PULLMAN CARS.

IN the year 1859 Mr. Pullman constructed the first of the cars which have since made the name of Pullman world-famed, and this car was placed in service on the Chicago and Alton Railway, a line extending from Chicago to St. Louis, some 280 miles in length. Previous to this time sleeping cars had been in use, to a limited extent, upon several American railways, but they were for the most part crude in their arrangements, and ill adapted for meeting the requirements of fatiguing journeys. The introduction of the new carriage, so superior in all its arrangements to anything previously in use, met with much favour from the railway public, and was followed almost immediately by the construction of others embodying still greater attractions, and in 1864 so general had become their popularity that the present "Pullman Palace Car Company" was organised. This company has since prosecuted the business of providing "sleeping," "drawing-room," and "dining" cars with such success that at this time their cars are in general use upon every important line in America, the company's contracts embracing over 30,000 miles of railway, and necessitating the use of over 800 cars. The great advantages which these cars and their system of operation afforded to travellers had, in very many instances, attracted the favourable attention of English tourists in America, but it was not until 1873 that any effort was made towards their introduction upon European lines.

Just previously to that time, however, Mr. James Allport, the able general manager of the Midland Company, having had occasion during a visit to the United States to perform a journey of some 6000 miles in a Pullman car, was so favourably impressed with the merits of the system that he determined upon introducing the cars upon the Midland Company's lines. The first train has now been in operation upon that railway about ten months, and the cars composing it form the subject of the illustrations we this week publish. Following the example of the Midland, the Alta Italia and other companies forming the railway system of Italy, have contracted with the Pullman Company for the immediate introduction of the cars there.

When rather more than a year ago we gave (*vide* page 162 of our seventeenth volume) a general account of the Pullman cars then just placed upon the Midland Railway, the regular running of these cars had not even commenced, and varied opinions were held as to the manner in which these vehicles were likely to be regarded by the travelling public. A train made up wholly of carriages constructed on the double-bogie system, and including Pullman "drawing-room" and "sleeping" cars, has now, however, as we have said, been running regularly between London and Bradford for ten months, and the results have been so satisfactory that the Midland Company are now largely extending their stock of double-bogie carriages, and on the 1st a service of such carriages was commenced between London and Liverpool. Altogether the Midland Company have now 68 double-bogie carriages either on their line or in course of construction, and of these 36 are real Pullman cars, 25 being drawing-room cars and 11 sleeping cars. The remainder of the double-bogie stock includes first and third class carriages.

It is not our intention in the present article to enter into any discussion of the relative advantages and disadvantages of rolling stock constructed on the ordinary and the double-bogie or American system; but we propose to describe in some detail two of the principal types of Pullman car introduced upon the Midland Railway, namely, a drawing-room car specially intended for day service, and a sleeping car. Of each of these cars we this week give a two-page engraving, while we also give on pages 264 and 265, views of various constructive details. In external dimensions and general construction the two cars illustrated are identical, the difference consisting in the internal arrangements. Each car is 58 ft. long over end platforms, or 51 ft. 6 in. long over the body, while the width is 9 ft. over mouldings, or 8 ft. 9 in. outside the body proper, the width inside being 8 ft. 2 in., and the height inside at the centre 8 ft. 6½ in. The width of the cars on the Midland Railway is, we may mention, considerably less than that of the Pullman cars in use in the United States, on lines of the same gauge. Each car is mounted on two four-wheeled trucks placed at a distance of 39 ft. apart from centre to centre, and each having a wheel base of 6 ft.

The general arrangement of the body framing will be best understood by reference to the right-hand half of Fig. 1 on each of our two-page sheets, and to Figs. 1, 2, 3, and 4, on page 265. From the latter views it will be seen that the floor framing consists of four longitudinal timbers besides the sole-bars; these longitudinals and the sole-bars being connected at short intervals by transverse timbers, and resistance to oblique strains being given by a double flooring, the planking of which is laid diagonally. The sole-bars are strengthened by truss-rods as shown, and at four points between the bogie centres there are also transverse bearers stiffened by double truss-rods as shown in the views just mentioned. The side framing of the bodies is shown by Figs. 1 of our two-page engravings. From these it will be seen that between the bogie centres the sole bars are strengthened not only by the truss-rods already mentioned, but also by diagonal timbers and straining beams, which form a regular truss beneath the windows. Besides this, a tie-rod or counter-brace extends along each side under the windows, this tie-rod bearing upon cast-iron struts, fixed on the sole bars in a line with the bogie centres, and then extending obliquely down through the soles so as to give support to the ends of the carriage, and keep all parts of the trussed framing well up to their work. It will be seen from what we have said that the floor combined with the trussed sole bars and body framing beneath the windows, really constitutes a kind of girder of ⊢ section, and constitutes a structure possessing great powers of resistance to either compressive or transverse strains.

