

No. 1,472.—“Railway Rolling-stock Capacity, in relation to the Dead Weight of Vehicles.” By WILLIAM ALEXANDER ADAMS, Assoc. Inst. C.E.¹

THE Author, who has been since 1842 connected with the designing and manufacturing of railway rolling stock, desires in this Paper to draw attention to the apparent disproportion of dead weight to paying load, of freight and mineral wagons.

Forty years ago the family travelling-carriage, accommodating four inside, the dress chariot, carrying two, with hammercloth on the driver's seat and standboard for footmen behind, hung upon C-springs, and resting on a heavy under-carriage, weighed upwards of $1\frac{1}{2}$ ton. But a few years before that date no other type of private carriage was in use, and for many years afterwards the only public hack conveyances were the old carriages of the nobility. The only means of public locomotion were the stage-coaches: omnibuses were unknown; and the hack cab on two wheels had not been seen. During the next twenty years the reduction of dead weight in proportion to paying load, and improvements in the construction of public and private common road vehicles, was open to the competitive intelligence of all, the public road being free to every one, and in 1861 broughams had been produced (Plate 10, Fig. 2) giving about the same accommodation and leg-room, and weighing only 6 cwt. 1 qr.

When railways were first opened, freight vehicles were fitted with buffing and drawing springs, and considerable attention was paid to details; but during the thirty ensuing years the types have gradually increased in dead weight; the use of spring buffers has been discontinued in coal and mineral wagons; and the increased dead weight necessitated heavier locomotives, and consequently heavier roads and heavier repairs to permanent way. The chief mineral moved in this country is coal, and the growth of that industry dates from the increase of business after the railway panic of 1848. The Author at that time built wagons, and let them out on hire for long periods, repairing and maintaining them at his own cost. The railway companies, who charged per ton for the load carried,

¹ The discussion upon this Paper was taken in conjunction with the preceding one, and occupied portions of three evenings.

were strangely indifferent to the weight of the wagon, which they hauled full and empty free of charge. They had no regulations limiting dead weight; but as it was the Author's endeavour to construct wagons economical in first cost and in cost of repair, extending over terms of years, it was necessary, in order to have a low-priced wagon, to make a light one, the cost decreasing pretty much in the ratio of its weight. Then, as now, mineral wagons were built without buffing springs, and to avoid cost of repairs it was essential that the wagon should be strong. The Author departed from the ordinary type of construction, introducing plank bodies and the plan of framing shown in Plate 10, Fig. 1. Railway companies at that period limited the load to be carried to 6 tons. The soles and headstocks were of sound straight English oak, 12 inches by $4\frac{1}{2}$ inches; cross bearers of the same, 11 inches by 6 inches; and the thrust framing, viz., the diagonals and the longitudinals, were of fir, the frame being held together by longitudinal and cross tie-rods. The floors were 7 inches by $2\frac{1}{2}$ inches fir, and advantage was taken to increase the rigidity of the frame by laying the floor-boards longitudinally, rabbeting on to the headstocks flush with the top of the soles and headstocks, and spiking firmly to the flat diagonals. The frame thus panelled was practically solid. The drawbars were $1\frac{3}{4}$ inch in diameter at the inside of the headstocks, and $1\frac{3}{8}$ inch at the cross bearer, reduced to $1\frac{1}{8}$ inch between the nuts.

The ordinary type of other builders' wagons was with soles 11 inches by $4\frac{1}{2}$ inches; headstocks $13\frac{1}{2}$ inches by $4\frac{1}{2}$ inches; the two cross bearers, and diagonals and longitudinals all in oak, and the floors laid transversely, resting on the sole-bars, thus failing to utilise the flooring to strengthen the frame, and further necessitating an outside sill in oak, to cover the end of the floors and to carry the outside planking. Fir for thrust purposes was strongly condemned, and has since been interdicted on most railways. Pitch-pine is used throughout the United States for rolling-stock framing; and experiments conducted by the Author twenty-five years ago, at the suggestion of Mr. J. E. McConnell, M. Inst. C.E., proved that wood to be stronger, weight for weight, than any other in ordinary use. It has been adopted by the Great Northern Railway Company for the underframing and bodies of goods wagons.

The type Fig. 1 tared under 3 tons 5 cwt.; the wagons of other builders tared about 3 tons 15 cwt.; the difference in weight representing a difference in cost. The solidity of the panelled frame and the simplicity in construction of the other parts; the use of best cable iron for drawbars and chains; efficient elastic side-

springs, large grease capacity in the axle-boxes, and a well-selected mixture for brass bearings, economised repairs and maintenance. The railway companies, however, did not approve of these wagons, notwithstanding the economy caused by the saving of dead weight. From time to time regulations were issued by the London and North-Western, the Midland, and the Great Western Railway Company, all tending to enforce greater dead weight, but all varying—sometimes to a serious extent—causing considerable difficulty in the supply of wagons to private freighters. Some companies interdicted the use of side-chains; others insisted upon their application. At present the Great Western insist upon spring buffers; the London and North-Western and the Midland companies dispense with them.

For the purposes of the Paper the Author has collected various statistics from English, French, American, and other wagons, as shown in Plates 10 and 11, Figs. 3 to 35.

London and North-Western Railway.—Fig. 3, Plate 10, represents the older type, carrying 6 tons; and Figs. 4 and 5 the newer types, carrying 7 tons, the proportion of dead weight remaining about the same.

Great Northern Railway.—Fig. 6 represents the ordinary type of coal and goods wagon, carrying 9 tons, which compares favourably with other companies.

Midland Railway.—Fig. 7 represents the ordinary type of 6-ton goods wagon, and Fig. 8 the 7-ton. The proportion of dead weight is much in excess to that of other companies. A large traffic is done by this company in beer in barrels, and it would appear, from observations made by the Author, that the 6-ton wagons do not load more than about 3 tons of beer in barrels, and that most of the wagons work back empty, so that the Midland Company in their beer trade convey, full and empty, 12 tons 8 cwt. of dead weight for every 3 tons of paying load, thus receiving payment for less than one-fourth of all they move. Twenty years ago, the Author, as shown in Fig. 1, built 6-ton wagons taring 3 tons 5 cwt., and after a life of fifteen years a large number of these were hired by the Midland Railway Company for their beer and general traffic. But in the beer-carrying trade, and probably in others, the loss by traction of dead weight does not represent the whole loss, as with wagons of larger capacity and less dead weight, shunting-sidings, and wharf-room, would also be less.

North-Eastern Railway.—Fig. 9 represents the type in use, and does not differ from that adopted ten years back.

Great Western Railway.—Fig. 10 represents the older type, and

Fig. 11 the modern. In the latter it will be noted that 8 tons of paying load are carried upon wheels and axles weighing 1 ton 8 cwt. 2 qrs.; whereas on the North-Eastern (Fig. 9) the same load is carried on wheels and axles weighing 1 ton 16 cwt. There would thus seem to be a difference of 7 cwt. 2 qrs. in wheels and axles alone. The coal wagons of the Great Northern Company's standard type tare 5 tons 2 cwt., and convey a paying load of 9 tons.

Taff Vale Railway.—This company probably conveys a larger tonnage of coal per mile than any railway in the world, on a descending gradient to the shipping ports, and the empties uphill, practically all in freighters' wagons. The administration are fully alive to the question of dead weight, and their regulations will not permit the use of wagons exceeding a tare of 3 tons 17 cwt. for the conveyance of 8 tons of coal. Fig. 12 represents the usual type of 8-ton and tip coal wagon.

Great differences exist between wagons owned by wagon companies and other private owners, and there might be seen on the same sidings of the London and North-Western, working in the same class of trade, and apparently under similar conditions—the coal wagons J. S. Claye, 3320 (Fig. 13), Glo'ster Wagon Company, 6593 (Plate 11, Fig. 19), the one conveying 1 ton 9 cwt. 3 qrs. per ton of dead weight, and the other 2 tons 7 cwt. per ton of dead weight.

Upon a Great Western siding, working with a Birmingham Wagon Company's coal wagon of similar type and tare to Fig. 15, was a Broughton Coal Company's coal wagon No. 21 (Fig. 16), the one conveying 1 ton 13 cwt. 3 qrs. per ton of dead weight, the other 2 tons 3 cwt. 2 qrs. per ton of dead weight.

Fig. 17 represents a Metropolitan Wagon Company's coal wagon No. 11,446, one of a number lately supplied to a colliery on the Midland railway; it tares 4 tons 1 cwt., and has a capacity of 6 tons. Under the Midland Railway Company's present regulations for the construction of 6-ton wagons, it would probably be difficult to construct them of less tare. The difference of tare between the present example and wagons built twenty years ago by the Author (Fig. 1) is 16 cwt.; and presuming that one hundred wagons each work, full and empty, 200 miles per week, the Midland Railway Company have contracted to convey, free of charge for the life of the wagon, extending probably over twenty years, an excess of 832,000 tons per year for 1 mile.

Orleans Railway of France.—Figs. 20 and 21, Plate 11, represent the ordinary type of that company's wagons, adopting in all cases a capacity of 10 tons, thereby reducing the proportion of dead to

paying load, and effecting large savings in siding and wharfage accommodation.

Western Railway of France.—Fig. 22 represents the old type of 6-ton wagons, and Figs. 23 and 24 the type now adopted. The latter exhibits a fair proportion of dead weight to paying load as compared with other railways.

American Railroads.—With the exception of the bulk of the coal traffic of Pennsylvania, nearly all American freights and minerals are conveyed in eight-wheel bogie cars. In the opinion of the Author the dead weight of bogie cars as against paying loads must necessarily be greater than in ordinary four-wheeled wagons, as, practically, each bogie is in itself a wagon, and the dead weight of bodies built upon and made a part of the bogie would be considerably less than that of the independent body carried upon the bogie, which body is necessarily very heavy.

