

small branch lines; they are hauled by a light engine, or are propelled by an engine secured to the same framing as the carriage. Such a carriage is variously referred to as an *auto-car*, a *railway motor-car*, or a *motor train*; the names are not strictly correct in their application, but in default of a more comprehensive and convenient term they are in common use.

**Classification of Workmen.**—During the course of its construction a railway carriage passes through the hands of men engaged in six different branches of the trade. The *bodymaker* constructs the outside, or shell, of the body, together with the roof and partitions. His work is allied to that of a carpenter, but he uses a larger variety of tools and works on harder and more expensive kinds of wood. The *underframe maker* is responsible for making and fitting together the frame on which the body is supported, and also for attaching all the metal fittings to that part of the structure. The *coach joiner* or *finisher* deals with the windows, glass frames, and all the inside work such as mouldings, panels, and fittings; this work requires the skill of the joiner and cabinetmaker combined. The *coachsmith* makes the body plates, corner irons, iron roof supports, brake gear, and other details of a similar character. *Coach trimmers*, or *upholsterers* as they are sometimes called, make the seat cushions and the back rests, the latter being known in the trade as *squabs*. The trimmers also cover the floors with linoleum. The carriage finally passes through the hands of the *painters*, who do all the painting, decorating, and varnishing.

#### TYPICAL RAILWAY CARRIAGE

**Features of Design.**—The general construction of a six-wheeled third-class carriage is illustrated in Fig. 1, in which (*a*) is a side elevation and (*b*) is a plan showing the interior of the compartments. The extreme overall length of the body is 30 feet, and the wooden underframe *a* is 1 inch shorter; this allows the body to overhang  $\frac{1}{2}$  inch at each end, and thus conceals the joint between the body and the underframe. The width of the body of any vehicle, whether for road or rail, is measured across the waist rails; in the present case the width is 8 feet. The greatest

width of the doorways *b* is 2 feet 2 inches ; allowing  $\frac{1}{2}$  inch on each side for the door checks, the distance between the edges of the seats *c* is therefore 1 inch less, or 2 feet 1 inch. The height of the doorways, from the bottom side to the cant-rail, is 6 feet.

There are five compartments, separated by partitions *d*, which are constructed of deal. The body framing may be either English ash, oak, or teak, while the outside panels *e* and the

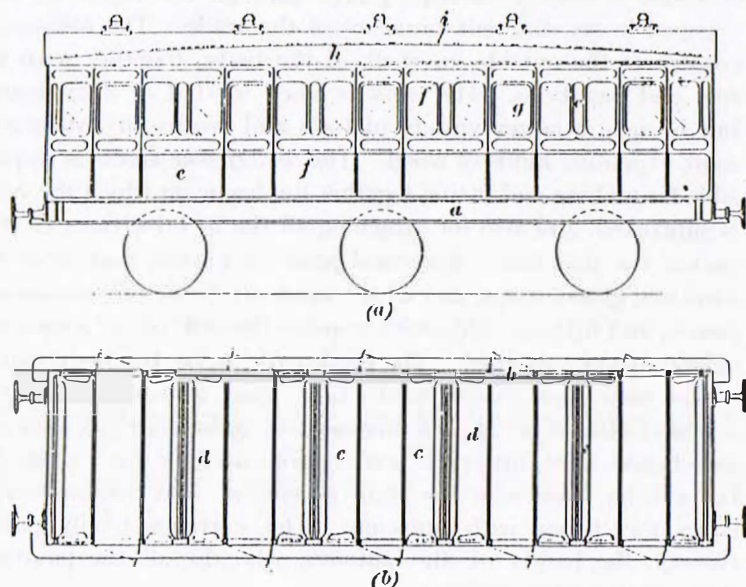


FIG. 1

fascias *f* are made of Honduras mahogany ; the latter wood is also used for the lock-rails, ventilator slides, and mouldings, all of which are inside the door. The door lights or window frames *g* are made of teak, and may be either varnished or polished. The roof *h* is supported by hoop sticks or by channel irons, and is covered with canvas or moleskin, on which the *weather strips i* are screwed down.

