SCHEDULE NO. 2.—EXEMPTIONS FROM THE RULE

(*a*) Wagons used upon railways of a gauge less than 4 ft. 8½ in.
(*b*) Chaldron wagons of a carrying capacity of 5 tons or less.
(*c*) Wagons of a carrying capacity of over 20 tons.
(*d*) Boiler wagons.
(*e*) All wagons fitted with the Dean and Churchward brake, as described in Specification No. 202, of 1902, if arranged as a cross-cornered brake.
(*f*) Any wagons with regard to which compliance with this Rule is, in the opinion of the Board of Trade, unnecessary or impracticable.

Provided that all wagons exempted under *c*, *d*, and *f* are fitted on both sides with such other appliances as will enable sufficient brake power to be conveniently applied from either side, if, in the opinion of the Board, such other appliances are necessary.

Examples of Either-side Brakes.—It will now be seen that the latest requirements are for the brakes to be applicable from either side, but only capable of being released from the side on which applied. Fig. 109 probably shows the cheapest form of brake which complies with this rule, and is what is known as a " Morton " brake. Some companies prefer that the work done by the side lever B be obtained by means of an additional fulcrum and a link working on to a loose lever on the shaft; as by this arrangement the wear of the engaging portions of clutch and side lever is prevented. Some companies fit the wagons with two complete sets of brake gear, but this adds both to weight and cost.

Illustrated in fig. 110 is the Dean and Churchward brake, as exempted by Clause *e* of Schedule 2; and as a further example of an either-side brake, which has been in work for several years with excellent results, the writer illustrates in fig. 111 Frampton's wagon brake. It will be seen on reference to the drawing that this brake possesses the desirable feature of being capable of being graduated for use on inclines, and also has a definite rest for the handles when the brake is " off ".

CHAPTER X

Wagons and Miscellaneous Types of Stock

Railway companies' wagons and those belonging to private traders represent a very large portion of the capital laid out on rolling stock in this country, and with several companies the receipts from goods and mineral traffic are the chief sources of income. It will be understood, therefore, how important it is that these vehicles should be strongly constructed and maintained in an efficient manner for the work they have to do, and that constant examination should be carried out. Further, the enormous number of private owners' wagons running upon the various

lines rendered it very necessary, not only in the interest of public safety, but for the protection of the railway companies themselves, that all private owners' new wagons should be subject to most careful inspection and registration before being permitted to be sent into general traffic on the lines of railway.

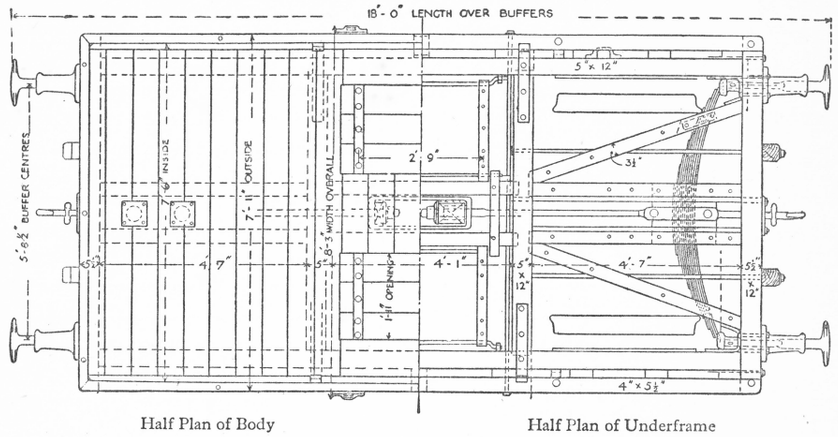
In 1887 the railway companies unanimously decided to carry out such inspection and registration of private wagons, this decision being the outcome of a report and suggestion made to the Board of Trade by Major Marindin, R.E., with reference to an accident which occurred at Penistone on the 1st January, 1885, where, owing to the breaking of an axle belonging to an empty coal wagon, great damage was done, and serious loss of life occurred. This inspection and registration has since been carried out and extended to include reconstructed and " converted " wagons, the latter expression being used to designate trucks which formerly had dead or solid buffers and were afterwards fitted with self-contained buffers of an elastic type. It may be noted here, that on and after the first day of January, 1914, dead-buffered wagons were not allowed to travel upon the railways in Great Britain, the owners of such trucks having had ample time and opportunity afforded them to effect the conversion. The definition of a reconstructed wagon was as follows. When a dead-buffered wagon was so far worn as to require the following new members, viz. two new solebars, or one new solebar and three cross members, the wagon had to be reconstructed, the limit of time between the replacement of the solebars or main members being one year. The wheels and ironwork could be used again, provided they complied with certain specified conditions.

Specifications for Private Owners' Wagons.—The standard specifications and drawings for private traders' wagons were drawn up jointly by the technical experts of all the railway companies of Britain, and it will therefore be conceded that they are thoroughly representative in character, and ensure that private owners when buying trucks receive good and substantial wagons from the builders. The original specification of 1887 was only for wagons with carrying capacity of 10 tons or under, but from time to time these specifications have been so enlarged that at present they provide for the building of 8-, 10-, 12-, 15-, 20-, and 30-ton trucks, and also for the various forms of tank wagons for the conveyance of liquids, and did up to 31st December, 1914, provide for the reconstruction and conversion of wagons as mentioned above. Wagons previously registered might be rebuilt when the truck was so far worn as to require the renewal of the same members referred to for the reconstruction of dead-buffered wagons. There can be no doubt whatever that the standardization of the strength of the parts used in the construction of private owners' wagons, and their inspection before being permitted to run, has saved many serious accidents, and, in addition, has effected much good by the companies themselves conforming as far as possible with the standard laid down for the private owner.

There is a great variety of wagons running in Britain, but general prac-

tice and much detailed information is given in the following paragraphs, which deal with the leading types of trucks.

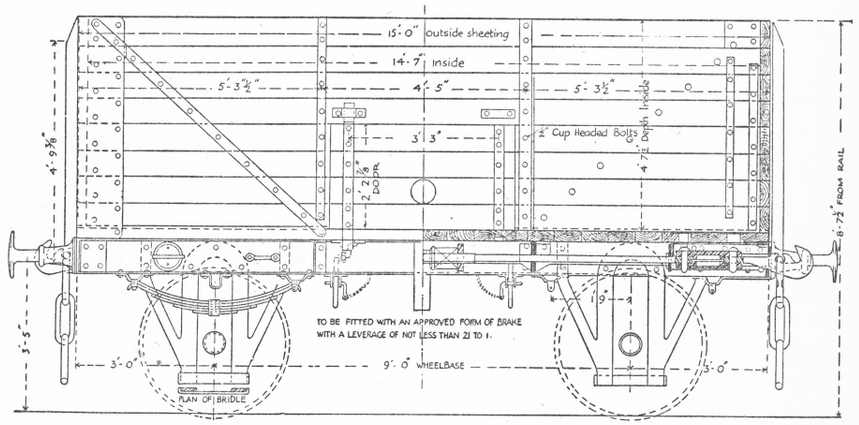
Modern requirements for ordinary short wagons will be represented by



Half Plan of Body — Half Plan of Underframe

Fig. 112.—Standard Private Owners' 10-ton Wagon with Wood Body and Underframe

stating the present specification and illustrating two types of private owners' 10-ton wagons, one with wooden underframe (fig. 112) and the other with steel underframe (fig. 113), both having side and bottom doors. The specification (given below) also applies to 8- and 12-ton trucks, the only



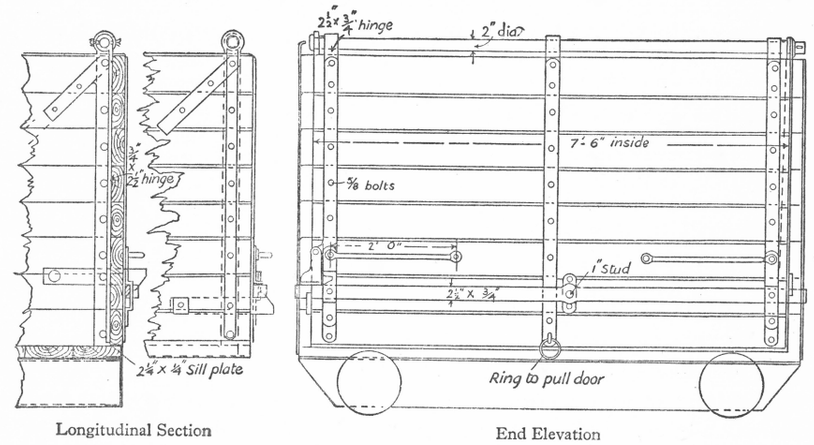
Half Side Elevation — Half Longitudinal Section

Fig. 113.—Standard Private Owners' 10-ton Wagon with Wood Body and Steel or Iron Underframe

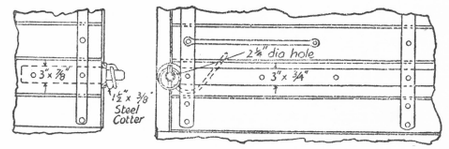
difference being that the bearing springs and axles of the latter are somewhat stronger than for the 10-ton truck (see Clauses 11 and 16). For wagons required to be built with an end door the arrangement is as shown in fig. 114. Eight-ton new wagons are now seldom built, and the same

remark applies to steel underframes for wagons, it having been found that unless the steel frames are kept efficiently painted the corrosion will in course of a fairly short time seriously deteriorate the strength of the parts (see p. 184). The wooden frame lends itself more readily for repairs whether required by wear and tear or as the result of an accident.

The workshop practice for preparing and putting together both wood and steel frames of wagons is similar to the descriptions given in the chapter



Longitudinal Section — End Elevation



Alternative Method of securing End Door

Fig. 114.—Arrangement of End Door on Private Owners' Wagon

on underframes. For vehicles with covered bodies the framing is dealt with somewhat similarly to that described for coachwork (see Chapter VII), the main difference being that the bodies are not built separately, but direct on the frames.