For coal the large bogie cars are inconvenient; and the Author believes that in practice nearly all the coal mined in Pennsylvania, and carried over the Pennsylvania and Lehigh Valley railroads, is conveyed in four-wheel wagons of somewhat rude construction (Fig. 25). They are without springs. The axle-boxes are carried in horizontal bars of hard wood, bolted to blocks under the soles of the wagon. Conveyed at slow speeds, these wagons appear to work well enough, but, judiciously constructed, the tare might be much reduced.

The light rails and imperfect road-bed of the bulk of the American railways precludes working such lines with the rigid engines and four-wheel wagons of European railways. The elastic American locomotive, without rigid side frames, and the low-wheeled car bogies with short wheel base, where the weight rests on the centre of the bogies and allows the wheels to lift and adjust themselves to the inequalities of the road, certainly go along, at from 12 to 16 miles an hour, in a surprising manner. Considerable reduction might, however, be effected in the weight of American freight cars, and the proportion of dead weight reduced from its present average of about ton per ton of paying load (Figs. 26, 27, 28).

The promoters and makers of the Denver and Rio Grande, and other 3-foot gauges, have looked well into the question of dead weight. The design and construction of the Denver and Rio Grande cars was placed in the hands of Messrs. Bilmeyer and Smalls, car-builders, of York, Pa., with excellent results, as shown in Figs. 29, 30. The promoters of these narrow-gauge lines claim as the advantage of their gauge the reduction of dead weight, a reduction just as readily to be effected on the 4-foot

8½-inch gauge by applying to the subject the same care and thought.

Soudan Railway of Egypt.—Fig. 32 represents the type of wagon designed by Mr. John Fowler, Past-President Inst. C.E., for a 3-feet 6-inch gauge. These wagons are constructed entirely of wrought iron, excepting the floors, which are of pitch-pine.

Festiniog Railway.—Figs. 33, 34, and 35 are the principal wagons upon that 2-feet gauge railway. It is to be noted that the tares are the extreme loads that are permitted to be carried, if the wagons will contain them.

The slate wagon (Fig. 33) does not usually load beyond 3 to 3½ tons of slate, and the coal wagon (Fig. 34) beyond 4 to 4½ tons of coal; but, allowing for that, the proportion of paying to dead weight is more economical on the cars of this railway than on those of any other. If 3 tons of paying weight to 1 ton of dead weight can be carried upon so inconvenient a gauge as the 2-feet, as good results should be looked for on the 4-feet 8½-inch gauge.

The Midland Railway Company have formally announced the intention to buy up all private coal wagons upon their system, and to supply freighters with wagons as well as locomotive power. If they do so, it is to be hoped they will, for increase of stock and replacements, endeavour to design wagons that shall carry 2½ tons and upwards of paying weight to 1 ton of dead weight. It appears that there are 28,805 wagons belonging to the company and 40,000 belonging to private owners—in round numbers, 69,000 wagons—none of which probably average in tare less than 4 tons 14 cwt. The Author has no reliable data upon which to base his assumption, but he understands that these wagons average 200 miles per week each, full and empty. Assuming the excess of dead weight to that which is required to be 1 ton per wagon, this represents a wasteful movement of 717,600,000 tons per annum moved 1 mile, which is equal to running thirty-four ordinary loaded mineral trains to Birmingham and back every working day in the year.

The Paper is accompanied by a series of diagrams, from which Plates 10 and 11 have been compiled.

[Mr. ADAMS

Mr. ADAMS said since the Paper was read he had been informed that the Pennsylvania Railroad Company now ran wagons of the class shown in Fig. 27, taring about the same, and carrying a load of 15 tons of coal. The use of small wagons on the Pennsylvania main lines was continued, and the larger wagons were for the western branches. He wished it to be understood that he had no personal interest whatever in the matters under discussion. With regard to Plate 10, Fig. 1, it was not to be supposed that he considered it a perfect wagon. There were many things about it which, if he were designing a wagon for railways, he should not introduce. The wagon in question was intended to meet the requirements of the freighter, not those of the railway company. He never should have recommended a wagon without buffer springs or drawing springs, and he thought that such wagons should not be permitted on a railway. He had, however, built about five thousand of those wagons, which by their low tare had up to the present time saved the railways in conveyance about 500 million tons conveyed 1 mile. No doubt they gave a good deal of trouble to the companies for repairs. In the early days the manufacturers had not sufficient repairing stations, and the freighter rarely thought of sending a wagon for repair until it was almost falling to pieces. The owners who let them out on hire could not get them in for repairs, and wagons often continued running in a condition that ought not to have been permitted. As to dead weight, the difficulty was not in regard to the mechanical question, how to construct wagons of fair tare for the duty to be performed, but to direct the attention of the railway companies to the subject. For the past fifteen or twenty years these had looked favourably upon wagons that tared heavily, and wagon-owners and freighters had done the same.

He had not proposed to make any remarks upon the details of construction, but as another Paper had been read upon that subject, he could not leave it unnoticed. The wagon shown in Plate 9 would not pass the regulations of the Great Western Railway Company, which stated that no freighter's wagon should work upon the line unless it had buffer springs and drawing springs—an excellent regulation that ought always to be followed. The wagon would pass the Midland and the London and North-Western Companies, but wagons built under the regulations of the London and North-Western Company would not pass the Midland Company or the Great Western. The wheel was one of a type that had been out of use fifteen or twenty years. The standard wheels of the Great Western Company weighed 28 cwt. 2 qrs.; those of the North-Eastern 36 cwt. He could see no necessity for making wheels

so heavy. A solid wrought-iron skeleton of fair proportions would weigh about 9 cwt. the set, axles 6 cwt. 1 qr. If upon that skeleton $1\frac{3}{4}$ -inch tires were put, all purposes of safety would be answered. He believed that the wheel and axle of the future were not those now in use. The future axle he thought would be a tubular one, 7 or 8 inches in diameter. He was of opinion that it was a mistake to make the wheel and then put the tire on the outside; and with steel, or more properly ingot iron, he believed it was possible to make the wheel in a solid piece, tire, skeleton, and nave. The tire would not then be in tension, and both tire and skeleton could be utilised. If these suggestions were adopted there would be an end of broken tires and broken axles. In theory a spring should be triangular in form, and in one plate that would deflect sufficiently without breaking or setting. In practice a spring should deflect about $1\frac{3}{4}$ inch with the weight of the body and load, and should be capable of deflecting say 5 inches in all without fracture or permanent set; then it would not matter whether it was 2, or 3, or 5 feet long, or whether there was one plate or fifty. In order to make a light spring the plates should be thickened. In setting out a spring, the proper course was to ascertain the greatest thickness of steel that would pass through 5 inches of space, and then add plate to plate until there were enough to carry the weight to be imposed upon them. He quite agreed in the view expressed by Mr. Browne, that oil was much superior to grease, and he considered the latter a barbarism. Grease had been continued in consequence of there being no effective means of oiling freighters' wagons. The only additional cost of oil-boxes was in the rings at the back making a joint upon the axle, and the cotton wool, or the springs put in to push the oil against the bottom of the axle. He had some time ago designed an oil axle-box for the time when it should be required by railway companies; it had never been used, but any one desiring to have an effectual and simple oil-box was welcome to the design. With regard to the axle-guards, his opinion was that they should be made strong. When wagons got off the road the axle-guards often bent and got out of shape, so that the wagons could not immediately be put on the line again, as they might be if strong axle-guards were used with the L iron wider than at present employed, Plate 9. A set of wheels and axles such as he had described would weigh 1 ton 5 cwt. 3 qrs., the springs 2 qrs. 2 cwt., and the oil-box 2 qrs. 2 cwt.; in making the box it would be worth while to resort to malleable cast iron. It was possible, he thought, to make thoroughly efficient wheels, springs and axle-box weighing 1 ton 9 cwt. 3 qrs. as against

1 ton 8 cwt. 2 qrs., the lightest description used by railway companies for wheels and axle alone. With reference to drawing and buffing springs, his opinion was that there was no method of buffing and drawing equal to that of laminated cross-springs; the plan was adopted thirty years ago, and there was nothing to supersede it. As to buffer-rods, he never could understand why they had not been made tubular. A buffer-rod $3\frac{1}{2}$ inches in diameter, with a head worked carefully on, would be much lighter, stiffer and better than the ordinary form. He did not approve of the use of American oak cut from the log for wagon-making. It was poor in fibre, and consisted of about 20 per cent. of water. For 12-ton broad-gauge wagons he had usually stiffened the soles by flitching. The flitch was about 2 inches by 6 inches, and answered the purpose very well; there was no hogging, and the sole-bar was much stiffened.

Mr. BERKLEY was reluctant to detain the meeting from the practical remarks of carriage and wagon superintendents and traffic managers, who had more knowledge on the subject of the proportion between capacity and dead weight than other persons, though traffic managers might not know so much in regard to the details of mechanical construction. He ventured, however, to speak, because a few years ago he had prepared a document (pages 110-113) showing the proportionate weights, capacities, and bearing powers of railway wagons. The statement included wagons of all kinds, on sixteen 4-feet $8\frac{1}{2}$ -inch gauge lines, on seven 5-feet 6-inch lines, on one 5-feet line, and on one 5-feet 3-inch line. He had not given the maximum weight, as that only represented what could be put upon the vehicle under certain conditions of traffic. The capacity should not be represented by these figures, but by the floor area of a low-sided wagon, or the cubic contents of a high-sided or covered wagon; and his headings had been arranged accordingly. Having arrived at these points, he wished to ascertain where the bearing power was. He assumed that the frames would be strong enough in ordinary practice, but he found that the springs gave way, that the axles heated, and that the journals and the springs were therefore the parts which required special attention, in order to secure the bearing power being equal to the capacity represented by the floor area or the cubic contents of the wagons.