**Bottom Framing.**—The usual method of framing the bottom of an ordinary railway carriage is shown in Fig. 2, which is a plan of one end of the bottom framing. The side bars *a* are mortised to receive the tenons of the end bars *b* and cross-bars *c*, while the

longitudinals *d* are tenoned to fit into the end bars. Both the longitudinals and the cross-bars are lapped where they cross one

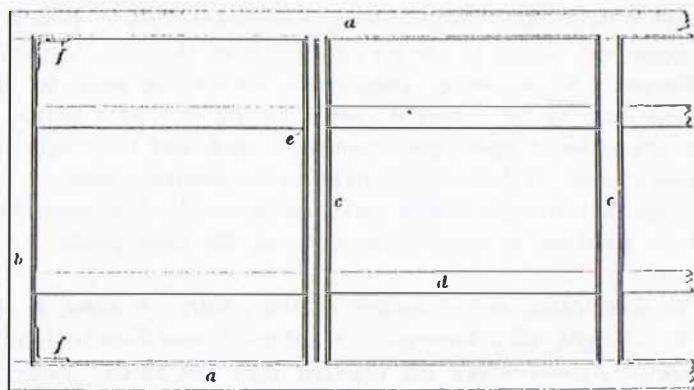


FIG. 2

another, as at *e*. The ends of the bottom framing are further strengthened by fitting iron *knee plates* *f* into each corner; these are generally fastened with coach screws.

An elevation of the side framing of a carriage is given in Fig. 3, illustrating a typical method of construction. The bottom sides *a* are mortised to receive the tenoned ends of the corner

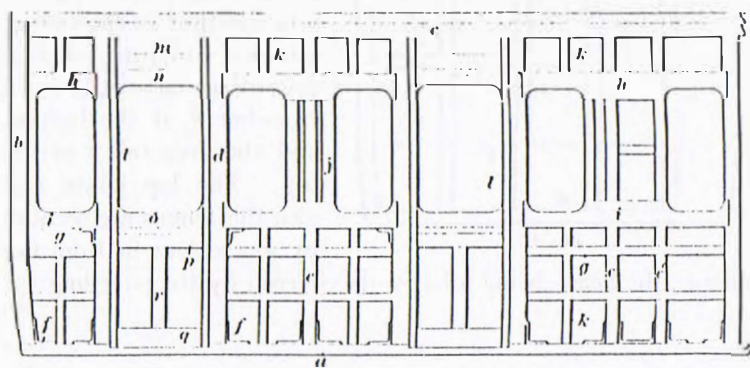


FIG. 3

pillars *b*, which in turn are mortised to receive the ends of the cant-rails *c*. The door standing pillars *d* and partition pillars *e* are tenoned at both ends; also, when a first-class compartment

adjoins a third-class compartment, additional upright pillars *e'* are employed, owing to the greater length of the first-class compartments. All standing pillars are further secured to the bottom framing by means of angle plates, or corner plates, *f*. The *bells* or waist rails *g* are tenoned at each end to fit into the standing pillars, and are lapped to fit on the partition pillars. The top- and bottom-light rails *h* and *i* are secured in the same way, and are mortised to receive the ends of the light pillars *j* and battens *k*.

The door frames are composed of the pillars, or *stiles*, *l*, top rail *m*, top-light rail *n*, fence rail *o*, waist rail *p*, and door bottom *q*; all these cross-members are tenoned into the stiles. There is also a batten *r* to support the panelling.

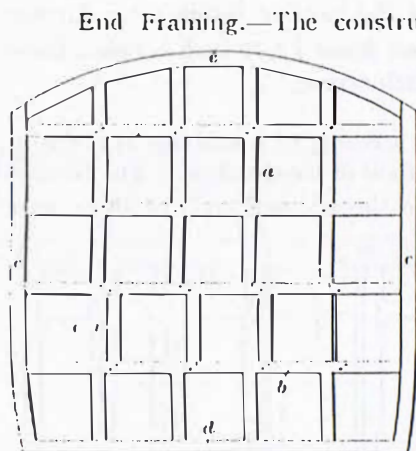


FIG. 4

End Framing.—The construction of the end framing is shown in elevation in Fig. 4. The pillars *a* and the rails *b* are lapped where they cross one another; all these members are tenoned at each end. The rails fit into mortises in the corner pillars *c*, while the pillars *a* are fitted into the end cross-bar *d* at the bottom and the arch rail *e* at the top. The lap joints and also the tenons are secured by screws put in from the

outside, the heads being afterwards covered by the panelling.

#### CONSTRUCTIONAL DETAILS

Setting Out the Framing.—When all the timber required for the framing has been planed to the required size the various parts are taken to the *marking-off bench*, where the different mortises, tenons, rabbets, and grooves are marked on them ready for machining. The pillars and battens that are shaped to form the turn-under of the body, and which cannot be worked on the planing machine, are usually finished off to a template on a spindle machine. A rod equal to the full length of the body

is required for marking off the cant-rails and bottom sides, and on this rod are marked the exact positions of the different mortises and tenons that form the joints with the uprights and cross-members. Templates are used for marking off all the other parts of the framing, thus ensuring correct spacing and alinement of the different parts when they are fitted together.

