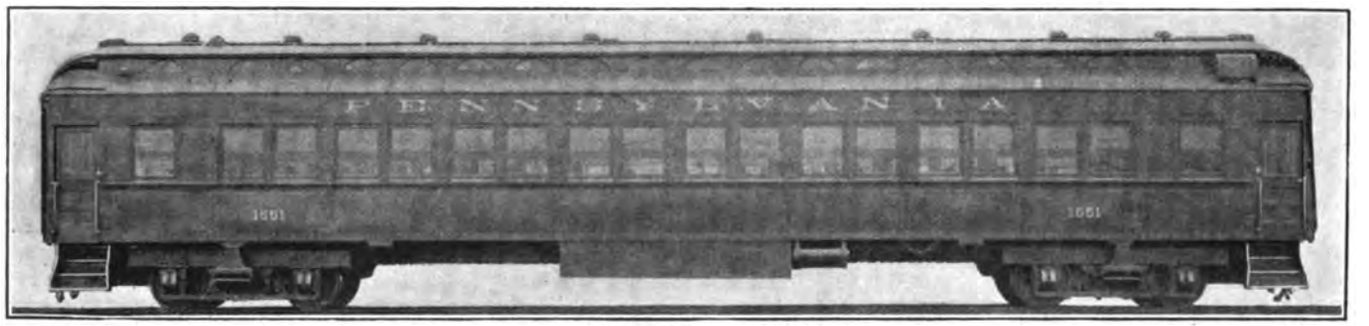


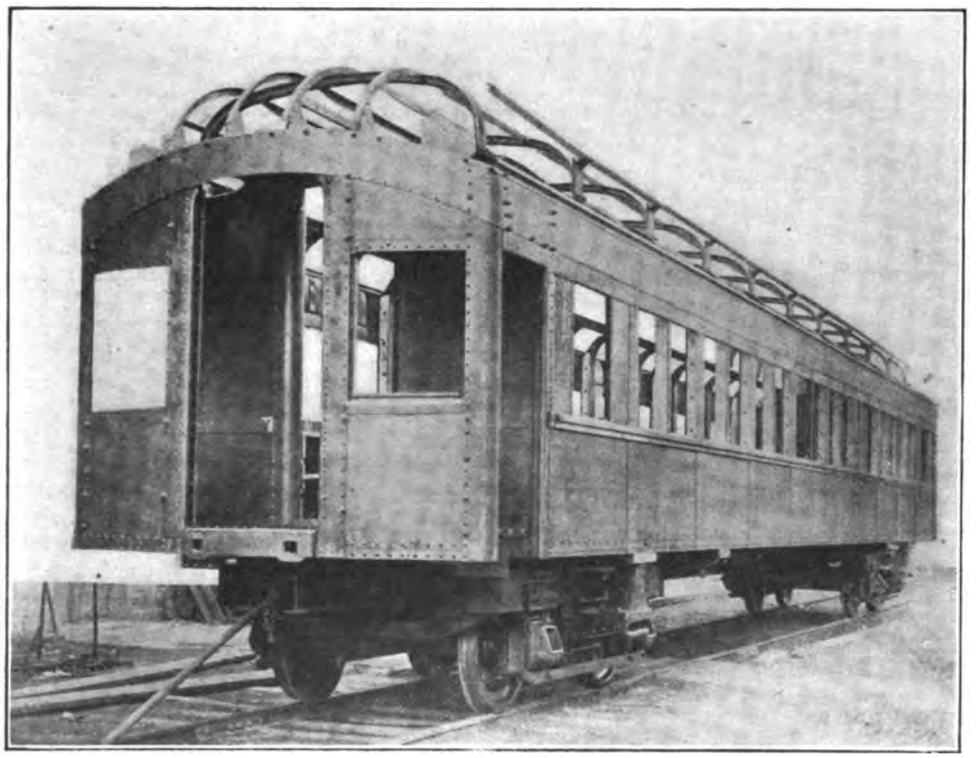
SEVENTY-FOOT STEEL PASSENGER COACH—PENNSYLVANIA RAILROAD.

ALL STEEL PASSENGER SERVICE CARS.

Pennsylvania Railroad.

The introduction of the all-steel car for passenger service on American railroads has been prophesied many times during the past few years and the past month has seen the first real move toward its fulfilment. This refers to the order for 200 passenger cars, placed by the Pennsylvania R. R. with the American Car & Foundry Company, the Pressed Steel Car Company and the Altoona car shops, the general design of which is illustrated herewith.

Our readers are acquainted with what has been done in the line of steel passenger car building in this country and know that several railroads have built cars of this type during the past few years, which have been placed in service and are now being given a practical trial. In addition to these strictly experimental cars there are also in operation comparatively large numbers of all-steel cars built for short haul traffic, such as subway, elevated and suburban work. These cars, while of course a big step in progress, do not present the difficulties in design that a full-sized modern passenger coach for a long haul service gives. Their service, however, and many of them have been in operation for over three years, has of course been of great value, and incidentally a great stimulus, in the design of the larger type, since they have conclusively proved that a steel car can be built which is perfectly satisfactory to both the traveling public and the railways.



VIEW SHOWING STEEL PASSENGER COACH PARTIALLY COMPLETED.

