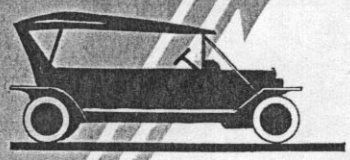
The American Public *wants to ride in coaches*

The Ancestors of the Twin Coach

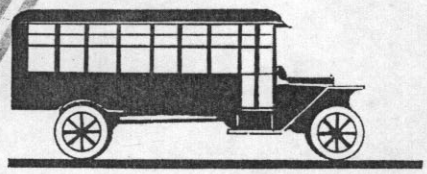


7 PASSENGERS

1916 to 1922

Generation One:

The forerunners of the modern highway coach equipment were enlarged and rebuilt touring cars, and modified trucks altered to accommodate passengers. These makeshift devices served the infant motor transit industry satisfactorily as could be expected until the traveling public became weary of their discomforts and the operators saw that they were less profitable than properly designed coaches.

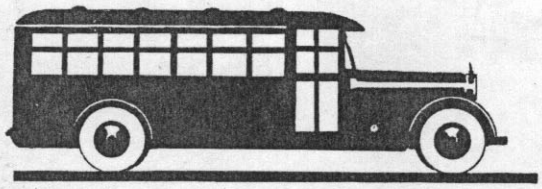


20 PASSENGERS

1922 to 1927

Generation Two:

The second period in Motor Coach Transportation was ushered in by the designing of Safety type Coaches by Fageol. Here was a type of coach which more nearly satisfied the public's demand for safety, comfort and reliability. With rapid strides, motor transit grew in popularity. New routes—new companies sprang up with surprising rapidity. The advent of the Safety type Coach revolutionized the business.



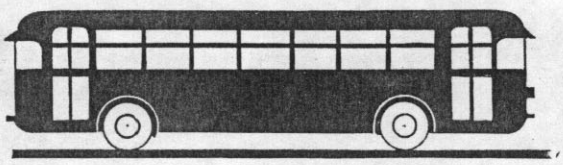
29 PASSENGERS

1927 to ?

Generation Three:

But even the Safety Coach Type has been passed in the march of progress. The ideal of designers has been to design a motor coach wherein stresses and strains, set up by the inequalities of the road, could be equalized and distributed over the entire area of the coach. In the Twin Coach this has been accomplished and a new era opened—the third in the history of motor coach transportation and design.

Best of all in this new era the operators find an adequate Capacity—40 seats in the street car type and 37 to 41 in the interurban or parlor car.



40 PASSENGERS

The New Era in Motor Coach Transportation
Both Urban and Interurban

LEADERSHIP

SINCE the first deliveries to operators in August of 1927, the Twin Coach has won increasing approval monthly and definitely marked this new era in coach building.

Within twelve months the factory delivered $4,000,000 worth of this latest type of transportation unit. Insofar as we can ascertain, this record has never been equalled by a new coach model.

The Twin Coach Corporation leaped in production in the first year of its existence from a position of sixteenth to rank among the first five producers of motor coach equipment.

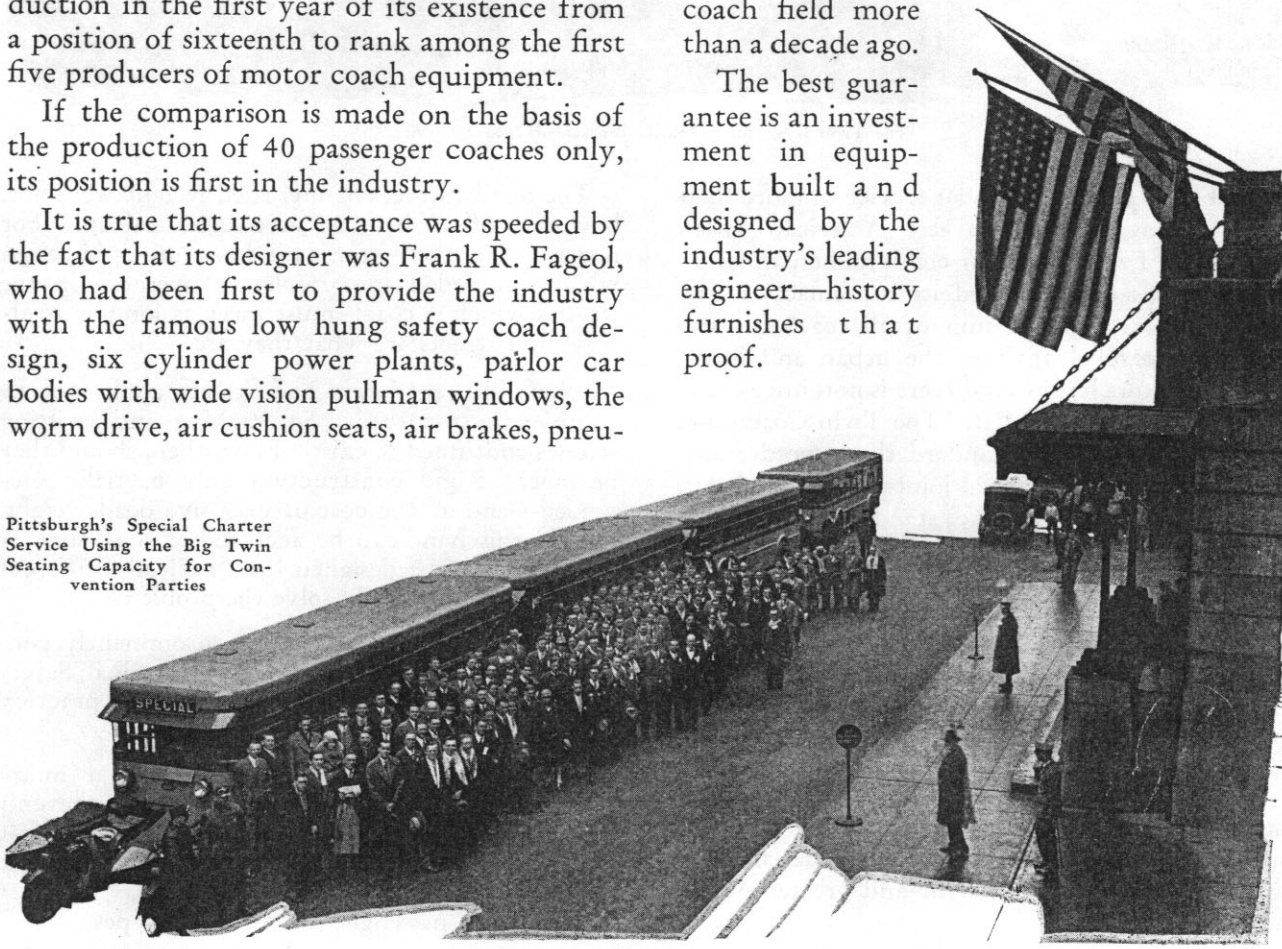
If the comparison is made on the basis of the production of 40 passenger coaches only, its position is first in the industry.

It is true that its acceptance was speeded by the fact that its designer was Frank R. Fageol, who had been first to provide the industry with the famous low hung safety coach design, six cylinder power plants, parlor car bodies with wide vision pullman windows, the worm drive, air cushion seats, air brakes, pneumatic tires, lengthened wheel bases and minimum weight per passenger.

Consequently, operators everywhere were quick to adopt his twin motored coach design with a body providing revenue capacity for every foot of street space occupied and rider appeal at that time unheard of.

The phenomenal sales record of Twin Coaches in the first year is convincing proof that Frank R. Fageol has maintained again that leadership which he assumed in the motor coach field more than a decade ago.

The best guarantee is an investment in equipment built and designed by the industry's leading engineer—history furnishes that proof.



Pittsburgh's Special Charter Service Using the Big Twin Seating Capacity for Convention Parties

The Twin is an Ideal Vehicle for School Feeder Service

OPERATING in regular service in more than twenty of the largest American cities, the Twin Coach in eight million miles of operation has demonstrated its supremacy as the most practical highway unit of all coach history. Yet, upon careful analysis, the urban and inter-urban operators have found there is nothing experimental or untried about it. The Twin Coach uses standard type motors, standard three-speed transmissions, standard universal joints and drive shafts, standard worms for driving, standard air brakes—metal to metal, standard wheels, standard steering mechanism, standard type front axle, standard spring construction of latest type. In fact, there is not a single untried mechanical feature in the Twin Coach. They merely have been re-arranged and proportioned to suit modern motor coach operation.

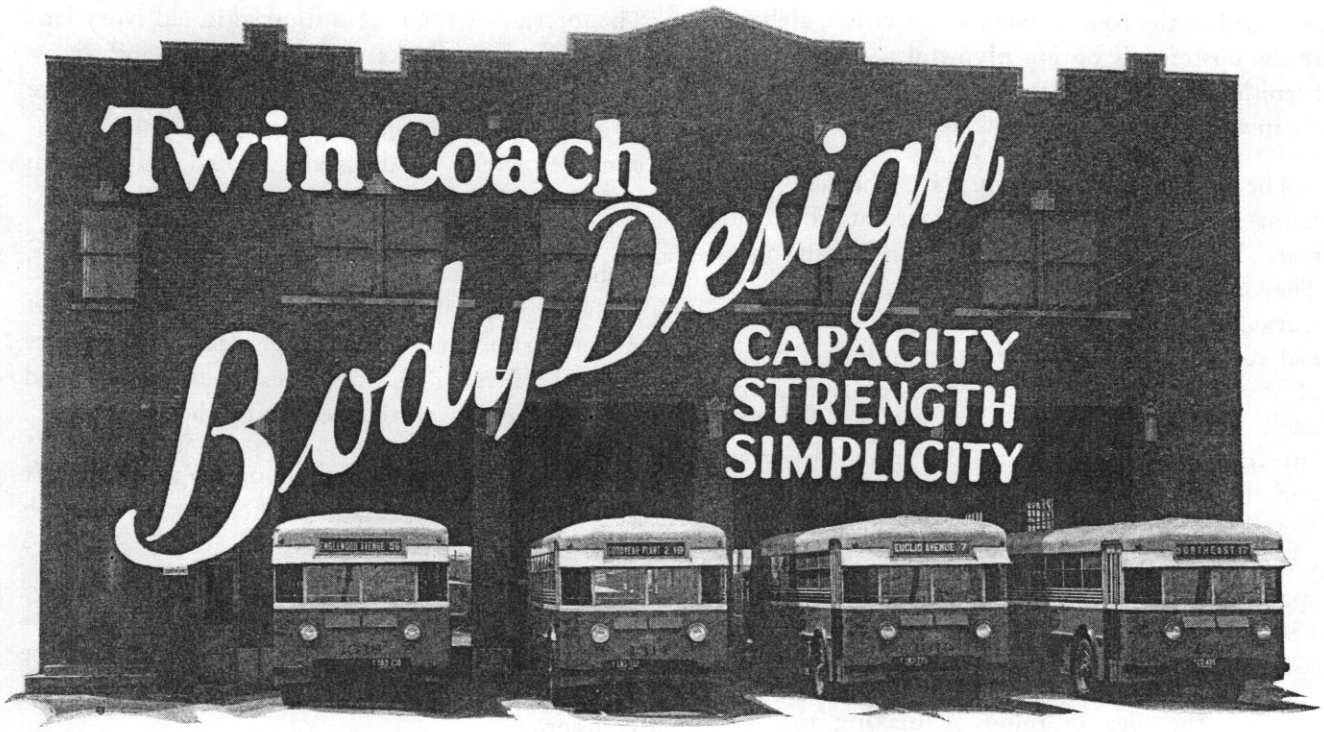
With the increasing of sizes and carrying capacities in motor coaches came a tendency toward rigid and semi-rigid construction. This necessarily resulted in greater gross weight and greater weight per passenger.

The disadvantages of increased weight were not, however, offset by the advantages gained. For never yet has there been a rigid or semi-rigid design which succeeded in *completely* overcoming the stresses which a coach must meet as long as roadways and streets are what they are.

Obviously, roadways and streets could not be completely smoothed. So, racking and twisting stresses continued to exist. How, then, should they be met? Rigid construction only partially succeeded—and at the cost of excessive dead weight. Should this handicap be accepted as inevitable or could coaches be designed on a radically different principle which would solve the problem?

Frank R. Fageol, who was so prominently connected with the designing of the original Safety Coach, studied this problem and found a practical solution.

Discarding precedent, he developed a motor coach which distributed torsional stresses evenly throughout a semi-flexible body—which seated 40 passengers, an increase of 40 per cent over old types, and which permitted a weight saving of 30 per cent per passenger seat over old types.



