MODERN STREET CARS FOR CHICAGO

by Ralph H. Rice

IN 1929, the American Electric Railway Association (now the American Transit Association) formed a committee, known as the President's Conference Committee. (P.C.C.), and provided a fund well over $500,000, to develop a modern street car. This Committee created a research group, with a well known research engineer as director, and work has been continuously carried forward upon the design of a car embodying many new features, and having the ability to compete successfully with automotive units. In this development the operating companies and the manufacturers of various parts of the car cooperated quite fully.

Probably the greatest public demand is for a reduction in the noise incidental to the operation of the cars. A modern appearance is also desired, with comfort while in a smooth riding, well lighted, heated, and ventilated vehicle. The modern car must also have a higher schedule speed than formerly. This requires the ability to maintain a higher speed and a rapid acceleration to hold its place in traffic. With increase in speed it is necessary to increase the braking power adequately so that there shall be no sacrifice of safety.

Economy in construction was an element to be considered, since the purchase of new cars would put a heavy burden upon the financial resources of the companies. Economy was sought by standardizing upon a design suitable for all companies, rather than having each company design its own equipment. By manufacturing a large number of cars, improving methods of manufacture, and using lighter weight material, additional savings were effected. An experimental car was built by the P.C.C. to test out new ideas and to discover desirable changes.

Details of the New Car

The Chicago Surface Lines, one of the leaders in this investigation, placed in service in 1934 two cars, from different manufacturers, which utilized the developments made up to that time by the P.C.C. These cars were in service to the "Century of Progress" and are still operating.

The new cars recently placed in service on the Madison street line contain the very latest developments of the P.C.C. as well as some changes made by the Chicago Surface Lines. There are now about 400 of the standard P.C.C. cars under contract for use in several cities.

The Chicago cars are somewhat longer and wider than the standard and have certain features which better adapt them to use here. The general structure of the body is the same, the trucks, motors and control, and braking features are the same as the standard P.C.C. car. The Chicago car is a single end, front entrance, center and rear exit, for two-man operation. Figure 1 is a view of the "step side" of the car and shows the three front entrance doors and the two center and the one rear exit doors. The overall length is 50′5″, the width 8′9″, and the height from rail to top of car is 10′1⅛″. In appearance it is moderately streamlined, the apron below the floor line adding to this appearance and also hiding the trucks and equipment from view. The car complete, but unloaded, weighs about 35000 lbs., has a free running speed of 42 m.p.h., and a safe maximum speed of 50 m.p.h. Under ordinary service conditions, with eight stops per mile, the schedule speed should exceed 14 m.p.h.

The exterior is painted a Buckingham gray on the lower portion and ivory above. From the rail to the car floor there are three steps of 15″, 8½″ and 8½″ with a 9″ tread. The doors are operated pneumatically and are of the "blinker" type which swing and rotate at the same time, so that no part of the door, whether open or closed, projects beyond the sides of the car. The rear of the car is provided with markers and a stop light which operate from a storage battery.

Figure 2 is an interior view looking toward the rear. It shows the seating arrangement for 58 passengers, the wide aisle, the ample headroom, and the large loading space. The conductor's position is in the center. Passengers enter the front, fill the loading space, and pay their fare as they pass the conductor. They may leave by the center or rear door. The seats are leather covered and provide ample knee space. The register shown is of a new type and records five kinds of payment, with the accompaniment of a musical note and the illumination of the top of the register by a different color for each kind of payment. As one humorist said, it blushed a deep pink upon accepting three cents from a child.

The floor is level and a non-skid type throughout the length of the car. The windows have frames of stainless steel and are easily operated. The interior grills on the windows, the stanchions, the tubular framing of the seats, and in fact all the interior trimmings are of stainless steel. Heating is accomplished by drawing air through ducts, heating it by blowing it through a compartment containing the motor resistors and then venting it to the car interior through grilles just above the floor. The lighting of the car body is by 37 fixtures providing a directed illumination of high intensity. The fixture is designed to prevent any direct light being visible, and all glare is avoided.