Specification for 10-ton Wagon.—The following is the standard specification for private owners' 10-ton wagons:

1. *Dimensions.*—No wagon to exceed 8 ft. 6 in. wide over all, nor to exceed in height 10 ft. at the sides and 11 ft. 6 in. in the middle above the top of the rails. (No wagon for tipping coal at Roath Dock, Cardiff, must be of a greater width than 8 ft. 3 in., and for other Bristol Channel ports not to exceed 8 ft. 4½ in.)

The length of coal wagons not to exceed 16 ft. 6 in. over headstocks.

Coke wagons may be made 17 ft. 6 in. over headstocks.

The wheel base not to be less than 8 ft. nor to exceed 9 ft.

The load not to exceed 8, 10, or 12 tons respectively, and the building of 8-ton wagons to be limited as much as possible.

2. *Tare*.—Maximum tares:

	Single-spoke wheels with wrought-iron centres 2½-in. sheeting.				Open-spoke wheels with wrought-iron centres 2½-in. sheeting.			
	10 Tons.		12 Tons.		10 Tons.		12 Tons.	
	tons.	cwt.	tons.	cwt.	tons.	cwt.	tons.	cwt.
Side only	5	19	6	7	6	2	6	10
Side and bottom ..	6	1	6	9	6	4	6	12
Side and end ..	6	2	6	10	6	5	6	13
Side, end, and bottom	6	4	6	12	6	7	6	15

Extra to the above, the tares may be increased:

For 3-in. sheeting, 3 cwt.
For coke rails, 6 cwt.
For 2½-in. tyres, 3½ cwt.
For oak frames, 2 cwt.
For pitch-pine sheeting, 2 cwt.
For commode rod and steps, ½ cwt.
For hinged top planks, 1 cwt.
For coke wagons of full length, 2 cwt.
For additional single brake, 3½ cwt.
For a " Morton " brake, 2 cwt.
For large drawbar cradles, large drawbar spring and stop, additional rubber springs and plates, additional plates in buffing springs, lengthened buffer cylinders, increased width of end door latch bar, ⅝-in. bolts in body and bolted spring shoes = 1½ cwt.
For 10-ton coke wagons having a capacity of not less than 500 c. ft. exclusive of the coke rails, 5 cwt.

The maximum tares allowed for wagons for traffic on the Barry, Port Talbot Railway and Docks, Rhondda and Swansea Bay, Rhymney and Taff Vale Companies' lines are as follows:

10-ton wagons maximum tare.			12-ton wagons maximum tare.	
tons.	cwt.		tons.	cwt.
6	7	....	6	15

3. *Body*.—The bodies of the wagons may be made of wood, iron, or steel.

For wood bodies, 2½-in. or 3-in. sheeting of approved quality may be used.

Commode rods, buffer steps, and brake racks to be fixed as required on end-tipping wagons for the Bristol Channel Ports.

4. *Underframes*.—The underframe to be of steel, iron, or wood, and the members to be so prepared that the ends have a good bearing on the adjacent parts.

The dimensions of the principal members of steel or iron underframes to be as follows:

Headstocks and solebars ..	9-in.-by-3-in.-by-⅜-in. channel bars.
Trimmers	6-in.-by-3½-in.-by-½-in. ,,
Middle bearers	8-in.-by-3½-in.-by-½-in. angle bars; or 9-in.-by-3-in.-by-⅜-in. channel bars.
Diagonals and longitudinals	6-in.-by-3½-in.-by-⅜-in. angle bars.
End stanchions	5-in.-by-3½-in.-by-½-in. tee bars.
Curb rails for wagons with wood bodies	7-in.-by-3-in.-by-⅜-in. / 9½-in.-by-3-in.-by-⅜-in. / 3-in.-by-3-in.-by-$\frac{5}{16}$-in. — special angle bars; or special angle bars riveted to $\frac{3}{16}$-in. plate.
End rails for wagons with wood bodies	3-in.-by-3-in.-by-$\frac{5}{16}$-in. special angle bars.

Wood underframes to be of sound white oak, or other timber not less in strength and quality than white oak, the dimensions of the principal members being as follows:

Solebars	12 in. by 5 in., or if with steel or iron plate $\frac{5}{16}$ in. thick; the full depth and length of solebar, 12 in. by 4½ in.
Headstocks	12 in. by 5½ in.
Crossbearers	12 in. by 5 in.
Longitudinals and diagonals	12 in. by 3½ in.

5. *Doors*.—Horizontally hung side doors when down must clear rail level by 8½ in. with the wagon unloaded, and vertically hung doors when open must not extend beyond 6 ft. 6 in. from the centre of the wagon.

Bottom doors must, when down and the wagon unloaded, clear the rail level by 7 in.

6. *Draw Gear*.—The draw gear throughout to be made of Grade A iron (British Standard Specification), or mild weldable steel, of Government chain-proof quality, and to be continuous and elastic, and of the dimensions shown on the Standard Drawings. The drawbar pins to be of steel of the same quality as the tyres (42 to 48 tons tensile). The bars from which the coupling links are made to be 1½ in. in diameter, and the chains to hang loosely in the drawbar; all links to be welded at the side. Two per cent of the chains to be tested, if required, and to withstand a breaking strain of 60 tons.

When couplings are worn below 1$\frac{3}{16}$ in. in thickness at the ends they must be removed.

7. *Axleguards*.—The axleguards to be made of 3¾-in.-by-¾-in. iron, and the wings to be 2½ or 3 in. by ¾ in.; the bottom stay or bridle to be 2 in. by ⅝ in. or other approved design.

Each axleguard must be securely attached to the underframe by, in the case of steel or iron frames, 7 rivets or bolts ⅞ in. diameter; and, in the case of wood frames, 7 bolts ⅞ in. diameter. Bolts to have oval necks.

8. *Brake*.—Each wagon to be fitted with a double-block brake having a cast-iron block applied to one wheel of each pair, and a leverage of not less than 21 to 1, and so that the handle of the lever shall not project more than 7 in. beyond the headstock; each brake to have also a lever guard with a pin and chain (which in its lowest possible position shall not hang lower than 6 in. above the running rail) or rack for holding the lever down. Safety loops must be applied to the brake

gear as shown on Standard Drawing. Split pins to be used outside all nuts on brake rigging.[1]

9. *Buffers*.—Laminated buffing springs to be used; the buffers to be 18 in. in length from headstock to face, which is to be 12 in. in diameter; the centres to be 5 ft. 8½ in. apart, and 3 ft. 5 in. high from top of rails when the wagon is unloaded.

10. *Buffing Springs*.—The buffing springs to be made of fourteen plates of 3-in.-by-½-in. steel. The spring buckles must be forged or made from the solid from Class B steel (25 to 32 tons tensile) capable of withstanding a pull of not less than 65 tons. They must be made in accordance with the Standard Drawing.

11. *Bearing Springs*.—For 8- and 10-ton wagons the bearing springs to be made of either 5 plates 4-in.-by-⅝-in. steel, or 9 plates 4-in.-by-½-in. steel; and for 12-ton wagons either 5 plates 4-in.-by-⅝-in. steel, or 10 plates 4-in.-by-½-in. steel; and to be fitted with a wrought-iron hoop 3 in. by ½ in., with ½-in. rivet in middle, or a flat rivet of equal strength.

The bearing springs to be secured in position by bolts and nuts, as shown on the Standard Drawings.

Split pins to be used outside all nuts.

12. *Axleboxes*.—The axleboxes to be of good strong iron or steel (cast or pressed), and to have bronze or gun-metal bearings well fitted in. The grease chamber to have a capacity of about 100 c. in., and the lid to be made of wrought or malleable cast iron well fitted, and with a spring upon it; a ⅞-in. bolt to go through the axlebox underneath the centre of the journal. The top of the axlebox to be so formed that the bearing spring will " bed " into it 2 in.

Shepherd's Patent wrought-iron or mild-steel drop forged and welded axleboxes (see description page 130) may also be used.

Other approved axleboxes may be used for either grease or oil.

An efficient shield to be put in the back of the box to keep out dust.

Each axlebox must have cast or stamped upon the front the size of the journal for which it is constructed.

12-ton wagons to be fitted with oil axleboxes of approved pattern; but, if desired, 12-ton wagons used for tipping coal, &c., may have grease axleboxes.

The bearings for oil axleboxes for 12-ton wagons to be roughly bored and then lined with approved anti-friction metal having a minimum thickness of $\frac{3}{16}$ in.

13. *Tyres*.—The tyres to be made of acid or basic open-hearth or acid Bessemer steel (British Standard Specification, No. 5A, Class B).

The tyres to be 5 in. wide, and not less than 2 in. nor more than 2½ in. thick on tread when finished, truly bored out, with not more than $\frac{1}{16}$ in. allowance for contraction. Tyres to be secured to the wheels by the method of fastening shown on the Standard Drawings.

Tyres for 8-, 10-, and 12-ton ordinary wagons and 10-ton tank wagons must not be turned below $1\frac{1}{16}$ in. on tread, and for 15- and 20-ton ordinary wagons, and 12-, 14-, and 20-ton tank wagons, not below $1\frac{5}{16}$ in. on tread.

14. *Axles*.—The axles to be made of acid open-hearth or basic open-hearth steel (British Standard Specification, No. 3).

Wrought-iron axles will be accepted where required, provided they pass the following tests, and on the understanding that when a specification for iron axles is issued by the British Standards Committee the tests provided therein will be substituted:

[1] The Board of Trade new rules having now come into operation, double brakes must be provided.

Tensile Test.—A test piece of half a square inch area cut from any part of the axle tested or from the ends left on the forgings to give an ultimate strength of not more than 23 tons and not less than 20 tons per square inch, with not less than 25 per cent elongation measured over a parallel length of 3 in.

NOTE.—The axles must also comply with the falling-weight test.