The abstract of gross averages gave the proportion of weight in tons of the wagons, to the floor area, to the cubic contents, and to other parts which really represented the bearing power. The form of the wagon should be determined by the nature of

its contents (as to whether they were bulky or heavy), and should also have some reference to the line itself. The curves on the railway would necessarily affect the construction, the length of the coupling, the use of bogie wheels and the like. Mr. Adams proposed to make wheels lighter than those used on some railways, which he complained of as being too heavy. He had taken a $1\frac{3}{4}$ -inch instead of a 2-inch tire. Whether that was economical appeared doubtful. It was a pity that some standard of efficiency could not be adopted as a basis of comparison. With reference to the use of thick plates for springs, there could be no doubt that they gave greater bearing power than thin plates. Some years ago, however, the Great Western Railway Company almost invariably employed thick plates, and other companies had also tried them; but they were not now used, and he was at a loss to know the reason why. Experience had led to the use of thinner plates, which appeared therefore to be practically better than the others. In the comparison between wood and iron frames, no distinction had been made between the various kinds of wood, it being simply said that wood was cheaper and lighter. Taking teak, however, which was undoubtedly the best wood for such purposes, the difference in weight and cost was very small, but of course the difference would be affected by the varying market prices of the two articles. With oak or pitch-pine there would be a considerable advantage over iron both in regard to cost and weight. It was important that the wooden frames of wagons should be seasoned. Formerly the wood was properly seasoned, but in the present days of keen competition, when men were obliged to work for the lowest price, unseasoned wood was often employed, and hence the wagons were of inferior quality. He agreed as to the form of the axle behind the wheel; he had known many break from the shoulder at the back of the wheel. The shoulder was no doubt a great source of weakness, but that could be avoided.

STATEMENT of PROPORTIONATE WEIGHTS, CAPACITIES, AND

Name of Railway.	Class of Vehicle.	Dimensions of Body.				Capacity.		Wheels.
		Inside.		Inside.		Area of the Floor.	Cubical Contents.	
		Length.	Width.	Height at the Centre.	Height at the Side.			
4 feet 8½ inches Gauge.								
London and North-Western	Low sided, open	15 0	7 1½	0 9	0 9	107 0	..	4
	" " " "	15 0	7 1½	1 8	1 8	107 0	..	4
	" " " "	15 1	7 2	0 8½	0 8½	108 1	..	4
	" " " "	15 1	7 2	1 9	1 9	108 1	..	4
	" " " "	15 0	7 2	1 10	1 10	107 6	..	4
London and South-Western	Covered	12 10	6 6	6 2	5 6	83 5	496 9	4
	" " " "	15 4	6 10	6 2	5 6	104 9	611 0	4
	High sided, open	15 0	7 2	5 3	3 3	107 6	456 10	4
	" " " "	14 8	7 0½	4 9½	2 9½	103 3	395 9	4
	" " " "	14 8	7 0	4 9½	2 9½	102 8	393 6	4
Great Northern	Covered	15 9	7 1½	6 1	5 6	112 2	654 4	4
	High sided, open	14 7	7 1	2 11	2 11	103 3	361 2	4
	" " " "	14 7	7 1	2 9	2 2	103 3	258 1	4
	" " " "	14 7	7 1	3 0	3 0	103 3	309 9	4
	Covered	16 0	7 1	5 11	5 8	113 4	661 1	4
London, Brighton, and South Coast	High sided, open	15 6	7 5	4 2	2 3	115 0	373 9	4
	" " " "	14 10½	7 4	5 9	3 0	109 0	481 5	4
	Low sided, open	13 6	6 11	1 9	1 9	93 4	..	4
	" " " "	13 6	6 11	1 9	1 9	93 4	..	4
	" " " "	13 7	7 2	1 9	1 9	97 4	..	4
Midland	Covered	13 0	6 7	6 2	5 5	85 7	499 4	4
	High sided, open	13 5	6 11	6 0	3 9	92 9	409 7	4
	" " " "	13 7	7 1	3 0	3 0	96 2	288 6	4
	Low sided, open	17 6	7 2	0 11	0 11	125 5	..	4
	" " " "	17 6	7 2	1 6	1 6	125 5	..	4
Great Western	" " " "	15 0	7 0	0 11	0 11	105 0	..	4
	" " " "	17 6	7 3	0 10	0 10	126 10	..	4
	Covered	17 4	6 10	5 6	5 1	118 5	631 6	4
	" " " "	15 0	6 11	5 6	5 0	103 9	544 8	4
	Covered	14 0	7 3	6 6	6 2	101 6	642 10	4
South-Eastern	High sided, open	15 1	7 3	5 8½	2 8½	109 4	464 8	4
	" " " "	15 1	7 3	5 8½	2 8½	109 4	464 8	4
	High sided, open	15 8	6 10	4 0	2 3	106 9	338 0	4
	" " " "	15 7	7 6	4 0	2 3	110 10	370 0	4
	Low sided, open	15 7	7 2	0 8½	0 8½	111 8	..	4
Lancashire and Yorkshire	" " " "	15 7	7 2	1 6	1 6	111 8	..	4
	Covered	15 9	7 4	6 0	4 10	115 6	625 7	4
	Covered	14 6	7 2	5 3	4 9	103 11	519 7	4
	High sided, open	15 7	7 1	2 6	2 6	110 4	275 10	4
	High sided	15 0	7 2	5 1	3 3	107 6	447 11	4
Pembroke and Tenby	Covered	15 0	7 0	6 9	6 1½	105 0	682 6	4
	High sided, open	13 8	6 11	3 4	2 11	94 6	299 3	4
	Low sided, open	13 7	7 1	1 9	1 9	96 2	..	4
	Covered	13 6	6 11	5 3	4 9	93 4	466 8	4
	Low sided, open	15 0	7 0	1 6	1 6	105 0	..	4
Caledonian	Covered	13 8	6 6	6 0	5 6	88 10	510 9	4
	High sided, open	13 10	6 10	3 7½	2 9	94 6	307 1	4
	Covered	14 9	6 8	6 1	5 7½	98 4	581 9	4
	High sided, open	15 0	6 9	2 10	2 3	101 3	261 7	4
	Low sided, open	14 0	7 0	0 9	0 9	98 0	..	4
Mid Wales	Covered	13 10	6 10	6 8	5 5	94 6	574 10	4
	" " " "	13 10	6 10	6 8	6 0	94 6	598 6	4
	" " " "	13 10	6 10	6 8	6 0	91 6	598 6	4
	High sided, open	14 0	7 0	3 2	2 8	98 0	285 10	4
	Gross Averages 4 feet 8½ inches Gauge.							
Low sided		Mean of 14 sets of vehicles for 7 railways						
Covered		17	"	"	"	13	"	
High sided		20	"	"	"	12	"	

N.B.—Each "set of vehicles" represents the number of the particular vehicle returned by one of the rail-

BEARING POWERS OF WAGONS ON SEVERAL LINES OF RAILWAY.