**Flooring.**—There are three different ways of constructing the flooring of a railway carriage; these are illustrated in Fig. 5 (a), (b), and (c). Each of these views is a cross-section through the frame and flooring, showing the sides *a* and the longitudinals *b*. In the floor (a) there is a rabbet *c* in the top edge of the framing only, to receive the boards, which are usually  $1\frac{1}{4}$  inches thick and are laid across the frame. This is known as a *single floor* and is chiefly used for luggage vans and brake vans and also for guards' compartments. Deal boards are generally used, laid transversely and tongued and grooved together. In

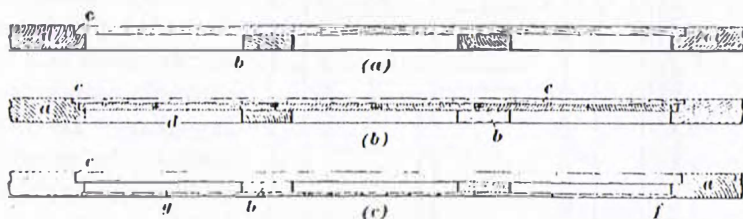


FIG. 5

the *double-boarded floor* (b), two rabbets are formed in the top of the framing, as shown at *c*. The first layer *d* of the flooring is laid with the joints running longitudinally, and the second layer *e* is laid at right angles to the first, with the grain running across the frame.

What is known as a *double floor* is shown at (c), in which the frame is rabbeted on both top and bottom at *e* and *f*; this form of floor is always used in the best class of work. The bottom boards are about  $\frac{5}{8}$  inch thick and are laid diagonally between the cross-bars, the direction of the boards being reversed in each section; the boards thus act as struts and add greatly to the strength of the framing. The top boards are  $\frac{7}{8}$  inch thick; these are placed across the frame and rest in wider rabbets than the bottom boards in order to gain more support. The space *g* between the boards is filled with some substance that is a non-conductor of sound, such as felt or sawdust. All these flooring boards are tongued and grooved.

**Carriage Doors.**—Full details of the construction of a railway-carriage door are shown in Fig. 17 (*a*), (*b*), and (*c*). The front view (*a*) shows the right-hand half of the door in framing, and the left-hand half as it appears when finished. View (*b*) is

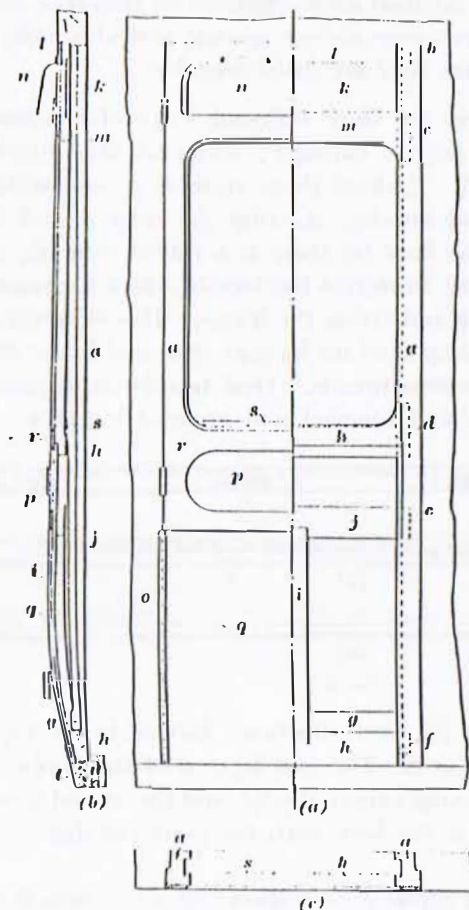


FIG. 17

a vertical section through the door, and (*c*) is a section taken across the opening for the light. These doors are from 2 feet 2 inches to 2 feet 6 inches wide, and are usually made by a separate group of workmen. The doors are fitted into the doorways afterwards, and in this respect the practice differs from that employed in making the doors of a road vehicle, such as a brougham. In other respects the details of construction are almost identical; hence, only a general description will be necessary in the present case. The cross-members are stub-tenoned into the stiles *a* in the manner shown in dotted lines at *b*, *c*, *d*, *e*, and *f*, and are secured

with flat-headed screws driven in from the outsides of the pillars.

The glass rest *g*, which prevents the glass frame from dropping too low, is screwed to the door bottom *h*, two small rubber cushions being fitted on the top edge of this rest to prevent



damage to the glass frame when it is dropped. The batten *i* is lapped on the waist rail *j* and on the door bottom. The space *k* between the top rail *l* and the top-light rail *m* is covered with a ventilator *n*, made of either zinc or tin. Edge plates *o* are fitted on each edge of the door, from the waist rail to the bottom, to cover the joint and keep the panelling to the shape of the turn-under of the body.