15. *Axles, 8- and 10-ton Wagons*.—For 8- and 10-ton wagons the axles to be 6 ft. 6 in. in length from centre to centre of journals; 5¼ in. in diameter through the boss of the wheel, and gradually tapered to 4½ in. in the middle. There must be no shoulder on the axle behind the boss. The journals to be 8 in. long by 3¾ in. in diameter.

Axles are to be discarded when the journals are, in the case of 8-ton wagons, worn below 3⅜ in., and in the case of 10-ton wagons below 3½ in. in diameter.

16. *Axles, 12-ton Wagons*.—For 12-ton wagons the axles to be 6 ft. 6 in. in length from centre to centre of journals, 5½ in. in diameter through the boss of the wheel, and gradually tapered to 4⅞ in. in the middle. There must be no shoulder on the axle behind the boss. The journals to be 9 in. long by 4¼ in. in diameter.

Axles under 12-ton wagons are to be discarded when the journals are worn below 3⅞ in. in diameter.

17. *Wheels*.—The body of the wheel to be made of wrought iron with eight solid or open spokes, or of mild steel or cast steel with eight solid spokes, to the dimensions shown on the Standard Drawings.

All wheel skeletons to be turned exactly to 2 ft. 9 in. in diameter.

The bosses must be bored out, and the wheels then forced untired on to the axle by hydraulic pressure of not less than 50 tons for 8- and 10-ton wagons, and 60 tons for 12-ton wagons. If tyred wheels are forced on the axle, the pressures must be not less than 60 tons and 70 tons respectively.

No keys are to be used.

18. *Bolts and Nuts*.—All bolts and nuts to be screwed to Whitworth Standard Thread, and, wherever practicable, all nuts and cotters must be placed outside, so as to be easily seen.

19. *Quality of Wrought Iron or Steel*.—All steel or wrought iron used in the construction of wagons under this specification to be, unless otherwise specified, to the quality, and to withstand the tests set forth in the Standard Specification and Tests for Materials to be used in the construction of private owners' wagons.

20. *Stamping of Iron Work and Steel Work*.—All iron work and steel work as far as practicable to be stamped distinctly with the name or initials of the builder or owner.

The top side planks of the wagon shown in fig. 113, p. 220, are carried through from end to end; but as the arrangement is sometimes very inconvenient for loading and unloading at the side doors, it is permissible for these top planks to terminate at either side of the doorway, and for vertically hung doors or hinged planks to be fitted in place thereof. It may be added that the through top side planks are a considerable source of strength to the wagon, and should be retained whenever possible.

If it is necessary for a wagon to be sheeted when loaded, an arrangement for carrying the tarpaulin is made of 2-in. tubing bent to the required

shape, with solid ends welded on. The carrier is capable of being radiated from brackets fixed on the ends of the wagon, so that the support may rest on the sides of the truck when not in use.

Specification for 15-ton Wagons.—Fifteen-ton wagons are being fairly extensively built both by the railway companies and for private traders; and although the former seldom require to load them to their full carrying capacity (excepting with coal), they are found to be very economical for working between certain points where there is constantly a large quantity of medium-weight articles to be conveyed. In such cases full advantage can be taken of the additional cubic capacity. With but little variation, the dimensions of the standard private owners' 15-ton wagon (see fig. 115)

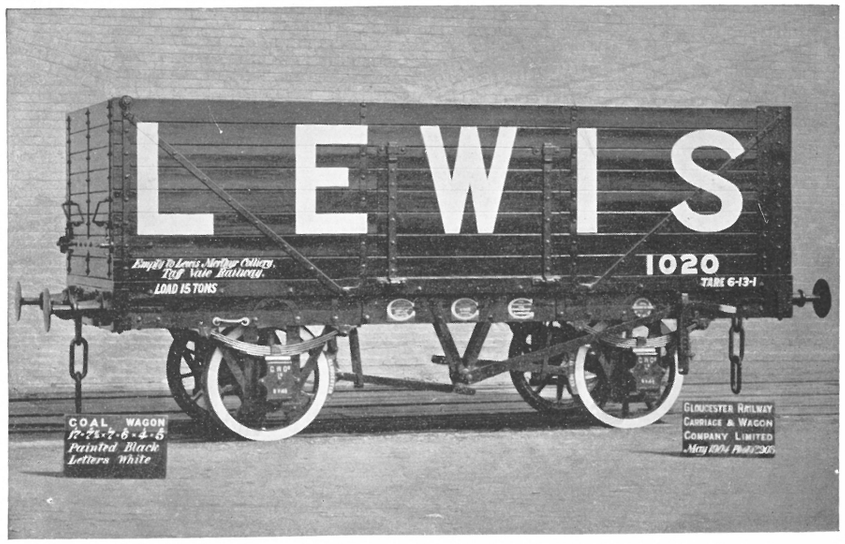


Fig. 115.—Private Owners' 15-ton Wagon

apply to these trucks as built by the railway companies for their own use. The underframe is generally of wood with $\frac{5}{16}$-in. steel sole plates, but steel channels may be used throughout if preferred. The wagon may be fitted with an end door if required.

The specification for this truck is the same as for 10-ton trucks, with the following exceptions:

1. *Dimensions.*—Length not to exceed 18 ft. outside body, and wheel base not to be less than 9 ft. 6 in. nor to exceed 10 ft.

2. *Maximum Tares.*

Doors.	Wagons with $2\frac{1}{2}$-in. Sheeting
Side only	7 tons 4 cwt.
Side and bottom	7 tons 6 cwt.
Side and end	7 tons 7 cwt.
Side, end, and bottom	7 tons 9 cwt.

Extra to the above, the tares may be increased:

For 3-in. sheeting	$3\frac{1}{2}$ cwt.
For oak frames	$2\frac{1}{2}$,,
For pitch-pine sheeting	$2\frac{1}{2}$,,

3. *Underframe.*—The dimensions of the principal members of steel or iron underframes to be as follows:

Headstocks and solebars	10-in.-by-$3\frac{1}{2}$-in.-by-$\frac{3}{8}$-in. channel bars.
Trimmers	6-in.-by-$3\frac{1}{2}$-in.-by-$\frac{1}{2}$-in. channel bars.
Middle bearers, diagonals, and longitudinals	9-in.-by-4-in.-by-$\frac{1}{2}$-in. angle bars, or 9-in.-by-3-in.-by-$\frac{3}{8}$-in. channel bars.
End stanchions	5-in.-by-$3\frac{1}{2}$-in.-by-$\frac{1}{2}$-in. tee bars.
Curb rails for wagons with wood bodies	7-in.-by-3-in.-by-$\frac{3}{8}$-in special angle bars, or $9\frac{1}{2}$-in.-by-3-in.-by-$\frac{3}{8}$-in. special angle bars, or 3-in.-by-3-in.-by-$\frac{5}{16}$-in. special angle bars riveted to $\frac{3}{16}$-in. plate.
End rails for wagons with wood bodies	3-in.-by-3-in.-by-$\frac{5}{16}$-in. special angle bars.

Wood underframes to be of sound white oak, or other timber not less in strength and quality than white oak, the dimensions of the principal members being as follows:

Solebars	12 in. by $5\frac{1}{2}$ in., or if with steel or iron plate $\frac{5}{16}$ in. thick; the full depth and length of solebar, 12 in. by 5 in.
Headstocks and crossbearers	12 in. by $5\frac{1}{2}$ in.
Longitudinals and diagonals	12 in. by $3\frac{1}{2}$ in.

4. *Axleguards.*—The axleguards to be made of 4-in.-by-$\frac{3}{4}$-in. iron, and the wings to be $2\frac{1}{2}$ in. by $\frac{3}{4}$ in. or 3 in. by $\frac{3}{4}$ in., the tie-rod to be 2 in. by $\frac{5}{8}$ in. or of other approved design. Each axleguard must be securely attached to the underframe by, in the case of steel or iron frames, 7 rivets or bolts $\frac{7}{8}$ in. in diameter; and, in the case of wood frames, by 7 bolts $\frac{7}{8}$ in. in diameter. Bolts to have oval necks.

5. *Brake.*—Brake leverage to be not less than 25 to 1.

6. *Buffers.*—Buffer heads to be 13 in. in diameter.

7. *Bearing Springs.*—The bearing springs are to be made of 6 plates of 4-in.-by-$\frac{5}{8}$-in. steel; to have $4\frac{3}{4}$ in. of camber, unweighted, and to be fitted with a wrought-iron hoop 3 in. by $\frac{1}{2}$ in., with $\frac{1}{2}$-in. rivet in middle, or flat rivet of equal strength.

8. *Axleboxes.*—Oil axleboxes to be used, except that, in the case of tipping wagons, grease boxes may be fitted. The bearings for oil axleboxes to be as specified for 12-ton wagons.

9. *Axles.*—The axles to be 6 ft. 6 in. in length from centre to centre of journals, $5\frac{3}{4}$ in. in diameter through the boss of the wheel, and gradually tapered to 5 in. in the middle. There must be no shoulder on the axle behind the boss. The journals to be 9 in. long by $4\frac{1}{2}$ in. in diameter.

Axles are to be discarded when the journals are worn below $4\frac{1}{4}$ in. in diameter.

Private Owners' 20-ton Wagon (see fig. 116).—Up till now these trucks have not been extensively built, the 10-ton trucks having found most favour with private traders.