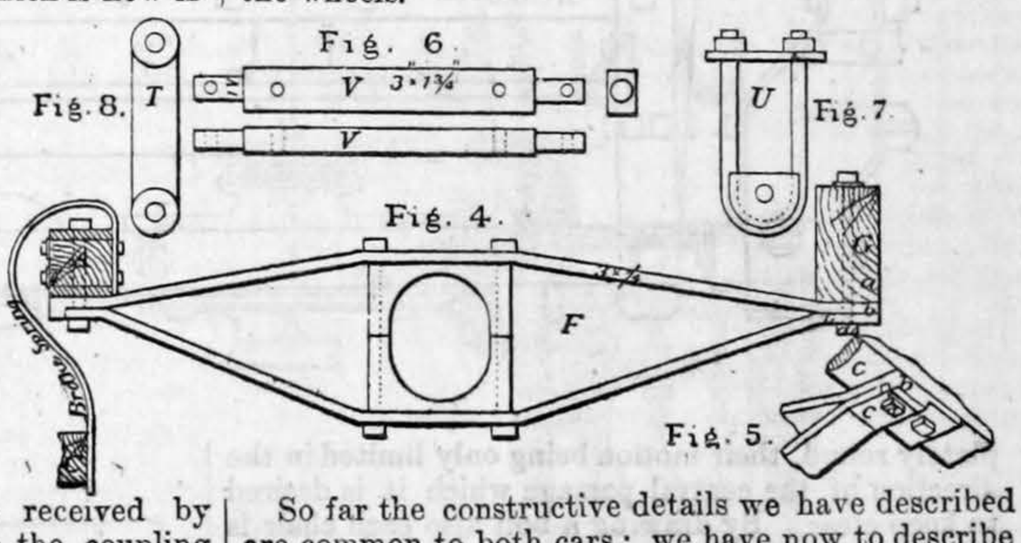
The upper part of the body framing consists of vertical pillars of apparently light section, a number of these pillars being, however, strengthened by wrought-iron rods, extending through them from top to bottom as shown by dotted lines in Fig. 1 on our two-page engraving of the sleeping cars. An appearance of great lightness is thus obtained without a sacrifice of strength. The roof is so formed, as shown in the transverse section, that the central portion of each car is considerably higher than the rest, and to avoid the necessity of carrying roof sticks across this raised part, T-iron is largely used in the roof framing, the T-iron roof sticks following the contour of the roof. Altogether the detail of the framing of the Pullman cars affords abundant evidence of the care with which it has been worked out. The construction of such long vehicles so as to secure strength and rigidity without incurring excessive weight is by no means an easy task, and the successful issue now arrived at represents the results of many years practical experience.

The cars are fitted with central buffers and couplings, the end platforms and the couplings being arranged on Miller's system, a system which is now in extended use in the United States. The Miller coupling was illustrated and described by us in detail on page 272 of our second volume, but we may nevertheless point out its special features here. In the case of the ordinary American combined central buffer and coupling, any compressive strain imparted to the buffers is transmitted indirectly to the framing, and moreover, as the coupling is effected by links, there is a certain amount of slack between the cars. In the Miller arrangement, on the other hand, the compressive strains are received by central buffers placed directly above the coupling hooks, these buffers transmitting the strain direct to the framing. The coupling hooks are formed on the ends of bars of cruciform section, connected to draw springs fixed to the two central longitudinal timbers of the floor framing, the connexion being such, that the outer end of the hook is free to move horizontally to a small extent, although its tendency is to remain in a central position. The ends of the hooks are so formed that when two cars are brought together the hooks at first push each aside, until the cars having come sufficiently close the hooks engage each other, the operation of coupling being thus automatic. When the cars are coupled the buffers are somewhat compressed so that there is no slack. To uncouple the cars one of the hooks is drawn aside by a hand lever provided for the purpose, and connected to the hook bar by a chain as shown by Figs. 4 of our two-page engravings. By pulling these levers over into a notch, the hooks can, if desired, be kept from engaging with each other when the cars are brought together.