The panelling consists of a small waist panel *p* and a large bottom panel *q*, the joints being covered with a fascia *r*. The brass fence plate *s* projects about  $\frac{1}{2}$  inch above the edge of the fence rail, and a similar plate on the bottom of the glass frame passes over the fence plate and rests on the fence rail when the frame is up and the window closed. Two or three  $\frac{1}{2}$ -inch holes should be bored up through the door bottom to allow water to escape. When the door is closed the bottom edge fits into a rabbet *t* in the bottom side *u*, a metal plate, called a door tread, being screwed into the rabbet to prevent the wear that would otherwise take place due to persons getting in and out.

**Door Locks.** The locks that are fitted to the doors of railway carriages vary considerably in design. Some are simple slam locks, while in others the catch is moved in or out by turning the handle. In Fig. 18 is shown a combination lock that is used by some railway companies. The catch *a* is connected directly to the handle *b*, and works like a budget lock. The slam catch *c* is kept out by means of a spring, but can be drawn back by a slight extra movement of the handle when the catch *a* is clear of the catch plate. A small budget lock is also fitted about half-way between the waist rail and the top of the door; this lock has no handle and is for the use of railway officials only, being opened with a private key.

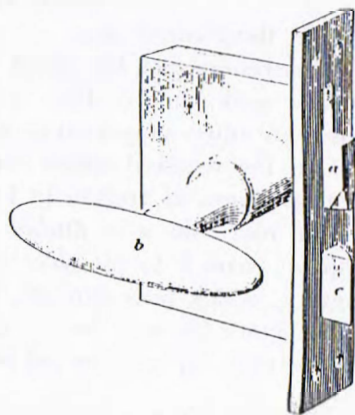


FIG. 18

**Types of Roofs.** In Fig. 22 (*a*), (*b*), and (*c*) are shown three different types of roofs for railway carriages. The circular

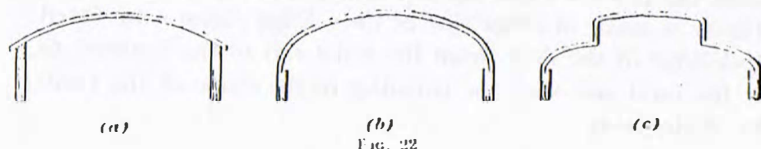


FIG. 22

roof (*a*) is adopted chiefly for ordinary third-class carriages, for guards' vans, and for all covered vans intended for goods traffic. The radius of this type of roof is usually 7 feet, and the roof boards are supported by wooden arch rails and hoop sticks. A more widely used type is the elliptical roof (*b*), in which the roof boards are generally supported by light channel-iron bars bent to the required shape. The method of securing the roof boards is shown in Fig. 23, in which *a* is a sectional view of the channel bar, the channel or groove of which is filled with a strip of wood *b*. The roof boards *c* are held down by screws *d*, which are driven from the inside of the carriage and pass through holes in the channel iron.

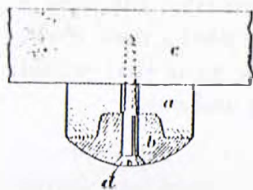


FIG. 23

The clerestory roof, Fig. 22 (*c*), is generally adopted in high-class carriage work, and in this case the roof boards are often supported by flat iron bars bent to the required shape and set up on edge, as shown in section in Fig. 24. The bar or roof iron *a* is *flitched* by securing strips of wood *b* to the sides by means of screws *c*, which pass through holes drilled in the iron; the roof boards *d* are secured to these strips by screws *e* put in from the outside.

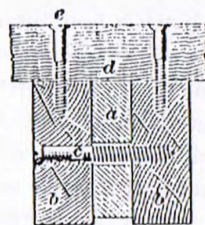


FIG. 24

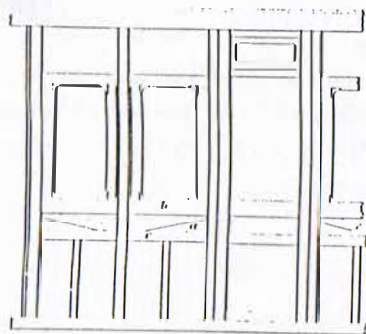


FIG. 25

#### TRUSSED CAR- RIAGE FRAMING

**Trussing Rec-  
tangular Frames.** The principal objec-  
tion to the rectan-  
gular method of  
framing railway  
carriages is that  
there is only the  
good fit of the

joints to prevent the framing from being racked, or strained,