The Big Loads from Akron Tire Factories Ride Twins

THE body of the Twin Coach resembles a modern street car in appearance. It is 31′, 10″ long, including bumpers and visors, 8′, 7″ in overall height, and 7′, 11½″ in width. The front and rear ends are shaped exactly alike. The over-hang is the same in front and rear, 83″ from the front axle to the foremost part of the coach, and from the rear axle to the rear end.

Body and chassis are built as one complete unit with two main channel beams or sills running full length and serving as the "backbone" for the entire coach. Cross members, of specially formed channel section, are riveted to these sills to support the body frame. The body posts are 1¼″ T-iron and begin at the bottom of the body, continuing above the window line as the window posts and curving at the top to form the sides and ends of the roof. The whole structure is re-inforced with ample gusset plates and all joints are hot riveted.

The floor, of ¾″ laminated wood, is perfectly flat and made in four large sections. Paneling of sturdy plymetal with metal on both sides covers the sides and ends of the body from the bottom up to the window belt. The upper curved ends of the body posts are covered with sheet steel on the outside and lined with aluminum on the inside. This forms the sides and ends of the roof. The center section of the roof, 42″ wide and 24′ long, is made of ¼″ plymetal with metal on both sides. This roof construction is strong and light and provides good insulation to keep heat within the body and cold from entering from outside.

The floor, the side paneling and the roof covering brace the frame laterally and provide a bridge construction possessing great strength with a lightness not possible in a standard type of coach.

The windows are mounted in special patented non-rattling metal sash, and are easily adjusted to

any height up to 15″. Curved glass windows are provided at the four corners of the coach, although at the customer's option plymetal rear corners are furnished. The windshield and the rear window are in two sections, each of which is 23 3/16″ x 28″.

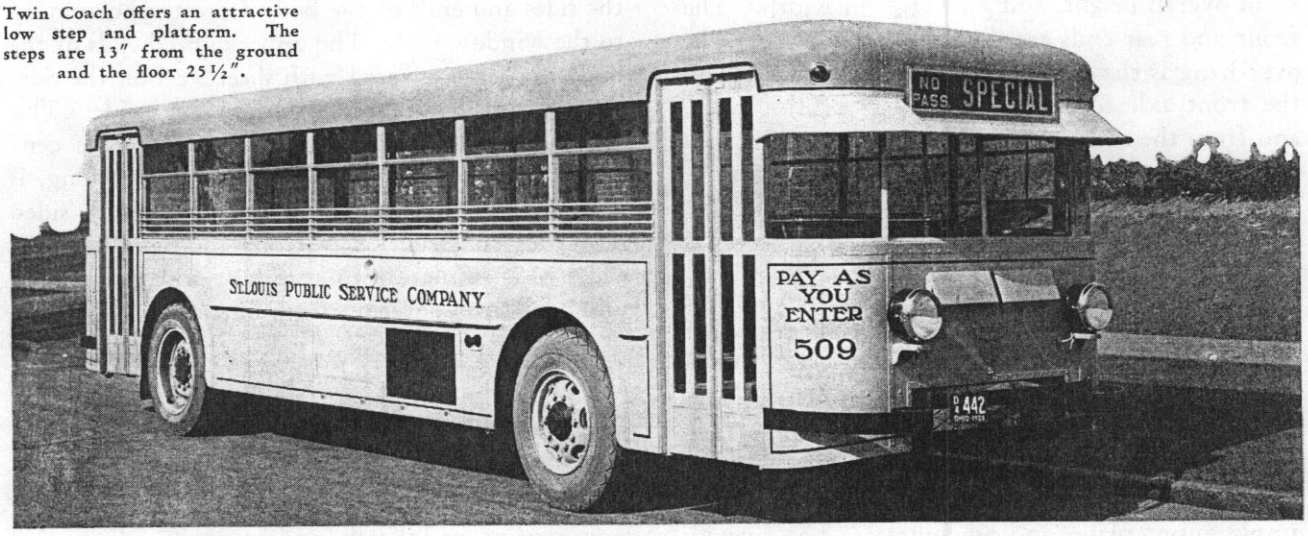
The entrance door is on the right side at the front and the exit door on the right side at the rear. Both doors are air operated on Urban models. They are of the four-leaf, fold out type in two sections and provide a clear opening of 28″. Especial care has been taken in working out a method of weather-stripping these doors so as to efficiently exclude cold, rain and dust. The height of the entrance and exit steps is 13″ from the ground and the coach floor is 12½″ above the steps. The wide door opening and the easy step height facilitate rapid loading and unloading. Ample floor space inside both doors is provided for standing passengers who have just entered or are about to leave the coach.

With the idea in mind of making the Twin Coach easy to keep clean, the interior has been worked out to present as smooth and unbroken a surface as possible. This has been accomplished in a manner which augments its rich appearance. The interior of the roof is finished in old ivory lacquer with card racks along both sides and across the rear. Window pilasters, trim strips and sills are of aluminum and together with the plymetal paneling below the windows are painted a soft warm gray. The floor is covered with Battleship Linoleum, with the edges metal bound. The absence of heater pipes and other obstructions and the level surface of the floor prevent the accumulation of dirt and rubbish in inaccessible places. The entire inside surface of the coach can be easily washed without damage to the lacquer finish.

The driver's seat is placed in the extreme left front corner with an unobstructed view through the front and to both sides. The curved glass corners eliminate the usual "blind spot" and his range of vision is far wider than in old type coaches. Sitting in the extreme front end of the coach, the driver can most easily judge clearances and avoid collision.

Aluminum hand rails, for the accommodation of standees are attached to the ceiling and

Twin Coach offers an attractive low step and platform. The steps are 13″ from the ground and the floor 25½″.



62% of All Twin Coaches Built to Date Have Been Reorders by Earlier Customers

stanchions of the same material are conveniently located at the entrance and exit doors to assist passengers in entering or leaving the coach. All models have a minimum head room of 6′, 5½″ with a level floor throughout.

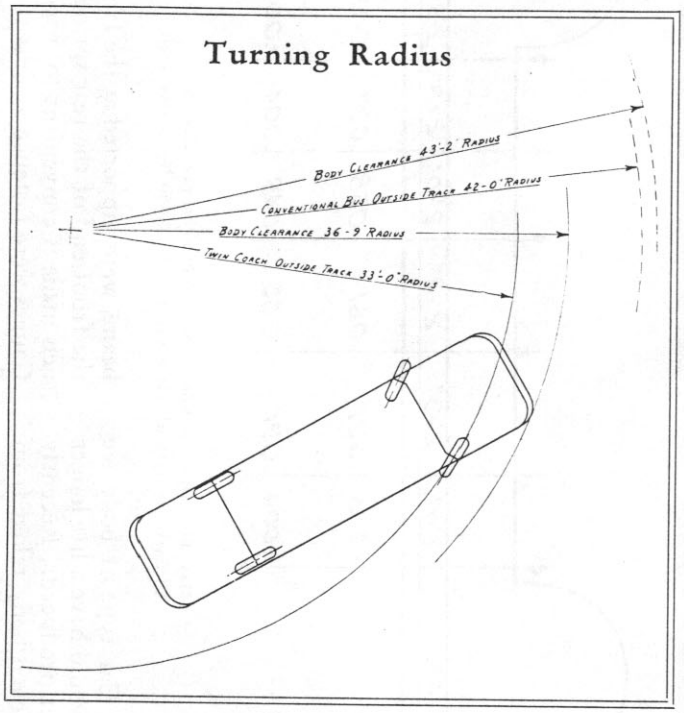
The windows of the Parlor Coach are fiitted with "Sunfast Silk" curtains attached to nickel-plated rods at top and bottom and tied back to the window pilasters at the middle. Substantial overhead baggage racks of large capacity run almost the full length of the coach. These are arranged on each side so as to preserve the full head room (6′, 5½″) in the aisle. Each passenger's baggage is easily accessible and, being inside the coach, it is protected from rain and dust.

The design of the Twin Coach makes it possible to employ what is known as an "indirect radiation" system of heating which not only ventilates the coach but also efficiently heats it, even in severe weather.

The fans provided for cooling the engines draw part of their air from the interior of the coach through openings under two of the seats. This, with fresh air taken from outside, is drawn through the engine radiators and, thus heated, is forced back into the coach through adjustable openings in the engine housings, escaping eventually through four ventilators in the roof.

In mild weather the hot air openings into the coach may be closed and louvers, in the outside panels of the engine compartments, opened. The hot air is then blown out through these louvers. Fresh air is admitted to the coach through two ventilators in the front end and through the windows, the circulation being assisted by the engine fans as before.

Wiring for the interior lighting is concealed under removable panels thus making it easy of access in case of trouble. All wiring is protected by flexible "loom" and soldered terminals are provided at all connections. The interior of the coach is lighted by ten dome lights fitted with 21 candlepower bulbs. Two "Tiltray" head lights are attached to brackets on the front end of the coach 60″ apart. Marker lights with colored lenses are mounted at each corner of the coach at the roof line and a combination stop and tail light with license plate bracket is attached to the rear. A "Hunter" illuminated destination sign with a glass opening 7¼″ x 42½″ is built into the coach at the front. The sign roll will be lettered to suit the purchasers' specifications.

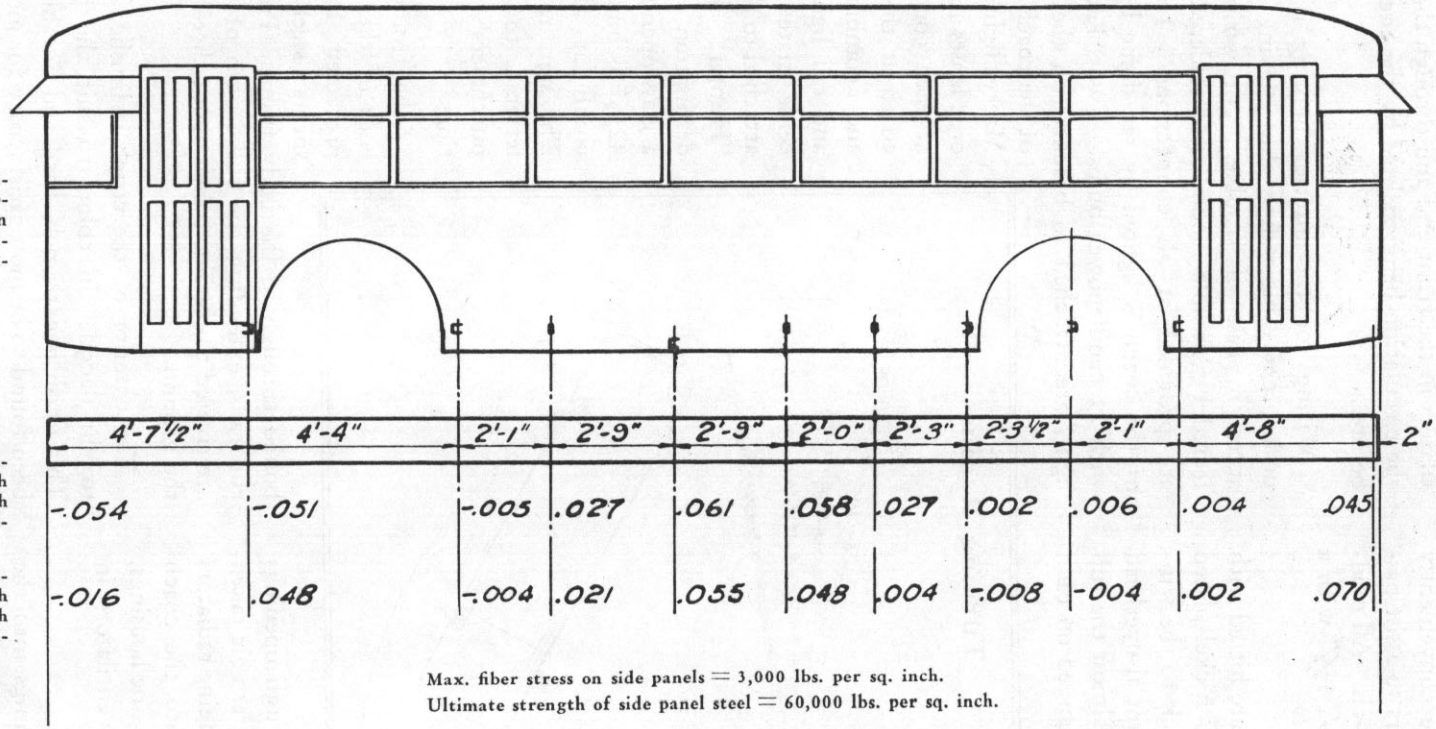


The front and rear ends of the coach are protected by rugged spring steel bumpers bolted through to the body frame. Pressed steel rub rails, extending the full length of the body, are riveted to the side panels about three feet from the ground.

