper cuts to get the wheel back into proper shape. The Columbus, London & Springfield, Canton-Akron, Dayton & Troy and several other roads have designed simple heating outfits for shrinking steel tires onto the centers. They consist of circular gasoline burners built of tubing having fine holes drilled on the inner circumferance so as to give an even heat all the way around the tire. The axle with center attached is lowered into the rim by means of a chain hoist.

A wheel which has a special locking ring for the tire is being used with success by several roads, while the bolted tire has also been found very satisfactory.

Rolled and forged-steel wheels have many friends with some of the best high-speed roads. The Cleveland & Southwestern reports 200,000 miles with forged wheels, while the Western Ohio ran wheels of this type 60,000 miles before turning.

In spite of the widespread use of the steel wheel and the remarkable mileages shown, there are a number of roads which claim that the cast iron chilled wheels are fully as safe and more economical in the long run. The Toledo & Indiana, whose limiteds are as fast as any in the two States, formerly used steel tires and has gone back to the chilled wheel. Manager Darrow, of the company, reports 50,000 to 60,000 miles with chilled wheels at less than one-seventh the cost of steel-tire wheels. Unevenness of wear and the necessity for turning off heavy cuts on some wheels and lighter ones on others are among his objections to the steel wheel. The Cincinnati, Milford & Loveland feels well satisfied with 55,000 miles for chilled wheels.

As intimated in another column, many of the interurbans have been obliged to keep their wheel flanges down to a point that is undesirable, owing to the unsuitable tracks and special work on city entrances. There is a tendency on the part of a number of city roads to consider this matter in laying new track and special work. The Cleveland Electric Railway, for instance, in its new work aims to permit the interurbans to use flanges 1¼ ins. wide, which gives an excellent margin of safety, especially where steel tires are used. On account of city pavements it has been necessary to reduce the tread to 3¼ ins. or 3½ ins. in most cases. The Scioto Valley and the Cincinnati, Georgetown & Portsmouth use practically M. C. B tread, and the latter uses a standard 1½ in. x 1¼-in. flange. The practice of the various roads investigated is shown in Table III.

With one exception steel wheels or steel tire wheels are used on the roads visited in Indiana and Michigan. The Detroit, Ypsilanti, Ann Arbor & Jackson uses chilled wheels. Good results are obtained with them and the company has seen no cause to adopt steel tires. An average mileage of 40,000 miles is obtained. The cars operate over the tracks in Detroit and the depth and width of flange is ⅞ in., yet no trouble is experienced by broken or chipped flanges. This is partly due to the fact that the girder rails in Detroit have been well grooved out. An all-steel wheel weighing 590 lbs. is used by the Terre Haute Traction & Light Company. Rolled steel wheels are also used by the Detroit United. Wheels of diameters varying from 37¼ ins. to 33 ins. are used. The larger diameter has been adopted by the Indiana Union Traction Company and the Fort Wayne & Wabash Valley Traction Company, while the smaller one is employed by the Terre Haute Traction & Light Company. Flanges range in depth from ⅞ in. to 1⅛ ins. and the width of tread varies from 2½ ins. to 3 ins. Both special fasteners and double-lipped riveted retaining rings are used in connection with steel tirees. In one instance where double-lipped rings are employed, preference was expressed for the fasteners, the objection to the double-lipped rings being the breaking of the edge of the tire when worn thin, and also the necessity for putting the wheels in the lathe and turning the edge of the tire to make possible the removal of the retaining rings. In another shop where double-lipped retaining rings were used, they were thought better than the special fasteners.

Axles were found to vary in diameter from 5 ins. to 6½ ins. The heaviest car had a 5½-in. axle. With one exception axles are made of steel. The axles of the Detroit, Ypsilanti, Ann Arbor & Jackson Railway, however, are of iron.

Heavier axles and larger journals on the interurbans in the Central West are becoming the rule. The Scioto Valley and Fort Wayne, Van Wert & Lima with their heavy equipment are using 6½-in. axles. The Stark Electric, which has a 34-ton car and 50-hp motors uses a 6-in. axle with a 7-in. gear seat. Journals on the latest Cleveland & Southwestern cars are 5 ins. x 9 ins. In Indiana lengths of journals varied from 3½ ins. to 5 ins. and widths from 7 ins. to 10 ins. The smallest journal, 4¼ ins. x 7 ins., was found on a car weighing 65,000 lbs. The largest, which measures 5 ins. x 9 ins., was in use on the Fort Wayne & Wabash Valley Traction Company and the Indianapolis & Cincinnati Traction Company.

The variety of sizes of journals emphasizes the necessity for standardization of journals and journal boxes.

LUBRICATION

Babbitted brass journal bearings are used on the greater number of roads. The Terre Haute Traction & Light Company, however, uses a composition bearing, and the Indianapolis & Northwestern Traction Company an all-brass bearing. The general practice is to lubricate journal bearings by packing the boxes with oil and waste, although two or three roads in Ohio continue to use grease for journals.

BRAKES

Straight air brakes are almost universally used by Ohio roads. The Scioto Valley has its cars equipped with both straight and automatic air to provide for train operation. The Dayton & Muncie uses a storage air system, as does also the Detroit, Monroe & Toledo Short Line. While the storage systems have been found convenient and economical, they possess the disadvantage of rendering it impossible for these roads to send their cars over other lines, a decided handicap since interline excursion business is becoming quite prevalent in this district.