In the case of the cars on the Midland line it was necessary to provide for their being in some instances coupled up with stock having the ordinary side buffers, and to meet these conditions the arrangement shown by the detail figures on page 265, has been designed. A reference to the views there given will at once show that the side buffers P and central drawhook K can at any time be very readily removed, the latter being replaced by the Miller buffer, while the Miller hook can be connected to the spring specially provided for it. The alteration of the car from the side to the central buffing system or *vice versâ* is thus an operation requiring a few minutes only. More recently another arrangement of side buffers, &c., for the Pullman cars has been designed, which possesses some special advantages, and of which we hope to give particulars at an early date.

The construction of the trucks or bogies on which the cars are mounted is so clearly shown by the detail views on page 264, that but very little description will be necessary. The trucks are, as will be seen, four-wheeled, but in the United States it is preferred to use six-wheeled trucks on the Pullman cars, and such trucks are stated to ride more easily than those with four wheels. The wheels of the Midland carriages are larger than those used in America, they being 3 ft. 6 in. in diameter. With the exception of one set they are all wooden disc wheels of the Mansell pattern, the exception being a set of Allen's paper disc wheels, of which we shall give engravings in an early number.

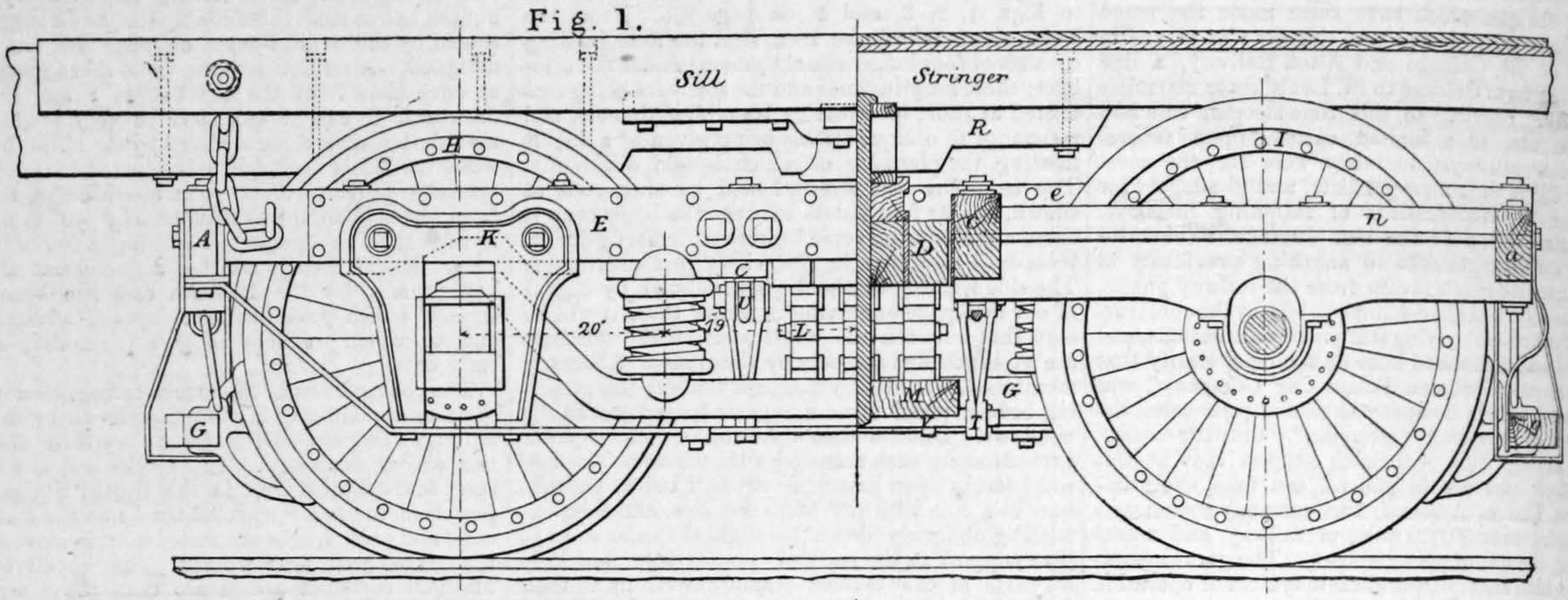
As will be seen from the views on page 264, the bolster body is connected to the truck by a centre pin, and takes its bearing partly on the plates surrounding this pin and partly on the side rubbing pieces J. The weight of the body is thus transferred to the beam D, between which and the swing beam M, are interposed the bearing springs L, *l*, there being three of these springs on each side. The beams D and M, together with the springs, are free to swing laterally, the beam M taking its bearing on the pins V, which connect the lower ends of the links T on each side. By the links T the the swing beam is suspended from the side frames E, and these, in their turn, bear upon spiral springs which are interposed between their under sides and bent bars, the ends of which rest upon the axle-boxes. The load is thus transmitted to the axles through two series of springs. The reference letters affixed to the various parts in the different views on page 264 and to the detailed Figs. 4 to 8 annexed, will enable the whole arrangement to be readily traced out. The cars we should add are fitted with the Westinghouse air brake, the brake blocks, which are of cast iron, being applied to all the wheels.