Reasons for Building Steel Cars.

The most important reasons why the construction of all-steel cars for regular service in through trains is desirable is very clearly explained and summed up in an article by Messrs. Barba and Singer in this issue. Briefly these are: the increasingly high price of satisfactory timber, the public demand for fireproof cars and the desire to obtain the full benefit in the way of carrying capacity for the weight of the material in a non-collapsible car.

Action of the Pennsylvania.

These conditions have been recognized for some time by the Pennsylvania Railroad and several experimental steel cars have been built and put into service on its lines. The first of these was a 58-ft. passenger coach designed in 1904, and built in 1906, which has a steel underframe and a steel outside sheathing up to the roof. This car, however, contains about 1,500 lbs. of wood. Following this there was constructed a 60-ft. all-steel baggage car, which was completed last November, and a 70-ft. mail car,* which was finished in February of this year. There was also a car built by the American Car & Foundry Company for the Long Island Railroad,† which was operated over the Pennsylvania Lines for some time.

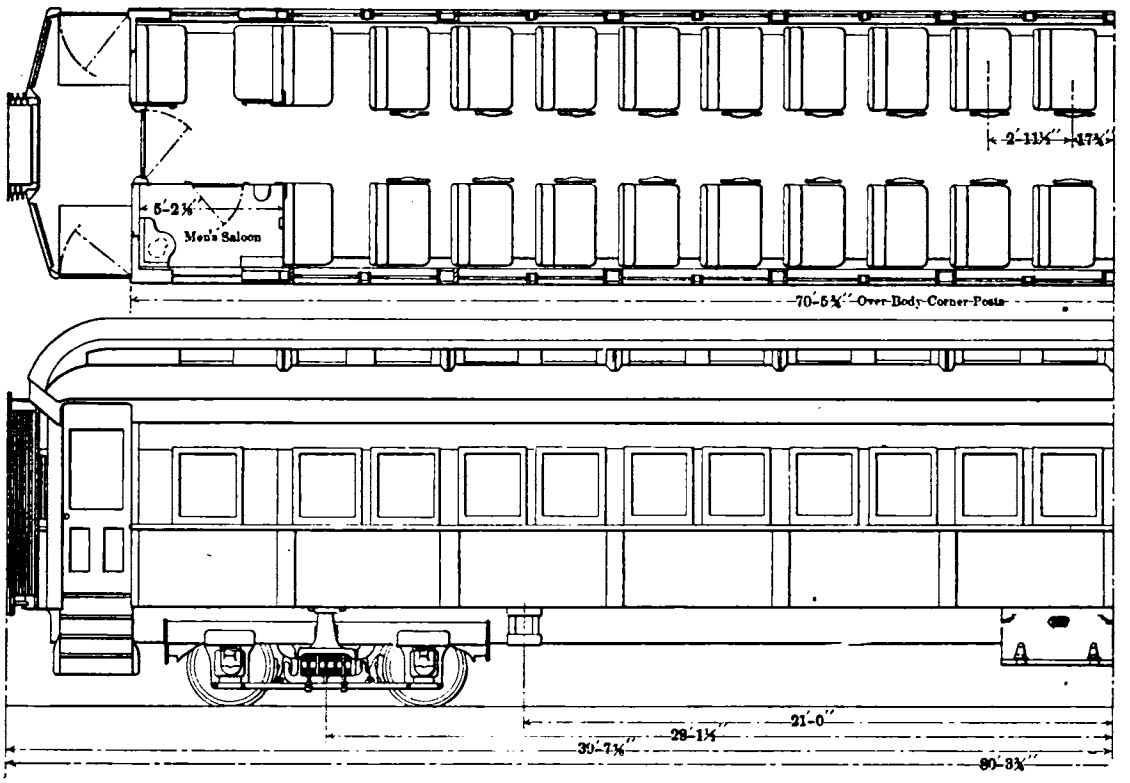
President Cassatt took a very active interest in this work. A committee composed of motive power and other officials of the Pennsylvania Railroad, was appointed to carefully investigate the whole subject, using the experience gained by the operation of these cars over their own lines, as well as of steel passenger cars on other roads, and the much longer and broader experience with steel freight cars, as a basis for recommending a design which should be adopted for a large order of cars. The cars which have now been ordered are of the design recommended by that committee. The recommendations included passenger service cars of all kinds for both through and suburban trains, having the general dimensions shown in the table below.

	Length.	Truck.	Capacity.	Weight.
Passenger coach	70′ 5¼″	4 wheel	88 passengers	113,500 lbs.
Mail car	71′ 4⅛″	6 "	.....	128,000 "
Baggage and express car	60′ 10⅜″	4 "	40,000 lbs.	91,000 "
Special baggage car.....	70′ 0″	6 "	60,000 lbs.	120,000 "
Passenger-baggage	71′ 1″	6 "	.....	130,000 "
Dining	71′ 11¼″	6 "	30 passengers	140,000 "
Suburban car	54′ 4″	4 "	70 passengers	75,000 "

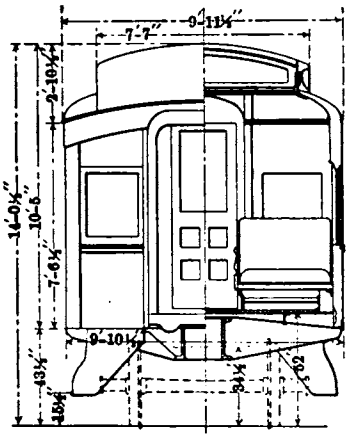
General Principles of Design.