The exterior of the coach is finished with pyroxylin lacquer in colors to suit the purchaser. This finish is extremely hard and durable and has been found to be most satisfactory for motor coach service. It is weather proof, quick dripping and can be easily patched in case of damage. A reasonable amount of lettering will be applied without extra cost to the purchaser.

Stress Test on Standard Twin Coach with a 150% Overload

(—) Negative readings indicate upward deflection while positive readings indicate downward deflection.



Deflections in thousandths of an inch on R. H. side with load of 100 passengers.

Deflection in thousandths of an inch on L. H. side with load of 100 passengers.

Max. fiber stress on side panels = 3,000 lbs. per sq. inch.
Ultimate strength of side panel steel = 60,000 lbs. per sq. inch.

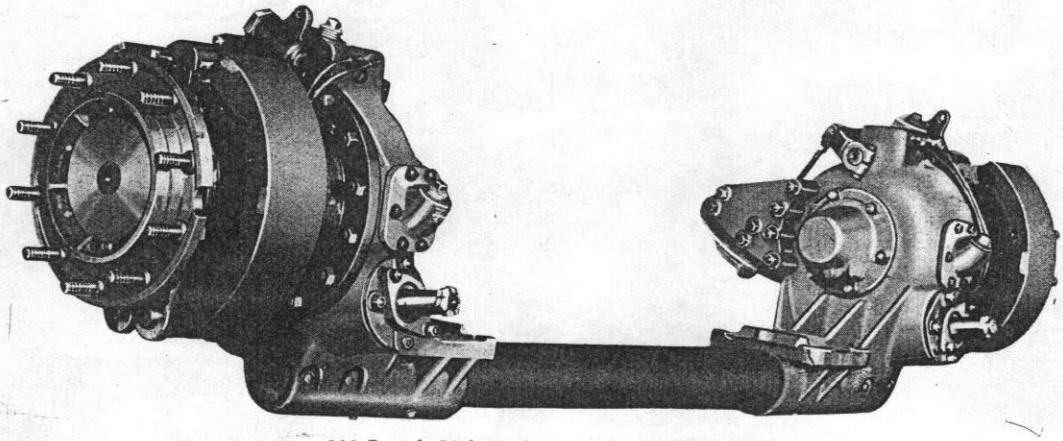
IN presenting the Twin Coach Street Car type of body we have stated that in our estimation it would have a life longer than any other type of coach body yet produced. Recently a stress test made of a standard Twin Coach body taken from regular service indicates that the expectation of life should be at least ten years. As shown in the diagram above, this coach body was supported and then weighted with a 150% overload of 15,000 lbs., whereupon Starrett Gauge registrations were taken of the body deflection at different points. This test showed that the greatest deflection was one-sixteenth of an inch.

The plan of procedure was to load the bus uniformly with weights and measure the resulting deflection of the longitudinal chassis channels. For this purpose the bus body was blocked about one foot off the floor and two 6" I-beams were hung under the channels extending the full length of the bus. These beams were supported at the front end of the front springs and the front end of the rear springs. Tie-rods between the channels made it convenient to suspend the I-beams at these points. Gauges were fastened against the under surface of the channels. Before reading each gauge it was lightly jarred to eliminate lost motion. Zero load readings were taken first, then a uniformly distributed load was applied. Deflection readings were taken and recorded.

With the exception of those demands resulting from collision, the Factory Service Department has been practically without demand for Twin Coach body service up to the present time. It would seem that the above stress test and diagram are plausible reasons why this situation exists.

Twin Coach weight and stress distribution is as theoretically perfect as it is possible to make it. Equal weight distribution is the first essential to long life and low maintenance costs.

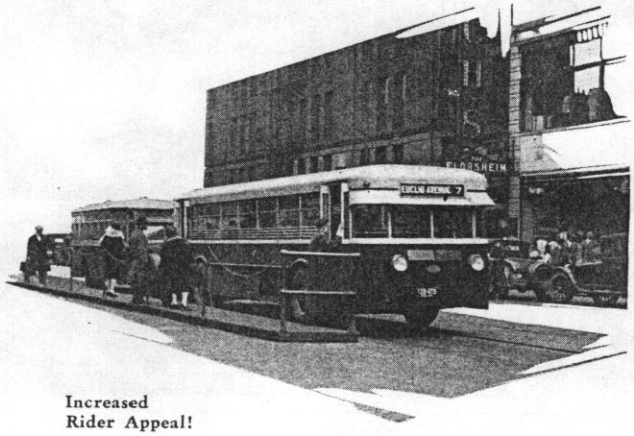
No Differential In the Axle Greatly Reduces Maintenance



500 Pounds Lighter than Conventional Unit

THE rear axle is built by Timken to Twin Coach design and with Twin Coach tools and fixtures, weighs 500 pounds less than the differential type of axle. This unit consists of a center section of heavy walled steel tubing four inches in diameter carrying cast steel housings, worm drives and bearings, on each end. Spring seats are cast integral with the housings. The tubular center section is slightly tapered at the ends and the housings are pressed onto these tapered ends under hydraulic pressure and riveted.

Each rear wheel is mounted on a short shaft 3¼" in diameter and made of Chrome Vanadium steel—the shaft having a large diameter flange forged integral with it to which the wheel and brake drum are bolted. The shafts are carried on double opposed Timken bearings so located as to be directly over the contact of the tires with the ground. The worm gears are keyed to the inner ends of the shafts which are further supported at these points of non-adjustable roller bearings.

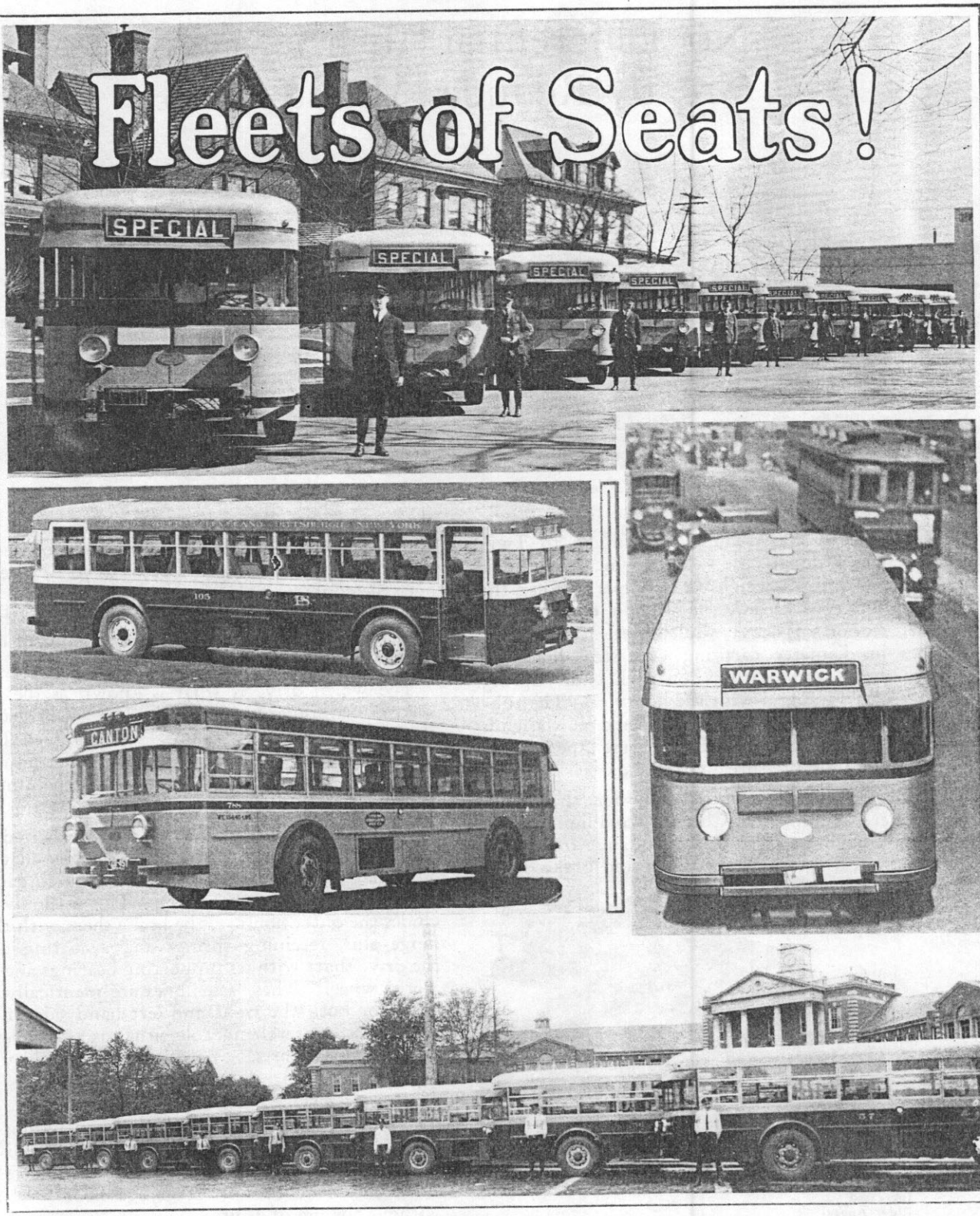


Increased Rider Appeal!

The worm drive is what is known as the "inverted" or "underslung" type. The worm shaft is also carried on three bearings—two opposed Timken bearings and one non-adjustable roller bearing. The brake shoes and their operating mechanism are supported on the outside of the housing.

Each housing is made in two sections bolted together in a vertical plane in such a manner that the outer half, which carries all the vital parts, can be easily removed as an assembly. This assembly includes the outer housing, the brake shoes with their hinge-pins, retaining springs and actuating cam, the drive shaft with its supporting bearings and the worm wheel. These assemblies are identically the same for both the right and left hand side of the axle and are interchangeable either as assemblies or as individual parts. This interchangeability of right and left hand units materially reduces the number of service parts to be carried in stock. All maintenance operations on the axle, including the dismounting of the housings, can be accomplished from outside of the coach. Therefore all necessary work can be done on the garage floor level and without the use of a pit.

Fleets of Seats!



Top picture: Pittsburgh Motor Coach fleet at inspection; Right Center: Kansas City Public Service coach; Left Center: Inter-City Coach of Purple Stages, Inc., New York to Chicago; Lower center: Inter-city Coach of N. O. P. and L. fleet at Akron, Ohio; Bottom: Cincinnati Street Railway fleet.

Unusual Seating Arrangements

Extra Seats—Lower Weight

Insure Operators Added Profit

THE Twin Coach will accommodate 40 per cent more passengers than the current Coach type with 30 per cent less weight per seat.

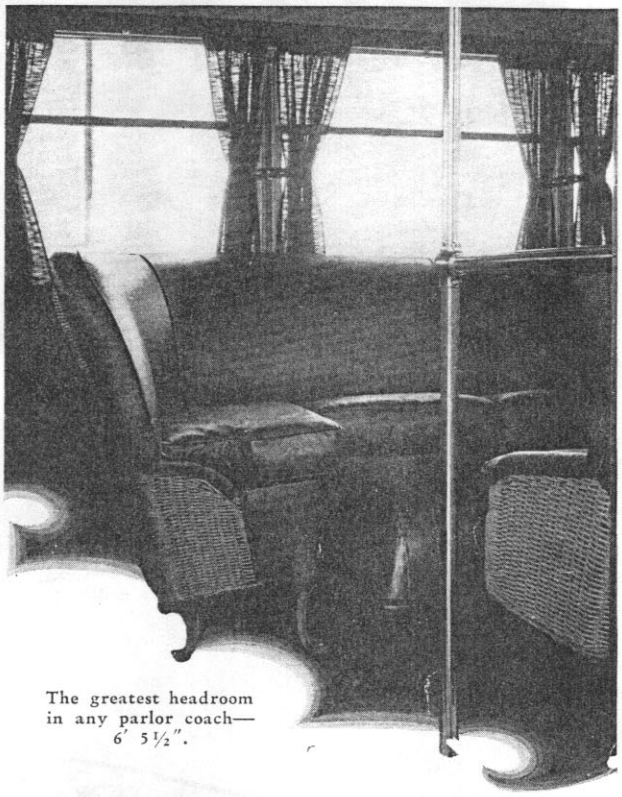
Practically *all* of the length and breadth of the Twin Coach can be utilized for the carrying of passengers. Therein lies the secret of the extra revenue which operators may expect. In the Urban Street Car Model, 40 passengers can be seated and 35 people can stand.

The driver sits at the left front corner. Back of him is a 2-passenger cross seat. Behind this, on the left side, is a 2-passenger longitudinal seat over front left wheelhousing. Back of that come two 2-passenger cross seats. Then a 2-passenger longitudinal seat over motor housing. Next on the left side are two 2-passenger cross seats followed by a 2-passenger longitudinal seat over rear left wheelhousing. Then comes a 2-passenger cross seat and last, a 6-passenger settee-type cross seat clear across the rear of the body.

