

HISTORY OF THE FURNESS RAILWAY LOCOMOTIVES.

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As the Members of this Institution are visiting the district served by the Furness Railway, it will no doubt be interesting to many of them to learn something of the locomotive engines that have at different times been in use on that line.

The first portion of this Railway was opened in 1846, from Kirkby to Dalton and Piel Pier for mineral traffic; passenger traffic commenced in December of the same year. After this, various amalgamations and extensions took place to Carnforth, Coniston, &c. In 1866 the Whitehaven and Furness Junction Railway, extending from Whitehaven to Broughton, along with nine locomotives, was taken over. Following this the Furness Railway became joint owners with the London and North Western Railway of the Whitehaven, Cleator, and Egremont Railway, at the same time taking over sixteen locomotives. The traffic on this railway has been chiefly goods and mineral, three-fourths of the locomotives being so employed, although the passenger traffic has made great progress during the last six years.

The principal works are at Barrow-in-Furness, Plate 156, whilst running sheds are provided at Carnforth, Moor Row, and Whitehaven. The total miles worked by the engines are 170½.

The locomotive engines in use in the early days of the Furness Railway Company were of the "Bury" class. Many of the Members have no doubt seen the "Old Copper Nob," No. 3, Plate 145, which is so called owing to its dome-shaped fire-box with copper casing. The first engines of this type for this railway were built in 1844, and numbered 1 and 2. Unfortunately there are no drawings of these engines, although they were practically similar to Nos. 3 and 4 delivered two years later, with the exception of the cylinders, which were 13 inches diameter, and the working pressure 80 lbs. per square inch. The life of the first two was short compared with Nos. 3 and 4, for in 1866 No. 1, whilst stationed at Carnforth, had the fire-box badly burned, owing to the fire having been lighted with an empty boiler, so that it was decided to break her up. No. 2 was afterwards sold to a Northumberland colliery in 1871.

Nos. 3 and 4, Plate 145, built by the same makers—Messrs. Bury, Curtis and Kennedy, Liverpool—were delivered in 1846; these have had an exceptionally long career, No. 3 having been worked up to within a year ago. A few particulars concerning the dimensions of these engines will no doubt be of interest. They had inside cylinders 14 inches diameter by 24 inches stroke, the slide-valves being placed between the cylinders in the usual manner. The width of steam ports is $1\frac{1}{4}$ inch, exhaust 3 inches by $10\frac{1}{2}$ inches long, and lap of valve $\frac{3}{4}$ inch. Each cylinder is a separate casting, both of which have a separate exhaust-pipe which converges at the mouth of the chimney into one. The wheels are four-coupled 4 feet 9 inches diameter on tread; the centres are of wrought-iron with cast-iron bosses, and had iron tyres secured to the rims by 1-inch bolts. The main bearings are $5\frac{1}{4}$ inches diameter by 7 inches in length, and the crank pins $2\frac{1}{4}$ inches diameter by $2\frac{3}{4}$ inches in length.

The engine frames, which are of the bar type, have upper and lower members united by the pedestals; the frames are of rectangular section 4 inches by 2 inches, and the lower bar $2\frac{3}{8}$ inches diameter. The axle-boxes are of gun-metal. The motion is of the curved link type, the eccentric-rods being coupled direct with crossed rods, and the links are suspended from the bottom. The sheaves are of cast-iron with gun-metal eccentric straps. The connecting-rods

are round and have fork ends, all the brasses being secured by means of the double gib and cotter. The boiler plates throughout, with the exception of fire-box, consist of Low Moor iron, the barrel being made up of three rings; each ring is of two plates $\frac{7}{16}$ -inch thick, the back ring being flanged back to join the fire-box casing, the crown of which is in the form of a dome, made up of no less than twelve plates, eight of which go to make the crown. The seams throughout are single-riveted lap with $\frac{3}{4}$ -inch rivets.