Without exception, air brakes are employed on the interurban cars of the roads visited in Indiana and Michigan, and practically all use straight air equipments, notwithstanding the fact that several are equipped with multiple-unit control systems.

It seems to be universal practice to hang the brake shoes between the pairs of wheels of a truck rather than outside. A few years ago many outside-hung brakes were to be found. The change in practice has been brought about partly because of the tendency of outside-hung brakes to pull the ends of the truck frame down and increase the chattering of the shoes.

BRAKE SHOES

The practice on the different roads varies widely with regard to brake shoes. Plain gray iron shoes without inserts and with steel or wrought-iron inserts, as well as composition filled shoes, are used. Steel back shoes are also being employed. The argument in favor of the steel back shoe is that it can be worn down very thin without danger of it breaking and causing derailment of the car. There is very little in the service on different interurban roads, and there are no local conditions that necessitate a difference in practice with regard to brake shoes on different roads, yet a wide variety in practice exists. The shoes are invariably used with a holder or head. A few years

ago shoes were frequently made with lugs on them, so that the shoe itself could be attached to the truck lever. However, this method increased the weight of that portion of the shoe that goes into scrap, and it also required more time in changing shoes. The chief reason for the shoes being made in this manner was probably because of the limited space between the wheels. The lengthening of the wheel base a few inches has removed the difficulty, and the brake-shoe head has been generally adopted.

The original weight of shoes is found to vary from 24 lbs. to 35 lbs. Where the space is not limited it would seemingly be good practice to use the heavier shoe. This would remove the necessity for frequently changing the shoes. In several instances the weight at which shoes were discarded could not be given. The figures given for discarded shoes varied from 8 to 16 lbs. The lowest figure was for a well-worn steel back shoe. This figure was given with the added statement that this was the weight to which it was intended that the shoes should be worn.

In general, it might be said that the weight at which shoes are discarded could with advantage be given considerably more attention than is customary. The scrap heap offers convincing evidence of this. Shoes are frequently found worn thin at one end while the other end has not been in contact with the wheel, and it is safe to say that not more than two-thirds of the available metal is usually worn away. The fault usually lies in the length and adjustment of the brake hangers. Varying loads on the cars make it impossible to keep the brakes in exactly the proper position, but, judging from the manner in which discarded shoes are worn, the opinion is formed that in some cases, at least, improvements could be made in the brake apparatus so as to get more even wear of the brake shoes. Very few figures were obtained as to the mileage of brake shoes. On the Detroit United Railways new brake shoes cost 0.043 cent per car mile. This figure, however, does not include credit for the scrapped shoes. The number of stops and the weight of cars differ so widely on different systems that widely varying brake shoe mileages are obtained. Figures as to the mileage of shoes on the Marion Special, which operates over the Indiana Union Traction system, and makes but two scheduled stops in 72 miles, would be high, as compared with similar cars in local service. The mileage of shoes, in fact, offers very little grounds for comparison of the results on different roads. Difference in operating conditions is probably largely responsible for the wide difference in brake shoe mileage obtained on the Indianapolis & Northwestern Traction Company and the Fort Wayne & Wabash Valley Traction Company. On the former road a mileage of 1050 is obtained with a 27-lb. shoe, and on the latter 3500 miles are secured with a 26-lb. shoe. The brake levers are usually proportioned to give a braking pressure of from 80 to 90 per cent of the weight of the car.

Seven roads in Ohio favor outside-hung brake shoes, while ten roads believe best braking results can be obtained from hanging the brakes between the wheels. Few roads in Ohio have given much attention to the subject of most desirable braking pressure or to the life of brake shoes. Hardly a road keeps accurate mileages on brake shoes. The Stark Electric is using a soft iron shoe weighing 45 lbs., and reports 6000 miles wear. Others say their shoes wear less than 1000 miles. Five roads favor the use of inserts in brake shoes and eleven favor the plain type.

The tendency to run cars in trains has occasioned a demand for drawbars which will allow the close coupling of cars, and, at the same time, enable them to take the right angle curves in city streets. The Scioto Valley and the Lake Shore Electric have their latest cars equipped with drawbars especially designed for train operation.

SINGLE END OPERATION

Preference for single end operation is on the increase. Roads out of Dayton are obliged to use double end cars, as there are no loops available in that city, but several of these roads would change if they could. The ability to run a car in either direction and from either end is undoubtedly an advantage, and the claim is made by several master mechanics that motors, gears and pinions show better life where they run in both directions, but, as a rule, the objections are thought to overbalance the advantages. The Fort Wayne, Van Wert & Lima has controllers at both ends, so it is possible to run cars in either direction, but the operation is in one direction only. The arguments advanced by roads favoring single end operation are numerous. This practice enables the arrangement of cars to remain the same at all times, so that ladies are not obliged to climb over a lot of trunks, or pass through obnoxious smoking compartments to get to their seats. Where this is necessary, it is claimed that it necessitates longer stops for ladies desiring to leave the car. Aside from the saving in cost in dispensing with one set of controllers, the controller on the rear platform is apt to be tampered with, besides which it takes up space, necessitating a longer platform. The coming type of car is that in which the sides are carried continuous to the forward end, giving a car without front platform. This type enables the motorman to have a cab by himself where he cannot be annoyed by passengers and where he is in close proximity to the baggage compartment, enabling him to readily assist in loading. Single end operation eliminates the necessity for placing fenders or pilots at both ends, and, on the whole, a more symmetrical car can be built with this arrangement than with the other. Of the Ohio roads investigated, eleven have single end operation and six double end.