The visible mechanism for operating the car consists of two levers which may be raised or lowered by the motorman. One controls the running of the car and the other the braking. In front of him there are a number of small switches which control the lighting, door operation, wind-shield wipers, and various other devices.

The Car Frame

The car bodies are being manufactured and the equipment assembled by the St. Louis Car Co. The "line" method of production is used, which is adopted from automobile assembly methods, and now used for the first time for street cars. Parts and equip-

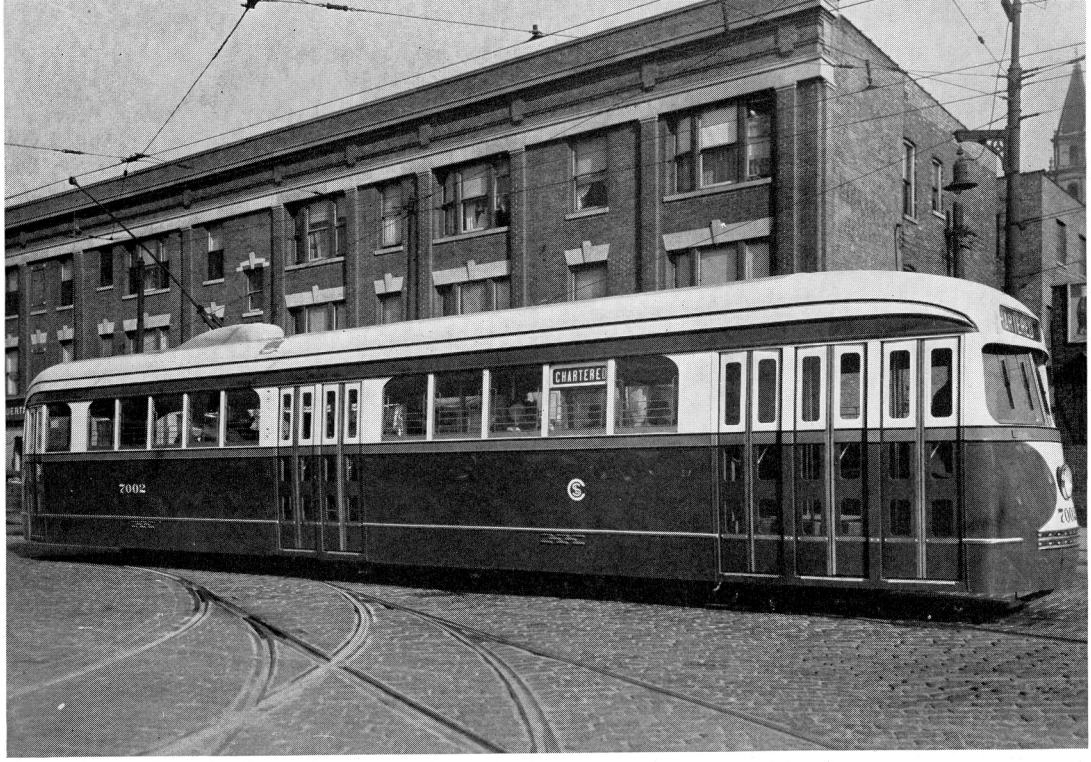

Fig. 1

Step side of the new car.

ment have been furnished by about forty manufacturers, and approximately seventy-five different contract items enter into the car. The frame of the car is of alloy steel, all welded into a single structural unit. Floor plates, side sheets, door and window frames, posts and carlines are all welded and become a part of the structure. Equipment supports and housings are, as far as possible, incorporated into the body framing. Connection between car body and each truck is by means of a single large diameter tube at each body bolster, which projects downward into a well in the truck. (See No. 4 in Fig. 3). These two tubes, or king pins, are the centers around which the trucks move with respect to the car body. This arrangement permits the horizontal forces moving the car to be applied only 11 inches above the rail and improves the riding quality of the car over older ones which have a high point of attachment between body and trucks.