At the right front is the entrance door, next comes a 4-passenger longitudinal seat over right front wheelhousing, followed by two 2-passenger cross seats. Behind them is a 2-passenger longitudinal seat over right motor housing and then two 2-passenger cross seats. Next is a 2-passenger longitudinal seat over right rear wheelhousing after which comes the exit door and the long seat across the rear end previously mentioned.

For interurban work, the Parlor Car type is generally arranged as shown in charts at back of this volume, but other plans may be made. There is comfortable seating arrangement for 37 passengers on a long journey while at the same time there is available ample baggage room in specially designed overhead racks, fully capable of bearing large size luggage. Special plans will be submitted showing the coach fitted with a rear compartment for larger baggage, or for smoking.

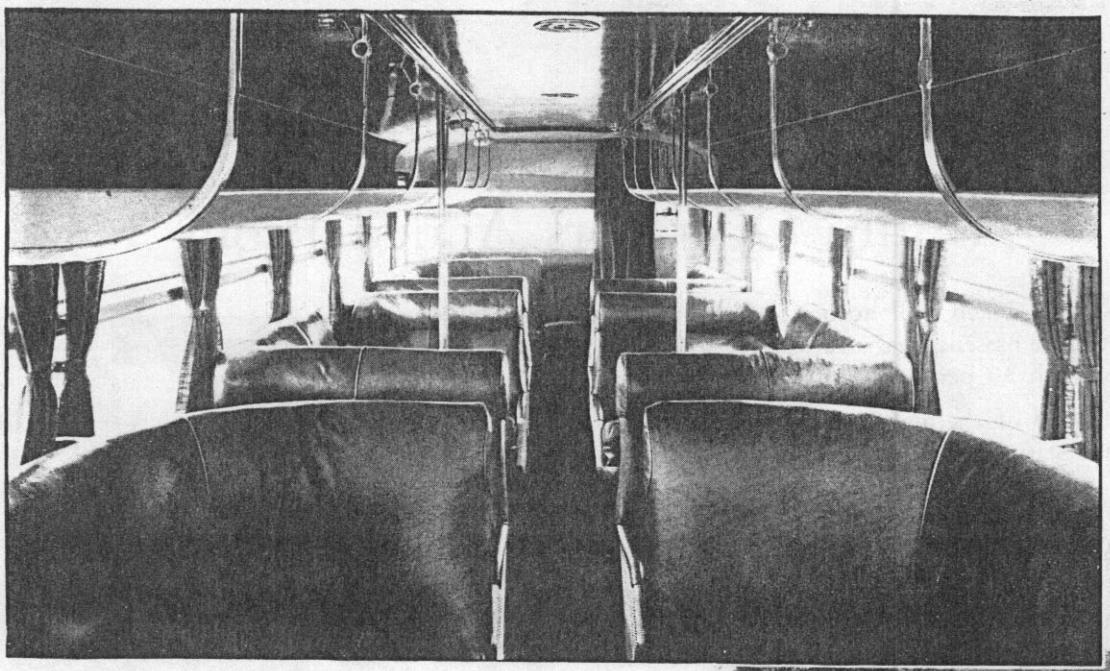
Parlor car traffic already is looking for greater comfort on long journeys and Frank Fageol with his intimate knowledge of operating conditions on the highways has anticipated the patrons growing wishes along these lines.

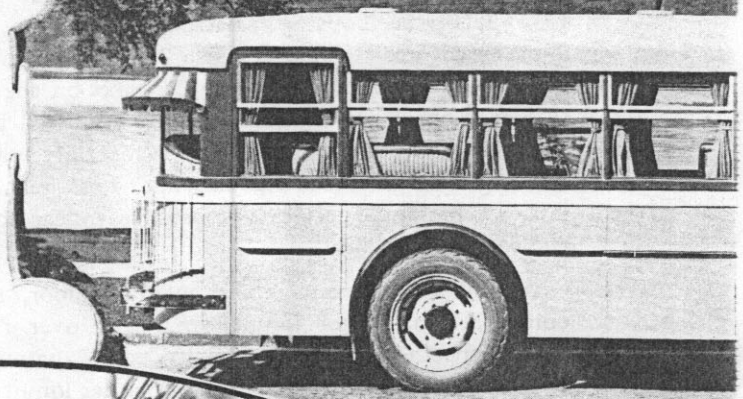


The greatest headroom in any parlor coach—6′ 5½″.

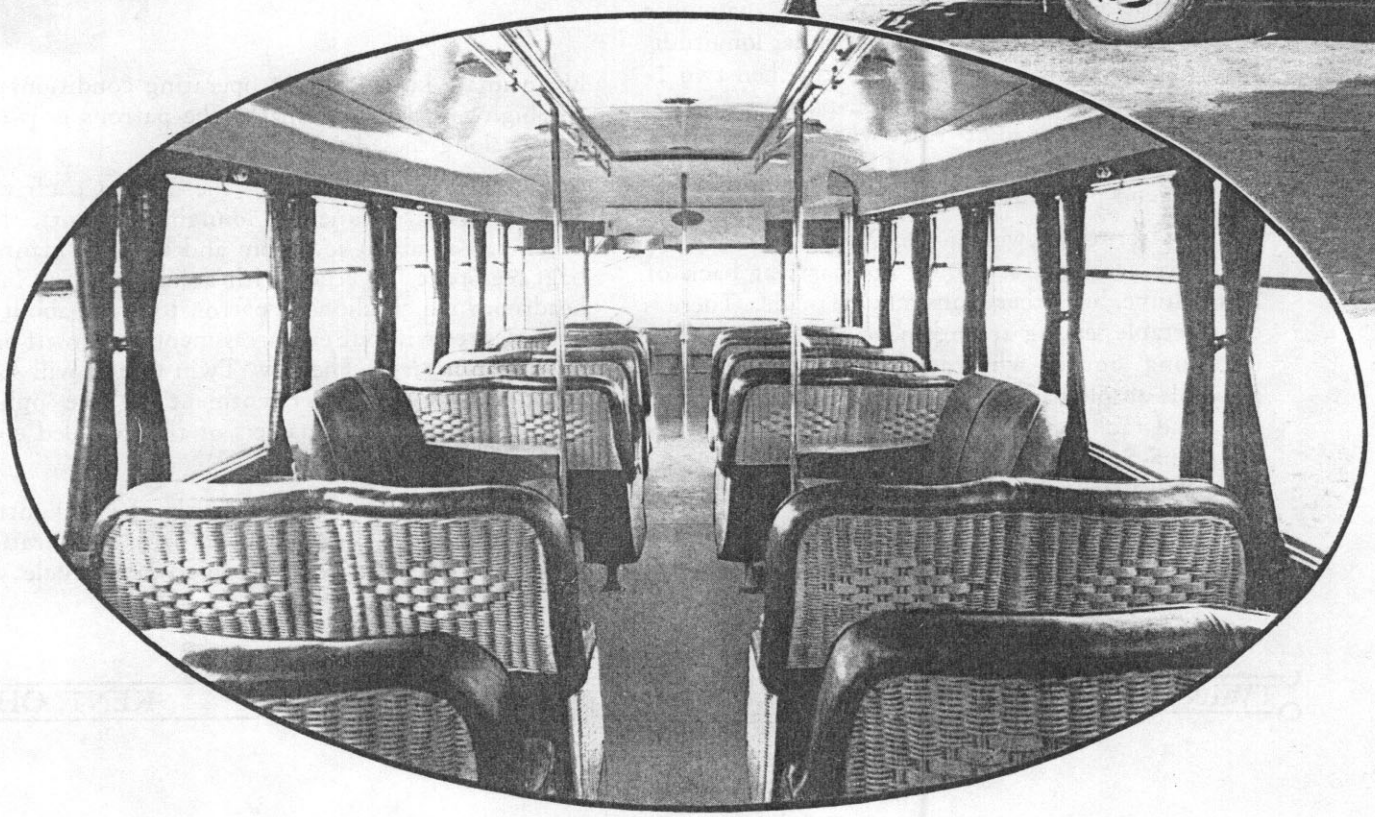
The parlor car patron in the Twin Coach will find for the first time real lounging comfort, that much talked about leg room and actually planned baggage space, together with a six feet, five inch headroom which allows a patron to move about if he so desires without embarrassment to himself and other passengers. The new Twin Coach will stop at once the growing resentment by the public against the cramped quarters of the so-called conventional type of parlor car.

This roominess together with the delightful buoyancy of the vehicle and its lack of vibration makes it appeal as no other highway vehicle yet developed.

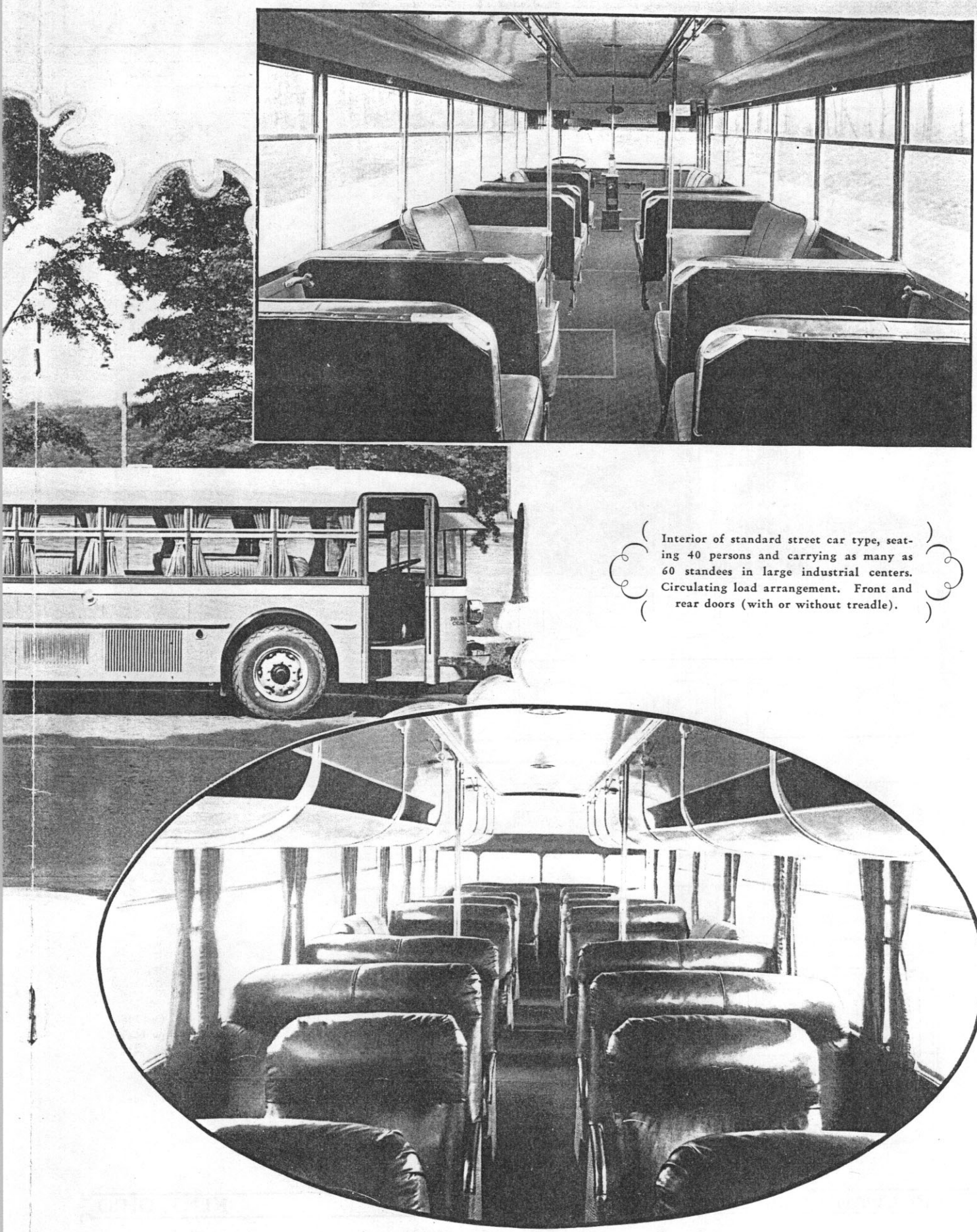




Special deluxe parlor car model equipped with lavatory, running water, fans and baggage racks. Operating on 300 mile inter-city run—seating 39. Center panel shows exterior of coach with rear grill.