With one exception, cars of the roads visited in Indiana and Michigan are built for operation in one direction only. The one exception is the system of the Terre Haute Traction & Light Company. The cars of the Indianapolis & Northwestern Traction Company, as well as those of the Indianapolis & Cincinnati Traction Company, while built for operation from one end only, are fitted with controllers at both ends, to facilitate the movement of cars in switching and at other times when occasion may require.

MOTORS AND CONTROLLERS

Four-motor equipments are universal in Ohio on interurban roads. Two or three years ago the Lake Shore Electric used two motors, one on each truck, and for a long time the Indiana Union Traction Company used but two motors, placing both on the rear trucks.

The use of larger cars, higher speeds and longer runs has resulted in the use of larger motors. The 75-hp may be said to be the standard equipment in this district, although some of the roads in recent purchases for high-speed cars have gone beyond this. The new Lake Shore Electric cars have four 85-hp motors, and the Fort Wayne, Van Wert & Lima has adopted similar equipment. The Scioto Valley is the only road which has gone beyond this, and it uses 100-hp motors. On the other hand, the Toledo & Indiana and the Western Ohio, both operating at speeds of 60 miles an hour, believe that the 50-hp equipments are heavy enough and more economical in power consumption than the larger motors. The experience of the Western Ohio is interesting. Its cars cover the run from Dayton to Toledo and return, 320 miles, in 12 hours, with practically no layovers, a number of stretches calling for 60 miles an hour, and it is claimed there is no heating of the motors and that they are not overworked. It is claimed that tests have shown that the cars consume 2.43 kw-hours per car-mile, while it is said that the cars of another road in the same

service in making the same schedules consume 3.01 kw-hours per car-mile, the cars being practically the same weight, 31 tons.

There is a decided tendency towards the adoption of multiple-unit controllers. In adopting these controllers probably the future operation of cars in trains has been considered, but evidently the avoidance of controller troubles has been the main consideration. The direct controller is generally conceded as being ill suited for controlling the larger types of motors. Flashing in the controller when the circuit is broken necessitates constant attention to the controller to keep it in operating condition. On one of the roads visited which has a direct controller on large cars it is the custom to throw off the current by means of the circuit breaker whenever the car is not up to speed. This practice usually results in the circuit breaker being put into such condition that it cannot be relied upon to care for overloads. On the Indianapolis & Northwestern Traction provision is being made to change the wiring on some L-4 controllers that are in use in such a manner that the circuit will be broken through contactors underneath the car.

The multiple-unit system of control is now used on the latest cars of six of the roads in Ohio, although only two of these, the Lake Shore Electric and the Scioto Valley, are using train operation in regular service, and that, too, only on occasions of especially heavy traffic. The Scioto Valley, Western Ohio, Springfield, Troy & Piqua and Dayton & Troy frequently haul trailers behind their express cars, the trailers being equipped with air brakes, with train control of brakes, but no motor trailers are used in the express service. The Stark Electric owns a number of old Manhattan Elevated cars, which have been equipped for trailers, but the train control system is not employed.

After experimenting with several different types of rheostats, the grid type has been generally adopted. It is considered the standard on all of the roads visited. The adoption of this type has reduced the maintenance cost of rheostats, as well as increased the reliability. Where the proper number of rheostats are provided and rheostats are properly proportioned, very little trouble is experienced with them.

While the cars on some systems are equipped with multiple-unit controllers, the practice, in Indiana and Michigan, of running single cars instead of cars in trains is followed entirely. On the Detroit United Railways a train is sometimes divided into two or three sections. Difficulty in getting in and out of cities is probably largely responsible for the practice of operating cars singly, but there are several other reasons which combine to make the practice preferable. The Indiana Union Traction Company has several trail cars of about the same length as the motor cars, and on special occasions some of the cars are operated with trailers. To avoid cutting down the schedule when trailers are used, it is at times the practice to divide a train into two sections, the front section having the trailer, while the rear section consists of a single car. The first train makes only a few stops, and is thereby enabled to run on scheduled time and to stay ahead of the rear section, which makes all of the local stops.

As far as Indiana and Michigan are concerned, a few years ago the cars of several interurban systems were equipped with two motors, but this practice seems to have been generally abandoned, and all of the later types of cars are supplied with four motors. The better traction obtained by having all of the wheels drivers was probably the reason most influencing the change, yet there were, in fact, no great advantages in employing but two motors. The total horse-power of the motors under the cars varies from 200 to 400. Several of the cars are equipped with four 75-hp motors, which size seems to give very good satisfaction.

LUBRICATION OF ARMATURE AND MOTOR BEARINGS

Oil lubrication of armature and motor bearings, as well as journal bearings, is becoming the popular method in Ohio. Some of the roads are simply using the receptacles provided on the motors, plugging up the slot provided where grease was formerly used, and filling the chamber with waste or wicking and oil. Others are using special oil cups designed for this purpose. Several of the roads in the district have given contracts to leading oil concerns for the entire lubrication of their cars on a flat rate of so much per thousand miles with very satisfactory results. Others prefer to do their own experimenting and design lubricating devices to suit their particular requirements. The quality of oil used in this service varies. The Stark Electric Railway uses a red engine oil, costing 14 cents per gallon, packing the lower surface with cotton waste and using wool waste above. Its expense for lubrication, exclusive of waste, is about 10½ cents per thousand miles. The Scioto Valley reports that its entire car lubrication cost is 22 cents per thousand miles. It uses oil at 25 cents a gallon, and, of course, its equipment is much heavier and speed considerably higher than the other road mentioned.