The fire-box is of copper, semicircular in plan with a curved crown, and made up of four plates $\frac{9}{16}$ -inch thick, the tube plate being $\frac{3}{4}$ -inch thick. The crown plate originally consisted of two plates, a lap seam running longitudinally, which at times gave trouble; it is supported by four solid roof-bars of wrought-iron which are secured by 1-inch rivets, and connected to the outer shell by eight sling-stays $1\frac{1}{2}$ inches diameter. The sides are stayed throughout by copper stays screwed into both plates and riveted over; they are $\frac{7}{8}$ -inch diameter and 4 inches centre to centre. The foundation ring is 4 inches by $1\frac{1}{2}$ inches, excepting at the front end which is 4 inches by 2 inches, the plates being set back to allow for a $2\frac{1}{2}$ -inch water space. The front tube plate is $\frac{5}{8}$ -inch thick, and is attached to the barrel by two gusset stays. The tubes were brass, $2\frac{1}{4}$ inches external diameter, and pitched $2\frac{5}{8}$ inches centres. Inside the dome is placed the regulator valve, which is of the equilibrium type, with a main steam-pipe 4 inches diameter to cylinders. The safety-valves are fixed on the dome with valves $2\frac{1}{2}$ inches diameter, the springs of which are adjusted for a working pressure of 110 lbs. per square inch. The smoke-box is of iron plates $\frac{5}{8}$ -inch thick, and the chimney is also of iron with a copper top. The total heating surface is 854 square feet, and grate area 9 square feet, and the total weight in working order of the engine is $19\frac{1}{2}$ tons.

The tender, which has a capacity of 1,000 gallons, has the underframe constructed entirely of oak, and was fitted originally with a buffing spring similar to those used on wagon stock. The wheel centres were of cast-iron with wrought-iron tyres, 3 feet $1\frac{1}{2}$ inches diameter on tread, with a wheel-base of 6 feet 8 inches. The total weight in working order of the tender is 12 tons 18 cwts. These engines

were of late years used as shunting engines at the Barrow Docks. It will be of interest to know that it has been decided to preserve No. 3 engine, which will afford many people an opportunity of seeing a "Copper-nob" engine with such a record. No. 4 engine has recently been broken up.

Up to the discovery in 1851 of large ore deposits in the district, these four engines were found capable of dealing with the traffic. It was then decided to order two more engines from Messrs. Sharp Brothers of Manchester (now Messrs. Sharp, Stewart and Co., Glasgow), which were delivered in 1852. They were numbered 5 and 6, and are shown in Fig. 2, Plate 146. They had single-driving wheels, 5 feet 6 inches in diameter with tank under the foot-plate. Owing to the increase in the traffic four engines were ordered from Messrs. Fairbairn and Sons, Manchester, shown in Fig. 3, Plate 146, Nos. 7 and 8 being delivered in 1854, and Nos. 9 and 10 in 1855. These engines were of the "Bury" type with dome-shaped fire-box and bar frames, although the cylinders had the valve placed on the top, the motion being worked by means of rocking shafts. The principal dimensions are:—cylinders 15 inches by 24 inches, wheels 4 feet 6 inches diameter, total heating surface 940 square feet. The total weight of engine and tender is 36 tons in working order. After forty-five years' hard work, two of these engines are still at work shunting at the docks; the others have been replaced.

The next engines delivered were two tank engines with single driving wheels, built by Messrs. Sharp Brothers in 1857, and numbered 11 and 12, being of the standard design of that period and similar in all respects to the engines shown on Fig. 4, Plate 147, with the exception that the cylinders were only 14 inches diameter. Both these engines were replaced, No. 11 being sold to Messrs. Sharp, Stewart and Company in 1875, and No. 12 being renumbered 12A, and was sold in 1898 to the Clevedon and Portishead Light Railway.

Four more engines were ordered from Messrs. Fairbairn and Sons, which were numbered 13 to 16, the first two being delivered in 1858 and Nos. 15 and 16 in 1861. They were of the same dimensions as shown in Fig. 3, Plate 146.

In 1863 four four-wheel coupled goods engines, Fig. 5, Plate 147, were built by Messrs. Sharp, Stewart and Co., of their own design, and numbered 17 to 20. The dimensions were, cylinders $15\frac{1}{2}$ inches by 24 inches, and coupled wheels 4 feet 9 inches diameter. The heating surface was 926 square feet, and the weight of engine in working order was 24 tons 18 cwts. These four engines were sold to the Barrow Hematite Steel Company in 1870, being converted into saddle-tank shunting engines for them by Messrs. Sharp, Stewart and Co., and are still working.