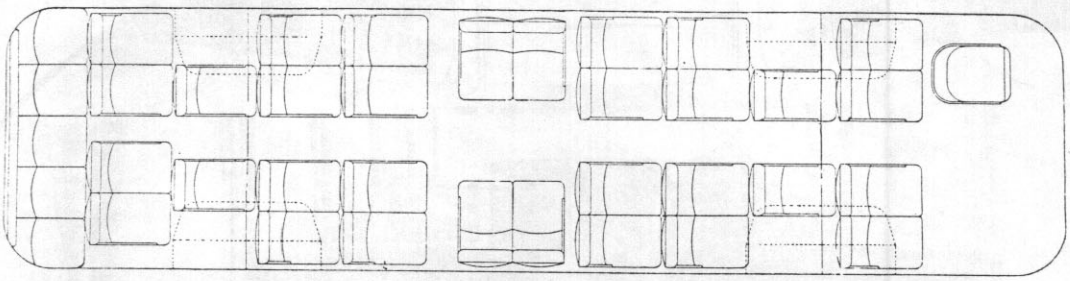
Parlor car model with low back chairs for medium length inter-city operation, or extra fare deluxe urban routes—seats 3[illegible]



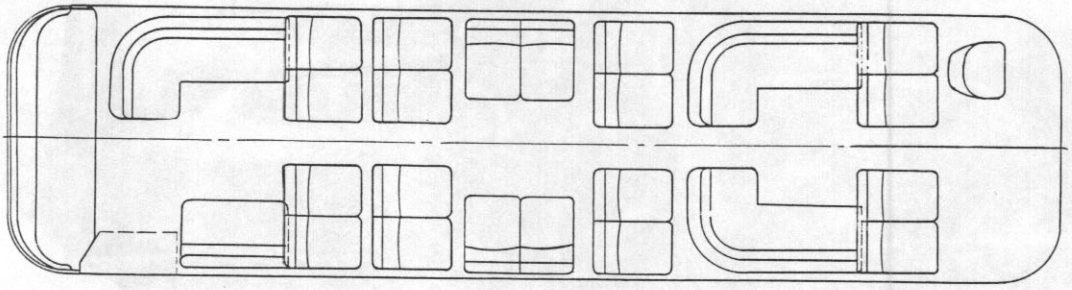
Interior of standard street car type, seating 40 persons and carrying as many as 60 standees in large industrial centers. Circulating load arrangement. Front and rear doors (with or without treadle).

Parlor car type with baggage rack and high back soft cushioned roll top sleeping chairs for long urban work — seats 37 persons.

For Urban Street Car Coach—40 seats and 35 standees.

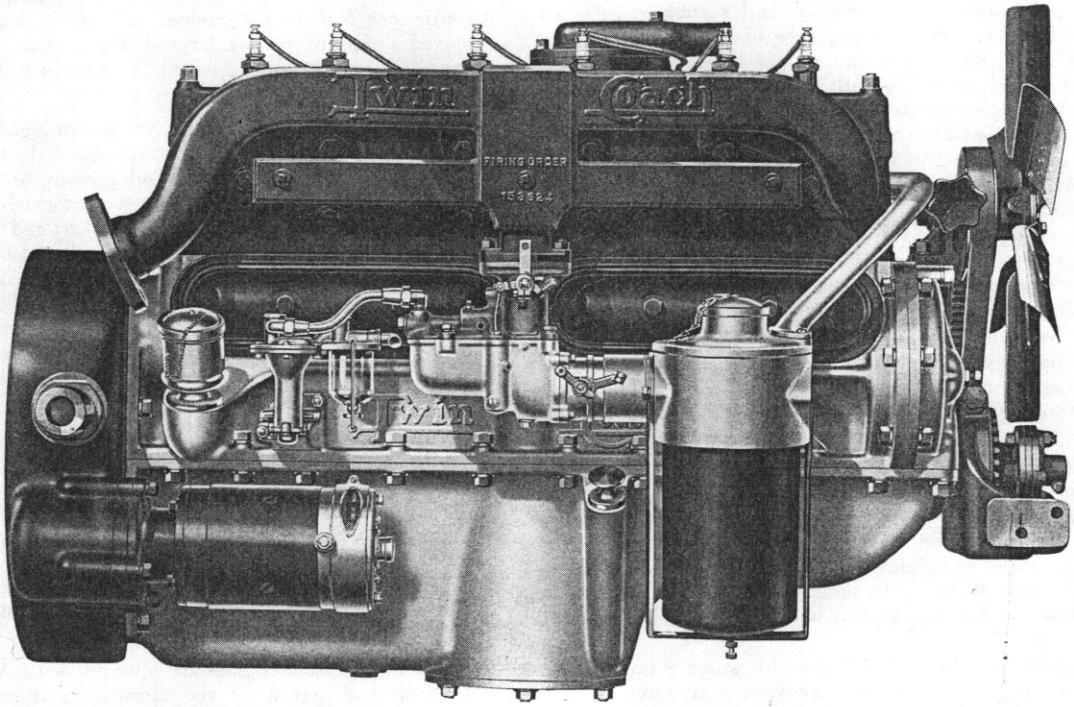


Long Route Parlor Car with high back chairs seating 37 passengers.



Parlor Car Plan with low back chairs for 41 passengers—Suburban Express Type

Super-Powered!



THE motors in Twin Coaches are developed from the service records of years of motor coach manufacturing. They are not revamped commercial motors, not that American commercial motors have been inferior, but rather because the demands upon them do not compare with those placed upon coach motors. Every point of Twin Coach motor design has its basis in the actual experience of transporting human beings over varying topography and in complicated traffic situations. The location and composition of every component part is the result of concentrated study to see that these power plants may be operated the maximum number of hours each day with a minimum time required for maintenance work.

Light weight, so essential to low cost of maintenance, has been obtained by the use of a separate aluminum crankcase and special alloy cylinder block. The block contains the proper quantities of nickel and chromium to produce a very close-grained iron, insuring a very high tensile strength. The sides of the cylinders are tapered, providing greater strength. The water jackets are extended to the crankcase, helping to cool it. The lower part of the cylinder barrels below the water jacket is oil cooled.

Maximum rigidity is obtained by extending the sixteen main bearing bolts through the crankcase, on through the cylinder block and cylinder head, giving a tie-rod construction. These main bearing bolts are designed so that the crankcase, cylinder block, or cylinder head can be removed without affecting the assembly or tightness of the parts not removed.

Two breathers are provided for the crankcase, one at the rear end on the valve side where the air is admitted through a special type of breather with proper baffling and through a strainer of curled hair. The light gases in the crankcase combine with this air and are drawn out through a similar breather at the front end of the crankcase on the water pump side. The mixture then proceeds through a special designed "down-flo" air cleaner, placing a constant vacuum on the breather and suction on the carburetor This arrangement reduces

crankcase temperatures and ventilates the crankcase in such a manner that oil dilution is kept at a minimum. It also eliminates any disagreeable fumes which might be carried into the body, thus causing annoyance to passengers.

A seven-bearing crankshaft is used with large oversized bearings. It is made from chromium nickel alloy steel with a minimum Brinell hardness of 302. It is exceptionally strong, having wide cheeks. The main and connecting rod bearings overlap each other in a vertical plane, giving great strength inasmuch as the two bearings are very close together and deflection of the cheeks is reduced to a minimum.

Each crankshaft is dynamically and statically balanced, with the finest and best known type of equipment, assuring crankshaft of rigid design and proper balance. Each connecting rod is also carefully balanced and after it is assembled to the piston the two are again balanced and weighed. A weight tolerance of only one-quarter ounce is allowed between any six of these assemblies. The connecting rods are made from heat-treated chrome nickel forgings. The bearing metal is poured into the steel in a special grooved broaching operation, providing for maximum adhering surface. The alloy steel in the rods and crankshaft is especially suited to the high speeds incurred in bus service.

Connecting rods and pistons are designed to combine strength with light weight. The pistons, which are made from Lynite aluminum alloy, are of the Invar-Strut type. The pins are large and strong, having a diameter of 1⅛ inches. The piston pin lock is designed to give maximum strength and has proven to be the best type for high-speed service as it permits a maximum amount of bearing surface for the pin.

The piston assembly includes three compression rings and an additional oil regulating ring immediately above the piston pin, providing maximum lubrication plus effective sealing. Piston pins are of molybdenum steel having a minimum scleroscopic hardness of 86. The same material is also used in the valve tappets. No steel known will give longer life or better service.

A high volume centrifugal type of water pump is used, delivering 64 gallons of water per minute at 2,000 r. p. m. The pump is bolted directly to the crankcase, its delivery passage registering with the water passage in the cylinder block. This eliminates troublesome hose connections and assures a perfect alignment of the water pump. It is driven by a chromium plated shaft and contains very large packing glands, requiring little attention. The water flows from the pump to the valve side of the cylinder block where it is distributed around the valves and to the valve stem guides, which have been brought very close to the valve head to promote immediate radiation of heat.

The diameter of the intake valve is 1⅛". It is made of an alloy containing 3½% nickel. The diameter of exhaust valve is 1½". It is made from the highest grade silichrome steel. Both valves are made from a one-piece forging. The tappets operating these valves are mounted in removable clusters, bolted directly to the crankcase. This type of cluster design is of special interest as it helps to tie together the side of the crankcase and the inner support through which the main bearing bolts pass, each cluster being held in place by five large bolts. This construction permits accessibility through openings in the crankcase to the valve tappets without affecting the strength of the crankcase itself.

The timing gear cover and oil pan are made of cast aluminum, giving much faster radiation of heat. The oil filter is built into the side of the crankcase, held in place by four studs and connected directly to the oil lines into the crankcase. A special arrangement in the oil filter permits passage of oil by an auxiliary by-pass in case of stoppage through the filtering element because of careless inspection.

An oversize oil pump is located at the center of the engine, sucking from the body of the oil pan, and is installed inside of a very large oil strainer. The pump has hardened steel gears and shafts. A shield is installed around the oil pump so designed that if the oil screen becomes clogged a vacuum is formed, drawing the oil up over the screen, thus assuring continuous feed to the engine. The oil screen is readily removed and is of such a large diameter that when removed, the oil pan sump can be wiped clean without removing same from the engine.

The oil regulator, which is of the plunger type, is conveniently mounted on the filtrator, being located in a horizontally reamed hole. Proper oil pressure at either high or low speed is maintained by this regulator which is metered very accurately. Oil leaks at the flywheel and at the rear end are prevented by a patented design of oil seal having no felts, being entirely mechanical. The seal at the rear is designed to eliminate unnecessary overhang of the flywheel and the rear main bearing and to prevent distortion of the crankshaft, making the operation very smooth. Oil slingers without felts are provided at the front end of the engine and at the fan driveshaft.

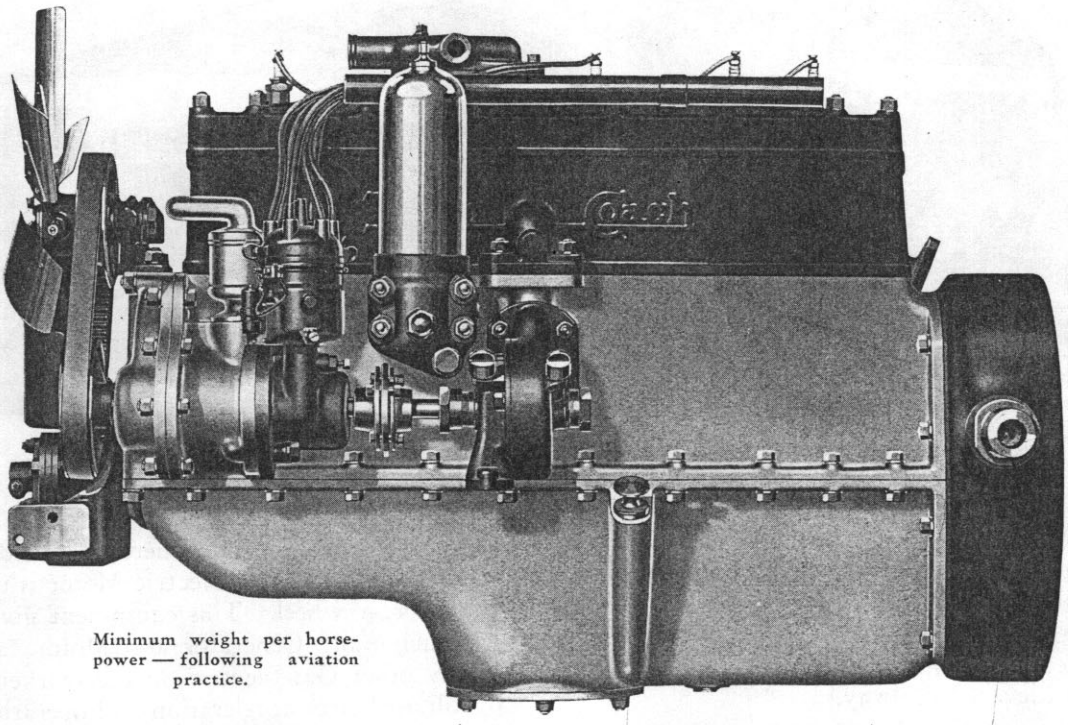
A special air cleaner has been designed of the downflo centrifugal type, self-cleaning, which requires only the addition of a small quantity of oil each time oil is placed in the crankcase of the engine. This assures long life to the engine, minimizes wearing of cylinder walls and reduces to a minimum the forming of carbon. These cleaners are adapted to all Twin Coach engines and are interchangeable right and left. The engines are provided with a combined oil filler and oil level gauge on either side of the crankcase.