Journals.			Springs.					Weight.		Averages.					
Length.	Diameter.	Product of the length × the diameter.	Distance centre to centre of Spring Shoes.	No. of Plates.	Width of Plates.	Thickness of Plates.	Product of the total thickness × the width.	Total weight when empty.	Weight.	Capacity.		Journals	Springs.		
									When empty.	Area of Floor.	Cubical Contents.	Product of the length × the diameter.	Distance from centre to centre of Shoes.	Product of the total thickness × the width.	
In.	In.	In.	Ft. In.	No.	In.	In.	In.	T. c.	T. c.	Ft. in.	Ft. in.	In.	Ft. in.	In.	
6	3	18	3 6	14	3	5 15 ¹⁵ ₁₆	15 1 ¹⁵ ₁₆	3 15							
6	3	18	3 6	14	3	5 15 ¹⁵ ₁₆	15 1 ¹⁵ ₁₆	4 0							
6	3	18	3 6	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	4 1	4 0 ¹ ₂	107	6 3 ³ ₄	..	18	3 6	
6	3	18	3 6	13	3	4 12 ¹² ₁₆	12 1 ¹² ₁₆	4 2						14 3 ³ ₄	
6	3	18	3 6	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	4 4							
6	3	18	3 6	14	3	5 15 ¹⁵ ₁₆	15 1 ¹⁵ ₁₆	4 10							
6	3	18	3 6	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	5 1	4 15 ¹ ₂	94	1	548	10 1 ¹ ₂	18	
7	3 1 ¹ ₂	24 1 ¹ ₂	3 2	11	3	4 12 ¹² ₁₆	12 1 ¹² ₁₆	5 18						14 3 ³ ₄	
6	3	18	3 6	11	3	4 12 ¹² ₁₆	12 1 ¹² ₁₆	5 2	5 10 1 ¹ ₂	104	5 3 ³ ₄	415	4 3 ³ ₄	20 1 ¹ ₂	
6	3	18	3 6	11	3	4 12 ¹² ₁₆	12 1 ¹² ₁₆	5 11						3 4 3 ³ ₄	
8	3 1 ¹ ₂	26	3 6	14	3	5 16 ¹⁶ ₁₆	16 1 ¹⁶ ₁₆	5 6	5 6	112	2	654	4	26	
8	3	24	3 6	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	5 0						3 6	
8	3 1 ¹ ₂	26	3 6	14	3	5 16 ¹⁶ ₁₆	16 1 ¹⁶ ₁₆	4 18	4 16	103	3	289	8	24 3 ³ ₄	
8	3 1 ¹ ₂	28	4 3	9	3 1 ¹ ₂	3 15 ¹⁵ ₁₆	13 3 ¹⁵ ₁₆	6 2	6 2	113	4	661	1	28	
8	3 1 ¹ ₂	26	3 6	13	3	4 14 ¹⁴ ₁₆	14 1 ¹⁴ ₁₆	5 11						4 3	
8	3 1 ¹ ₂	28	3 5	12	3	5 15 ¹⁵ ₁₆	15 1 ¹⁵ ₁₆	4 15	5 3	112	0	427	7	13 3 ³ ₄	
6	3	18	3 1 1 ¹ ₂	11	3	4 12 ¹² ₁₆	12 1 ¹² ₁₆	4 0						15	
6	3	18	3 2	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	4 13	4 9 3 ³ ₄	94	8	..	18	3 1 1 ¹ ₂	
6	3	18	3 2	11	3	4 12 ¹² ₁₆	12 1 ¹² ₁₆	4 16						12 1 ¹ ₂	
6	3	18	3 2	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	4 18	4 18	85	7	499	4	18	
6	3	18	3 2	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	5 0						3 2	
8	3 1 ¹ ₂	28	3 2	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	5 14	5 7	94	5 1 ¹ ₂	349	0 1 ¹ ₂	13 1 ¹ ₂	
7	3 1 ¹ ₂	24 1 ¹ ₂	3 6	11	4	4 17	17	5 6						13 1 ¹ ₂	
7	3 1 ¹ ₂	24 1 ¹ ₂	3 6	11	4	4 17	17	5 8							
7	3 1 ¹ ₂	24 1 ¹ ₂	3 6	10	4	4 16	16	4 7	5 1 1 ¹ ₂	120	8	..	24 1 ¹ ₂	3 6	
7	3 1 ¹ ₂	24 1 ¹ ₂	3 6	11	4	4 17	17	5 5						16 1 ¹ ₂	
7	3 1 ¹ ₂	24 1 ¹ ₂	3 6	11	4	4 17	17	5 18							
7	3 1 ¹ ₂	24 1 ¹ ₂	4 3	19	3	7 21 3 ³ ₄	21 3 ³ ₄	5 4	5 11	111	1	588	1	24 1 ¹ ₂	
8	3 1 ¹ ₂	26	3 4	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	5 5	5 5	101	6	642	10	3 10 1 ¹ ₂	
8	3 1 ¹ ₂	26	3 4	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	5 0						19 3 ³ ₄	
8	3 1 ¹ ₂	26	3 4	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	5 10	5 5	109	4	464	8	13 1 ¹ ₂	
8	3 1 ¹ ₂	26	3 6	11	3 1 ¹ ₂	4 14 1 ¹ ₂	14 1 ¹ ₂	4 17	4 19 1 ¹ ₂	111	9 1 ¹ ₂	354	0	26	
8	3 1 ¹ ₂	28	3 8	11	3 1 ¹ ₂	4 14	14	5 2						27	
6	3	18	3 6	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	4 3	4 19 1 ¹ ₂	111	8	..	18	3 7	
6	3	18	3 6	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	4 5	4 4	111	8	..	18	3 6	
6	3	18	3 6	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	4 18	4 18	115	6	625	7	13 1 ¹ ₂	
8	3 1 ¹ ₂	26	3 6	12	3 1 ¹ ₂	4 16 1 ¹ ₂	16 1 ¹ ₂	5 3	5 3	103	11	519	7	18	
8	3 1 ¹ ₂	26	3 6	12	3 1 ¹ ₂	4 16 1 ¹ ₂	16 1 ¹ ₂	4 12	4 12	110	4	275	10	26	
8	3 1 ¹ ₂	28	3 6	12	3	4 13 ¹³ ₁₆	13 1 ¹³ ₁₆	5 8	5 8	107	6	447	11	3 6	
7	3 1 ¹ ₂	24 1 ¹ ₂	3 3	10	3 1 ¹ ₂	3 13 1 ¹ ₂	13 1 ¹ ₂	5 12	5 12	105	0	682	6	13 1 ¹ ₂	
6	3	18	3 0	11	3	4 12 1 ¹ ₂	12 1 ¹ ₂	3 19	3 19	94	6	299	3	3 3	
6	3	18	3 2	11	3	4 12 1 ¹ ₂	12 1 ¹ ₂	4 13	4 13	96	2	..	18	3 0	
6	3	18	3 2	11	3	4 12 1 ¹ ₂	12 1 ¹ ₂	4 16	4 16	93	4	466	8	12 1 ¹ ₂	
8	3 1 ¹ ₂	26	4 3 1 ¹ ₂	10	4	3 15 1 ¹ ₂	15 1 ¹ ₂	5 5	5 5	105	0	..	..	18
8	3 1 ¹ ₂	26	3 2	10	3 1 ¹ ₂	5 18 1 ¹ ₂	18 1 ¹ ₂	5 15	5 15	88	10	510	9	26	
8	3 1 ¹ ₂	26	3 3	10	4	5 20	20	4 10	4 10	94	6	307	1	26	
7	3 1 ¹ ₂	22 1 ¹ ₂	3 4	12	3	4 13 1 ¹ ₂	13 1 ¹ ₂	5 5	5 5	98	4	581	9	22 1 ¹ ₂	
7	3 1 ¹ ₂	22 1 ¹ ₂	3 4	12	3	4 13 1 ¹ ₂	13 1 ¹ ₂	4 10	4 10	101	3	261	7	22 1 ¹ ₂	
9	3 1 ¹ ₂	29 1 ¹ ₂	3 6	11	3	4 12 1 ¹ ₂	12 1 ¹ ₂	4 2	4 2	98	0	..	..	3 4
9	3 1 ¹ ₂	29 1 ¹ ₂	3 6	11	3	4 12 1 ¹ ₂	12 1 ¹ ₂	5 13						3 6	
9	3 1 ¹ ₂	29 1 ¹ ₂	3 6	11	3	4 12 1 ¹ ₂	12 1 ¹ ₂	5 15	5 17 3 ³ ₄	94	6	590	10	29 1 ¹ ₂	
9	3 1 ¹ ₂	29 1 ¹ ₂	3 6	11	3	4 12 1 ¹ ₂	12 1 ¹ ₂	6 5						3 4	
9	3 1 ¹ ₂	29 1 ¹ ₂	3 6	11	3	4 12 1 ¹ ₂	12 1 ¹ ₂	4 15	4 15	98	0	285	10	29 1 ¹ ₂	
..	..	..	..	..	..	..	..	..	4 10 1 ¹ ₂	104	9 1 ¹ ₂	..	21 1 ¹ ₂	3 6 1 ¹ ₂
..	..	..	..	..	..	..	..	..	5 6 3 ³ ₄	101	4	582	5 1 ¹ ₂	23 1 ¹ ₂
..	..	..	..	..	..	..	..	..	4 18	102	9 1 ¹ ₂	348	1 3 ³ ₄	24 1 ¹ ₂

way companies, for whom the same has been manufactured, or by the wagon-maker by whom it has been manufactured.

STATEMENT OF PROPORTIONATE WEIGHTS, CAPACITIES AND

Name of Railway.	Class of Vehicle.	Dimensions of Body.				Capacity.		Wheels.	
		Inside.		Inside.		Area of the Floor.	Cubical Contents.	Number of.	
		Length.	Width.	Height at the Centre.	Height at the Side.				
5 feet 6 inches Gauge.		Ft. in.	Ft. in.	Ft. in.	Ft. in.	Ft. in.	Ft. in.		
Great Indian Peninsula . . .	Low sided, open . . .	18 7	8 1	1 2½	1 2½	150 3	..	4	
		18 7	8 1	2 0	2 0	150 3	..	4	
		16 8	8 1	1 2½	1 2½	134 8	..	4	
	Covered	16 6	7 8	6 6	5 3	124 6	736 7	4	
		16 6	7 8	6 6	5 3	124 6	736 7	4	
	Cotton van	23 6	9 0	8 0	6 8	211 6	1,551 0	4	
		19 6	9 0	8 0	6 8	175 6	1,287 0	4	
	High sided, open . . .	16 8	7 8	4 11	3 1½	127 9	521 8	4	
16 8		7 8	4 11	3 1½	127 9	521 8	4		
Delhi	Covered	15 5½	7 9½	7 2	6 4	120 5	812 10	4	
	"	15 4	7 8	7 2	5 6	117 6	744 2	4	
	High sided, open . . .	15 6	7 10	7 4½	6 5	121 5	839 9	4	
		15 6	7 8	5 0	3 6	118 10	505 0	4	
	Bombay and Baroda	15 8	7 10	5 0	3 6	122 9	521 8	4	
		15 4	7 8	7 1	5 2	117 6	724 7	4	
	Eastern Bengal	Covered	18 3	8 0	7 5	7 0	146 0	1,053 6	4
		High sided, open . . .	15 7	7 10½	3 1½	2 7½	122 9	358 0	4
	Tudela and Bilbao	Covered	15 10	8 5	7 0	6 10½	133 3	932 9	4
		High sided, open . . .	14 8	7 8	4 9	3 0	112 5	440 3	4
Ceylon	Low sided, open . . .	15 7	7 9	1 1	1 1	120 9	..	4	
	Covered	15 5	7 7	6 3	5 10	117 0	711 9	4	
	"	14 5	7 7	6 3	5 10	109 4	665 1	4	
Santiago and Valparaiso . .	High sided, open . . .	15 7	7 9	2 11½	2 11½	120 9	357 1	4	
	Low sided, open . . .	15 7	8 1	2 4	2 4	126 0	..	4	
	Covered	15 4	7 9	8 0	7 2	118 10	901 1	4	

Gross Averages of the 5 feet 6 inches Gauge, excepting the G. I. P.