So far the constructive details we have described are common to both cars; we have now to describe the internal arrangements and we shall commence with the cars for day service. Referring to Figs. 2 and 3 of our two-page engraving of the drawing-room car it will be seen that the body is divided into a main saloon 30 ft. long, two private compartments each 6 ft. long, and some smaller compartments forming lavatories, &c. Commencing at the end shown on the left of our engraving, we find access to the interior of the car is afforded by a central door opening to a short passage provided with another door at its inner end. On one side of this passage is the gentlemen's and on the other the ladies' lavatory. From the passage access is gained to the main saloon which in the car shown by our engraving contains nineteen chairs. In the cars now running on the Midland line, however, the number of seats in the saloon has been reduced to seventeen, the chairs being spaced wider apart than shown by our engraving. The chairs are of very comfortable shape and are each mounted on a central standard so that they can be turned almost com-

DETAILS OF PULLMAN CARS FOR THE MIDLAND RAILWAY.

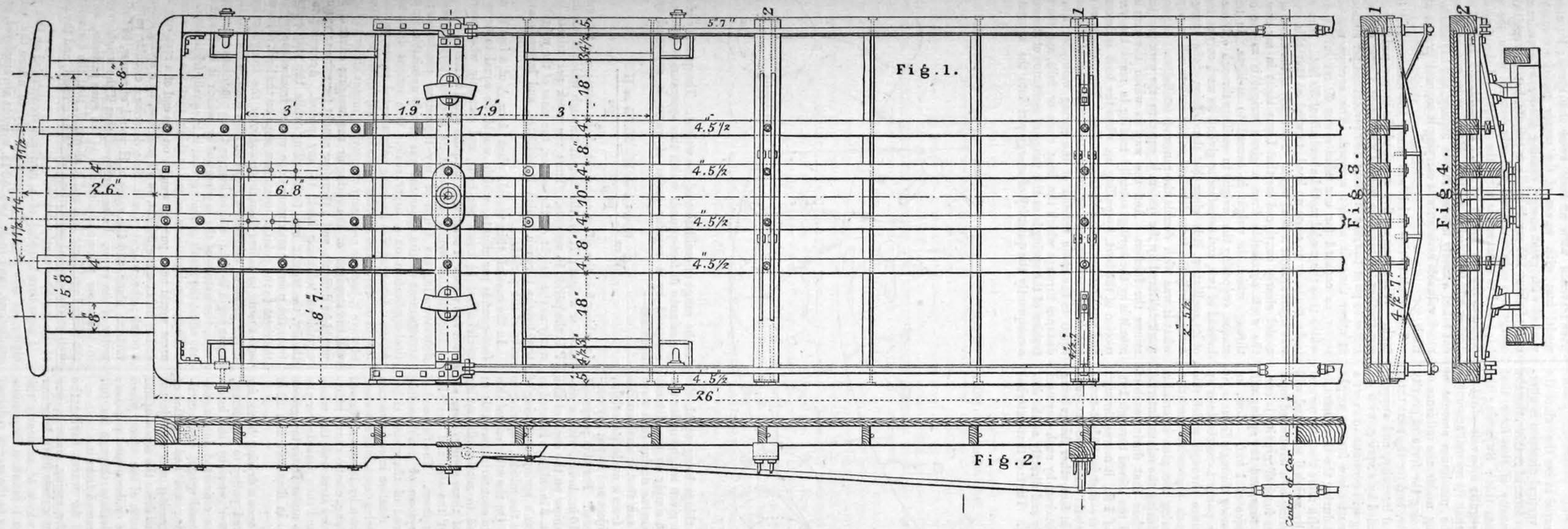
Fig. 1.



pletely round, their motion being only limited in the direction of the central passage which it is desired to keep clear. By drawing a bolt also each chair is left free to be canted backwards into the position shown by one of the chairs in Fig. 2.