All Twin Coach engines are equipped with A-C fuel pumps built in and driven off the camshaft and located to make them readily accessible. This mounting eliminates the use of long gas lines to the carburetor and assures a constant supply of gasoline on heavy pulls and over hilly routes.

All accessories are conveniently mounted. Accessory shaft mounted on the left side of the engine supported by a Babbitt lined bearing $1\frac{5}{16}$" in diameter and 3½" long. The large diameter of the shaft helps to withstand the heavy belt pull to the fan and prevents gear noises. The timing gears are also mounted on very large shafts, the bearings of which are rigidly mounted. Perfect gear centers are assured by a special line reaming operation.

A swan type one-piece combination intake and exhaust manifold is used, with the intake and its branches completely surrounded by a heat jacket. Proper gas temperatures and maximum power is obtained through a constant flow of heat from the exhaust port through this passage.

The engines can be used on either the right or left-hand side of the coach, the only alteration necessary being the mounting of the starting crank bracket on one side or the other. The fans have been set a considerable distance from the cylinder block which together with the design of the front end of the engine allows a free passage of air from the fan.



Minimum weight per horsepower — following aviation practice.

Bore and Stroke, 3¾ x 4½". Number of Cylinders, 6. N. A. C. C. Horsepower, 33.75. Piston Displacement, 298.8 cu. in. Actual Brake Horsepower, 65.

Cylinders—Cast Enbloc—Material—Special Nickel Chromium Alloy containing fully 1½% nickel giving a very close grained iron. Brinell hardness 225; minimum 245, maximum. Assuring a very high tensile strength and long life.

Crankcase—Cast Aluminum giving a minimum tensile strength of 22,000 lbs. per sq. in. It is rigidly constructed and well braced, in which sixteen of the main bearing bolts extend through the crankcase and as one piece continue on through the cylinder block and hold the cylinder head. The construction is such that either the bearings or the cylinder block and head can be removed without affecting the tightness of the other. This through bolt construction assures the maximum possible tie and rigidity of the crankcase when assembled with the cylinder block in place, and provides for a quickly removable cylinder block after the head is off.

Cylinder Head—Removable and is designed to give maximum power at all speed without detonation. It has ample water space to properly cool the explosion temperatures, is cast and machined to be relieved of all stresses and strains when assembled on engine.

Pistons—Lynite Aluminum Alloy (Mfg. by Aluminum Co. of Amer.) Invar-Strut Design.

Piston Rings—Four above the piston pin of the Perfect Circle type. The one ring immediately above the pin is a Double Duty Oil Regulating Type.

Piston Pin—Diameter, 1⅛"; Bearing Length, 2"; Bearing location, in Piston; No. of Bearings, 2; Material, Nickel Molybdenum Steel (minimum hardness 85 scleroscope).

Timing Gears—Helical teeth, Face width, 1¼; Crank and Accessory Shaft Gears, Chromium Nickel Steel Forgings; Camshaft and Idler Gears, Special Chromium Alloy Castings with tensile strength of 38,000 lbs. per sq. in.

Crankshaft—No. of Bearings, 7. Bearing diameter, 2⅝"; Bearing length, (front), 1⅝"; Bearing length (center), 2⅝"; Bearing length (rear), 2¾"; Bearing length (intermediate), 1½". Material — Chromium Nickel Alloy, minimum Brinell hardness, 302.

Camshaft—No. of Bearings, 4; Bearing diameter, 2⅛"; Material—Carbon Steel Case Hardened. Bearing Material —Babbitt lined brass back.

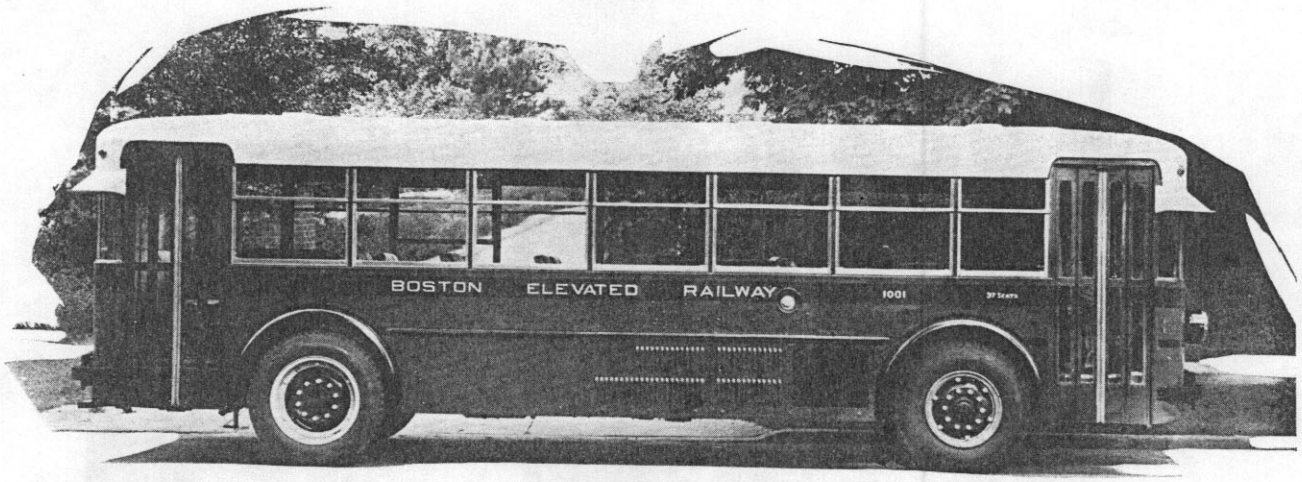
Connecting Rods—Bearing diameter, 2¼"; Bearing length, 1½"; Material—Chromium Nickel. The bearing babbitt is poured direct into the steel after a special grooving broach operation which provides for maximum adhering surface.

Valves—Arrangement, L head type. Inlet Valve diameter clear, 1⅝"; Exhaust Valve diameter clear, 1½"; Inlet Valve material, 3½% Nickel one piece forging. Exhaust Valve material, highest grade Silchrome, one piece forging.

Cooling System—High pressure, high volume centrifugal pump. Shaft is chromium plated. Very large packing glands. Pump positive aligned by direct bolting to crankcase without any hose connections.

Accessory Drive—Bearing diameter, $1\frac{5}{16}$". Bearing length, 3½". Bearing material—Babbitt. Lined Brass Back.

Lubricating System—Forced feed by positive gear pump. The oil channels are drilled in the crankcase proper leading to the main bearings and the crankshaft is drilled to conduct pressure feed to the connecting rod bearings. Positive force feed line to the timing gears.



Gas-Electrical Drive Equipment

TWIN COACHES may be had with either standard mechanical drive, or with Gas-Electric Drive.

The illustration above shows one of a fleet of 10 Gas-Electric Twin Coaches manufactured for the Boston Elevated Railway.

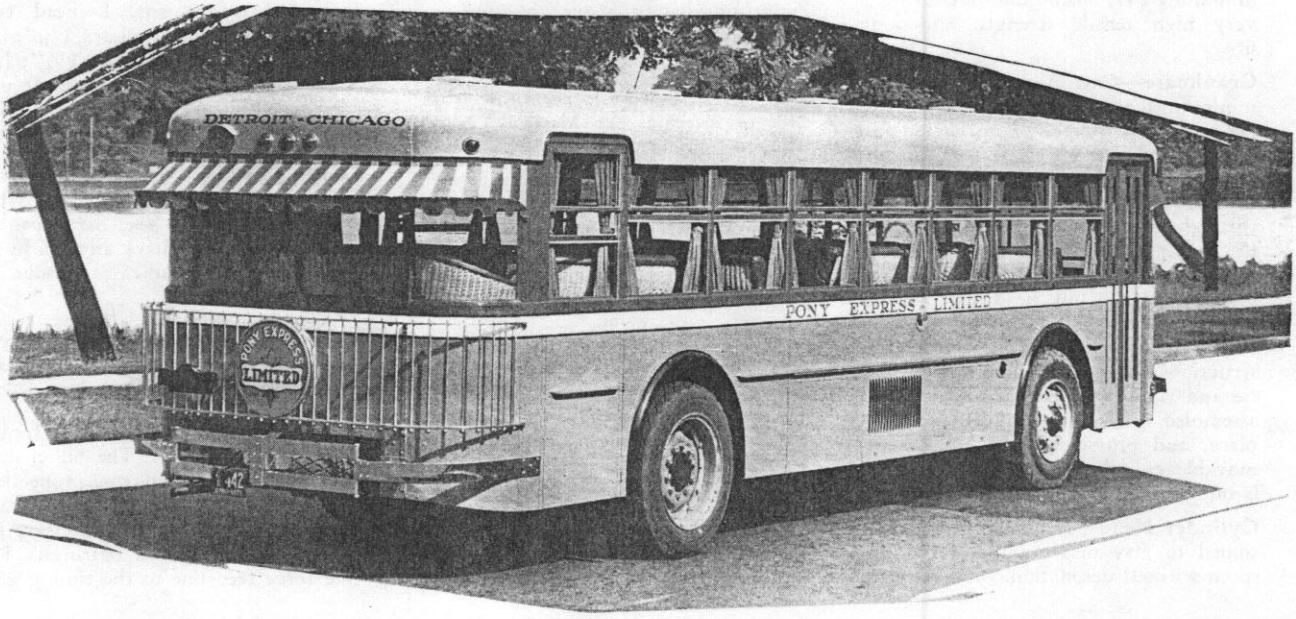
The use of Gas-Electric drive necessitates placing the engines 35 inches farther forward than mechanical drive models. This results in a slight change in seating arrangement but does not affect seating capacity.

Engine, cooling system, generator, air compressor and other motor assembly units remain the same as in mechanical drive.

A General Electric Generator is used on each engine and a General Electric Motor is used to drive each rear wheel. This equipment gives the Twin Coach more Generator and Motor capacity than any other Gas-Electric on the market, with a resultant better acceleration and operating speeds.

Independent drive shaft brakes are provided just back of each electric motor. This gives three independent sets of brakes—just as on the standard mechanical drive models.

Electric generators and motors are very accessible through lower side panels in the body.