	Low sided, open	Mean of 2 sets of vehicles for 2 railways				..
	Covered . . .	9	5	5	4	..
	High sided, open	..	..	..	..	..
MIXED GAUGES.						
Irish 5 feet 3 inches	Covered . . .	13 3	7 3	6 10	5 1	96 1
	High sided . . .	15 0	7 6	6 10	5 1	112 6
	Covered . . .	13 4	7 3	6 10	5 0	96 8
	High sided, open . . .	13 8	7 2	3 3	2 9	98 0
Russian 5 feet 0 inches	Covered . . .	20 10	8 5	7 10	7 4	175 4
	High sided, open . . .	20 7	8 7	7 4	6 11½	176 8
	High sided, open . . .	20 8	8 8	5 8	3 3½	179 1

In Tons, Cwts.—Feet, Inches.

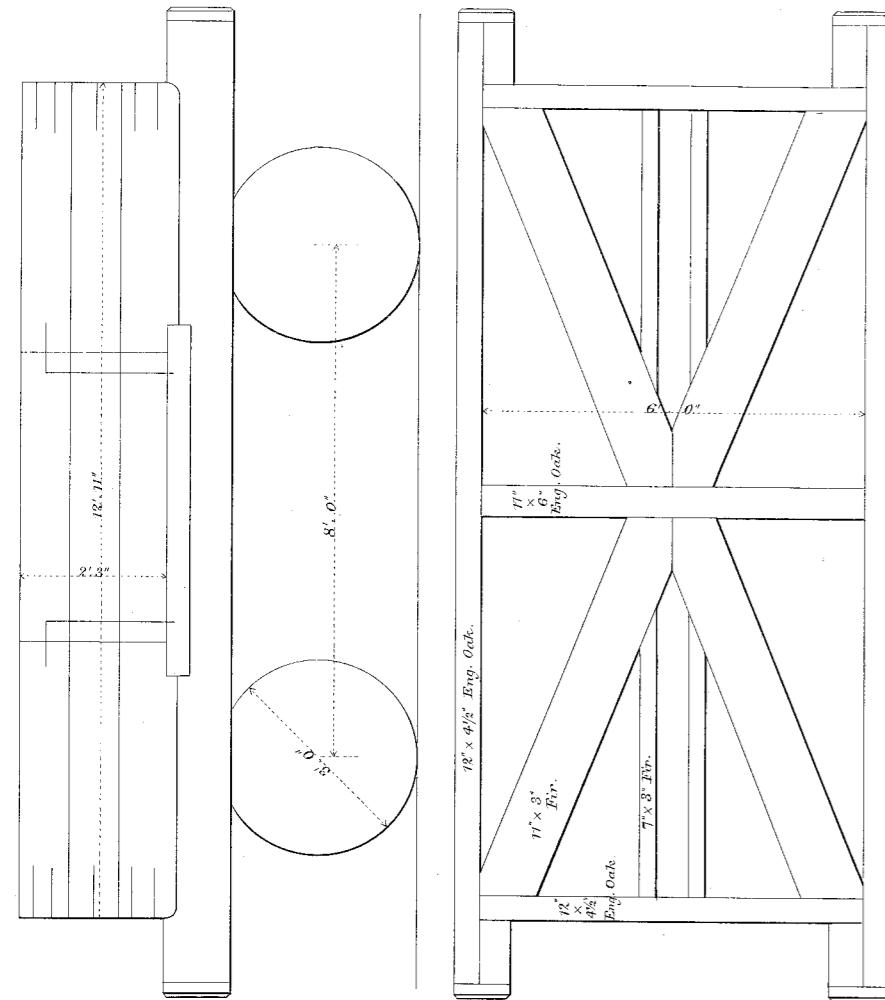
Abstract of Gross Averages.				Weight Empty.	Area of Floor.	Cubical Contents.	Journals.	Springs.					
							Area.	Length.	Sectional Area.				
										Product of the length × the diameter.	Centre to centre of Spring Shoes.	Width × the total thickness.	
4 ft. 8½ ins. gauge.	Low sided .	Mean of 14 sets of vehicles on 7 railways			T. cwt.	Ft. ins.	Ft. ins.	Ins.	Ft. ins.	Ins.			
	Covered . .	"	17	"	"	13	"	4 10½	104 9½	..	21 ¾	3 6 ⅝	14
	High sided .	"	20	"	"	12	"	5 6 ⅝	101 4	582 5½	23 ⅓	3 5½ ⅝	14½ ⅞
G. I. P. 5 ft. 6 ins. gauge.	Low sided	Mean of 3 sets of vehicles . .			5 12½	145 0½	..	30	3 6	14 ⅝			
	Covered .	"	2	"	"	..	5 16	124 6	736 7	30 ¾	3 6	14 ⅓ ⅙	
	High sided	"	2	"	"	..	5 11	127 9	521 8	30 ¾	3 6	14 ⅓ ⅙	
	Cotton . .	"	2	"	"	..	6 9½	193 6	1,419 0	30 ¾	3 6	16 ⅞	
5 ft. 6 ins. gauge, excepting the G. I. P.	Low sided .	Mean of 2 sets of vehicles on 2 railways			5 1	123 4½	..	28 ⅝	3 6	15 ⅓ ⅔			
	Covered . .	"	9	"	"	6	"	6 10½	124 9	850 6	28 ⅞	3 5½	16
	High sided .	"	5	"	"	4	"	5 3½	119 2½	417 2	28 ⅞	3 4½	14 ⅓ ⅔

BEARING POWERS OF WAGONS, ON SEVERAL LINES OF RAILWAY.

Journals.			Springs.					Weight.	Averages.							
Length.	Diameter.	Product of the length \times the diameter.	Distance centre to centre of Spring Shoes.	No. of Plates.	Width of Plates.	Thickness of Plates.	Product of the total thickness \times the width.	Total weight when empty.	Weight.		Capacity.		Journals		Springs.	
									When empty.	Area of Floor.	Cubical Contents.	Product of the length \times the diameter.	Distance from centre to centre of Shoes.	Product of the total thickness \times the width.		
In.	In.	In.	Ft. in.	No.	In.	In.	In.	T. c.	T. c.	Ft. in.	Ft. in.	In.	Ft. in.	In.		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	12	3	4 $\frac{1}{2}$	14 $\frac{1}{2}$	5 17	} 5 12 $\frac{1}{2}$	145 0 $\frac{3}{4}$	..	30	3 6	14 $\frac{1}{2}$	
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	13	3	5 $\frac{1}{2}$	14 $\frac{1}{2}$	5 18		124 6	736 7	30 $\frac{1}{2}$	3 6	14 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	12	3	4 $\frac{1}{2}$	14 $\frac{1}{2}$	5 17		193 6	1,419 0	30 $\frac{1}{2}$	3 6	16 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	13	3	5 $\frac{1}{2}$	15 $\frac{1}{2}$	5 17	} 6 9 $\frac{1}{2}$	127 9	521 8	30 $\frac{1}{2}$	3 6	14 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	12	3	4 $\frac{1}{2}$	14 $\frac{1}{2}$	5 18		119 9 $\frac{1}{2}$	798 11	29 $\frac{1}{2}$	3 6	15		
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	13	3	5 $\frac{1}{2}$	15 $\frac{1}{2}$	5 17		120 9 $\frac{1}{2}$	513 4	29 $\frac{1}{2}$	3 3	15		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	10	3	4	12	6 5	} 5 5	117 6	724 7	31 $\frac{1}{2}$	3 6	12		
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	14	3	5 $\frac{1}{2}$	16 $\frac{1}{2}$	7 0		146 0	1,058 6	29 $\frac{1}{2}$	3 6	16 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	13	3	5 $\frac{1}{2}$	15 $\frac{1}{2}$	5 0		122 9	358 0	29 $\frac{1}{2}$	3 6	15 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	10	3	4	12	6 10	} 6 10	133 3	932 9	26	3 4	16 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	10	3 $\frac{1}{2}$	4	14	5 5		112 5	440 3	26	3 4	15		
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	10	3 $\frac{1}{2}$	4	14	4 14		113 2	688 5	29 $\frac{1}{2}$	3 6	14		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	10	3 $\frac{1}{2}$	4	14	6 5	} 6 4	120 9	357 1	29 $\frac{1}{2}$	3 6	14		
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	10	3 $\frac{1}{2}$	4	14	6 3		120 9	357 1	29 $\frac{1}{2}$	3 6	14		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	10	3 $\frac{1}{2}$	4	14	5 8		126 0	..	28	3 6	16 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	12	3 $\frac{1}{2}$	4 $\frac{1}{2}$	16 $\frac{1}{2}$	5 8	} 5 11	118 10	901 1	28	3 6	16 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	12	3 $\frac{1}{2}$	4 $\frac{1}{2}$	16 $\frac{1}{2}$	6 15		123 4 $\frac{1}{2}$	850 6	28 $\frac{1}{2}$	3 6	15 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	13	3	5	15	5 17		124 8	850 6	28 $\frac{1}{2}$	3 5 $\frac{1}{2}$	15		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	12	3	4 $\frac{1}{2}$	14 $\frac{1}{2}$	5 14	} 5 3 $\frac{1}{2}$	119 2 $\frac{1}{2}$	417 2	28 $\frac{1}{2}$	3 4 $\frac{1}{2}$	14 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	13	3	5	15	5 17		101 9	607 10	20 $\frac{1}{2}$	3 3 $\frac{1}{2}$	17 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	10	3	4	12	6 5		98 0	294 0	18	3 6	17 $\frac{1}{2}$		
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	10	3	4	12	5 15	} 6 5	176 0	1,297 10	22 $\frac{1}{2}$	3 6	12		
9	3 $\frac{1}{2}$	29 $\frac{1}{2}$	3 6	10	3	4	12	6 15		179 1	805 10	21 $\frac{1}{2}$	3 6	12		
9	3 $\frac{1}{2}$	31 $\frac{1}{2}$	3 6	10	3	4	12	5 5		179 1	805 10	21 $\frac{1}{2}$	3 6	12		