From the end of the main saloon a passage leads along one side of the carriage past the two private compartments already mentioned, doors opening from the passage giving access to these compartments, each of which contains a seat or sofa and two chairs similar to those in the main saloon. Beyond the private compartment is a sort of lobby, having on one side a small compartment containing the heating apparatus and on the other a store closet. A door from this lobby opens to the end platform. In the internal fittings of these drawing-room cars no expense has been spared to add to the comfort of the passengers. The seats, which are very comfortable, are upholstered with Utrecht velvet, the floor is well carpeted, and the car is well lighted by handsome lamps, arranged as shown in our engravings. The lining panels are of American walnut relieved by gilt chamfers, which contrast well with the colour of the wood. The windows are large and well fitted, and provided with blinds made of a peculiar material finished off with stamped

DETAILS OF PULLMAN CARS FOR THE MIDLAND RAILWAY.



leather. These blinds are mounted on rollers fitted with a very neat little contrivance for holding them in any position, and which, unlike such contrivances in general, does not seem likely to get out of order. It consists simply of an elliptical cam fixed to the roller, and pressed upon by a spring, the result being that at two points in each revolution the roller tends to stick. The material of the blinds is sufficiently rigid to impart motion to the roller and move it past the sticking points when the blind is pushed up.

Nothing about the cars probably will contribute more to the comfort of passengers than the arrangements for warming and ventilation. The warming is effected by hot water pipes led off from one of Baker's patent warming apparatus contained in the small compartment already mentioned. This apparatus, which is shown more clearly in Fig. 2 of our two-page engraving of the sleeping car, consists of a small heating furnace or stove containing a coil of piping. The water heated in this coil passes up to a tank on the roof, and from this it is led off through the pipes which traverse the carriage, a return pipe bringing it back when cooled to the heating coil. The water thus circulates constantly, while the small tank on the roof serves to contain a reserve supply which will make up any slight losses due to evaporation or leakage. The heating pipes pass along the sides of the carriage below the windows.

The ventilation is provided for by the windows, by openings at the sides of the raised portion of the roof, and by air inlets in the under sides of the hoods which protect the end platforms. These air inlets, as well as the other roof openings, are protected by fine wire gauze, so as to avoid severe draught and prevent the entrance of dust and cinders.

With the exception of the lamps, and the hat rail brackets, which are bronzed, the metal work within the car, such as the door handles, &c., is almost all nickle plated. The water for the lavatories is contained in tanks beneath the basins, a small pump beside each basin rasing the water as required. This arrangement is adopted to avoid the employment of roof tanks, which are difficult to fill. Each lavatory also contains a special cistern containing a supply of drinking water.

We have now to describe the arrangements of the sleeping car, and for that purpose we refer to our other two-page engraving published this week. Commencing at the left-hand end in our engravings we find, as shown by Fig. 3, access given by a central door opening to the end platform, to a passage 5 ft. long, a gentleman's lavatory being situated on one side of this passage and a water-closet and linen closet on the other. At the inner end of the passage is another door opening to the main compartment which is 25 ft. 9 in. long inside, and which is traversed by a central aisle from end to end. On each side of this aisle are, during the day, four pairs of seats with a table between the seats of each pair. For night service the tables are removed, and each pair of opposite seats converted into a bed, while a second bed is formed above them. In Fig. 2 three of the pairs of seats are shown as they appear during the day, while the other pair is represented arranged to afford sleeping accommodation. To form the bed the seats are drawn out, and the backs then fall down and fill up the spaces left by the withdrawal of the seats. A mattress is then placed over the seats, and in this way a very comfort-

able bed is obtained. The arrangement of the upper tier of beds will be understood on reference to Fig. 5. During the day the shelves containing these beds are folded up obliquely against the roof of the carriage as shown on the right-hand side of the figure just mentioned, whilst, when required for use, they are drawn down, as shown on the left-hand side. The beds are balanced by connecting the shelves by a chain to a coiled spring, the spring being coiled up as the bed is pulled down and *vice versâ*. They can thus be pulled down and pushed up very easily. When down they are at such a height above the floor that passengers can, if they desire it, still occupy the seats beneath them. These seats, we may add, are each of sufficient length to accommodate two passengers, and the beds are nominally double beds. They are, however, rarely occupied by more than one passenger each. The mattress and bed linen for the lower bed is, during the daytime, stowed away upon the upper one, while a box below the seats receives the pillows, as shown on the right-hand side of Fig. 5.