The New Car Truck

The truck is one of the most revolutionary features of the new car. The general requirements were that vibrations and sound produced by the wheel or truck should not be transmitted to the car body, that no part of the truck should so vibrate under operating conditions as to produce an objectionable sound, that the parts should be interchangeable, require a minimum of servicing, and that as much as possible of the car weight should be spring borne. The truck now placed in service was built by the Clark Equipment Co. A view of this truck is shown in Figure 3. The truck frame is two tubular longitudinal members with cross members supporting the motors and other parts. The cross members and side frames are welded together. There are no steel springs—all being of rubber. Eight cylindrical springs are used—one behind and one in front of each journal. (See No. 3 in Fig. 3.) The outer housing of each spring is a part of the journal box casting. The inner part of the spring is a steel tube with its upper end welded to the tubular side frame. Between the inner and outer members of the spring

Fig. 2

Interior view looking toward the rear. . .

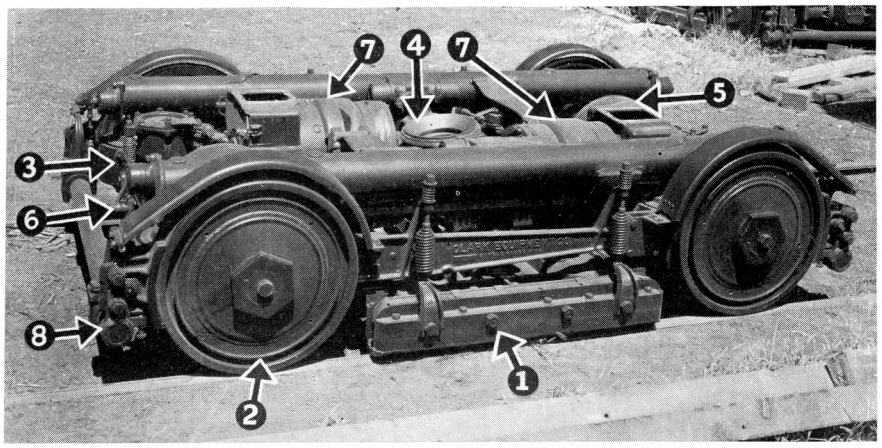

Fig. 3—One of the trucks, showing details.

four concentric cylindrical "sandwiches" are inserted. These sandwiches are rubber between two metal cylinders and vulcanized to the cylinders. The up and down motion between the inner and outer portions of the spring puts the rubber in shear, which produces an excellent cushioning effect. Hydraulic shock absorbers are shown at No. 6 in Fig. 3. These are used to dampen vibrations, and are connected between the ends of the truck side frame and the outer housing of the springs. The wheel is of the disc type, the web being a plate with the rim and flange attached. An inner face plate is welded to a hub pressed on the car axles. Between this inner plate and the web plate a flat "sandwich" is placed, outside of the web plate another sandwich, and then an outer face plate. A compression of 35000 lbs. is used to force the plates together, and finally a nut is put in place to hold the plates in position. (See No. 2 in Fig. 3.)

Operation

The operation of the motors is controlled, so far as the motorman is concerned, by the one control lever at his left hand. The acceleration and speed desired is secured by depressing this lever as required to produce the result. Likewise braking is secured at the desired rate by depressing the brake lever. The action from then on is entirely automatic in both cases. The depression of the control lever operates mechanically on a form of master controller which in turn initiates a sequence of operations in the electrical circuits which control the car motors. The sequence is in general the closing of a line switch energizing the motor circuits, then gradually cutting out resistance which is in series with the motor, and finally shunting the motor fields, such operations speeding up the motor to the desired amount and at the desired rate as fixed by the position of the control lever.