The Toledo, Port Clinton & Lakeside uses grease on its motor bearings and oil cups on its armature bearings. Five roads use grease exclusively.

In Indiana there is a tendency to abandon babbitted motor axle bearings. Brass bearings without babbit lining are used on the Indianapolis, Columbus & Southern system, the Indianapolis & Northwestern system and the Fort Wayne & Wabash Valley system. Where babbitt is used it is usually only a thin lining of about 1-16 of an inch. The same practice with regard to babbitting is followed in armature bearings. With such a lining, should the bearings get hot and the babbitt melt, the armature will not fall down far enough to touch the pole pieces. The shell is either of brass or a composition metal. Bronze shells are used by the Fort Wayne & Wabash Valley Traction Company. Both motor armature bearings and motor axle bearings in the later types of motors are lubricated by means of oil and waste packed in housings. With some of the older types of motors special oil cups are inserted in the grease cups.

TROLLEY WHEELS

The little trolley wheel probably makes more trouble for the average master mechanic than any other single piece of mechanism in the equipment of the road. While there are a number of very excellent wheels on the market, a fortune awaits the man who can invent a trolley wheel which will do the work demanded of it and show a life approaching to that of other wearing parts of the equipment. While the average life of several well-known makes of wheels is very creditable, it is the great variation of results which annoys the master mechanic. Some wheels of a certain lot will show surprising results. Wheels which have run 6000 to 8000 miles are found frequently, yet the next few wheels of the same lot may develop soft spots or may not be perfectly round, and they go to pieces in a few hundred miles.

The high-speed limited service, with its rapid acceleration and heavy flow of current, is extremely hard on trolley wheels. On the Dayton-Toledo limited run of 320 miles of almost continuous operation, at speeds frequently reaching 60 miles an hour, it is no uncommon thing to have to stop once or twice to change trolley wheels. This, in spite of the fact that it has become the practice to place a new trolley wheel on limited cars each day and then change them to the local cars after the day's run.

In justice to trolley wheel makers, it should be said that the life of a wheel is almost directly proportional to the speed of

cars and to the tensions placed upon the wheel. Roads operating at high speeds have increased the tension higher and higher, so that the trolley wheel will not leave the wire, and, quite naturally, the wheel suffers. This will be seen in the case of the Dayton & Troy, where on local cars the tension is 28 lbs. and the average mileage 4200 miles, and on limiteds 34 lbs. and the mileage 3000 miles. The Fort Wayne, Van Wert & Lima, with 45-lb. tension, gets 2500 miles, while the Cincinnati, Milford & Loveland, with speeds not exceeding 45 miles an hour and 18 lbs. tension, gets 7500 miles. The Lake Shore Electric and the Toledo & Indiana make their own trolley wheels; the latter averages only 1500 miles on its limited cars, using a tension of 43 lbs.

Other conditions have an important bearing upon the life of the trolley wheel. Oil reservoirs should be kept filled and the holes admitting the oil to the bearing should be large enough, or numerous enough, to admit sufficient oil to keep the bearing well lubricated at highest speed. An attempt to save oil on trolley wheels is usually a poor investment. Bearings should be inspected frequently and pins changed when they become worn. An excessive amount of play between the pin and the bushing causes an arcing effect, and the bearing runs dry and the wheel quickly wears out.

Some master mechanics believe that a free-playing trolley base which allows the pole to swing at every curve will increase the life of the wheel, and the roller or ball-bearing base is preferred for this reason.

Several roads are experimenting with iron wheels. An iron wheel has been used for the past year by the Stark Electric Railway, with an average mileage of 4000. This wheel is said to be made of a magnetic metal whose base is iron, giving, it is claimed, a conductivity approaching closely to copper. It is claimed that the wheel will not injure the wire and that there is no arcing effect. The low cost of the wheel renders its use advantageous, it is claimed.

Interurban roads in Indiana seem to have gotten well away from the small sized trolley wheel. A few years ago many roads were using the small wheel usually found on city lines. All the roads visited, however, are now using a 6-in. wheel. The mileage obtained varies more than the differences in scheduled speed, current consumption and other influencing factors seem to warrant. The extremes are 500 to 5000 miles, and, moreover, these extremes are obtained with the same type of wheel, with practically the same scheduled speeds and with very little difference in the weight of the cars. In one instance where short mileage is obtained, the equipment, as well as the track and overhead construction, are comparatively new, and this may be partly responsible for the difference. On another road, where short mileage is obtained, the tension carried is rather high. On the Indianapolis & Cincinnati Traction system the trolley wheel question is of minor importance, as the wheel trolley is used only about one-tenth of the time. This road, it will be remembered, is operated by single-phase, alternating current, and a bow trolley is used, except in towns and cities.

The trolley retriever has been substituted for the trolley catcher on most roads in the Central West. Where the catcher is still used, no objection was found to it. On the Detroit, Ypsilanti, Ann Arbor & Jackson Railway it was stated that it was not deemed advisable to abandon the catchers in use for retrievers, because it was a rare occurrence for the trolley to leave the wire, and this is due largely to the fact that trolley bases are given close attention and kept in good condition.