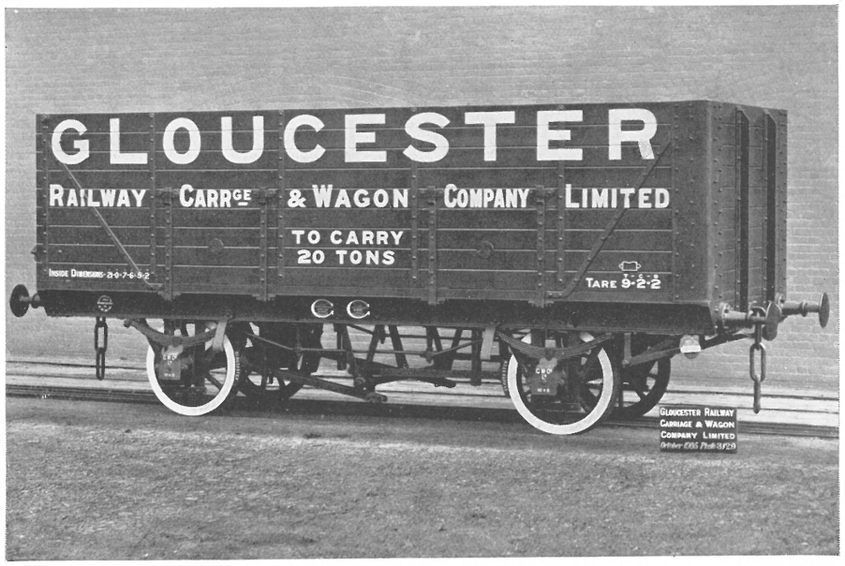


Fig. 116.—Private Owners' 20-ton Wagon

The specification for these vehicles is the same as for the 10-ton trucks, with the following exceptions:

1. *Dimensions*.—Length not to exceed 21 ft. 6 in. outside body. The wheel base for the length quoted to be 12 ft., and for the shorter wagons to be proportionately reduced, 10 ft. being the minimum.

2. *Maximum Tares*.

Doors.	Wagons with 2½-in. Sheeting.
Side only	8 tons 9 cwt.
Side and bottom	8 tons 11 cwt.
Side and end	8 tons 12 cwt.
Side, end, and bottom	8 tons 14 cwt.

Extra to the above, the tares may be increased:

For 3-in. sheeting	4 cwt.
For pitch-pine sheeting	3½ „
Hinged top planks	2 „

3. *Underframe*.—The underframe to be of steel or iron, and the members to be so prepared that the ends have a good bearing on the adjacent parts.

The dimensions of the principal members to be as follows:

Solebars	10-in.-by-3½-in.-by-½-in. channel bars.
Headstocks, diagonals, longitudinals, and middle bearers	10-in.-by-3½-in.-by-⅜-in. channel bars.
Trimmers	6-in.-by-3½-in.-by-½-in. channel bars.
End stanchions	5-in.-by-3½-in.-by-½-in. tee bars.
Curb rails for wagons with wood bodies	7-in.-by-3-in.-by-⅜-in. special angle bars, or 9½-in.-by-3-in.-by-⅜-in. special angle bar, or 3-in.-by-3-in.-by-$\frac{5}{16}$-in. special angle bar riveted to $\frac{3}{16}$-in. plate.
End rails for wagons with wood bodies	3-in.-by-3-in.-by-$\frac{5}{16}$-in. special angle bars.

4. *Axleguards*.—The axleguards to be made of 4-in.-by-⅞-in. iron, and the wings to be 2½ in. by ⅞ in.; the tie-bar to be 2½ in. by ⅝ in. or of other approved design. Each axleguard must be securely attached to the frame by 7 rivets or bolts, ⅞ in. diameter; rivet holes to be $\frac{15}{16}$-in. diameter. Bolts to have oval necks.

5. *Brake*.—Each wagon to have a four-block brake with leverage not less than 30 to 1.

6. *Buffers*.—Buffer heads to be 13 in. in diameter.

7. *Bearing Springs*.—The bearing springs to be made of 7 plates of 4-in.-by-⅝-in. steel; to have 6½ in. camber, unweighted, and to be fitted with a wrought-iron hoop 3 in. by ½ in., with ½-in. rivet in middle, or a flat rivet of equal strength.

8. *Axleboxes*.—Oil axleboxes to be used, made of cast steel or, alternatively, they can be of wrought-iron or mild-steel drop forgings welded (Shepherd's Patent). The bearings to be roughly bored and then lined with approved anti-friction metal, having a minimum thickness of $\frac{3}{16}$-in.

9. *Axles*.—The axles to be 6 ft. 6 in. in length from centre to centre of journals, 6¾ in. in diameter through the boss of the wheel, and gradually tapered to 6 in. in the middle. There must be no shoulder on the axle behind the boss. The journals to be 10 in. long by 5 in. in diameter. Axles are to be discarded when the journals are worn below 4⅝ in. in diameter.

Private Owners' 30-ton Wagon.—The type of bogie usually used under these trucks is given in fig. 16, p. 118. The specification for these wagons is the same as for the 10-ton truck, with the following exceptions:

1. *Dimensions*.—Length not to exceed 32 ft. outside body, nor to exceed 8 ft. in width over all.

The centres of bogies to be not less than 7 ft. from the face of the buffers (the face of buffer to face of headstock being 1 ft. 6 in.), and the distance between the centres of bogies under any one wagon not to be less than 15 ft.

The wheel base of bogies to be 5 ft. 6 in.

2. *Maximum Tare*.

Doors.	Wagons with 2½-in. Sheetings.
Side only	14 tons 1 cwt.
Side and bottom	14 tons 5 cwt.

Extra to the above, tares may be increased:

For 3-in. sheeting	6 cwt.
For $2\frac{1}{2}$-in. tyres	7 „
For pitch-pine sheeting	5 „
For hinged top planks	4 „

3. *Underframe.*—The underframe to be of steel or iron, and the members to be so prepared that the ends have a good bearing upon the adjacent parts.

The dimensions of the principal members to be as follows:

Solebars, headstocks, longitudinals, and bolsters ..	10-in.-by-$3\frac{1}{2}$-in.-by-$\frac{3}{8}$-in. channel bars.
Diagonals	6-in.-by-$3\frac{1}{2}$-in.-by-$\frac{1}{2}$-in. channel bars.
Middle bearers for wagons with wood floors ..	6-in.-by-$3\frac{1}{2}$-in.-by-$\frac{3}{8}$-in. angle bars.
Middle bearers for wagons with steel floors ..	4-in.-by-5-in.-by-$\frac{1}{2}$-in. tee bars.
End stanchions	5-in.-by-$3\frac{1}{2}$-in.-by-$\frac{1}{2}$-in. tee bars.
Curb rails for wagons with wood bodies	7-in.-by-3-in.-by-$\frac{3}{8}$-in. special angle bars.
End rails for wagons with wood bodies	3-in.-by-3-in.-by-$\frac{5}{16}$-in. special angle bars.

4. *Bogies.*—For bogies of the diamond type the arch bars to be 5 in. by $1\frac{3}{8}$ in.; inverted arch bars to be 5 in. by $1\frac{1}{4}$ in., and the pedestal tie-bars to be 5 in. by $\frac{3}{4}$ in.—all to be bolted together through pedestals by $1\frac{1}{2}$-in. bolts, and through axleboxes with $1\frac{1}{8}$-in. bolts.

The spring plank to be 1-ft.-1-in.-by-$3\frac{1}{2}$-in.-by-$\frac{7}{16}$-in. channel bar; the bolster to consist of two angle bars 6 in. by 6 in. by $\frac{7}{16}$ in., trussed with a plate 11 in. by 1 in.

The bogie centre and side bearings to be stamped or cast as per drawings.

Other approved bogies may be used.

5. *Brake.*—Each wagon to be fitted with an approved brake, with a cast-iron block on each wheel.

6. *Buffers.*—The buffer heads to be oval, 1 ft. 5 in. by 1 ft., horizontal and vertical axes respectively.

7. *Bearing Springs.*—The bearing springs (helical) for diamond bogies to be in clusters, two being used for each bogie. Each cluster to consist of four springs.

Diameter of spring, $5\frac{7}{16}$ in.; section, $1\frac{3}{16}$ in. diameter.
Height of spring (light), $8\frac{1}{4}$ in.
Height of spring (solid), $6\frac{9}{16}$ in.

For other bogies, springs to be as shown in the Standard Drawing of 15-ton wagon, except camber free to be $3\frac{1}{8}$ in.

Split pins to be used outside all nuts in cases where laminated side-bearing springs are used.

8. *Axleboxes.*—Oil axleboxes to be used. They are to be of good strong iron or steel (cast or pressed), or, alternatively, can be made of wrought-iron or mild-steel drop forgings welded (Shepherd's Patent), and to have bronze or gun-metal

bearings well fitted in. Each box to be held in position by two bolts $1\frac{1}{8}$ in. diameter and 10-in. centres.

Other approved axleboxes to suit the bogies adopted may be used.

The bearings to be roughly bored and then lined with approved anti-friction metal having a minimum thickness of $\frac{3}{16}$ in.

9. *Axles.*—Exactly as specified for 15-ton wagons.

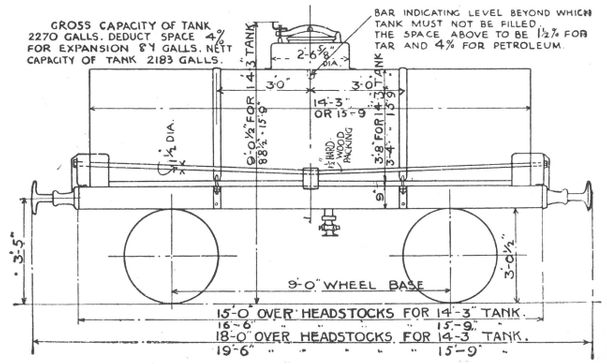


Fig. 117.—Private Owners' Standard 10- or 12-ton Rectangular Tank Wagon (side elevation)

Tank Wagons.—Private owners are permitted to have tank wagons built for the conveyance of liquids, but these are not numerous, and are principally used in the districts where chemicals are manufactured, and for the carriage of tar from gasworks to these manufacturers. As illustrations

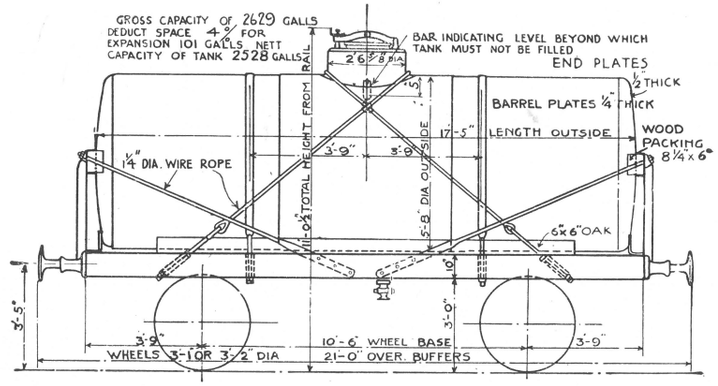


Fig. 118.—Private Owners' Standard 10- or 12-ton Cylindrical Tank Wagon (side elevation)

of these vehicles, figs. 117, 118, 119 show three types, the first being a 10- or 12-ton rectangular tank, the second a 10- or 12-ton cylindrical tank, and the third a 20-ton cylindrical tank. As it would not be of general interest to give full drawings and specifications of these, notes are given under the diagrams of the principal points appertaining to each, and sufficient detail is embodied to give a general idea of the construction of the trucks. It

may be added that under no circumstances are wooden underframes permitted in the construction of tanks intended to convey inflammable liquids, and that such tanks when built have to be painted a light stone colour, with a bright-red band 6 in. wide running horizontally round the centre.