Both the General Electric Co. and the Westinghouse Co. have built equipments for these cars which carry out the above operations. The General Electric Co. has a "motor controller" which utilizes a stationary commutator with a revolving brush arm for cutting out sections of the accelerating resistance which are connected between the commutator segments. This brush arm is driven by a small air engine. The Westinghouse Co. uses an "accelerator" which is a group of contact fingers arranged around its circumference and having a roller arm which depresses the fingers as it rotates, pressing them against a bus bar and thus gradually cutting out the accelerating resistances which are connected between the finger contacts. This device is operated by a "pilot motor." One of these devices has 250 contacts and the other 99, so that no matter how rapid the action may be there is a very small increment of speed at each contact and consequently the acceleration is very smooth. After the car has reached its final speed the motor controller or accelerator remains in the same position during the subsequent running of the car. While the rate of change of acceleration is dependent upon the position of the control lever the maximum rate of acceleration has been fixed at 4.75 miles per hour per second. The rapidity with which the car gains speed is thus dependent upon the position of the control lever, but its final speed is independent of the time taken to reach that speed. The maximum acceleration and maximum speed are secured when the control lever is depressed as far as possible.

Equipment

There are additional items of equipment, such as a motor-generator, storage battery, air compressor, and blower, all of which are grouped with the control mechansm under the floor at the center of the car, and fully protected from dirt and water by covers. All wiring is enclosed in troughs or channels built into the car framing.

There are four 55 h.p. 300 volt high speed motors, which are operated, two permanently in series on the 600 volt line. These motors are mounted on the trucks as shown at No. 7 in Fig. 3 at right angles of the axles. Hypoid gears are used for the first time in street cars. (See No. 5 in Fig. 3.) The gear ratio is 7.17 to 1.00. These gears are a type of spiral bevel gear, and a life of about 750000 miles is claimed for them. (See No. 5 in Fig. 3.) Cooling air for the motors is taken in through an extension on the side of the car body bolster and passed through it by a flexible connection to an opening in the top of the motor case. This air is then blown through the motors by means of the armature fans.

The principal function of the motor-generator set is to supply 32 volt current for operating various control circuits and for dynamic and track braking. It runs continuously while the car is in service. The storage battery nominally floats on the motor-generator line and remains fully charged. The set is a 600 volt motor driving a 40 volt generator. The blower for heating and ventilating is attached to one end of the motor generator shaft. On the other end of the shaft is an air compressor for air brakes and door operation.

When it is desired to slow or stop the car the control lever is raised and the resistance is re-inserted in the motor circuit, thus shutting off the power partially or wholly as desired. The car will then coast. During coasting the motor controller or accelerator does not move to the off position but backward only until its position corresponds to the car speed, so that when it is desired to begin braking the proper resistor value for braking at that speed is set up.

Braking

Stopping the car is brought about by three sets of brakes which are automatically brought into action to an amount depending upon the depression of the brake lever which operates a brake controller. As in starting, the motorman can control the braking only by depressing the brake lever; the farther the lever is depressed the more rapid the braking. As the accelerating control is accomplished by cutting out resistors in series with the motor circuit and by shunting the

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MODERN STREET CARS

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fields, so the braking is brought about by reversing this process, using the same mechanism controlled by the brake controller. The first braking action is dynamic which uses the motors as generators. The motors are disconnected from the line and become generators operated by the kinetic energy of the moving car. The motors are then short - circuited through resistors which absorb the energy, and produce heat. Air blown through these resistors is used to heat the car. The motor (now generator) fields are initially excited by a low voltage battery current, the generator pickup is certain and rapid, and any desired rate of braking can be secured. Because of this battery excitation the braking action is independent of any trolley connection.