TROLLEY BASES AND POLES

Objection to ball-bearing trolley bases was made by one road on the grounds that the grooves soon wore out and prevented the base from operating properly. On another system where such bases were used they were giving entire satisfaction, the statement being made that when the ball-bearing base was given proper attention no difficulties were experienced. The usual length of trolley pole is 12 ft. This length is used by seven of the nine roads visited in Indiana and Michigan. In view of the fact that the height of the trolley varies from 18 ft. to 22 ft., and the height of the cars varies also, it would be expected that different length poles would be used.

On the Terre Haute Traction & Light system poles 14 ft., 13 ft. and 12 ft. in length have been tried. The best results have been obtained with a 12-ft. pole. The trolley wire is 19 ft. high and the roof of the car is 12 ft. above the rail. This gives a difference of 7 ft. between the roof and the trolley.

Practically the same difference between the car roof and the trolley exists on the Fort Wayne & Wabash Valley Traction Company, yet a trolley pole 13 ft. 6 ins. long is used. The cars are about 13 ft. from rail to roof and the trolley is 20 ft. high, giving a distance between roof and trolley of about 7 ft., as on the Terre Haute Traction & Light Company.

On the Indianapolis & Northwestern Traction Company the cars are 12 ft. 9 ins. high and the trolley is 18 ft. above the rail. There is, consequently, a difference of 5 ft. 3 ins. between the roof and the trolley. A 12-ft. pole is used. There is evidently some angle between the trolley pole and the wire that gives best results, but the foregoing figures show that widely varying angles exist on different roads. Some close attention to this detail of practice might result in some very valuable information as to the most suitable length of trolley pole.

There has within the last few years been quite a change in Indiana and Michigan in practice regarding the tension on the trolley pole. Where, a short time ago, 15 to 25 lbs. was the prevailing pressure, 30 to 40 lbs. is now found. This is another matter which warrants attention. The condition of the overhead construction and the speed of the cars are about the only reasons for a difference in pressure being used. On the roads investigated, while the usual tension was about 30 lbs., there was a variation of from 25 to 40 lbs., and this wide range existed on roads upon which the scheduled miles per hour are practically the same. The mileage of a trolley wheel is shortened considerably when a pressure greater than that necessary is used, and as the maintenance of trolley wheels is quite an item, the question of the proper tension to be used with given speeds would bear investigation. Many companies, evidently underestimating the importance of having the trolley pole tension right, allow the repair men to set the tension without the use of scales. What may appear 30 lbs. pull to one man may actually be 50 lbs. There are, no doubt, cars operating on one system with a 100 per cent difference of tension.

To guard against this a spring balance is used by C. M. Bange, master mechanic of the Detroit, Ypsilanti, Ann Arbor & Jackson Railway, to test the trolley tension. The trolley rope is caught by a grip on the balance so that the necessity of removing the rope from the trolley catcher is avoided. The tension on all cars is tested at frequent intervals. A tension of from 25 to 30 lbs. is carried, and this is about the lowest found on any of the roads visited.

HEATERS

The hot water type of heater is favored by thirteen out of seventeen Ohio interurban roads. The Canton-Akron Railway builds its own hot water heaters. The electric heater is preferred by a number of the roads on account of its cleanliness, uniformity of heat and the ability to turn it off immediately when it is not needed. The Scioto Valley finds that the cars consume about 4-10 of a kw-hour per car-mile more in winter than in summer, but, of course, all of this cannot be charged to the heaters, part of it being due to the heavier traction on

account of snow. Eight roads in Ohio using hot water heaters place them in the front vestibule adjoining the motorman, while four place them in the baggage compartment. The motorman usually appreciates the heat in extremely cold weather, but frequently at times it is altogether too hot for comfort. The Cincinnati, Georgetown & Portsmouth places its heater in the rear end and the conductor takes care of it.

The hot water heater also has been generally adopted by interurban roads in Indiana and Michigan. The cost of operation has had influence in determining practice with regard to heaters, but the fact that the car may be heated should it be left out on the line by the cutting off of the current has been considered also. One company, the Detroit, Ypsilanti, Ann Arbor & Jackson Railway Company, uses electric heaters. It is acknowledged that the cost of operating these is somewhat greater than for hot water heaters, but the company regards the appearance and the cleanliness of the car as of sufficient importance to compensate for the increased cost occasioned by the electric heaters. The increased carrying capacity of the car is considered also. Care has been taken to provide enough heaters to keep the car at a comfortable temperature in the coldest weather encountered.

The proper location of hot water heaters is as yet an undecided question in these districts. The front portion of the car, either the smoking compartment or the motorman's vestibule, appears to be the most frequent location. The value of the space occupied by the heater is evidently appreciated more than it was a few years ago, as on many of the systems the heater is so installed that it can be readily removed in winter and the space utilized either to increase the seating capacity of the car or to carry baggage.