Starring of Tank Wagons.—Tank wagons—having the draw and buffing gear, wheels, axles, and wheel base in accordance with the latest standard specification, also oil axleboxes, and bearings lined with white metal—may be run on fast goods trains at an average speed of 35 miles per hour from point to point; the distance between stops to be limited to 40 miles. New tank wagons will not be accepted for this traffic until they have run 100 miles on slow trains, the owner or builder to furnish proof of this before the wagons are accepted for " starred " traffic.

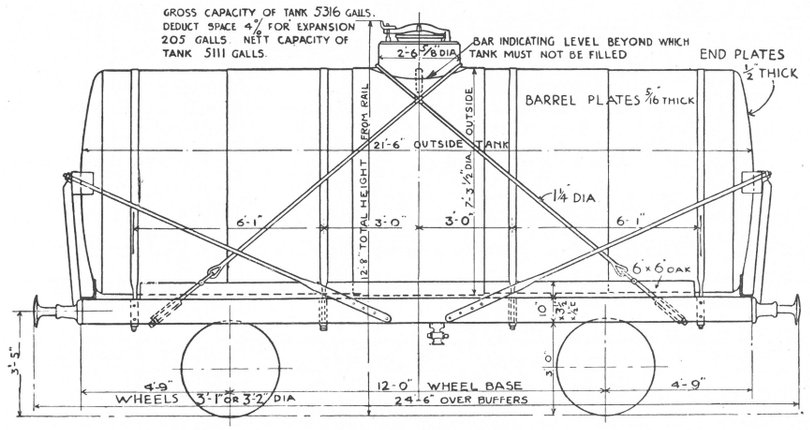


Fig. 119.—Private Owners' Standard 20-ton Tank Wagon (side elevation)

When the foregoing conditions have been complied with, the owner must paint upon each side of the tank at cross corners a star which must be black for white or yellow tanks, and white for other coloured tanks: whilst the railway company, which approved the starring, will affix to the underframe special plates showing their initials, the registered number of the wagon with the letter " A " affixed, and the month and year so dealt with.

Covered Goods Vans.—Covered goods trucks are mostly built and used by the railway companies themselves, being essential for the conveyance of dry and perishable goods. As these vehicles have frequently to run in passenger trains, many of them are equipped with a power brake (or brakes), carriage wheels, and long bearing springs, and have a wheel base suitable for travelling at high speeds. Such a vehicle is shown in fig. 120. As will be seen by reference to the illustration, it is equipped with portable shelves for carrying fruit at the proper season. Some companies construct these vehicles with top pair of hinged doors and a bottom flap, which latter can be opened on to a loading dock to facilitate loading and unloading operations. Ventilation is provided on the sides by a series

of holes bored through the casing and partially covered with sheet-iron plates; and two ventilators of the torpedo pattern are placed in the roof.

The underframe is of Stettin oak, and the 11-in.-by-$4\frac{1}{8}$-in. soles are plated with 11-in.-by-$\frac{3}{8}$-in. mild-steel plates. The draw gear is elastic and continuous, and the cradle is of the latest pattern, having both rubber and steel auxiliary springs. Similar trucks, fitted inside with bars and hooks, are also built for the conveyance of meat killed in this country, and sent up to London and other large towns by fast trains. In the vehicle illustrated the carrying capacity is marked at 8 tons, with a tare of about

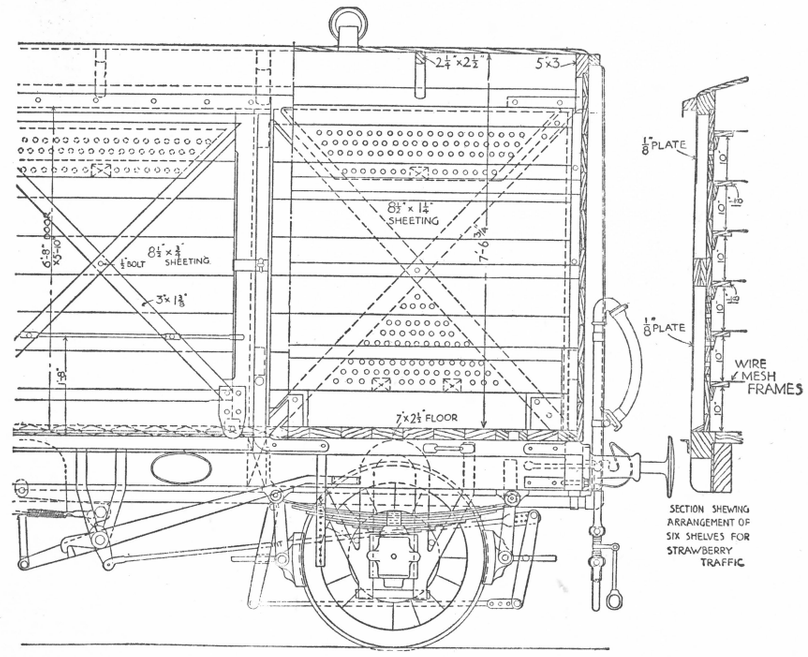


Fig. 120.—Ventilated Covered Goods Wagon

$8\frac{1}{4}$ tons; but when similar trucks are not required to travel with passenger trains, they are built with somewhat stronger frames, shorter springs, and wagon wheels, and carry a load of 10 tons.

Cattle Trucks.—Special vehicles are used on all railways for the conveyance of cattle. The charge made for the use of these is in proportion to the floor space occupied, and they are therefore so constructed that by means of a movable partition they may give " small ", " medium ", or " large " accommodation, as paid for, this accommodation being respectively 13 ft. 6 in., 15 ft. 6. in, and 18 ft. Very many devices, more or less successful, have been brought out to ensure that the partition shall not be surreptitiously moved during a journey; but the arrangement of a dovetail notch on the side rails was most generally used. To move the partition when once set, it was necessary not only to draw the bolts, but to raise

the partition to a considerable angle before the top bar could be lifted clear of the notch—an operation requiring considerable strength when the truck was empty, but becoming almost impossible when the vehicle was loaded if the attempt was made from the outside. However, whilst this arrangement possessed many advantages, it was found to be very difficult to load small animals behind the partition and larger ones in front thereof, and consequently on many lines these partitions are now made to drop into straight notches cut in top and bottom side rails at one end of the truck.

Much thought and care have been given in recent years to making the interior of these vehicles comfortable for the animals during transit. In recent military manœuvres these trucks have been found very useful for the conveyance of horses; and in order to give more head room in loading and unloading when used for this purpose, new vehicles are being constructed about 6 in. higher than formerly. To prevent infection, the trucks are thoroughly cleansed and limewashed after every journey in use.

The tare of the vehicle is approximately 7½ tons, and marked to carry 8 tons.

Prize animals and valuable live stock, when conveyed by rail, are generally attended by a drover, and for this class of traffic specially designed vehicles are used. There is not the necessity for inspection space at floor level in these trucks as in the ordinary vehicles, the beasts being under constant observation by the attendant, who can also regulate the ventilation by opening an end sliding door, &c., as required. Some companies fit their special cattle trucks with a manger and water trough for feeding during transit, the water being carried in a tank fitted in the roof. Such trucks and many of the ordinary ones are equipped with power brakes, carriage wheels, and long bearing springs, making them suitable for travelling in passenger trains when required.

Board of Agriculture Rules—Special Vehicles.—In March, 1904, the following regulations were issued by the Board of Agriculture as to the construction of cattle trucks, horse boxes, &c.:

1. From and after the Thirty-first day of October, 1904, this Article shall be substituted for Article 7 of the Animals (Transit and General) Order of 1895.

2. No animal, horse, ass, or mule shall be carried by railway in a truck, horse box, or other vehicle, unless such truck, horse box, or vehicle is in accordance with the provisions of this Article.

3. Every truck, horse box, or other vehicle shall be provided at each end with spring buffers; and the floors thereof, in order to prevent slipping, shall, in the case of a truck used for the carriage of cattle, horses, asses, or mules, be fitted with battens or other proper footholds, and in any other case either be so fitted or be strewn with a proper quantity of litter or sand or other proper substance.

4. The battens in a truck shall be placed across the truck, except between the doorways, where they shall be placed lengthways.

5. Every truck shall be so constructed as to admit of ventilation and inspection at the floor level.

6. Every truck shall be so constructed that the interior thereof shall be free from any boltheads, angles, or other projections likely to cause suffering to animals carried therein.

7. Every falling loading door and every gangway, passageway, loading or unloading board shall be fitted with longitudinal battens or other proper footholds.

8. Every truck built after the date of this Order shall be fitted with a roof and with falling loading doors of a pattern approved by the Board, and all internal projections shall be rounded.