All of these cars are based on the same general principles, which in brief are: that the car shall be absolutely fireproof;

* See American Engineer and Railroad Journal, April, 1907, p. 136.
† See American Engineer and Railroad Journal, Feb., 1907, p. 41.



PLAN AND ELEVATION OF SEVENTY-FOOT STEEL PASSENGER COACH.



that it shall be capable of withstanding, without any deformation or yielding, end shocks up to 400,000 lbs.; that the structure shall be such that the car body can be rolled down an embankment without collapsing; that the end structure shall be of sufficient strength to prevent one car sweeping the superstructure from another, and that the finished car shall be as light as the above conditions will permit.

In designing the framing for the cars there is offered a choice of two general types, one of which carries the whole load of the car and its lading by means of a heavy center sill, which is of sufficient strength in itself to resist very large buffing loads. The other is one in which the sides of the car beneath the windows form plate girders and carry a larger part of the load, the center sills being comparatively light. The Pennsylvania Railroad had in operation at that time a sample of both types of cars, the former being the one built at its own shops and the latter the Long Island car mentioned above.

Careful calculations were made by the committee which indicated that when the loads due to pulling and buffing are less than 100,000 lbs. the weight and cost of the car frame of either type will be practically the same. When, however, these strains exceed that figure the framing for the type where the sides carry the load increases considerably in weight, while for the center sill type the loads, due to pulling and buffing, may reach a value of 400,000 lbs. without any material increase in weight. In view of the primary requirements mentioned above these calculations led the committee to recommend the center sill type for cars used in through train service and a modification of that design for the suburban type, the modification being necessary to allow sufficient room for motors between the underframe and track.

DESIGN ADOPTED.

The design of framing finally adopted is one in which the weight of the car body is carried by the center sills at four points, two of which are near the ends of the sills and two between the trucks, the latter being located at points approximately the same distance from the center plates as the end loads. Reference to Fig. 1 will show the effect on the center sills of this method of carrying the loads, the shaded portions representing the live load and such part of the car as is supported directly on the center sills and the four arrow points the loads transferred to the sills by the end sills and cross bearers. The sill is supported by the trucks at the two points as shown. An inspection of the exaggerated deflection line will illustrate that the four points of support will be deflected practically the same amount and that therefore they will always be in line one with the other and no stress is placed upon the superstructure of the car by the deflection of the center sill. With this form of construction the sides of the car can be made comparatively light, as they have to carry but little transverse load and are supported at four points, and they can be designed principally to resist collapse in case of a corner blow or overturning. The fact that the side doors required by mail, express or baggage

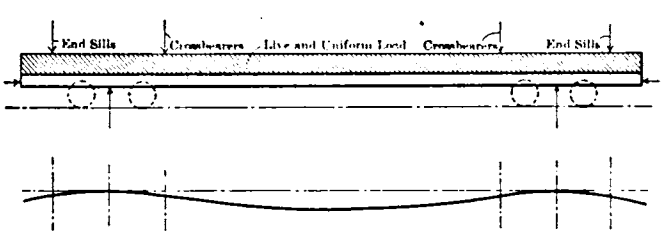
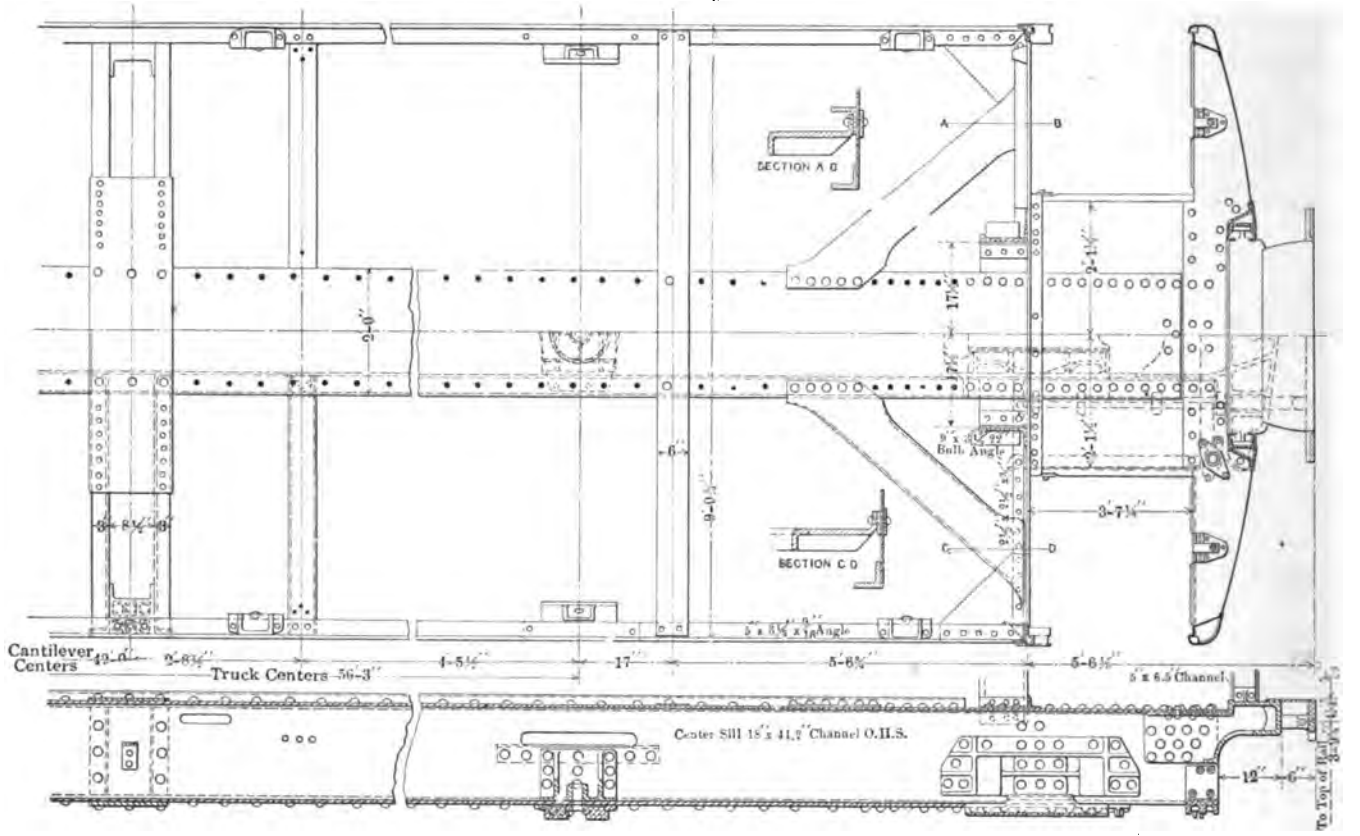