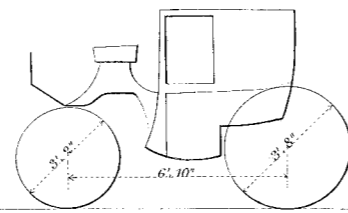
In per cent. taking G. I. P. as 100.						Proportions.					
Weight empty.	Area of Floor. (Square.)	Cubical Contents. (Cubical.)	Journals.		Springs.		Of Weight in tons to Floor Area.	Of Weight in tons to Cubical Contents.	Of Weight in tons to Area of Journal.	Of Weight in tons to Length of Springs.	Of Weight in tons to Sectional Area of Springs.
			Area.	Length.	Sectional Area.						
T. cwt.	Ft. ins.	Ft. ins.	Sq. ins.	Ft. ins.	Sq. ins.						
80.59	72.22	..	72.21	100.40	95.72	$\frac{1}{28.07}$	..	$\frac{1}{4.76}$	$\frac{1}{.77}$	$\frac{1}{3.14}$	
91.56	81.39	79.07	77.23	98.97	99.70	$\frac{1}{19.08}$	$\frac{1}{109.28}$	$\frac{1}{4.41}$	$\frac{1}{.63}$	$\frac{1}{2.78}$	
88.28	80.36	66.74	81.74	96.42	97.05	$\frac{1}{20.98}$	$\frac{1}{71.01}$	$\frac{1}{5.06}$	$\frac{1}{.66}$	$\frac{1}{2.93}$	
100.	100.	..	100.	100.	100.	$\frac{1}{25.75}$	..	$\frac{1}{5.32}$	$\frac{1}{.62}$	$\frac{1}{2.59}$	
100.	100.	100.	100.	100.	100.	$\frac{1}{21.46}$	$\frac{1}{126.99}$	$\frac{1}{5.23}$	$\frac{1}{.60}$	$\frac{1}{2.55}$	
100.	100.	100.	100.	100.	100.	$\frac{1}{23.01}$	$\frac{1}{93.99}$	$\frac{1}{5.47}$	$\frac{1}{.63}$	$\frac{1}{2.86}$	
..	..	..	..	..	..	$\frac{1}{20.90}$	$\frac{1}{219.31}$	$\frac{1}{4.69}$	$\frac{1}{.55}$	$\frac{1}{2.49}$	
89.65	85.05	..	95.41	100.	103.20	$\frac{1}{24.45}$	..	$\frac{1}{5.66}$	$\frac{1}{.69}$	$\frac{1}{2.81}$	
112.50	100.20	115.46	95.06	99.20	101.27	$\frac{1}{19.12}$	$\frac{1}{130.34}$	$\frac{1}{4.57}$	$\frac{1}{.54}$	$\frac{1}{2.29}$	
93.16	93.27	79.66	93.59	97.19	100.21	$\frac{1}{27.79}$	$\frac{1}{172.79}$	$\frac{1}{4.72}$	$\frac{1}{.57}$	$\frac{1}{2.56}$	

Fig: 1.



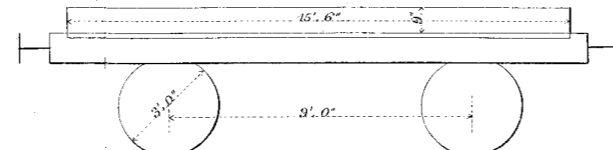
W.A. ADAMS' Coal Wagon, BIRMINGHAM 1850.
Capacity 6 Tons—Tare 3 Tons 5 Cwt.
Capacity per Ton of Dead weight 1 Ton 16 Cwt. 3 qrs.

Fig: 2.



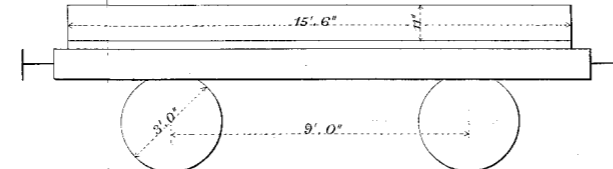
BROUGHAM BY HOLMES OF DERBY.
Tare 6 Cwt. 1 qr. 2 lbs.

Fig: 3.



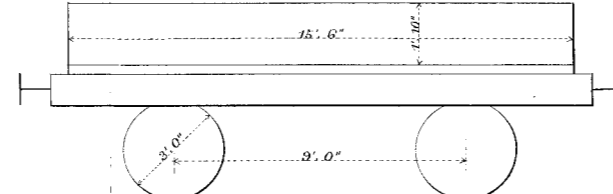
Gauge 4' 8 1/2"
LONDON & NORTH WESTERN RY Platform Goods Wagon, Old Type.
Capacity 6 Tons—Tare 3 Tons 15 Cwt. 1 qr.
Capacity per Ton of Dead weight 1 Ton 11 Cwt. 3 qrs.

Fig: 4.



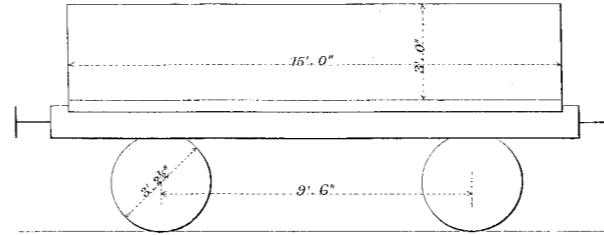
Gauge 4' 8 1/2"
LONDON & NORTH WESTERN RY Platform Goods Wagon, New Type.
Capacity 7 Tons—Tare 4 Tons 8 Cwt. 1 qr.
Capacity per Ton of Dead weight 1 Ton 11 Cwt. 3 qrs.

Fig: 5.



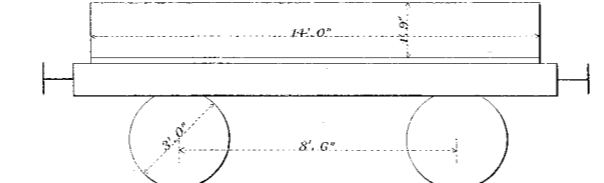
Gauge 4' 8 1/2"
LONDON & NORTH WESTERN RY Lowside Goods Wagon.
Capacity 7 Tons—Tare 4 Tons 12 Cwt. 1 qr.
Capacity per Ton of Dead weight 1 Ton 10 Cwt. 1 qr.

Fig: 6.



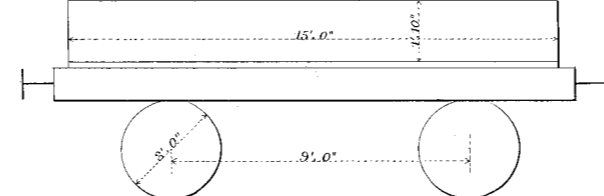
Gauge 4' 8 1/2"
GREAT NORTHERN RY Coal and Goods Wagon.
Capacity 9 Tons—Tare 5 Tons—
Capacity per Ton of Dead weight 1 Ton 16 Cwt.

Fig: 7.



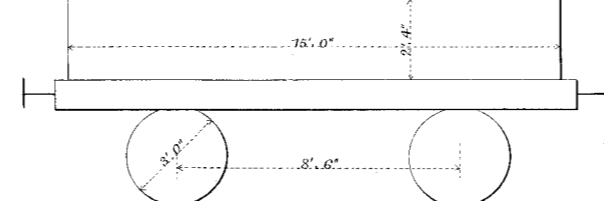
Gauge 4' 8 1/2"
MIDLAND RY Lowside Goods Wagon.
Capacity 6 Tons—Tare 4 Tons 14 Cwt. 2 qrs.
Capacity per Ton of Dead weight 1 Ton 5 Cwt. 2 qrs.

Fig: 8.



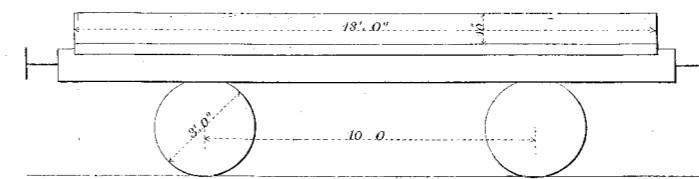
Gauge 4' 8 1/2"
MIDLAND RY Lowside Goods Wagon.
Capacity 7 Tons—Tare 4 Tons 15 Cwt. 1 qr.
Capacity per Ton of Dead weight 1 Ton 9 Cwt. 2 qrs.

Fig: 9.



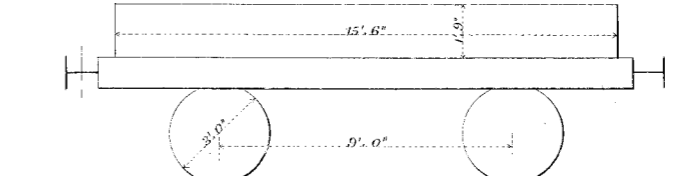
Gauge 4' 8 1/2"
NORTH EASTERN RY Coal and Goods Wagon.
Capacity 8 Tons—Tare 5 Tons 9 Cwt.
Capacity per Ton of Dead weight 1 Ton 9 Cwt.

Fig: 10.