9. Every truck or other vehicle shall be so constructed as to permit of its being effectually cleansed and disinfected in manner provided by the Animals (Transit and General) Order of 1895.

NOTE.—The above were subsequently confirmed and contained in General Order of 1912.

Boiler and Girder Wagons.—For the conveyance of heavy machinery, boilers, armour plate, bridgework, &c., it is necessary to have trucks with the floor line as near to the rail level as practicable, not only to keep the centre of gravity low, but to enable large articles when in position on the truck to be within the maximum loading gauge. There is a great variety of these trucks in use on the various railways, their carrying capacities ranging from about 12 to 50 tons. The solebars of long bogie wagons of high carrying capacity are usually of deep built-up girders with a suitable camber, put in when erected, as it is impossible to truss them for want of space below the frame. The designs of these special trucks vary considerably to suit the kind of traffic for which they are built, and it should be noted that no definite tare figure can be given in any way proportionate to the weight-carrying capacity. It should also be mentioned that 50 tons is not the maximum load that could be carried, as certain companies are prepared in emergency to provide vehicles in sets to carry a load up to 85 tons.

The conveyance of heavy guns during the recent Great War necessitated the construction of special vehicles for that purpose, and, as an example, it is of interest to record that sets of these (three) bogie wagons of tares about 17½ tons each with suitable superimposed girders gave a carrying capacity up to 130 tons.

One or two companies have built long boiler trucks with the buffing and draw gear fitted to the bogies instead of to the underframes, the main object being to facilitate the working of the vehicles on sharp curves. In this case the frame ends are suspended by strong links from the bogie centre, and, as all the buffing and draw stresses come upon the trucks, they have to be made very strong.

Timber Wagons.—The traffic in timber from the various seaports to inland towns is considerable in the form of logs, scantlings, deals, and battens, and special trucks are built and kept by the companies for this purpose. A fair proportion of this traffic is to the railway companies own works, and to contract shops for the building of rolling stock. Logs of oak, pitch pine, and pine, varying from about 40 to 70 ft. long, have to be conveyed by rail; and these are usually placed upon trucks similar to

that illustrated in fig. 121, the number of trucks used varying according to the length of log. These trucks are 13 ft. long over headstocks, and fitted with radial bolsters and screw couplings, the latter to enable them to be fairly closely coupled in transit. The draw gear, although it is continuous, is of a special character, the draw rubbers taking their bearing on the central bolster beams, and the draw bar having an elongated

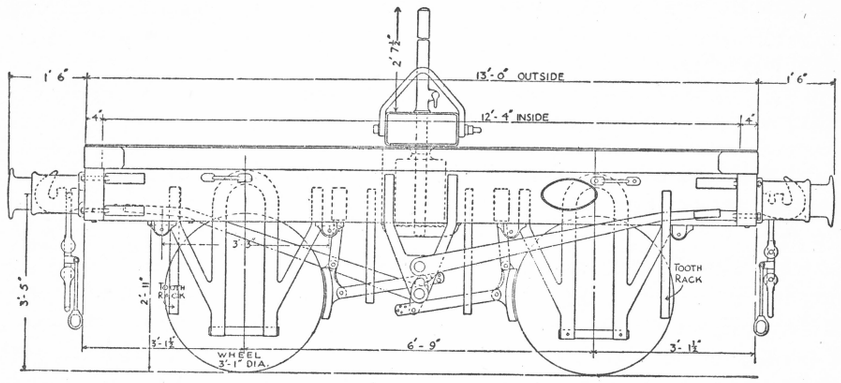


Fig. 121.—Timber Wagon

hole for the bolster centre pins to pass through. The shoulder of each draw hook is kept $\frac{1}{2}$ in. from the headstock draw-bar plates, and the draw movement therefore is limited to this figure. The vehicles are equipped with suitable binding chains, shackles, and stanchions for adequately securing the load, and each wagon is designed to carry 10 tons. The tare is 5 tons. Some companies run twin timber trucks (four-wheelers),

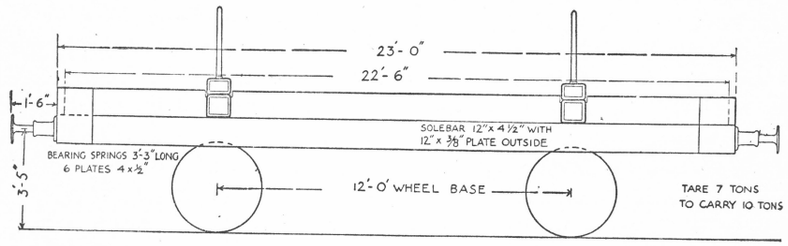


Fig. 122.—Batten Wagon

the extreme ends of which are fitted with ordinary buffers and draw gear; but the inner headstocks have radial faces, with a central slot, through which draw bars work somewhat on the " scissor " principle.

The practice of conveying long logs on a number of short trucks is not to be commended, and is gradually being superseded by the introduction of bogie timber trucks, somewhat of the type of the rail wagon shown in fig. 123; and when the logs are so long as to oversail the wagon at both ends. short runner trucks are used.

For the conveyance of battens and deals, which seldom exceed a length of 23 ft., trucks with two fixed bolsters are used, and a diagram of this type is shown in fig. 122. As the wheel base does not exceed 12 ft., it is possible to turn these trucks on the average turntable, a great convenience in wharves and shunting yards. The overhang from the wheel to the end (5 ft. 6 in.) being more than usual, the buffing spring in this case is not carried directly behind the headstock, but some 3 ft. nearer the wheel, so that the weight thereof will not have a tendency to " hog-back " the frame. These wagons have a carrying capacity of 10 tons, with an average tare of 7 tons.

Rail Trucks and Ballast Wagons.—The introduction of longer (45 ft.) and heavier (90 lb. to the yard) steel rails for use on the main lines of permanent way gave rise to the necessity of a suitable truck to carry them. The vehicle shown in fig. 123 was specially designed for this work, and is typical of similar trucks on most lines. It is 47 ft. 6 in. long over the headstocks, carried on two diamond-framed bogies 34 ft. 6 in. apart. The soles and middle longitudes are of mild steel of girder section 10 in. by $4\frac{1}{2}$ in., weighing 30 lb. per foot, all four being adequately trussed with $1\frac{3}{8}$-in.-diameter rods. It has four fixed bolsters with movable stanchions, all fitted with D shackles, chains, and binding screws for securing the load. The journals are 10 in. by 5 in., with oil axle-boxes, and the axles $6\frac{3}{4}$ in. diameter at the wheel seat and 6 in. diameter at the centre. The average tare of these trucks is $17\frac{1}{2}$ tons, with a carrying capacity of 40 tons.

Special trains for ballasting purposes are now in use on many lines, since they not only save considerable time compared with the old method of hand labour by navvies, but are a great convenience from a traffic point of view, enabling the ballasting to be done with little interruption of the ordinary working of the line. These trains consist of a number of ballast hopper wagons with a plough van at each end. The discharging gear of the wagons is worked by a screw and hand wheel, and can be so regulated as to deliver

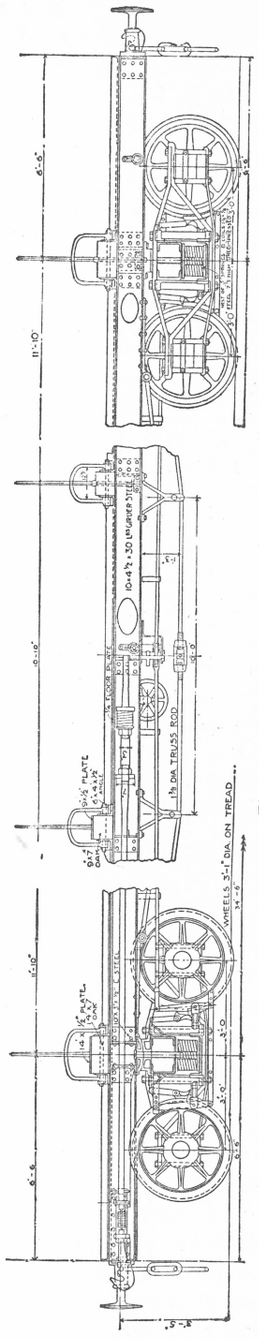


Fig. 123.—Rail Wagon to carry 40 tons

the requisite quantity of ballast to suit the speed (about walking pace) of the train when at work. When the spreader on the plough is lowered, it carries out the levelling required. In wet weather, should any of the ballast hold up on the inclined ends of the wagons, steps and hand rails have been provided to enable a man to clear the material away. These wagons have capacities up to 40 tons.

The London and South-Western Company's hopper trucks are 32 ft. long over headstocks, and have a capacity of about 32 c. yd., with a tare of about $17\frac{1}{4}$ tons. Smaller trucks with a capacity of $9\frac{1}{3}$ c. yd. (equivalent to about 12 tons) are also used for this work. The plough van is 20 ft. long over headstocks, with a wheel base of 13 ft., and also answers the ordinary purposes of a brake van. The underframe is of steel, with channel solebars 12 in. by 3 in. by $\frac{3}{8}$ in. It has laminated buffing and draw gear, but the latter is not continuous, owing to the position of the mechanism in connection with the lifting gear of the spreader. The latter is stiffened with $\frac{1}{4}$-in. plate and $2\frac{1}{2}$-in.-by-$2\frac{1}{2}$-in.-by-$\frac{3}{8}$-in. angles, and the stress, when in use, is taken up on a $3\frac{1}{2}$-in.-diameter pin and a suitable casting, together with stay guides at the back. Hopper wagons are sometimes fitted complete with the vacuum brake, but the plough vans have pipes only with the standard van valve and gauge.