GEARS

Solid gears are being used by the great majority of roads in Ohio and others are adopting them as rapidly as possible. The breaking of bolts, or the loss of nuts on split gears, has been the source of annoyance and accidents on a number of high-speed roads. The Toledo & Western Railway is using a sectional gear on which the rim may be detached and replaced with a new one when it becomes worn. The central portion is made in two sections, one of which is pressed onto the axle like a solid gear and held by a key. A shoulder of the disc fits into a groove on the gear. A locking disc is threaded onto the hub section of the gear by means of a special wrench and a shoulder on this fits into a corresponding groove in the gear. It is possible to take off the locking disc several times and insert new gear sections without removing the center from the hub. The gear has never worked loose, and it is believed to furnish a source of economy in the life of gears. Few roads attempt to keep any mileages on gears. The Dayton & Troy and Cleveland & Southwestern report about 300,000 miles on solid gears with 5-in. face.

Interurban systems in Indiana and Michigan seem to have gotten entirely away from city car practice with respect to gears. On all the roads visited solid gears are used, the use of split gears having been abandoned. The gears and pinions are usually either of 5 in. or 5½-in. face, and the diametral pitch is usually 2½ in. Figures as to the life of gears and pinions are hard to obtain, due partly to the fact that on many roads the gears originally furnished with the motors have not been worn out. The life, moreover, varies greatly with the attention they receive. Moreover, when cars are operated in both directions the life is increased somewhat, due to the fact that both sides of the teeth are worn. On the Detroit United Railways the cost of gears on both city and interurban cars for a period of 2,250,000 miles was 0.03 cent. per mile. On the Indianapolis & Northwestern Traction Company gears have a life of about 150,000 miles. The cars are operated in one direction only, but Mr. Clarke, master mechanic of the system, gets more mileage than would otherwise be obtained from them by turning them so that the other side is worn when a new pinion replaces a worn one. This practice has another good feature. When one new gear is used with an old one, the teeth do not mesh properly and their operation is attended with more or less grinding. By turning the gear when a new pinion is supplied, so far as the meshing of the teeth is concerned, the effect is practically the same as is obtained with both a new gear and pinion.

GEAR CASES

Wood gear cases have caused much discussion among master mechanics. But four roads out of seventeen in Ohio are using them. One or two roads have tried them and say they are not satisfactory for high-speed service, the claim being that they soon wear out, the screws shake out and they fall to pieces. The advocates of wood cases claim that, if properly made, they hold together and give excellent satisfaction, and they point the finger of scorn at the metal gear cases and say that nuts work off and the covers drop down, sometimes tearing the gears to pieces, but that when the wood gear cases drop off, no damage is done. There is no uniformity of ideas as to how a wood gear case should be made. The master mechanic of the Cincinnati, Milford & Loveland saws oak strips lengthwise, places them overnight in the feed-water heater at the power station, and then bends them over a steel gear case, forming them the proper shape for the top. He uses galvanized iron for the sides, bending it over the top and securing it with plenty of screws. This case costs about $2.50. The Toledo & Western makes the sides of one piece of rough wood and nails on a galvanized iron top, the whole being painted black. The cost is but $1.05. The Toledo & Indiana makes cases entirely of wood, the sides being of one piece and the tops of half stuff glued together at a total cost of about $1.50.

Several of the roads in Indiana are using both sheet steel and wood gear cases. Sheet steel gear cases have been found very satisfactory by the Indianapolis & Cincinnati Traction Company. The Terre Haute Traction & Light Company is also using gear cases of this type. The Detroit United Railway has adopted a wood gear case made in its own shops. On the Detroit, Ypsilanti, Ann Arbor & Jackson Railway, a sheet steel gear case is used, which was formerly made by the mechanical department. It is now obtained from a local metal shop. The corners are of angle-iron, while the surfaces are of No. 14 sheet steel. The sheet steel is riveted to the angle-iron corners at frequent intervals with cold rivets. These cases have been in use on the system for several years and are preferred to cast cases largely because the danger of derailment of the car by the dropping down of a gear case is avoided.

HEADLIGHTS

Electric headlights have almost entirely superseded oil lamps, although it is believed many motormen prefer a good oil lamp on account of the absence of shadows and the failure of the arc lamp when the trolley comes off, which is often at a critical moment. This has been remedied by one road by the use of a storage battery on the car. The tendency of large cities and a number of small towns to require that arc lights shall be shaded is a source of considerable annoyance. The combination arc and incandescent lamp supplied by two or three makers obviates this difficulty. The Western Ohio Railway has equipped all of its headlights with a simple curtain device, the motorman simply pulling a string attached to the curtain when passing through a town and releasing it when in the country.

The combination arc and incandescent headlight is being generally adopted in Indiana. This headlight is preferred on many roads because city regulations will not permit the undimmed arc

to be used inside city limits. The combination arc and incandescent headlight removes the necessity of screening. One of the illustrations presented shows the "Marion Flyer" of the Indiana Union Traction System with the headlight mounted in the hood of the car. While it was most probably located in this position in order that the approach of this car might be more easily distinguished from regular cars, it is stated that there are no serious drawbacks to this location.

SIGNAL LIGHTS

As more of the roads adopt steam railroad regulations in their train operation, there has come an increased use of signal lamps. The majority of high-speed roads in Ohio now use either oil or electric signal lamps, and among those which have adopted a new electric system of electric classification lamps are the Toledo, Port Clinton & Lakeside, the Lake Shore Electric, the Canton-Akron and the Fort Wayne, Van Wert & Lima.