At the end of the main compartment is another linen closet, while beyond are two private compartments entered from a passage which runs along one side of the car. Between these compartments is a third linen closet, as shown. Each of the private compartments just mentioned contains a couch—which can be drawn forward at night so as to form a comfortable double bed—an upper berth, and two seats, which are also convertible into a bed. Beyond the private compartment is a lobby having on one side a ladies' lavatory, and on the other a small compartment containing the heating apparatus. A door opening from this lobby gives access to the corresponding end platform.

As in the drawing-room car, the seats, &c., are upholstered with Utrecht velvet, and all the internal woodwork is of American walnut relieved by gilt chamfers. The workmanship of all the internal fittings—and indeed of the carriages throughout—is excellent. The arrangements for lighting, warming, and ventilation, are similar to those provided in the case of the drawing-room cars, while throughout the fittings are to be noticed almost numberless little "dodges" for preventing noise and rattle, and adding to the comfort of the passengers.

Just, however, as no hotel would long continue to attract customers if its sole claim for consideration rested in its being a handsome and well-furnished building, so the Pullman cars would not have attained their present popularity in the United States, had their sole recommendation consisted in their commodiousness and the luxurious character of their fittings. There is in reality something more than this. The Pullman cars are attended by well-trained servants, and it is the thoroughness with which they are looked after, and the scrupulous cleanliness of all the arrangements, which perhaps more than anything else has gained them their high reputation. The Pullman Company thoroughly appreciate the value of appearances and of attention to small comforts, and they not only provide bed-linen, &c., which is the best of its kind, but they maintain in their cars what—for want of a better term—we may describe as an almost military neatness which is unquestionably taking. As regards the smooth running of the cars, we have already spoken of it in high terms. Whether or not the Pullman cars will become as universally popular here as they are in the United States is a matter which can only be determined by time and experience, as it is always a difficult thing to say what will or not take the popular taste, and in railway travelling our social habits will have much influence on the amount of favour with which these vehicles will be received. However this may be, there can be no doubt about the comfort of the cars themselves, and the English travelling public are, we consider, indebted to the Midland Railway Company for enabling to test for themselves the qualifications of the Pullman cars.

WAVE MOTORS.

*On a Method of obtaining Motive Power from Wave Motion.**

By B. Tower.

I propose to lay before you to-night the results of an experimental and theoretical inquiry into the possibility of obtaining motive power from the motion of a ship in waves, for the purpose of actuating machinery on board.

This inquiry originated in the proposals of Mr. Spencer Deverell, of Portland, Australia, whose brother, Mr. W. Deverell, showed his confidence in his scheme by coming home from the antipodes for the purpose of promulgating it.

* Read before the Institution of Naval Architects.

PULLMAN SLEEPING CAR FOR THE MIDLAND RAILWAY.

PULLMAN DRAWING-ROOM CA FOR THE MIDLAND RAILWAY.

Fig. 1.