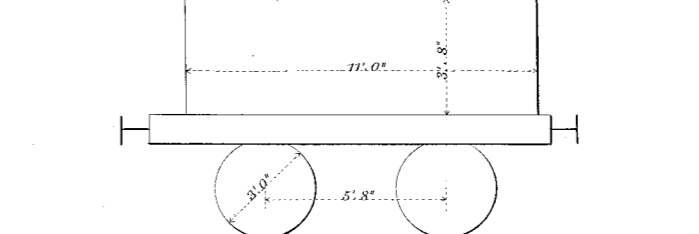
Gauge 4' 8 1/2"
GREAT WESTERN RY Lowside Goods Wagon.
Capacity 8 Tons—Tare 4 Tons 17 Cwt.
Capacity per Ton of Dead weight 1 Ton 13 Cwt.

Fig: 11.



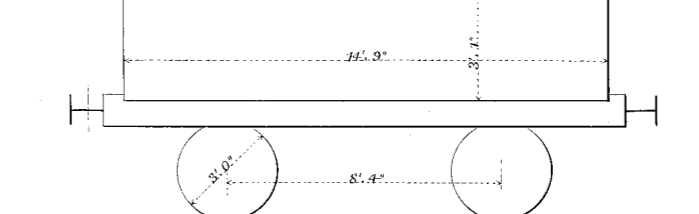
Gauge 4' 8 1/2"
GREAT WESTERN RY Lowside Goods Wagon, Swindon 1874.
Capacity 9 Tons—Tare 4 Tons 13 Cwt.
Capacity per Ton of Dead weight 1 Ton 18 Cwt. 3 qrs.

Fig: 12.



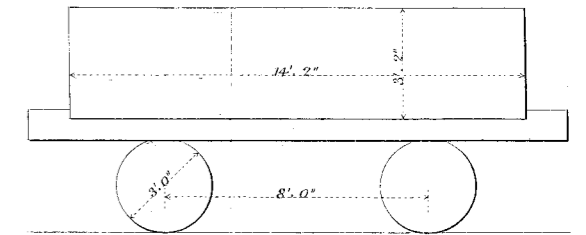
Gauge 4' 8 1/2"
TAFF VALE RY Coal Wagon (Bristol Wagon Works Co)
Capacity 8 Tons—Tare 3 Tons 15 Cwt.
Capacity per Ton of Dead weight 2 Tons 2 Cwt. 3 qrs.

Fig: 13.



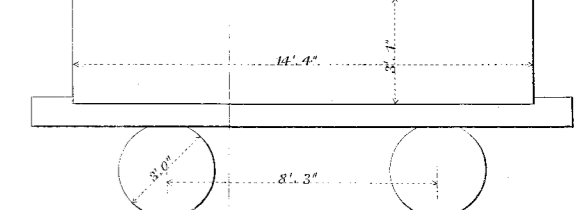
Gauge 4' 8 1/2"
S. J. CLAYE, Coal Wagon.
Capacity 8 Tons—Tare 5 Tons 8 Cwt.
Capacity per Ton of Dead weight 1 Ton 9 Cwt. 3 qrs.

Fig: 14.



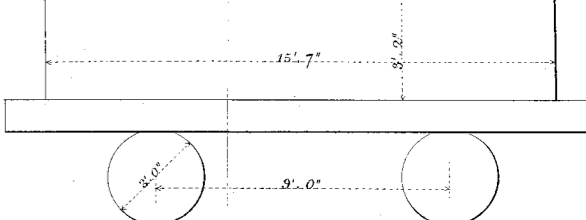
Gauge 4' 8 1/2"
MIDLAND WAGON CO Standard Coal Wagon.
Capacity 8 Tons—Tare 4 Tons 9 Cwt. 1 qr.
Capacity per Ton of Dead weight 1 Ton 15 Cwt. 3 qrs.

Fig: 15.



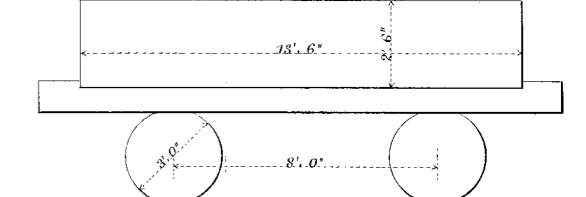
Gauge 4' 8 1/2"
BIRMINGHAM WAGON CO Standard Coal Wagon.
Capacity 8 Tons—Tare 4 Tons 15 Cwt.
Capacity per Ton of Dead weight 1 Ton 13 Cwt. 3 qrs.

Fig: 16.



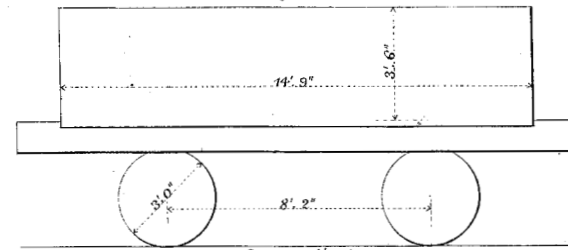
Gauge 4' 8 1/2"
BIRMINGHAM WAGON CO Broughton Coal Co's Wagon.
Capacity 10 Tons—Tare 4 Tons 12 Cwt.
Capacity per Ton of Dead weight 2 Tons 3 Cwt. 2 qrs.

Fig: 17.



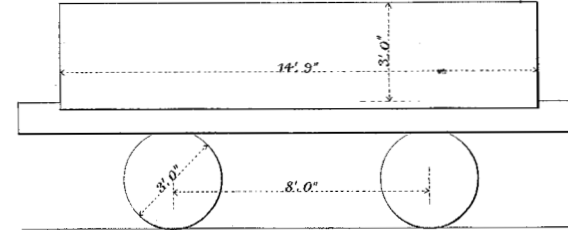
Gauge 4' 8 1/2"
METROPOLITAN WAGON CO Coal Wagon.
Capacity 6 Tons—Tare 4 Tons 1 Cwt.
Capacity per Ton of Dead weight 1 Ton 9 Cwt. 3 qrs.

Fig: 18.



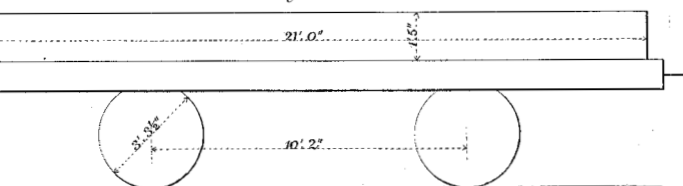
Gauge 4' 8 1/2"
GLOSTER WAGON C2 Standard Coal Wagon.
 Capacity 10 Tons—Tare 4 Tons 19 Cwt. 3 qrs.
 Capacity per Ton of Dead weight 2 Tons.

Fig: 19.



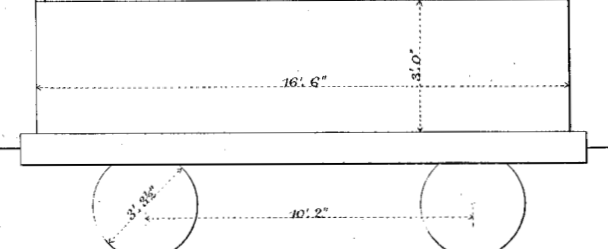
Gauge 4' 8 1/2"
GLOSTER WAGON C2 (Owned by L & N.W.) Coal Wagon.
 Capacity 10 Tons—Tare 4 Tons 5 Cwt.
 Capacity per Ton of Dead weight 2 Tons 7 Cwt.

Fig: 20.



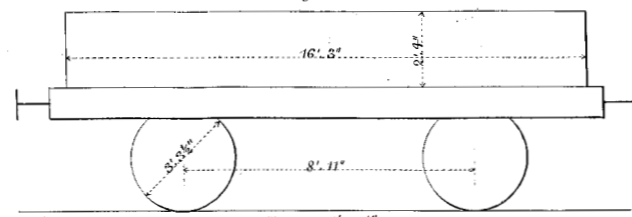
Gauge 4' 8 1/2"
ORLEANS RY OF FRANCE Platform Goods Wagon, Series H.
 Capacity 10 Tons—Tare 5 Tons—
 Capacity per Ton of Dead weight 2 Tons.

Fig: 21.



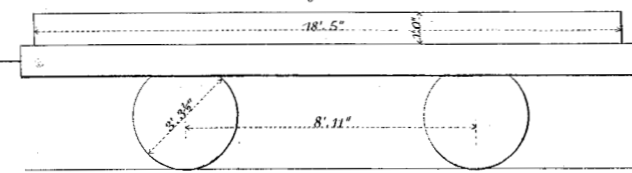
Gauge 4' 8 1/2"
ORLEANS RY OF FRANCE Coal Wagon, Series I.
 Capacity 10 Tons—Tare 4 Tons 8 Cwt.
 Capacity per Ton of Dead weight 2 Tons 4 Cwt. 2 qrs.

Fig: 22.



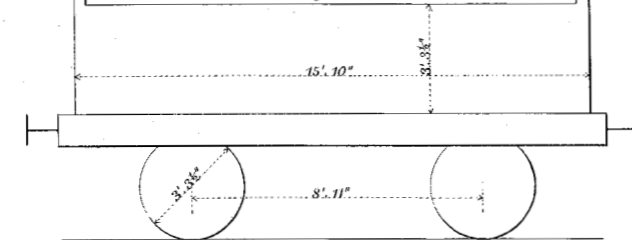
Gauge 4' 8 1/2"
WESTERN RY OF FRANCE, Lowside Goods Wagon, Old Type, Series L.
 Capacity 6 Tons—Tare 4 Tons—
 Capacity per Ton of Dead weight 1 Ton 10 Cwt.

Fig: 23.



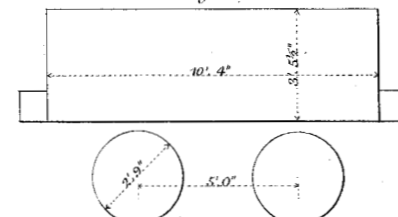
Gauge 4' 8 1/2"
WESTERN RY OF FRANCE, Platform Goods Wagon, New Type, Series M.
 Capacity 10 Tons—Tare 4 Tons 6 Cwt.
 Capacity per Ton of Dead weight 2 Tons 3 Cwt. 2 qrs.