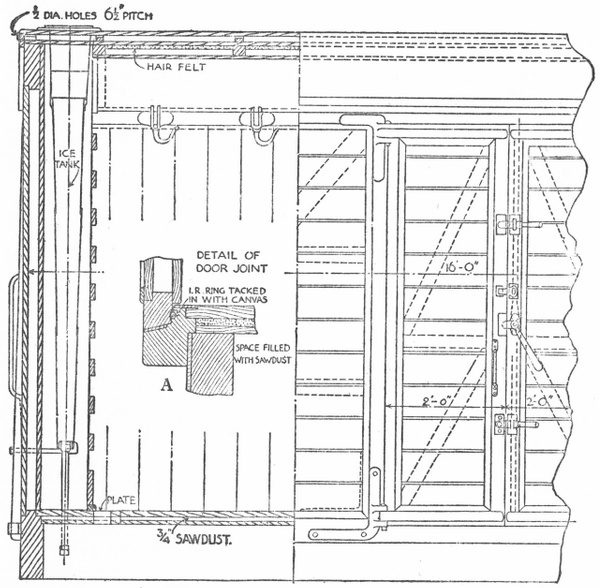


Fig. 124.—Refrigerator Van

Meat-traffic Vans.—Refrigerator vans are chiefly used for the conveyance of frozen meat from the seaports to the large towns, and the considerable increase in this traffic of recent years has made it necessary for those railway companies upon whose lines the ports are situated to largely augment their stock of these vehicles. A section of the body of an average British van is shown in fig. 124; and although the arrangement is not so elaborate as that adopted in American cars, it must be borne in mind that distances travelled in Great Britain do not call for the meat to be more than a day or two at most in the vans. The vehicle illustrated is 16 ft. long over headstocks and 7 ft. $1\frac{1}{2}$ in. width inside, with a length of about

13 ft. 8 in. clear inside. The sides and ends of the vehicle are double cased, the intervening space being filled in with silicate of cotton, while thick "Genasco" two-ply paper covers the inside casings. The roof is triple cased, and consists of: (1) a $\frac{7}{8}$-in. outside casing covered with roof canvas painted, (2) a $1\frac{1}{4}$-in. air space with $\frac{5}{8}$-in.-diameter holes leading in every direction to give a current of air when travelling, (3) a $\frac{3}{4}$-in. casing covered with about $\frac{1}{2}$ in. of hair felt, (4) another air space of $1\frac{1}{2}$ in., and (5) finally a $\frac{9}{16}$-in. casing. The floor is double cased, with $\frac{3}{4}$ in. of fine sawdust rammed tightly between. The joints of the door are sealed with rubber and canvas (see detail at A in fig. 124), and two tanks to receive ice are fixed one at each end of the vehicle. The interior of these vans is varnished; and although zinc has been extensively used for lining refrigerator cars, it has been found that under certain conditions of the atmosphere the sweating which takes place congeals on the zinc, and is not so conducive to keeping the inside "sweet" as when varnished boards are used. The method of insulation varies somewhat on the different lines, some companies using hair felt exclusively, and triple-casing the vehicles all over. The underframing of these vehicles is of similar construction to that shown in fig. 120. As they are fitted with power brakes, &c., these vans are enabled to travel in fast trains whenever required. They are painted a light stone colour so as not to absorb the heat. The tare is $9\frac{1}{4}$ tons, and they carry a load of 8 tons.

In connection with meat traffic, it may be mentioned that large quantities of meat are conveyed to London in road vans loaded upon trucks suitably designed for the work; and in this way much time and labour is saved at the railway terminus, all that is necessary for speedy delivery at the market being to run the vans off the truck and attach a pair of horses to each. Such trucks have a tare of $7\frac{3}{4}$ tons and will carry 12 tons. The road vans average in weight 34 cwt., and carry about 4 tons each.

Standardization of Wagons and Details.—During the last few years there has grown up a strong opinion that considerable economy in maintenance of wagon stock would be effected if all new wagons were built to standard types, and the main details, such as wheels, springs, axle-boxes, buffers, draw gear, and brakework all interchangeable. This opinion is no doubt, in a great measure, due to the delays and inconvenience experienced during the War in repairing damaged and crippled wagons, and this difficulty was mostly found in dealing with trucks belonging to the various railway companies. It is well known that the variety of the fittings on these wagons is very large indeed, and although to facilitate repairs under the common-user arrangements each company supplied to others at certain places a stock of spare parts for immediate use, this precaution did not prevent many serious delays. Under a rigid and compulsory system of standardization in building new trucks, this multiplicity of variation in details would gradually pass away in the next two decades as the stock became worn out and scrapped. However, the argument frequently heard against this proposal is certainly one which cannot be ignored, namely,

that such standardization would ultimately mean stagnation in progress and retardation in improvement. In all probability much could be effected by a reasonable middle course which should admit of the adoption at any time of improvements, which undoubtedly lessened the probability of breakdowns and damage to wagons, and which would thereby facilitate transport. The problem is a difficult and complicated one, and very naturally the representatives of the owners of private wagons (who have since 1887 been compelled to build to Railway Clearing-House specifications) demur to a new type of wagon being laid down unless all railway companies agree themselves to conform thereto. This to some companies would mean very heavy loss in having to scrap equipment details thus made obsolete but not yet worn out, and this proposed change coming at a time when the greatest need for economy exists to enable railways to pay their way, it is easy to understand why the matter is still unsettled and being further considered.

Briefly, the proposal at present is to have a 12-ton standard mineral wagon and a 12-ton standard merchandise and coke wagon, the former being 16 ft. 6 in. long over headstocks, 8 ft. 6 in. wide over all, and 4 ft. $4\frac{1}{2}$ in. depth inside, and the latter 17 ft. 6 in. long over headstocks, with width and depth to suit the kind of traffic they are intended for. It will be permissible to build the underframes of oak or other approved timber, or of wrought-iron or mild-steel sections, and the principal details will no doubt be retained as nearly as possible to those laid down in previous specifications.

It was hoped to have been able to include in this article full particulars and drawings of the new standards, but as a final settlement has not yet been arrived at, no good purpose would be served in anticipating the ultimate results and decisions. Presumably, if the 12-ton standard wagons are found satisfactory other specifications will from time to time be issued for standard trucks of higher capacity, but, for obvious reasons, their adoption in this country must of necessity be a matter of some considerable time.

Guards' Vans for Goods Trains.—Goods trains are heavier and longer than they were a few years ago, and the guards' vans for use with them have necessarily been increased in weight and equipped with very powerful screw hand brakes for use on inclines. The standard van formerly weighed about 10 or 12 tons, but vans from 20 to 25 tons are now the general practice. A modern 20-ton van used on the London and South-Western Railway may be taken for description, and is illustrated in fig. 125. The body is divided into four parts, viz. two verandas, enabling the guard to get in at either end; one transhipment compartment for road box traffic, &c., and one guards' compartment, the latter being equipped with a stove and hand-brake wheel within easy reach of the seat. The van has side lookouts similar to passenger coaches, and other windows suitably placed so that the guard may see out in either direction. This van is 18 ft. long over headstocks, with a wheel base of 10 ft. 6 in., and the body framing is constructed of Stettin oak with casings of deal. The outside panels of

the side lookouts are of mahogany and the wing pillars of teak. The underframe is entirely constructed of black butt (which weighs about 60 lb. per cubic foot as against about 50 lb. for oak), and all available space is converted into "pockets" to receive small scrap iron, &c., for weighting purposes. Between the top of the underframe and the $1\frac{1}{4}$-in. oak floorboards there are placed transversely castings 3 in. thick, 7 in. wide, and 6 ft. 10 in. long, and in this position the weight is well distributed over the frame. All the framing is 12 in. deep, with soles 12 in. by 5 in., strengthened with $\frac{1}{2}$-in. steel plates. The wheels are of the standard

Fig. 125.—20-ton Goods Brake Van

diameter for wagons, viz. 3 ft. 1 in., but the axles have 10-in.-by-5-in. journals, with wheel seats $6\frac{3}{4}$ in. in diameter, and are 6 in. in diameter at the centre. The theoretical hand-brake power of the brake in this vehicle is $885\frac{1}{2}$ to 1. As might be expected, the tare of these vans varies somewhat, the actual tare of the vehicle under description being 20 tons, 9 cwt. 3 qr. Some companies build these vans with frames entirely of steel, and slightly longer than the example described; in which case, as there is more room for the weighting scrap, the castings under the floor may be dispensed with.

Carriage Trucks.—The great increase in the use of motor-cars has considerably curtailed the use of open and covered carriage trucks on British railways. Many of these vehicles, which were built expressly for the conveyance of private carriages, are now more frequently used for carrying scenery, furniture vans, &c., but the longer covered trucks during

the European War proved very useful for the transit of parts of aeroplanes. The covered vehicles, when suitably ventilated, are often used for milk

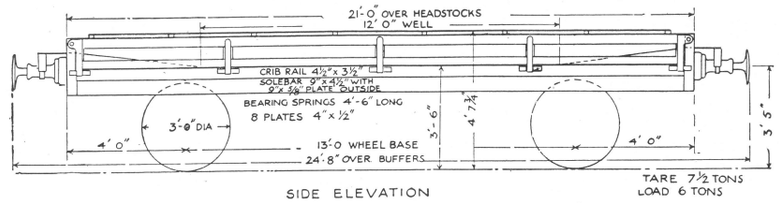


Diagram of 21-ft. Well-floor Open Carriage Truck

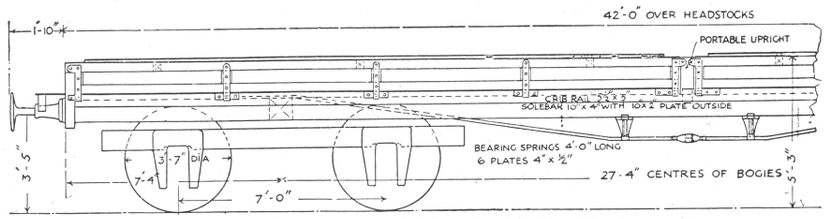
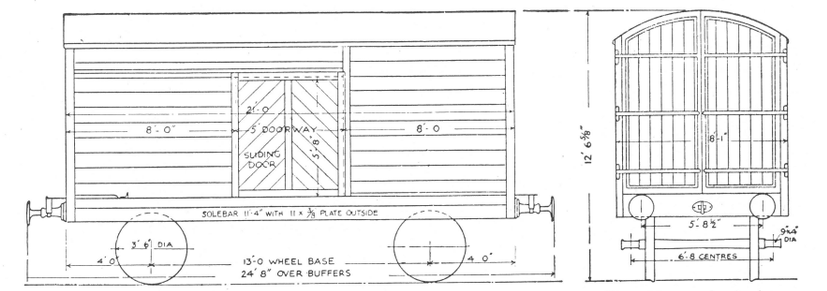
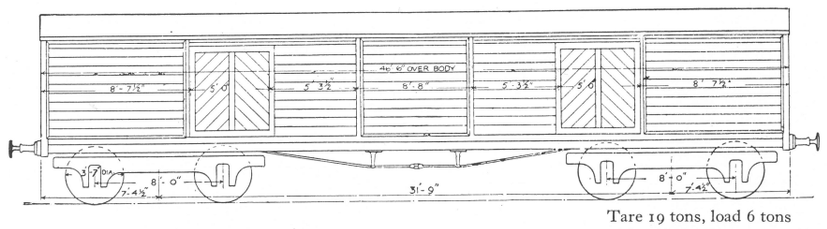