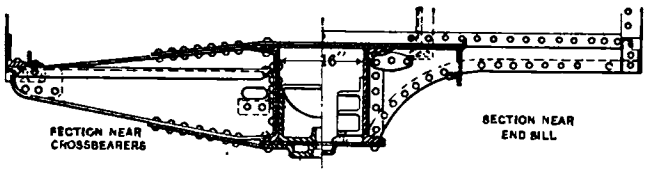
FIG. 1.

cars can be located where most convenient without requiring any material strengthening in the sides is also an important advantage.

In designing a center sill to fulfil these conditions it will be seen that it is possible to obtain practically equal fiber stresses



PLAN AND SECTIONS OF UNDERFRAME—STEEL PASSENGER COACH.



at the center of the sill and over the center plates, thereby giving a sill of uniform section throughout. At the same time a sill of sufficient depth to carry the load in this way permits the draw bar to be placed between the sills so that its stresses are transmitted directly to them instead of through auxiliary draft sills secured below. This eliminates a very serious bending movement at the end of the sills.

Through Service Passenger Coach.

In its general interior arrangement and appearance this car is almost an exact copy of the standard wooden passenger coach. It seats 88 passengers, has two large saloons in diagonally opposite corners and is estimated to weigh 113,500 lbs.

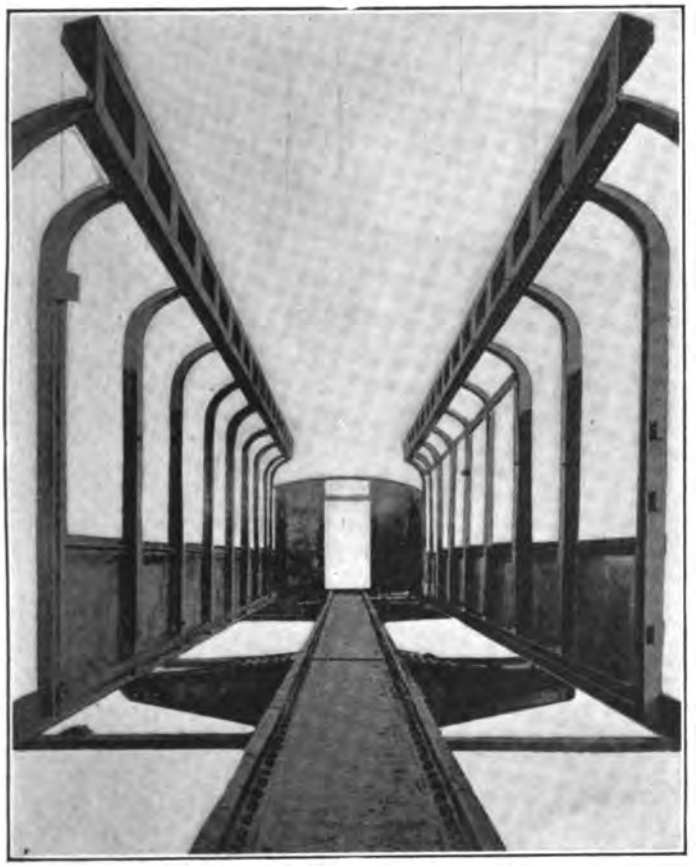
The Underframe follows the principles mentioned above and comprises two 18-in., 42.2-lb., channels set 16 in. apart and having ½ x 24-in. cover plates, top and bottom. These sills extend continuously from platform sill to platform sill. The weight of the superstructure is transferred to them by the body end sills, which are about 7 ft. from the truck center bearing, and by the cross bearers about 7 ft. 3½ in. inside of the center bearing. The distance between the cross bearers is 42 ft. The end sills are of the cantilever type, riveted to the center sills and built up of a web plate which is an extension of the end sheathing, and angles, top and bottom. The load is transferred to them partially by the corner posts and largely by the door posts. The cross bearers, which carry practically all of their load at the outer end, are also of cantilever form, being built up of two dished plates riveted to the center sills, set 8½ in. apart and having heavy top and bottom cover plates passing continuously above and below the center sill and riveted to the outstanding flanges of the web plates. These cover plates, however, extend only to a point about half way between the center and side sills. A malleable iron casting is fitted between the web plates at their outer end where the connection to the side sill is made. The side sills are of 5 x 3½ x 9/16-in. angles and are supported only at the end sills and cross bearers on top of which they rest. A series of nine struts composed of 5-in. channels are spaced between the side sills and center sills, being riveted to each and act as transverse stiffeners. The use of bolsters is not necessary in this design and the center plates are riveted directly to the bottom of the center sills, which are reinforced at this point by a steel casting secured inside. The side bearings are fastened directly to the side sills in line with the center plate. The connection between the side and end sills is stiffened by a gusset plate, as is shown, and two diagonal pressed steel shapes are fitted between the center sills and the outer end of the end sills, these being designed to resist the effect of a blow on the corner of the car and also to stiffen the structure of the underframe and keep it square. Projecting beyond the ends of the center sills are steel castings of special design, shown in the illustration, which act as a backing and support for the buffer plates.