Fig: 24.



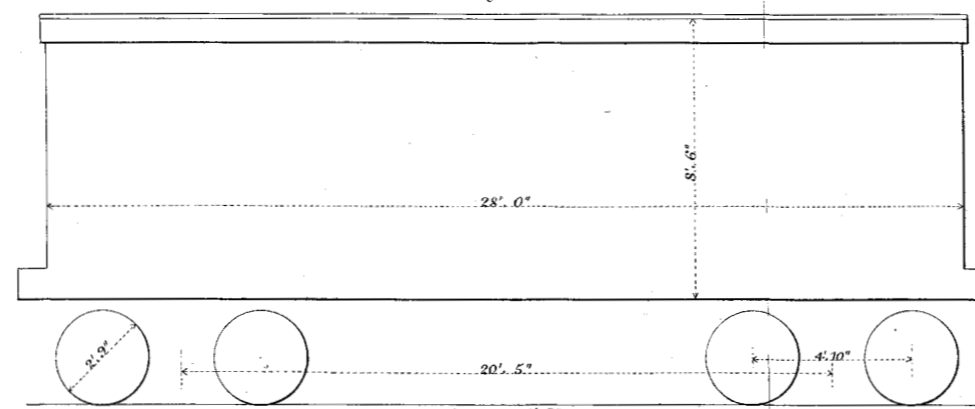
Gauge 4' 8 1/2"
WESTERN RY OF FRANCE, Highside Goods Wagon, New Type, Series L.
 Capacity 10 Tons—Tare 3 Tons 9 Cwt.—
 Capacity per Ton of Dead weight 2 Tons 11 Cwt. 1 qr.

Fig: 25.



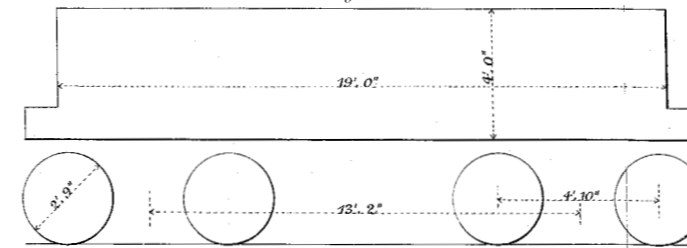
Gauge 4' 9"
PENNSYLVANIA R.R. Coal Wagon.
 Capacity 5 Tons 7 Cwt.—Tare 3 Tons 6 Cwt. 2 qrs.
 Capacity per Ton of Dead weight 1 Ton 12 Cwt. 1 qr.

Fig: 26.



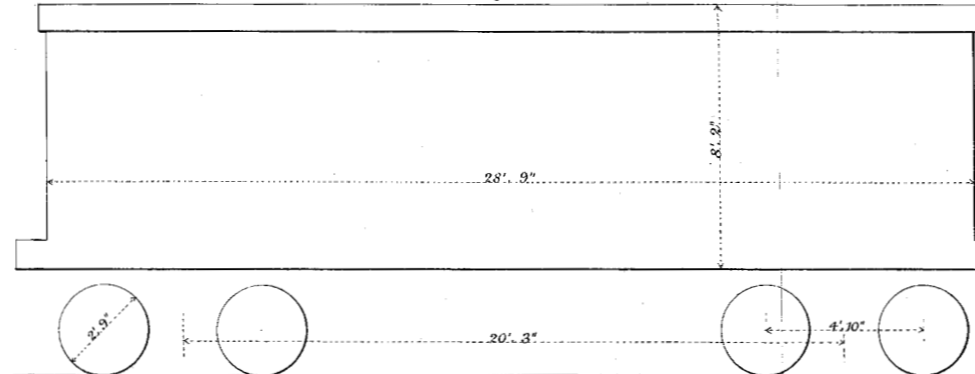
Gauge 4' 9"
PENNSYLVANIA R.R. Grain and Goods Wagon.
 Capacity, Goods 7 Tons 3 Cwt.—Grain 10 Tons 14 Cwt.—Tare 8 Tons 18 Cwt. 2 qrs.
 Capacity per Ton of Dead weight: Goods 16 Cwt.—Grain 1 Ton 4 Cwt.

Fig: 27.



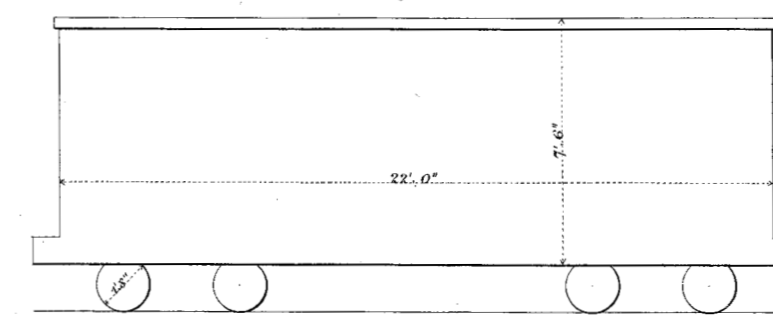
Gauge 4' 9"
PENNSYLVANIA R.R. Coal Wagon.
 Capacity 10 Tons 3 qrs.—Tare 7 Tons 2 Cwt. 3 qrs.
 Capacity per Ton of Dead weight 1 Ton 8 Cwt. 1 qr.

Fig: 28.



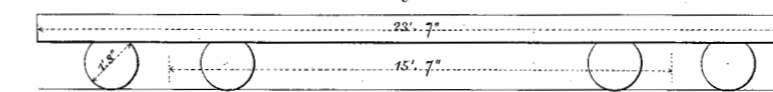
Gauge 4' 9"
CHICAGO, DANVILLE & VINCENNES R.R. Grain and Goods Wagon.
 Capacity, Goods 7 Tons 3 Cwt.—Grain 10 Tons 14 Cwt.—Tare 8 Tons 18 Cwt. 1 qr.
 Capacity per Ton of Dead weight: Goods 16 Cwt.—Grain 1 Ton 4 Cwt.

Fig: 29.



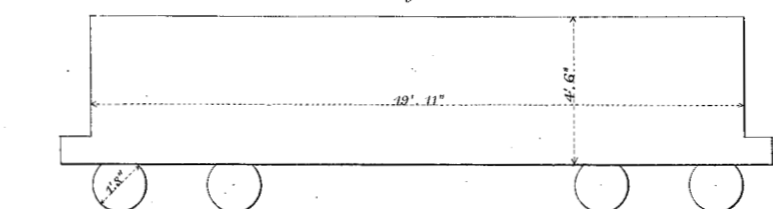
Gauge 3' 0"
DENVER & RIO GRANDE R.R. Grain and Goods Wagon.
 Capacity 8 Tons 1 qr.—Tare 4 Tons 7 Cwt. 2 qrs.
 Capacity per Ton of Dead weight 1 Ton 16 Cwt. 3 qrs.

Fig: 30.



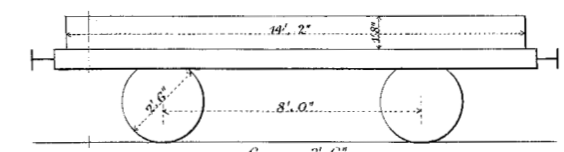
Gauge 3' 0"
DENVER & RIO GRANDE R.R. Flat Car.
 Capacity 10 Tons—Tare 2 Tons 16 Cwt.
 Capacity per Ton of Dead weight 3 Tons 11 Cwt. 2 qrs.

Fig: 31.



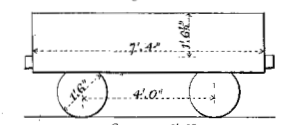
Gauge 3' 0"
EAST BROAD TOP R.R. Coal Wagon.
 Capacity 8 Tons—Tare 4 Tons 3 Cwt.
 Capacity per Ton of Dead weight 1 Ton 18 Cwt. 2 qrs.

Fig: 32.



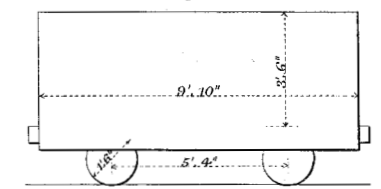
Gauge 3' 6"
SOUDAN RY Hinged Side Wagon.
 Capacity 6 Tons—Tare 3 Tons 8 Cwt. 2 qrs.
 Capacity per Ton of Dead weight 1 Ton 15 Cwt.

Fig: 33.



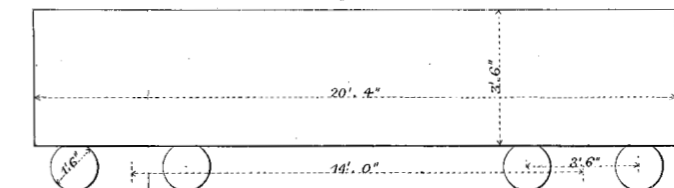
Gauge 2' 0"
FESTINIOG RY Slate Wagon.
 Capacity 4 Tons—Tare 1 Ton 2 Cwt.
 Capacity per Ton of Dead weight 4 Tons.

Fig: 34.



Gauge 2' 0"
FESTINIOG RY Coal Wagon.
 Capacity 5 Tons—Tare 1 Ton 6 Cwt. 2 qrs.
 Capacity per Ton of Dead weight 3 Tons 15 Cwt. 2 qrs.

Fig: 35.



Gauge 2' 0"
FESTINIOG RY Bogie Coal Wagon.
 Capacity 12 Tons—Tare 3 Tons 7 Cwt.
 Capacity per Ton of Dead weight 3 Tons 11 Cwt. 2 qrs.