Fig. 126.—Diagram of 42-ft. Bogie Open Carriage Truck

traffic. Fig. 126 gives diagrams of open trucks, the first being a 21-ft. well-floor vehicle, and the second a 42-ft. bogie truck. The former vehicle



Tare 8¾ tons, load 4 tons



Tare 19 tons, load 6 tons

Fig. 127.—Diagrams of 21-ft. and 46-ft.-6-in. Covered Carriage Trucks

has ramp ends, with a 12-ft. well 3 ft. 6 in. from rail level, thus enabling a road vehicle of exceptional height to be safely conveyed. The tare of this truck is $7\frac{1}{2}$ tons, and is designed to carry a load of 6 tons. The bogie

truck was more particularly designed for carrying theatrical scenery, but is capable of conveying three carriages if necessary. It is carried on two four-wheeled bogies 27 ft. 4 in. apart, the bogies themselves having a wheel base of 7 ft. The sides are of the drop pattern to facilitate side loading from a platform, and the truck is fitted with movable wheel bars, wheel plates, &c. The tare of this vehicle is $16\frac{1}{4}$ tons, with a weight-carrying capacity of 10 tons.

Two diagrams of modern covered carriage trucks are shown in fig. 127, one being a four-wheeled vehicle 21 ft. long, with a wheel base of 13 ft., and the other a bogie vehicle 46 ft. 6 in. long with bogie centres 31 ft. 9 in. apart; the latter being sufficiently long to convey the maximum size of theatrical scenery. Both vehicles are fitted with sliding doors at the side and hinged doors at the ends, and are 8 ft. 1 in. wide over body; but the bogie vehicle is about 1 ft. less in height, being built for through traffic and to pass the smallest loading gauge in Britain. The tares and loads of these vehicles are shown in the drawings. The trucks are fitted with Westinghouse and vacuum brakes complete, and through steam pipes, the latter to enable them to be placed in any part of a passenger train when required.

Horse Boxes.—Notwithstanding the rapid development of the motor-car industry, horse boxes are quite as much in requisition as formerly, and considerable improvement has taken place in recent years in the construction of these with the view of giving as much comfort as possible both to the horse and the attendant. The standard length for these vehicles was formerly about 16 ft. with a wheel base of 9 ft., but the riding of such vehicles on the end of a fast train was not all that could be desired, and modern practice is to build the boxes about 21 ft. long over the body with a wheel base of at least 13 ft. The body of such a vehicle is shown in fig. 128, and the underframe for this box was described and illustrated in the early part of the chapter on underframes (p. 98). The body is divided into three parts, viz. an attendant's compartment 4 ft. $10\frac{1}{2}$ in. long, one horse compartment (to take three horses) 10 ft. $1\frac{1}{2}$ in. long, and a luggage compartment 4 ft. 8 in. long, the latter being used to place the partition stalls in when not in use, as in the case when the vehicle is used as a loose box. The main framework of the body is of oak and teak, and the parts which are panelled are of $\frac{3}{8}$-in. mahogany, the bottom flap being made of $1\frac{3}{4}$-in. deal. A powerful spring cased in under the manger controls the flap when being let down, and this not only tends to prevent a restive horse from being frightened by the bang of the flap on the platform, but saves much damage to the flap itself. Most horse boxes have the manger pans open; but owing to the extraordinary fact that horses, although securely tethered, will occasionally get their fore feet in these, with serious results to themselves, some boxes have recently been equipped with strong iron sliding lids to the mangers, the object being that the horse would suffer much less injury by forcing through the back wooden flap than in kicking through a cast-iron pan. The attendant's compartment is

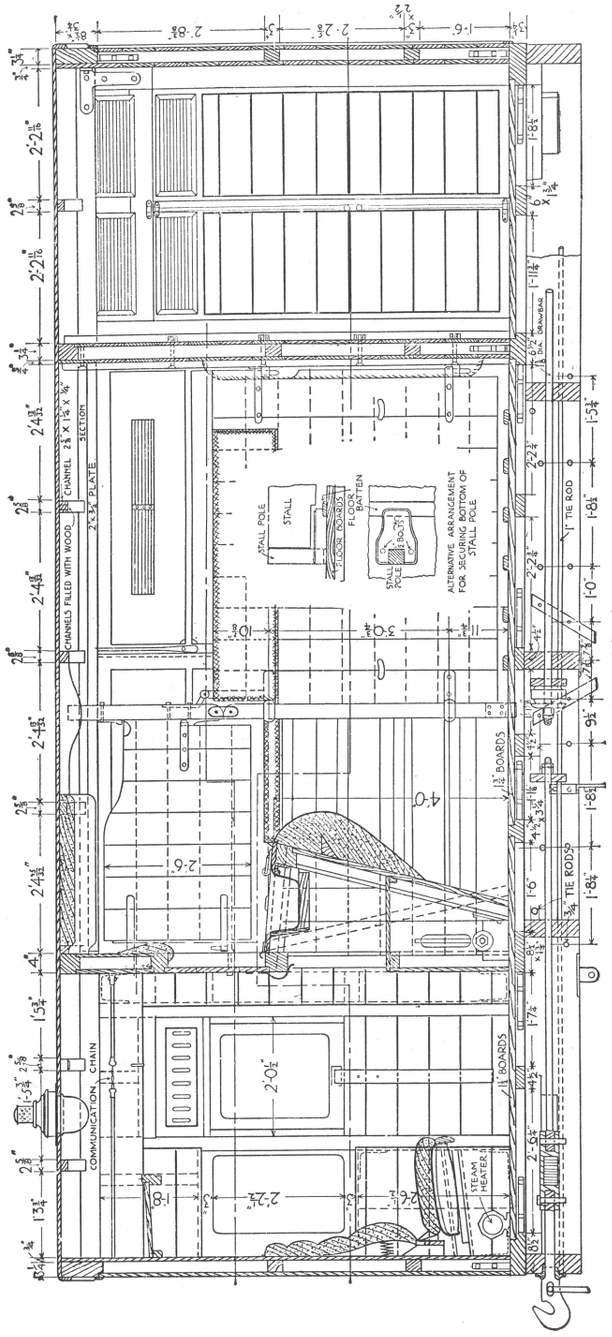


Fig. 128.—21-ft. Horse Box

gas-lighted and steam-heated, and the vehicle is fitted with dual power brakes, side hand brake, and passenger communication. The tare of this horse box is 9 tons 13 cwt.

CHAPTER XI

Horse-drawn Road Vehicles

Although part of the collection and delivery of goods in the towns is usually done by agents of the companies, a large portion is carried out by the railways themselves; and for this purpose they require a considerable stock of road vehicles. The building and maintenance of these form a part of the carriage and wagon department's work. The types of these vehicles vary considerably in different parts of the country, not only to suit the class of traffic, sizes and weights of loads, &c., but to be suitable for the district in which they are required to work. It will be readily understood that vehicles suitable for a flat district would often be of little use in a very hilly town, and that the flat-bottomed cotton lorries of the north of England would not be serviceable for much of the traffic in the south. Both horse-drawn and mechanically propelled vehicles are used for this work, and in order to illustrate average practice in the building of the former the writer gives in Plate IX a working drawing of a three-horse van designed to carry 6 tons; and proposes to describe

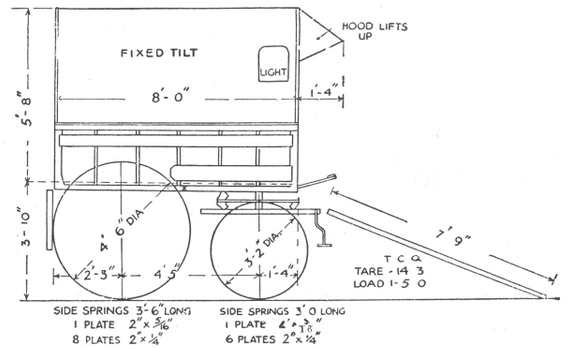


Fig. 129.—One-horse Parcel Van

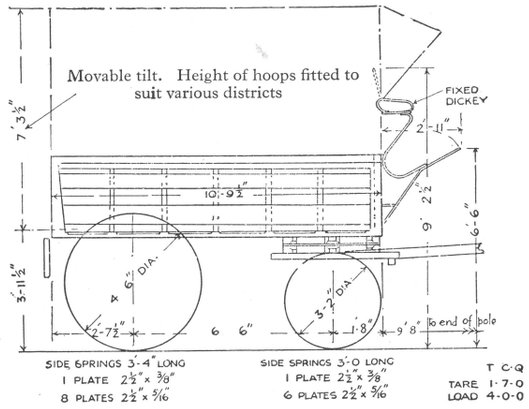


Fig. 130.—Pair-horse Van