The Main Side Posts are of pressed steel and are spaced 5 ft. 11 in. centers. They are of channel section and the edges are flanged out and riveted to the inside sheathing, thus forming a box section. They are securely riveted to the side sills at the lower end and the upper sections are tapered down and bent inward, forming lower deck carlines. At the upper end they are secured to the deck sill which is formed by a steel plate pressed into the shape shown in the illustration of the framing. It forms a continuous beam running the entire length of the superstructure.

Between the main posts are shorter intermediate posts, which extend only from the belt rail to the deck sill. They are of light channel section with edges flanged for riveting to the outside sheathing, forming a box section.

The Upper Deck Carlines are of sheet steel pressed to channel section with edges flanged out for riveting to the 3/32-in. steel roof sheet. The ends of the carlines are riveted to the combination deck sill and plate, to which the edge of the roof sheets are also riveted. Malleable iron posts of special design, located at the junction of each carline, act as stiffeners to the web of the sill and plate.

The Outside Body Sheathing is of ⅛-in. steel and the course below the belt rail is riveted to the outside sill and to



VIEW OF STEEL FRAMING.

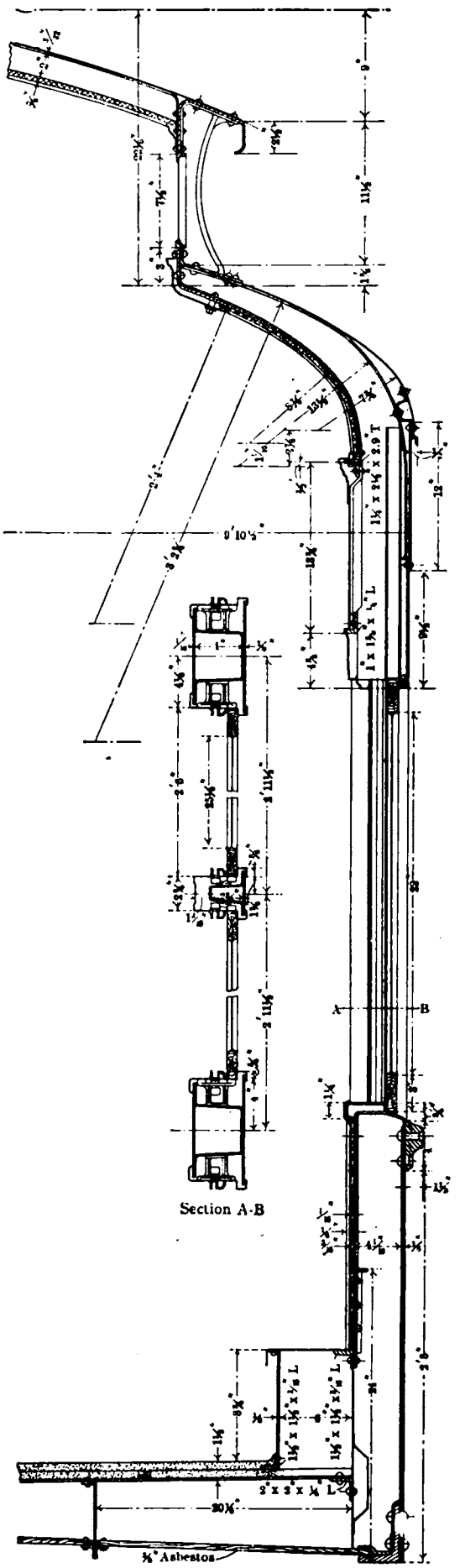
each post. The joints are butted and fitted with a cover plate. The steel shape forming the window water table laps over the side sheathing and under the belt rail. The outside sheathing above the windows is riveted vertically to the posts and its upper edge is secured to a channel shaped steel section forming the eaves for the lower deck and extending the entire length of the superstructure.