Part of Houston Electric Company's Fleet of 25 Twins

THE Twin Coach Company advocates daily maintenance which is "the every-day work necessary to keep equipment in efficient operating condition so that schedules can be filled without delay." If this work is systematically performed the equipment will not deteriorate and will always be ready to run. The periodical expensive "overhaul" then becomes unnecessary. The daily inspection, lubrication and adjustment of a Twin Coach requires comparatively little time and can be very economically performed by the Operator. *FOR ANY TYPE OF TRANSPORTATION EQUIPMENT THIS IS THE ONLY POSITIVE PREVENTATIVE OF DELAYS DUE TO BREAK-DOWN ON THE ROAD AND THE ONLY GUARANTEE OF MINIMUM OPERATING COSTS.*

EFFICIENT MAINTENANCE INVOLVES:—

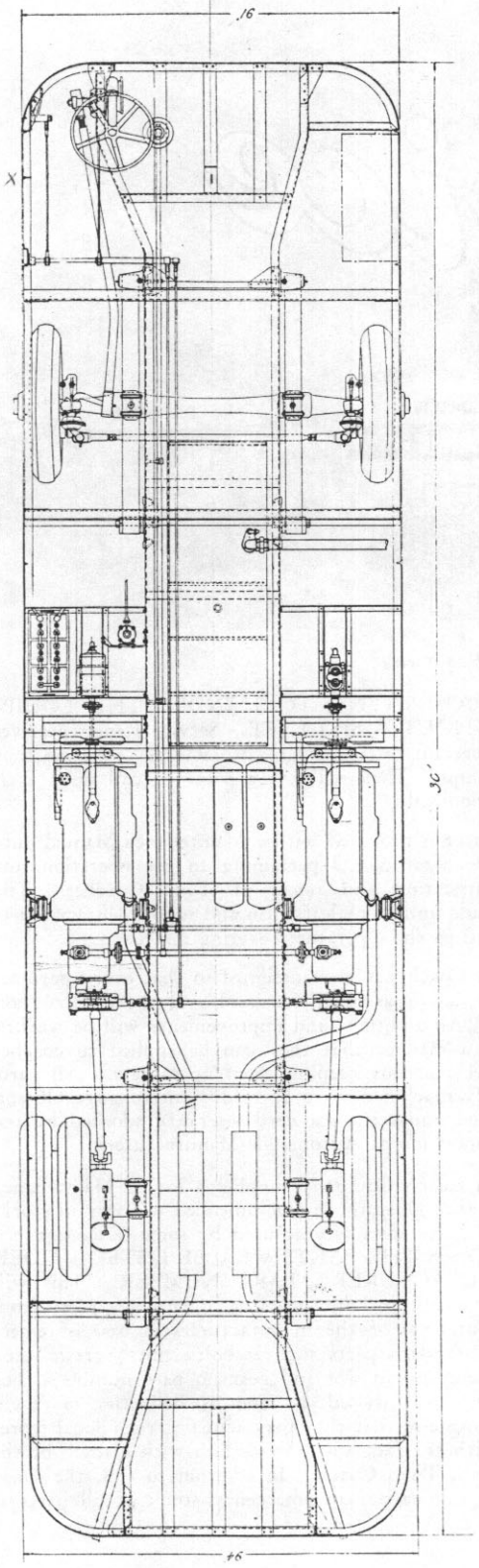
1st. Careful selection and training of Drivers, Inspectors and Mechanics—
2nd. *The intelligent inspection of equipment daily,* or better after each run—
3rd. Periodical lubrication of every part—
4th. Daily minor adjustment or replacement of units, as indicated by the inspection—
5th. Reconditioning of worn or defective units so that they may be available for replacement—
6th. An adequate stock of maintenance units and parts—

The Twin Coach Company will transmit to the Operator all available information pertaining to the operation, inspection, lubrication and repair of its product. A competent representative of Twin Coach always accompanies the first coaches delivered to an Operator. This representative will assist in training the Operator's employees in the proper handling of the coach, and WILL REMAIN WITH THE OPERATOR'S ORGANIZATION UNTIL HIS EMPLOYEES ARE COMPETENT TO HANDLE THE EQUIPMENT WITHOUT ASSISTANCE. Service Representatives assigned to certain territories are available at any time that trouble develops. They make it a point to call upon each Operator periodically.

The Operator is provided with a Maintenance Manual outlining all the vital points pertaining to the operation, inspection, lubrication and repair of Twin Coaches. The Manual is made up in looseleaf form and supplementary sheets will be mailed to the Operators covering any changes.

The Twin Coach has been designed so that every part requiring attention is as readily accessible as the construction will permit. All additions and improvements will be worked out in such a manner that they can be applied to coaches already in service thus keeping them up-to-date. All parts are accurately machined so to be readily interchangeable and are guaranteed under the standard warranty adopted by the National Association of Automobile Manufacturers.

The Twin Coach Company supplies a list of Maintenance Parts which each Operator is recommended to carry in stock. Where these parts are manufactured by some other concern than Twin Coach THE PARTS WILL BE LISTED UNDER THE MANUFACTURER'S PART NUMBER. This will make it convenient for the Operator to purchase parts from local representatives of the manufacturers in case of emergency. All standard parts such as bolts, nuts, screws, etc., are listed according to size and bear no part number. The manufacturers are advised as soon as deliveries of Twin Coaches are made so that they may acquaint their local representatives with the fact and provide him with a stock of the parts used in a Twin Coach. In addition to this, the Twin Coach Company carries an emergency stock of all parts at the Factory.



CHASSIS DIAGRAM and DATA

Engines—Each engine is mounted amidship with easy access from outside and from above inside. Each engine, with its corresponding rear wheel, transmission, radiator, etc., is a complete unit, independent of the unit on the opposite side.

Transmissions—A three-speed and reverse sliding gear transmission attached to each engine with shift shaft connecting the two, so arranged that both shift together, or either one can be disconnected and left in neutral which permits operating coach on one engine. Each transmission has individual dry plate, self-cleaning, single disc clutch of ample size.

Radiators—There is a separate radiator for each engine, mounted directly in front thereof. Air is drawn by fan through louvers on side and from vent under seat in interior, thus effecting ventilation. Heated air from radiators can be directed into interior for warmth.

Generator—The generator is driven direct from front end of crank shaft of left hand engine. It is of 12-volt 600-watt capacity.

Compressor—Compressed air is supplied by a two-cylinder Westinghouse air compressor of six cubic feet capacity. The compressor is direct driven off the front end of the right hand engine. Air is stored in two large capacity tanks slung between the two main body sills.

Gasoline Filler—Filling the gasoline tank is made easy by running a pipe to the right outside wall for filling, together with vent. The cap covering the two pipes is conveniently situated for quick access. Tank is suspended between main body sills and is equipped with gasoline gauge. Feed is by vacuum system.

Shift Mechanism—Synchronized shift control for both transmissions is achieved through one standard shift lever at driver's seat, and connecting rods to transmissions.

Worm Drives—The worm and gear of each rear wheel is encased in a steel cast housing. The drive to the worms is through drive shafts 40″ long, 3″ in diameter with Cleveland Universals at each end.

Service Brakes—All four wheels are equipped with Westinghouse air operated brakes—actuated by the conventional type foot pedal through a Westinghouse B4 brake valve. (American Brake Bloc.) Brake drums, shoes, hinge-pins, etc., are interchangeable for front or rear wheels and right or left sides.

Emergency Brakes—Drive shaft brakes are installed on each of the two drive shafts. They are operated by synchronized control from the driver's seat. This provides three completely independent sets of brakes.

Springs—The Twin Coach is carried on four chrome vanadium steel springs, each 60″ long and 4″ wide. These springs are practically flat under load and are mounted with the front ends higher than the rear so as to absorb the horizontal component of road shocks as well as the vertical.

The springs are attached to the main body sills by special brackets at the front ends and by "shackle bars" extending clear across the body at the rear ends. These shackle bars, instead of passing through the body members, are clamped to the undersides of them to facilitate removal.

All four springs are exactly alike and are interchangeable, front and rear, as well as the attaching parts. This, manifestly, insures economical maintenance.

Steering—Ross gear of the worm and lever type. The worm is cut in such a manner that it has practically no pitch at the center but increases in pitch as the ends are approached. This produces a steering condition that is irreversible in a "straight ahead" position and, at the same time, permits quick action for a "hard over" turn. 22″ steering wheel.

Front Axle—Built by Timken especially for Twin Coach. It provides an extra wide tread (78″) without increasing the over-all width of the coach. This insures stability on the road and freedom from "roll" and, at the same time, permits the maximum "cut under" of the front wheels and a small turning radius.

Specifications, Mechanical Drive*, 40 Passenger, Urban Coach; 41 Passenger, Inter-City Parlor Coach

GENERAL DIMENSIONS

Overall Length—Without bumpers and visors	30′
Overall Length—With bumpers and visors	31′ 10″
Overall Width	95 7/16″
Overall Height (loaded)	103″
Wheel Base	194″
Tread—Front and Rear	78″
Turning Radius (Approximately)	33′
Front and Rear Overhang	83″
Interior Headroom—Throughout	77½″
Road Clearance—Minimum under rear axle housings	8″
Lowest part of body at center	12″
Maximum body clearance at ends	15″
Weight (Approximately)	15,200 lbs.

BODY UNITS—Body and running gear are built integral and are interdependent for support.

Construction—All steel, trussed bridge type completely panelled with plymetl.

Overhang—Front and rear 83″. Both ends of body shaped alike.

Main Body Sills—6″ 8.2 lb. channel, which also forms chassis side rails.

Body Support Cross Members—Specially formed and trussed 2½″ x 2½″ channels.

Posts—3/16″ x 1¼″ x 1¼″ T-irons, outside covering 18 gauge steel above window line.

Floor—Made of ¾″ laminated wood; covered with 3/16″ Brown or grey Battleship Linoleum.

Roof—Center section 42″ wide, 24′ long, made of ¼″ plymetl (metal both sides). Sides and ends of roof formed by main side posts of metal formed to shape and covered outside with steel, lined inside with aluminum.

Windows—All four corners curved glass. Front corners and windshield, Safety Glass. Plymetl rear corners optional. Windshield and rear windows in two sections, each section 23 3/16″ x 28″. Side windows spaced 36 11/32″ centers, lift 15″. Sash—Heavy duty brass sash of special non-rattling construction. Sliding glass opening at left of driver for signalling.

Urban Doors—Entrance—ahead of front wheels. Exit—behind rear wheels on right-hand side. Air door operation with National Pneumatic door engine of ample capacity for each door. Door engines mounted over head under hinged covers which makes all working parts very accessible. Doors four-leaf fold-out type in two sections, constructed of special extruded aluminum and have removable glass panels. Elevation of entrance platform 13″ from ground when under load. Elevation of entrance platform to floor level 12½″. Door step of non-skid metal. Sedan type emergency door at rear, on left-hand side may be substituted for right-hand door if necessary.

Parlor Doors—Entrance, ahead of front wheels, air operated from driver's seat, with engine of ample capacity. Door engine mounted overhead under hinged cover which makes working parts very accessible. Entrance door four-leaf fold-out type in two sections. Door constructed of special extruded aluminum frames and have removable glass panels. Elevation of entrance platform to floor level—12½″. Elevation of entrance platform—13″ from ground under load. Door step of non-skid metal. Emergency door, behind rear wheels on right-hand side, Sedan type, equipped with emergency latch. If necessary to comply with certain state laws, left rear emergency door, Sedan type will be installed instead of right rear door.

WIRING—Light wiring single braid type, concealed in removable panels. Water-proof and readily accessible.

LIGHTING—Head Lights: Two-Guide Tilt Ray type (937 special), mounted at front end 60″ apart. **Marker Lights:** Standard "Beehive" 3″ in diameter mounted in each corner of the coach at roof line. Marker lights on special circuit and operate independently of the other lights. Front lenses green, rear lenses red. **Tail Light, Stop Light and Directional Indicator**—in unit with license bracket. Tail light red, stop light yellow, directional indicators green. Directional indicator operated from driver's seat by foot buttons. **Interior Lighting:** 10—5″ frosted decorative glass dome lights equipped with 15 c. p. Mazda lamps, distributed in pairs throughout length of coach, 5 on each side. Two rear lights are on one circuit and the remaining 8 on two separate circuits, 4 lights on each in alternate pairs. Each front light is shaded on front side with green enamel to prevent glare into driver's eyes. **Step Lights:** On front and rear step risers.

COLLISION STRIPS—V-shaped metal strips at sides of body, approximately 36″ from ground level.

BUMPERS—Spring steel front and rear with special removable pin and hinge to allow access to tire carriers. Bumpers attached directly to ends of main body channels and ends attached to reinforcements at sides of body, thus giving ample protection over entire front and rear of coach. Bumpers and visors bring overall length of 31′ 10″ and will be omitted at customer's option, thus making coach 30′ long, overall.

INTERIOR FINISH—Aluminum window Pilasters, plymetl lining below windows, ceiling metal as described under "Roof." Ceiling painted Ivory, sidewalls and window Pilasters painted Artillery Grey, a very pleasing combination, and easy to keep clean.

Card Racks—On Urban Coaches only. Conveniently situated above windows entire length both sides and at rear.

Baggage Racks—Overhead inside coach on Parlor Coach.

Floor Covering—3/16″ Brown Battleship Linoleum in urban coach, 3/16″ Grey Battleship Linoleum in Parlor Coach.

Seating Arrangement—Urban Type—40 passengers seated as follows: 2-passenger longitudinal seat over each wheel and motor housing, except right front wheel housing which has 4-passenger longitudinal seat to give additional floor clearance at entrance door. All other seats are 2-passenger transverse seats with 24″ knee room for passengers. The rear seat is across full width of body. Wheel housing seats are mounted with special brackets that do not contact with floor, thereby giving ample foot room.

Urban Seats—Specially designed Twin Coach Street Car type seats. Upholstered with first quality grain brown leather, unpleated. Cross seats equipped with corner grab handles. Driver's seat—Bucket type, easily adjustable forward or backward.

Seating Arrangement—Parlor Cars—41 passengers seated as follows: Short back seating arrangement from front to rear, on both sides of aisle as follows: Transverse dual seat, longitudinal dual seat over engine housings, two transverse dual seats, four passenger "circle" seat over rear wheel housings, five passenger built-in seat across rear of coach. At customer's option 37-passenger arrangement will be furnished, using all transverse high back head roll seats except those over engine housings. Single seats beside wheel housings.