On several systems in the other States mentioned, the old style of oil classification lamps and markers is being replaced by the electric classification lamps. Oil lamps must be given considerable attention to keep them in order. Electric marker lights have heretofore had the objection that in case the trolley came off or the current was cut off for any reason, the lights were extinguished. The new system of classification and marker lights has a small storage battery so connected in the circuit that the lights will burn several hours without being supplied with current direct from the trolley. The lamps are of very small candle-power and are placed behind concentrating lenses of proper colors.

The classification lights of the Indianapolis & Northwestern Traction System cars are mounted inside the car instead of on the front corner post. They are located just back of the forward window so that there is no loss in the brilliancy of the light.

In addition to the usual marker lights, the Detroit United Railways use what is termed a stereopticon lamp. This has a concentrating lense about 6 ins. in diameter and is lighted by an electric lamp. It is hung in the center of the rear platform. As classification signals, the Detroit, Ypsilanti, Ann Arbor & Jackson uses white for extra cars and red for car following. Instead of the customary flag during the daytime, round sheet metal discs are employed. A reproduction from a photograph presented in this issue shows the head end of the standard car of this system with this disc placed in a socket on the bumper. The objection to the use of flags is that they are hard to discern when the car is going at high speed.

FENDERS AND PILOTS

Owing to the objections of the city authorities in Toledo, Cleveland and Cincinnati, the interurban roads entering these places are unable to use built-up pilots and use fenders. The majority of roads centering from Dayton and Indianapolis and two of the Cincinnati roads which do not enter the center of the city, use solid built-up timber pilots, similar in shape to those used on locomotives. The Canton roads use a peculiar half-pilot, illustrated on another page. The Scioto Valley has two types of pilot, both of iron. One is very short and is built of tubing, permitting the cars to be coupled together, and the other is a large strap iron affair with a projecting front. These are shown in Plate XLII. The Columbus, Delaware & Marion has a fender which is attached to the car by means of bolts dropped through the bumper and braces extending back under the car. The bolts holding the braces are provided with springs so that any obstruction raises the front of the fender slightly, thus relieving the jar. The fender can be removed and carried to the other end by simply lifting out the pins in the bumper. A number of the roads use their pilots for snow plows, placing a board or sheet metal covering over the surface.

Heavy fenders are used by the Eastern Ohio, Cleveland & Southwestern and Toledo, Port Clinton & Lakeside and several other roads in Ohio. The Western Ohio and Dayton & Troy carry fenders on one end and pilots on the other on the cars used in the Dayton-Toledo limited service, to comply with the Toledo ordinance.

The Lake Shore Electric, Detroit, Monroe & Toledo and Toledo & Indiana use a heavy sheet iron fender resembling a huge "grid iron," by which name it is known. The Springfield, Troy & Piqua and Northern Ohio Traction & Light Company use a tilting fender. This is valuable in cities, and it is said to have picked up objects practically uninjured and without much damage to the fender at speeds up to 35 miles an hour.

Three of the nine systems visited in Indiana equip their cars with a wood pilot of the steam locomotive type. The angle of the bottom timbers of these pilots is usually about 45 degs. The staves are usually mortised in the top and bottom timbers, and the pilot, as a whole, is secured to the car by bolts through the bumpers and by braces running up from the bottom timbers to the platform timbers. Pilots are usually carried at from 8 to 12 ins. from the rail. On the Indianapolis & Northwestern system, clearances permit them to be carried 7 ins. from the rail, but 2-in. margin is allowed and they are hung 9 ins. above it. A mistake sometimes made when this type of pilot is adopted, is that the pilots are built too weak and are not secured to the car body properly. They should be constructed of oak and the staves should always be mortised into the upper and lower members and further secured by bolts passing through the stave and the members to which they are fastened. Frequently, lag bolts alone are depended on to secure the staves. The pilots should be constructed with a view to removing heavy obstructions from the track, but instead they are frequently built so that they crush under the car when such obstructions are encountered. The Indiana Union Traction System was one of the first roads to use this type of pilot and they are now used on all of the interurban cars of the system. The Indianapolis, Columbus & Southern Traction Company uses a fender of heavy construction. The interurban cars of the Detroit United Railways are equipped with a special drop fender manufactured by the company. The Detroit, Ypsilanti, Ann Arbor & Jackson Railway also uses a special type of fender, built in its own shops. The general design of these fenders may be observed in the photographs of head ends of cars presented on Plate XLII. in this issue.

SANDERS

Air sanders are used on the cars of nearly all of the systems visited in the three States. One objection to the manner in which sanding devices are frequently installed on cars is that the sand is not thrown close enough either to the rail or to the wheel. A great deal of the sand does not strike the rail, and some of that which does is jarred off or blown off before the wheel reaches it. The Indianapolis & Northwestern Traction Company is using a sanding device, by means of which the objections mentioned are removed. The pipes conducting the sand to the track throw the sand under the wheel. This device which is essentially an air sander is made in the shops of the company and it has many features to recommend it. The sand is carried in a heavy galvanized iron can in one corner of the motorman's cab. The can is covered by a wood-box which forms a seat and a protection for the can. The bottom of the can is of heavy oak. Bolts extending through the wood secure a heavy pipe flange to the bottom with a piece of metallic insertion packing between the flange and the wood bottom. A 1-in. pipe connection which is screwed into the flange leads to a mixing device under the car immediately below the sand-box. This device consists primarily of an ordinary cross-pipe fitting of which the bottom opening is plugged. The opening on one side is connected to an air valve in the cab by a connection which

terminates in the cross-connection in a ¼-in. pipe. From the other opening a pipe and a rubber hose lead to a long sweep double-branch elbow and from this the two 1-in. delivery pipes carry the sand to the rail. The admission of air through the valve in the cab blows the sand out of the mixer through the connecting pipes. The siphon effect produced, aided by gravity, causes sand from the box to fall into the mixer. A dividing appliance inside the double-sweep elbow divides the sand equally between the two delivery pipes. The cab is believed to be the proper place for the sand-box on account of the lessened liability of the sand to become damp. One idea in having the can holding the sand enclosed in a wood-box is to reduce this liability. With this arrangement no trouble at all is experienced with moist sand.