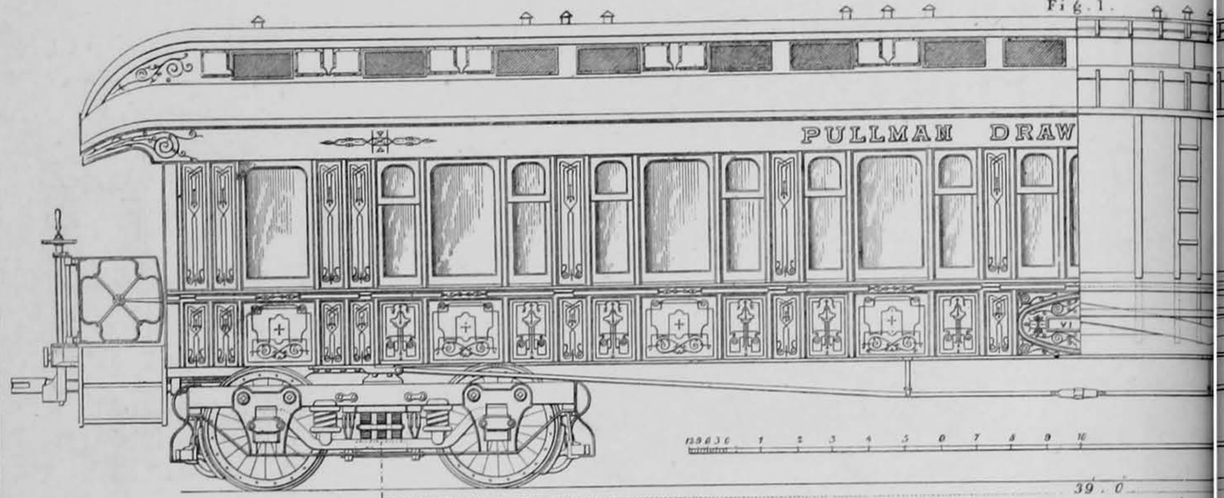


Fig. 2.

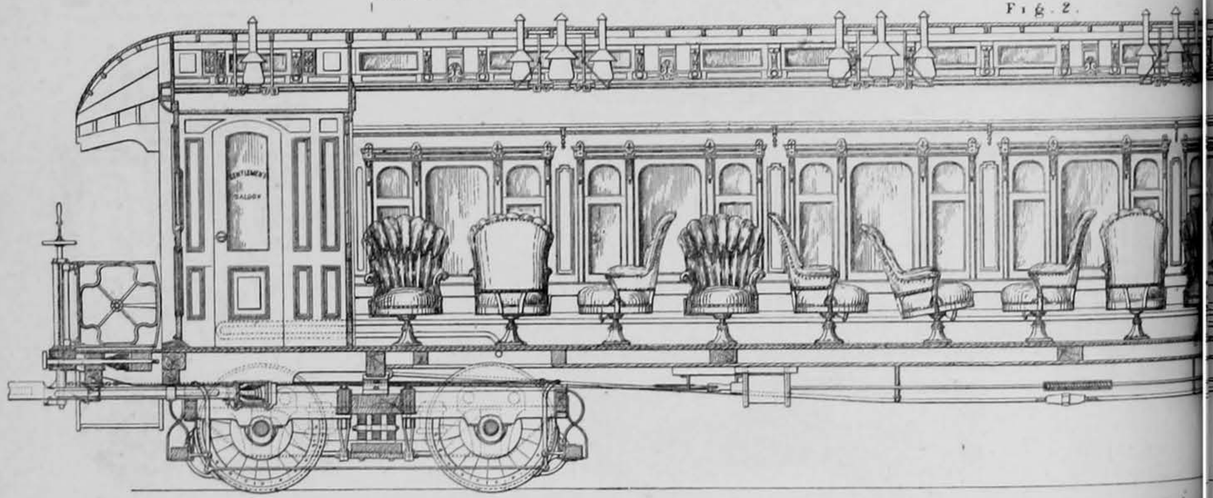
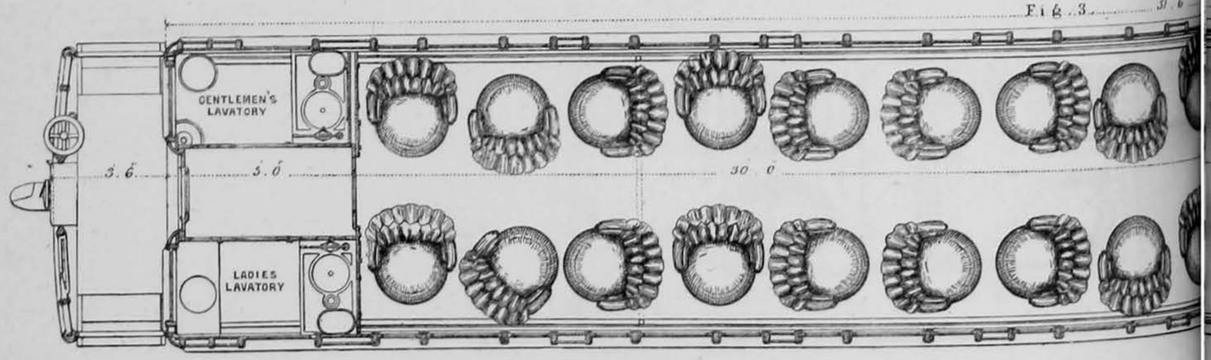
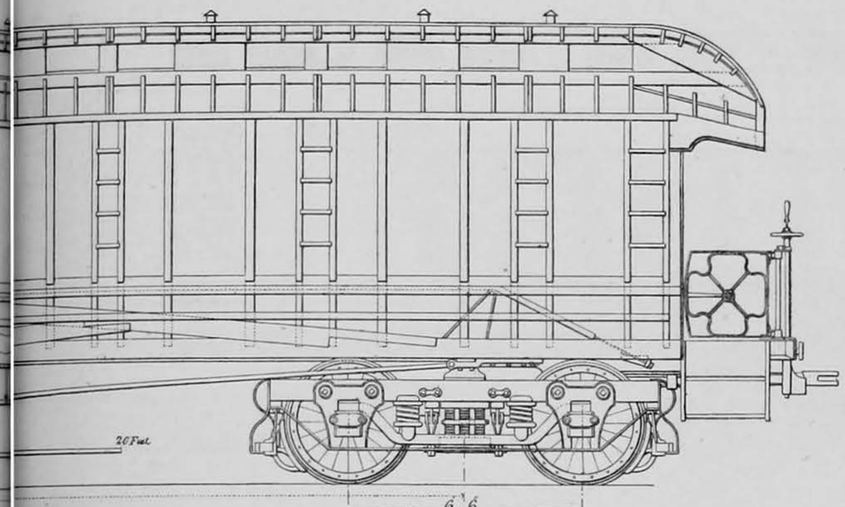
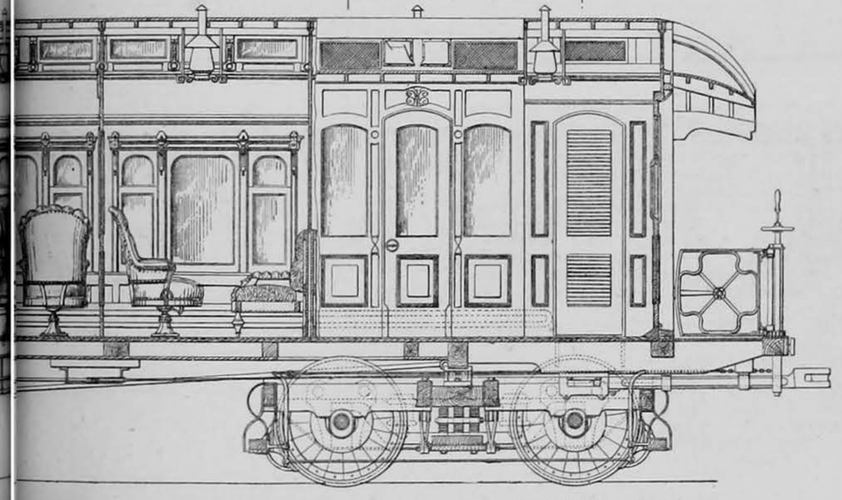