THE HEADLINING for the upper and lower decks is of composite board secured to the carlines and posts with metal strips. Below the belt rail the inside sheathing is of 1/16-in. steel, to the unexposed face of which 3/16-in. asbestos board is cemented. The bulkheads and remaining parts of the inside lining are of 1/16-in. sheet steel. Mouldings, closely resembling those used in wooden construction, are pressed from steel and their use adds greatly to the artistic appearance of the interior. By care in design it has been possible to almost wholly eliminate machine screws from the construction, and it is believed that economy in both construction and maintenance has been secured thereby.

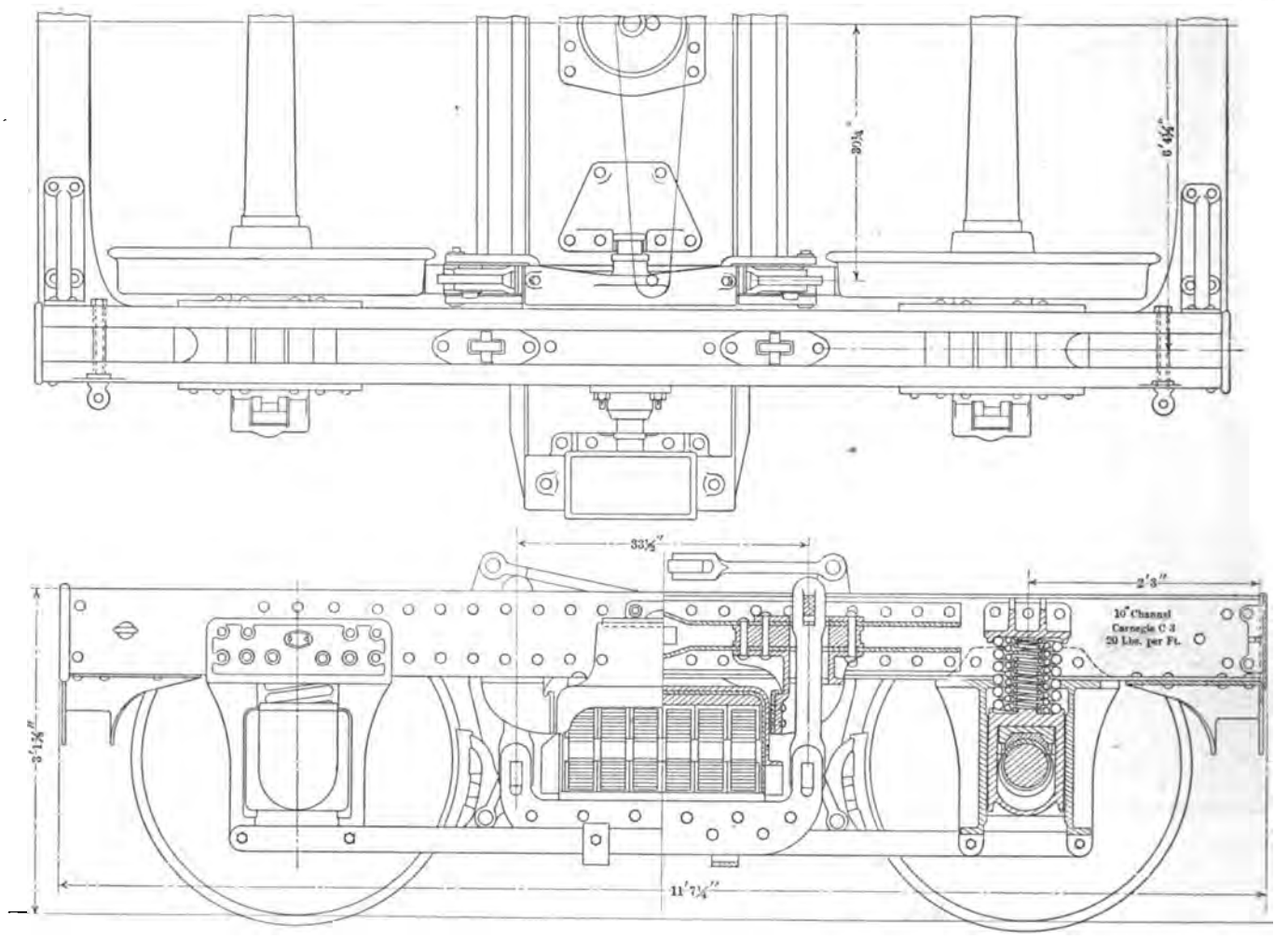
THE WINDOW SASHES are of wood and slide in pressed steel frames, which are supported and secured by malleable castings riveted to the posts. These castings are machined by jig, after being riveted in place, so that the frames will be true and parallel regardless of any slight irregularity in location of the posts. Window stops, which also form ways for the curtains, are of extruded bronze. The deck sash are of malleable iron.