The dynamic braking is dependent upon the motion of the car and as this diminishes in speed this method of braking becomes less effective. The second brake system, the magnetic track, then automatically comes into action. This brake system has shoes mounted between the wheels on both sides of both trucks, and all of these shoes are forced down on the rail by electro-magnets which are energized by the 32 volt battery current. (See No. 1 in Fig. 3.) As the car speed diminishes a larger part of the braking action is produced by these track brakes. This brake is also independent of any connection to the trolley wire and is also independent of rail conditions. The third system of braking is the ordinary air. Because of heat generated by friction of the brake shoe on the wheel tread, the air brake is not applicable to the new type of wheel as the rubber inserts insulate the wheel so that the heat cannot be dissipated as in the ordinary car. This brake comes into action only when the car speed has been reduced to about 4 or 5 miles per hour, and the magnetic brake is cut out. The air will also hold the car under brake application when standing. The air brake has four separate cylinders and lever systems, one for each axle. (See No. 8 in Fig. 3.) This does away with heavy and noisy brake rigging. In case of emergency the brake lever is depressed to its limit and this will bring all types of brakes into joint action, irrespective of speed, bringing the car to rest in minimum distance.

The car as it actually operates on the street has been found very quiet. This noiselessness, both inside and out, is probably one of the chief appeals to rider comfort. Attractive

appearance inside and out, comfortable seats, easy entrance and exit, ample lighting, smoothness of starting and stopping, and speed, all make a splendid contribution to the transportation facilities of the city.

STUDENT PERSONNEL

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does not undertake to treat serious illness, but refers the student to his family physician or other competent practitioner. In certain cases, where academic difficulties seem to be the result of physical deficiencies, the counsel of the Medical Advisor is sought in suggesting a remedy to the student.

Placement of Graduates

The final stage of the college personnel program comes with the placement of graduates in permanent positions, and in the proper maintenance of alumni contacts. The Placement Officer, who is also Assistant Registrar, maintains complete employment records for students and alumni, and cooperates with the faculty of each department in assisting graduates to obtain satisfactory employment. Personality ratings for all students are secured from the faculty during the senior year, and this information, together with the academic record and other personnel data already on file, permits a careful analysis of each graduate.

During the past year many more requests for graduates have come to the Institute from industry than it has been possible to satisfy, and since there are often demands for experienced men to fill excellent positions, alumni are urged to see that their experience records in the Placement Office files are always up-to-date. It is especially important for alumni to realize that the services of the Placement Office extend far beyond the securing of positions for those unemployed.

In conclusion, it may be said that the entire personnel program at Armour is designed to foster the individual development of the student. Certain phases of the work now in their early stages will undoubtedly be changed and improved as better methods are developed and experience is accumulated. No attempt is made to remove from the student the responsibility for solving his own problems, but it is believed that the systematic and understanding treatment of contacts outside the classroom will result in a better-rounded education and a fuller personal development for each graduate of the Institute.

MERCURY LAMPS

(From page 12)

1. In every outlet as a complete mercury system.
2. On alternate outlets with Mazda lamps.
3. Combined with Mazda lamps in a common fixture.
4. Supplementary to an existing Mazda lamp system.

When Mercury lamps are combined with Mazda lamps, as indicated by the last three items above, the color quality of lighting will approach daylight conditions. In other words, mercury light is relatively rich in blue rays while incandescent light has a predominance of red rays and when the two sources are combined the resultant light approximates daylight, depending, of course, upon the lumen output of the two types of light.

Equal lumen output of mercury and incandescent provides a fine quality of light from a color standpoint. This may be used for commercial lighting, such as offices and schools. Where greater color correction and an even closer approximation to daylight is desired, incandescent light up to 1½ to 2 times that of mercury should be used.

Unfortunately, Mercury lamps do not fit into the home lighting field at this time. Possibly in the future some type of vapor lighting will be developed for this purpose. To those interested in improving their home lighting conditions, reference is made to newly developed floor and table lamps as approved by the Illuminating Engineering Society. Modern homes are being built with various forms of indirect lighting or, at least, with well balanced illumination throughout a room, whether it be living room, dining room, or kitchen.

After all is said and done, the main requisite of lighting, as far as general welfare is concerned, is for the purpose of seeing, with the possible exception of decorative lighting which is an entirely different phase. The time has come when light must be treated as a product of many grades of quality in much the same way as steel and cloth. A finer technique and deeper appreciation of lighting for the purpose of seeing will be required of our professional lighting experts, so that lighting equipment is properly chosen and installed to serve best the needs of industry.