Fig. 3.







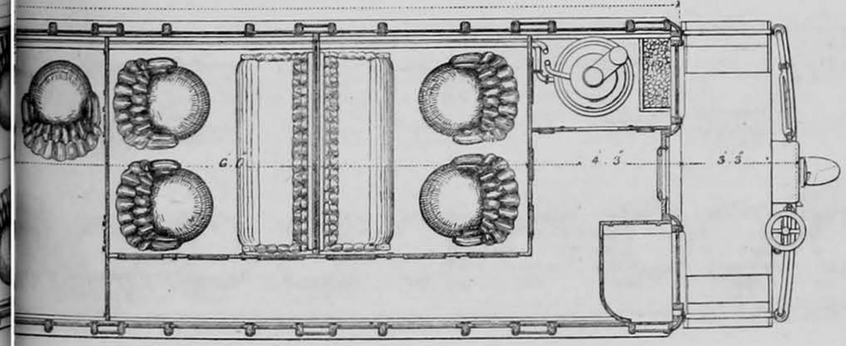


Fig. 4.

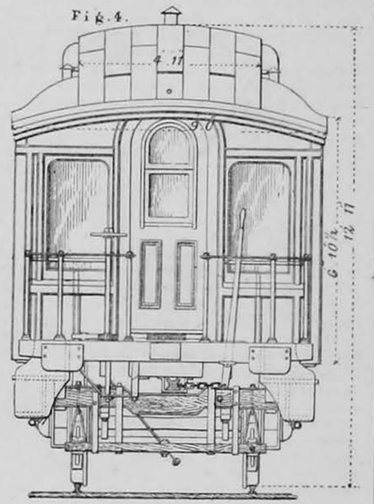


Fig. 5.