THE FLOOR is formed by corrugated steel plates which are supported by the center sill and upon the longitudinal angles secured to the side posts. These corrugated plates are covered to a maximum depth of 1½ in. with a plastic surface filling, composed largely of cement. A sub-floor of asbestos board ⅛ in. thick supported by No. 20 galvanized sheet steel is secured to the center and outside sills. Along each side of the car just above the floor, rectangular ventilating ducts are provided, which enclose the heating pipes.

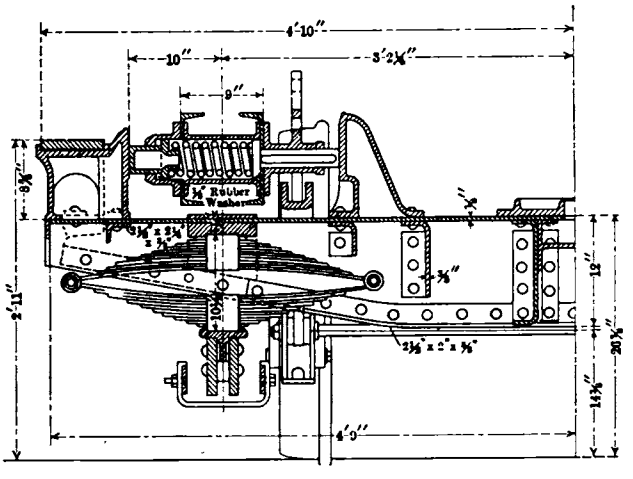
THE VESTIBULE.—Sufficient strength in the end of the car to prevent the superstructure from being swept from the underframe by the next car in event of a collision has been given careful attention. The center sill is the main support of the

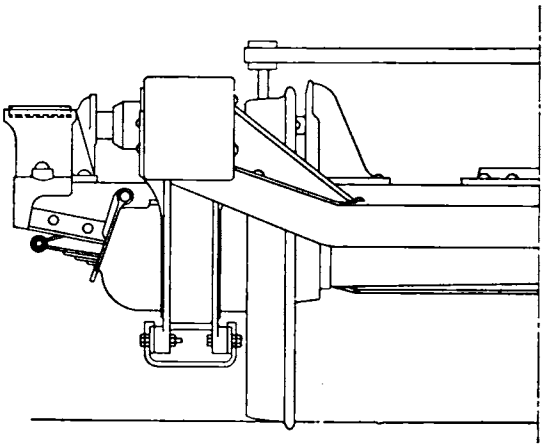


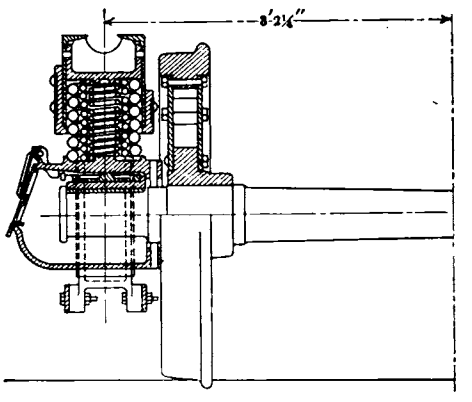
SECTIONAL ELEVATION THROUGH SIDE OF STEEL PASSENGER COACH—PENNSYLVANIA RAILROAD.



FOUR-WHEEL TRUCK—PENNSYLVANIA STEEL PASSENGER COACH.







entire vestibule and to it are securely fastened the 9-in. bulb angles forming the door posts. These, together with the 5-in. channels forming the vestibule posts, form the vertical members which are relied upon to prevent damage to the superstructure during collision. The vestibule floor plate, the end sills and sheathing, and the vertical bulb angles, are securely framed together to give an exceptionally strong foundation for the entire end construction.

Vertical corner angles uniting with the sides and an angle across the top secured to the vestibule ceiling form the support for the end sheathing. Two diagonal braces running from the eaves down to the floor and securely riveted to the sheathing give additional stiffness to the ends.

The end of the vestibule is supported by two outside posts of pressed sheet steel together with two channel posts forming a doorway. The base is formed by a pressed steel platform end sill, and the top support is given by the vestibule ceiling plate.

Door jambs and lintels are of pressed steel closely imitating the forms used in wooden construction and are provided with cast diaphragms at intervals to prevent collapse and furnish support for attaching hinges, railings, etc.

The end construction of the roof is of formed steel plates reinforced by angles secured to the end carline and the vestibule ceiling.