The Detroit United Railway uses a lever sander of its own make. The Detroit, Ypsilanti, Ann Arbor & Jackson Railway also uses a lever sander.

REGISTERS ON INTERURBAN CARS

There is a tendency to abandon registers on interurban cars having long runs. Some of the fares are beyond the range of registers usually in use at the present time and cash-fare receipts must be given for them. Since this is necessary for a portion of the fares on some roads, it is considered better to give receipts for all cash fares. The Indianapolis & Northwestern Traction Company uses a register only for registering 5-cent fares charged for going into and out of Indianapolis. Cash-fare receipts are given for purely interurban fares. The Detroit, Ypsilanti, Ann Arbor & Jackson Railway follows the same method.

On the Brazil division of the Terre Haute Traction & Light System cash-fare receipts are given for through fares and the fares are also rung up on the register. At the end of the route the cash-fare receipts are collected. Other than through fares are collected by 5-cent sections and rung on the register. On the Sullivan division a double register is used. One side indicates 10-cent fares and the other side cash collected for baggage.

SIGNS

Practice with respect to destination signs seems to vary according to location. The Cleveland roads all use a stenciled metal sign in a slot on the dash and illuminated at night by lights. On the Lake Shore Electric, the Sandusky limiteds show yellow, and the Toledo limiteds, red. The Northern Ohio Traction & Light Company, the Eastern Ohio and Cleveland, Painesville & Eastern have large board signs carried on the side of the deck giving names of the principal towns. The Columbus roads nearly all have plain metal signs on both front and rear, cars in this city being all double enders. The majority of the Dayton roads and the Western Ohio Railway do not carry any destination signs beyond the name of the road on the side of the car. At terminals they depend upon announcers to get people onto the right car. Limiteds on these roads are designated by large signs in front. The Canton-Akron Railway carries a revolving illuminated sign at one side of the front of the car above the motorman's head. It contains the names of all the routes on the system and is changed by turning a hand roller. The Interurban Railway & Terminal Company and the Cincinnati, Milford & Loveland have the names of towns printed on the deck windows with an illuminated revolving sign carried on the hood in front. Practically all roads operating limiteds carry board signs below the windows at the sides. Destination signs in Indiana are usually carried on both the front vestibule and the sides of the car near the rear door. Usually the signs bear the names of the terminal cities as well as of one or two of the intermediate towns. Wood signs are in many places being replaced by those of sheet steel. This is especially so for the signs on the front vestibules as the vestibules are frequently curved and necessitate the use of a curved sign. Some systems paint the names of the terminal cities directly on the vestibule dash. This method can only be adopted where the cars are always operated over one division.

CAR INSPECTION AND CLEANING

The importance of keeping the interior of cars clean and of making frequent inspections of the trucks and electrical apparatus is generally recognized by all of the roads visited. On the majority of the systems it is customary to clean the cars and inspect them after runs of from 80 to 200 miles. The runs are usually so arranged that after a car has made this mileage it is taken into a terminal house for a layover of an hour or more.

On the Indianapolis & Northwestern Traction System a 2-minute inspection is made of cars every trip of 60 miles. This inspection is made as the cars pass the shops at Lebanon by an inspector located in a small house near the track who occupies his spare time in cleaning headlights, marker and classification lights. The inspection made by this man includes trucks and bearings, trolley wheels, lights, etc. This inspector also keeps the water cooler filled. Every three days or after a mileage of about 1380 miles, the cars are brought into the shops for oiling and for a general inspection of electrical apparatus.

The Indianapolis, Columbus & Southern Traction Company give a great deal of attention to the cleaning of cars. The runs are arranged so that after each round trip from Columbus to Indianapolis the cars are laid over in the car house at Columbus. Two extra cars are kept at Columbus and this permits 2 hours to be spent in cleaning each car. Five men are employed to clean the cars and the cost per car is about 66 2/3 cents per day.

When the cars are brought in after each round trip, the car house foreman inspects the controller and rubs a little vaseline on the dry segments. The truck inspector inspects and oils the bearings and changes the brake-shoes when necessary. He also inspects the motors and the brushes. Another man cleans the windows, while another cleans the outside of the car body. Usually this is wiped with dry cotton waste, but when the body is unusually dirty, the waste is saturated with a cleaning compound and the car body is afterwards wiped dry. The floor of the car is mopped after each trip, the woodwork and light fixtures are cleaned and the seats are blown out with air. A 3/16-in. round air nozzle is used. Flat nozzles have been tried but round ones are preferred. The floors are painted about once in two months. Every six months all the seats are removed from the car and these as well as the car are given a thorough cleaning. The cars are touched up and revarnished once each year.