Parlor Seats—Specially designed Twin Coach wicker frame Parlor Car type. Deep two stage air and spring cushions, with deep cushion spring backs. Cushioned headroll at top of seat back. Height of seat back from cushion 24″. At customer's option same type of seat without headroll will be furnished. Height of seat back from cushion 16″. Driver's Seat—Bucket type, low back, easily adjusted backward or forward.

Buzzers—Actuated by artistic pull cords running above windows each side.

Stanchions—Nickel Plated Brass, conveniently located to assist passengers upon entering or leaving at front and rear doors.

Ceiling Hand Rails—Nickel Plated Brass, conveniently located on ceiling each side of aisle running full length of interior. (Urban Coach only.)

Heating—Coach is heated by using hot air directly from engine radiator which is deflected into coach through special vents. This arrangement is very effective and does away with troublesome heater pipe arrangements. Distribution of heat provided through ventilation system described below.

Ventilation—Coach thoroughly and effectively ventilated as follows: Large cast aluminum ventilators built into front of body give direct

** Also furnished in gas-electric drive models.*

ventilation to driver and interior when needed. Four roof ventilators of ample capacity. Engine radiators draw part of their air supply from interior of coach through special vents built in front of engine housings. This insures constant flow of air and distribution of heat when latter is used.

DESTINATION SIGN—Hunter illuminated, type 136 R. B. Size of glass opening 7¾" x 42½". Sign roll lettered to customer's specifications. (Single roll type.)

REAR VISION MIRROR—Installed above driver, giving complete view of rear and interior of coach. Auxiliary Mirror also installed at front right of Urban coach interior, giving unobstructed view to rear door.

BAGGAGE RACKS—Located on under side of roof, along each side above seats. Ample space for baggage or parcels of each passenger. Edge of baggage rack also serves as hand rail.

PAINT SPECIFICATIONS—Coach to be painted in "Arco" pyroxylin finish according to customer's specifications. This is an enameled finish of great hardness and durability which has been found especially suitable for bus work. Reasonable amount of lettering will be furnished on coach without additional charge.

RUNNING GEAR UNITS—In unit with body.

Springs—Front and rear—attached to main body sills. Made of chrome vanadium steel, 60" long, 4" wide, 2" camber.

Spring Pins: 1½" diameter nickel steel hardened and ground, operating in rolled and burnished bronze bushings, lubricated by Alemite lubricating system.

Shock Absorbers: Specially designed rubber snubbing device, non-wearing and bolted directly to spring.

Front Axle—Special Twin Coach manufactured by Timken, extra heavy drop-forged I-beam section, tread 78".

Rear Axle—Specially designed Twin Coach manufactured by Timken, underslung dual worm 78".

BRAKES—Service Brakes: Westinghouse air brakes on all four wheels, all parts interchangeable. American "Brake-Blok" shoes braking against gun-metal drums. Shoes equipped with special alloy steel, heat treated non-friction cam rollers. Compressed air supplied by one six-cubic-foot Westinghouse compressor, driven direct from front end of one engine. Two cylindrical air storage tanks 7" x 36" long each, maintained between body sills. 110 pounds pressure maintained in tanks by means of regulator and safety valve. **Emergency Brakes:** Two drive shaft brakes, one 8" diameter x 4⅜" wide drum on each drive shaft operated by one hand lever. This gives three complete and independent sets of brakes. Emergency brakes sufficiently powerful to control coach under load in case of air brake failure.

STEERING GEAR—Ross, No. 320, screw and lever type—new design irreversible in "straight ahead" position and at the same time permits quick action for a hard over-turn. Connected to front axle by drag link with 1¾" ball and socket ends, running forward to steering gear. Location of steering gear ahead of axle and length of drag link prevents "shimmy" at any speed.

ENGINES—2—Special Twin Coach design. See pages 13 and 14 for details.

Oil Filters: Hall-Winslow, one on each engine. **Air Cleaner:** Special Winslow "downflo." **Ignition:** Delco. Distributor coil and battery type automatic advance. **Starting Motors:** Delco Remy, one on each engine, remote control type. **Generator:** Delco Remy, 12-14 volt, 600 watt, output controlled by voltage and current regulators. Generator direct driven from front end of left engine. **Battery:** Exide "K," 12-volt, 160 ampere hour, 17 plate, quarter inch, specially designed for motor coach service. Mounted beside generator—readily accessible. **Carburetor:** Zenith—model 116. **Fuel System:** Special A-C fuel pump driven from cam shaft each engine. Sixty gallon gasoline tank suspended from main sills under floor. Filler pipe with vent extends to right side of body, covered by special design non-detachable cap.

CLUTCHES—Brown-Lipe extra large single disc type—actuated by synchronized remote control.

TRANSMISSIONS—Brown-Lipe Model 50-3S, which has extra large rear end bearings to take care of braking torque. Three forward speeds, and reverse. Gear shift by special remote control.

Drive Shafts—Two, 43¼" long, 2" diameter with 475 series Cleveland Universal joints at each end.

Gear Ratios—Dependent upon operating conditions. Standard ratios: Urban Coach 6¼ : 1. Parlor Coach 5¼ : 1.

WHEELS—Dayton Steel Wheels with special offset for dual rear tires, when latter are used.

TIRES—Front 40 x 10.50, 12-ply, medium pressure single, guaranteed by rubber manufacturers at 6,000 lbs. load per tire. Rear 38 x 7 dual or 40 x 10.50 medium pressure, 12-ply, single, at customer's option. If customer prefers to furnish the tires on a mileage contract with the tire manufacturer, said tires to be delivered at seller's factory at Kent, Ohio, and then mounted by seller before delivery of coach. Allowance to customer of $340.00 will be made from total price in such an instance.

SPARE TIRE CARRIERS—Located under floor at front and rear ends between main body channels, which are spread to accommodate tires.

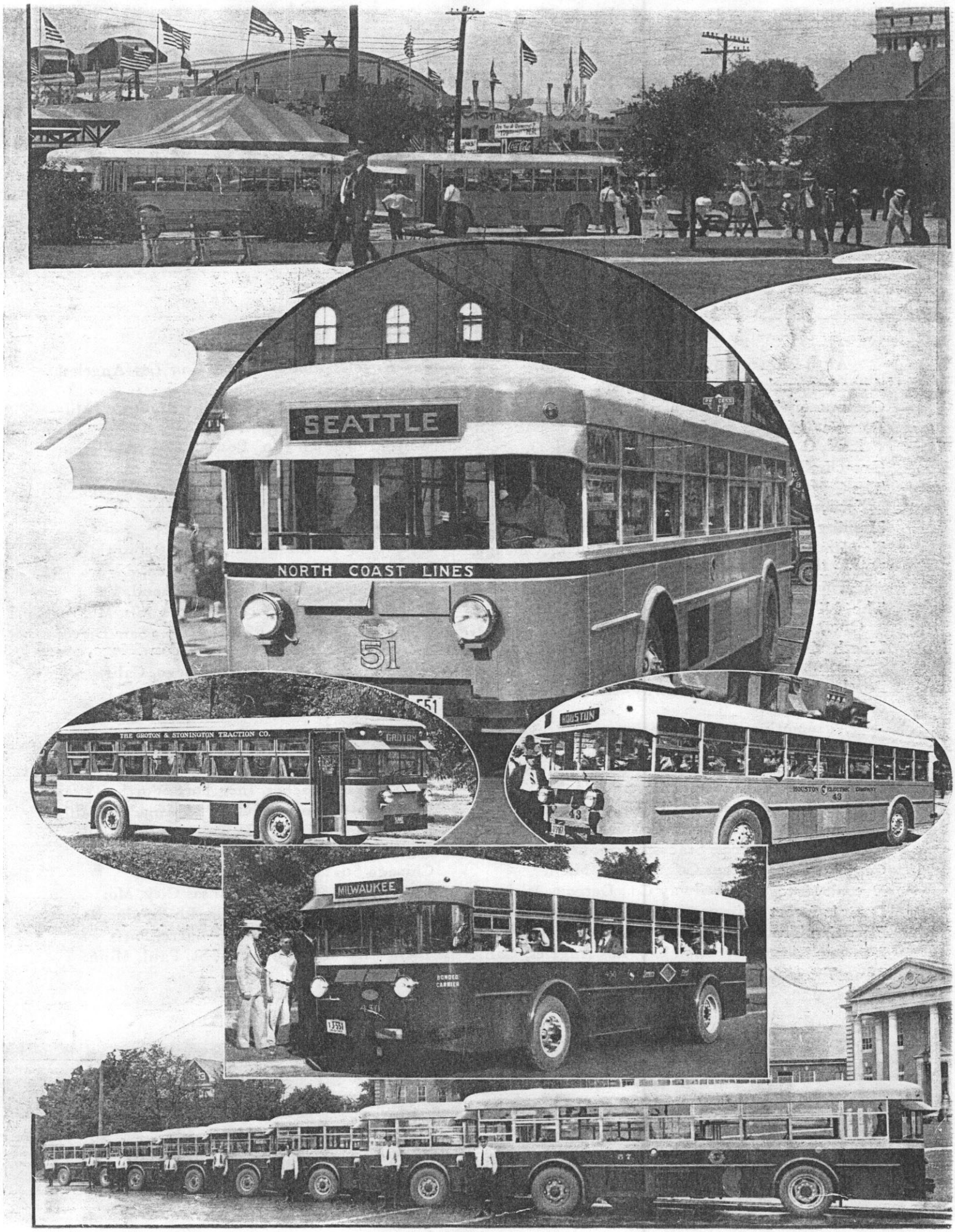
CHASSIS LUBRICATION—Alemite Chassis Lubricating System used to lubricate all chassis parts, except engines.

HORN—Bosch—Vibrator type.

12 Months' Progress

A Roster of Buyers of Twin Coach Equipment

Auto Interurban Co., Spokane, Wash.
Community Traction Co., Toledo, O.
Detroit-Toledo-Cleveland Bus Co., Cleveland, O.
Great Lakes Stages, Inc., Cleveland, O.
The Groton & Stonington Traction Co., Guilford, Conn.
Hamilton-Oxford Bus Line, Hamilton, O.
Key System Transit Co., Oakland, Calif.
Motor Transit Management Corp., Chicago, Ill.
The Niagara Safety Lines, Ltd., Windsor, Ont., Can.
North Coast Transportation Co., Tacoma, Wash.
Portland Electric Power Co., Portland, Ore.
United Electric Railways Co., Providence, R. I.
Automotive Transportation Co., Providence, R. I.
Boston Elevated Railway, Boston, Mass.
Buffalo Transit Co., Inc., Buffalo, N. Y.
Cincinnati Street Railway Co., Cincinnati, O.
Cleveland Railways Co., Cleveland, O.
Combs-Albatross Stages, Springfield, Mo.
Detroit Motorbus Co., Detroit, Mich.
Detroit Street Railway Co., Detroit, Mich.
Egyptian Transportation System, Marion, Ill.
Houston Electric Co., Houston, Texas
Lang Transportation Co., Los Angeles, Calif.
Los Angeles Motor Coach Co., Los Angeles, Calif.
Milwaukee Electric Railway & Light Co., Milwaukee, Wis.
Wisconsin Michigan Power Co., Appleton, Wis.
Northern Ohio Power & Light Co., Akron, O.
Pony Express Lines, Detroit, Mich.
Phelps-Dodge Corp., Bisbee, Ariz.
Pittsburgh Motor Coach Co., Pittsburgh, Pa.
Purple Stages, Inc., Pittsburgh, Pa.
Safety Transit Lines, Inc., Richmond, Va.
St. Louis Public Service Co., St. Louis, Mo.
San Diego Electric Railway Co., San Diego, Calif.
Sutherland Stages Co., San Diego, Calif.
Daniel W. Smith, Detroit, Mich.
Tennessee Electric & Power Co., Chattanooga, Tenn.
Winnipeg Electric Co., Winnipeg, Manitoba, Can.
West Texas Coaches, Inc., Fort Worth, Texas
Los Angeles Railway Co., Los Angeles, Calif.
United Motor Coach Co., Springfield, Ill.
Capital Traction Co., Washington, D. C.
Chicago Surface Lines, Chicago, Ill.
Interstate Stage Lines, Kansas City, Mo.
Manila Electric Co., Manila, Phillippine, Is.
White Transit Co., Wilkes-Barre, Pa.
Twin City Motor Bus Co., St. Paul, Minn.


SEATTLE
NORTH COAST LINES
51
THE GROTON & STONINGTON TRACTION CO.
GROTON
HOUSTON
HOUSTON ELECTRIC COMPANY
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MILWAUKEE
BONDED
CARRIER