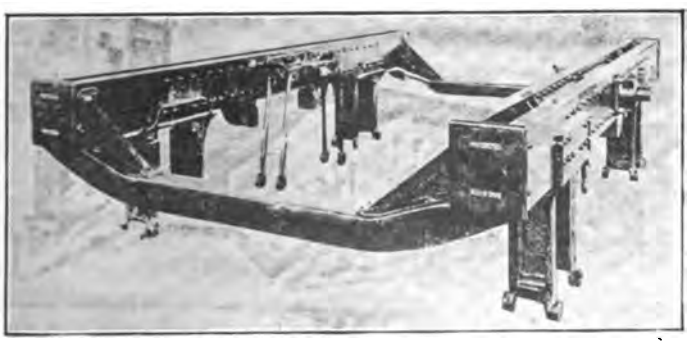
HEATING AND VENTILATING.—The passenger coaches will be equipped with a ventilating system by which, with all windows and doors closed, each passenger will be supplied with 1,000 cubic feet of fresh air per hour, which is equivalent to a complete change of air in the car every four minutes. The air is taken in by two hoods situated on diagonally opposite corners of the car roof. From each hood a vertical duct leads down, within the side of the car, to the horizontal duct which runs the entire length of the car, between the floor and the sub-floor next to the side sill. Above the floor of the car, and running its entire length along the sides, are the rectangular ducts, mentioned above, which contain the steam heating pipes. After circulating about the heating pipes and becoming thoroughly warmed the air is delivered into the aisles of the car through tubular outlets beneath each seat. It is discharged from the car through ventilators in the roof, which are provided with

BOLSTER—FOUR-WHEEL STEEL TRUCK.

valves. The movement of the car forces the air into it under slight pressure and by limiting the discharge this pressure is maintained and the entrance of cold air through cracks about the doors and windows is prevented. This system works equally well in either winter or summer. The warming of so much fresh air, however, requires considerably more steam than would be needed by the usual methods of heating without much, if any, ventilation.

TRUCKS.—An entirely new form of truck is required for these cars owing to the fact that the very deep center sills lower the center bearing plate to a point where it just clears the axle of the 36-in. wheel, having a 5 x 9-in. journal. As will be seen from the table above, both the six-wheel and four-wheel type of truck are required on different cars. The four-wheel truck is the one used on the passenger coach and will be considered first.

This truck is of steel throughout and weighs but 12,500 lbs.



TRUCK FRAME—FOUR-WHEEL STEEL TRUCK.

The ordinary wooden truck of the same capacity would weigh 16,000 lbs. The most noticeable feature of the general design is the elimination of the usual equalizers and the adaptation of the wheel pieces for this purpose. The wheel pieces consist of two 10-in. channels with the flanges turned inward and set 9 in. apart, outside measurement. The two channels are spaced and secured together at several points by filling pieces and supports for hangers and springs. The wheel pieces are connected by two cross bars, one at either end, each formed of steel pressed in channel shape. These are depressed in the center in order to clear the center sill. They are secured to the bottom of the wheel pieces and further stiffness is obtained by a malleable iron knee between the wheel piece and the cross bar.

The weight from the center plate is transferred to a bolster, built up of pressed steel shapes and angles in channel section. It has a depth of 12 in. at the center and is 26 in. in width. This bolster extends some distance beyond the wheel pieces and is supported by twelve elliptical springs, six at either end, which in turn are carried on a cast steel base hung by links from the wheel piece. The casting which forms the bearing and filling piece at the connection of the hangers to the wheel pieces is extended downward and forms a stop and guide for the bolster on either side. A spring centering device, the arrangement of which is clearly shown in one of the illustrations, has been incorporated.

The pedestals are secured to the wheel piece in the ordinary manner and are connected at the bottom by two tie rods, sufficient space being given the rods to permit the use of the jack on the bottom of the journal box. The weight is transferred from the wheel pieces to the journal boxes through nests of coiled springs resting on top of the boxes and extending up between the two channels, the lower flanges of which are cut out at this point, to a cast steel spring cap.

The side bearings are incorporated in the casting forming the outer stop of the spring centering device, which is connected on the extreme end of the bolster and comes directly below the side sill of the car.

In the brake rigging the principle of an independent set of duplex brakes for each side has been carried out and brake beams have been entirely dispensed with by directly suspending the brake-heads from hangers attached to the wheel piece.

The six-wheel truck, postal, baggage and suburban cars will be considered in our next issue.

WRITING FOR TECHNICAL JOURNALS.

The easiest way to find how little you know about a particular subject or thing is to endeavor to write about it. Unqualifiedly, I believe this to be true. How many of us have started to describe some little thing only to discover that at some point we must do a little investigating before we could go ahead! In description of principle or fact we must get the successive steps in their proper sequence and true relation if our ideas are to be conveyed logically to the reader or before they will "sound right" to us when we read them. So I believe that whether our subject be a chicken-coop or a 10,000-horse-power plant we know more about it after we have described it than we did before; our ideas are clearer, more logically formed. This is no new principle; it is applied in every school and college to-day and why is it not as applicable here?

But the greatest benefit derived is that of the interest stimulated by writing. If we get into the habit of describing things about the shop our interest grows, our knowledge broadens. If our story about a special chuck is published we inadvertently feel a pride in it, and want to see what the other fellows are saying and so we read more and our interest broadens.

Someone's description of a milling fixture may have helped you out of a hole; so you want to give other readers anything you have "up your sleeve" in return. And so you gradually obtain the power of *seeing* things, not just *looking* at them.

Every foreman, no matter how large or small his shop, has done something that is worth telling about. How much better it would be for him if he would not stop at developing the idea but would write it up for publication and in so doing stamp its principles upon his mind and at the same time develop his receptive powers and become on the alert for someone else's ideas that he can apply to his own work.—*"Egypt" in the American Machinist.*