Two single-wheel tank engines were built by Messrs. Sharp, Stewart and Co. in 1864, with driving-wheels 5 feet 6 inches diameter and numbered 21 and 22, Fig. 4, Plate 147. They had outside frames, the cylinders being 15 inches in diameter by 18 inches stroke, and the heating surface 858 square feet. They were well designed engines, and with light trains were very economical. Latterly, however, they were chiefly used for branch lines. They were replaced in 1896, No. 22 being sold to the Whitburn Colliery Company and No. 21 to a firm at Wigan. Two four-wheel coupled saddle-tank shunting engines, Fig. 6, Plate 148, were purchased from Messrs. Sharp, Stewart and Co. in the same year. The cylinders are 14 inches diameter by 20 inches stroke, wheels 4 feet diameter, heating surface 669 square feet, and the weight in working order 24 tons 10 cwts. These engines are still working on the docks. In 1865 two four-coupled engines, Nos. 25 and 26 were supplied duplicate in all respects to those before mentioned and shown on Fig. 5, Plate 147. These were sold to the Barrow Hematite Steel Company, and converted into saddle-tank engines.

In the year 1866 the Furness Railway Company acquired the Whitehaven and Furness Junction Railway, also nine engines which belonged to that company. Very little data concerning these engines can be found. They were accordingly numbered 42 to 50 in the books of the Furness Railway; these have all been sold, with the exception of No. 42 shown in Fig. 7, Plate 148. This engine was built by Messrs. Hawthorn; it is a six-wheel coupled goods engine, having cylinders 16 inches diameter by 24 inches stroke, and wheels 4 feet 6 inches diameter. No. 43 was of similar pattern built to the

designs of Mr. Meekly, the locomotive superintendent. It was afterwards sold to Messrs. Fletcher, Jennings and Co. in 1873. Nos. 44 and 45, which were also built by Messrs. Hawthorn, were tender engines having cylinders 14 inches diameter by 20 inches stroke.

No. 46 was a single driving-wheel tank engine built by the same makers in 1861, having cylinders 14 inches diameter by 20 inches stroke, driving wheels 5 feet 6 inches diameter, and leading and trailing wheels 3 feet 6 inches diameter. This engine was sold to the Isle of Wight Central Railway. Nos. 47 and 48 were single driving-wheel tank engines, Fig. 9, Plate 149; they had cylinders 12 inches diameter by 18 inches stroke, driving wheel 5 feet 3 inches, and were built by Messrs. E. B. Wilson and Co., of Leeds. Both these engines were afterwards sold. Nos. 49 and 50 were saddle-tank shunting engines, having cylinders 10 inches diameter by 16 inches stroke, four wheels coupled 4 feet diameter. No. 49 was built by Messrs. Fletcher, Jennings and Co. in 1862, and No. 50 by Messrs. Neilson and Co. in 1861; both of which were sold to a Whitehaven firm in 1883.

In 1866 the traffic had increased so much that fifteen engines were ordered from Messrs. Sharp, Stewart and Co. The first two, Nos. 27 and 28, were duplicate of Nos. 17 to 20, Fig. 5, Plate 147, as it was thought up to that time the wheel-base was quite sufficient for the many sharp curves on this railway. Nos. 29 to 33 and 38 to 41, however, were of the six-wheel coupled type. These were until recently the standard goods engine throughout the system. The coupled wheels are 4 feet 6½ inches diameter and cylinders 16 inches diameter by 24 inches stroke, total heating surface 959 square feet, and the tractive force 8,360 lbs. They had four-wheel tenders, the engine and tender weighing complete in working order 50½ tons. These engines, Fig. 8, Plate 149, are all still working. Several of this class of engine have since been fitted with the automatic vacuum and steam brake for passenger working; new cabs have also been fitted. Several also have had new steel boilers fitted of a much larger type, with flush top and Ramsbottom safety-valves, giving a much larger heating surface and grate area with economical results. Four engines purchased in 1866 had single-

driving wheels and well tank, duplicate in all respects of Nos. 21 and 22, Fig. 4, Plate 147; all of these were replaced in 1896, and afterwards sold.

In 1867 it was found necessary to introduce a new class of tank engine to assist in banking the goods and mineral trains between Plumpton and Lindal, which is about $3\frac{1}{2}$ miles, with a gradient at some points of 1 in 76, also between Askam and Lindal, a distance of $5\frac{1}{2}$ miles and gradients of 1 in 63. They have cylinders 18 inches diameter by 24 inches stroke, six wheels coupled 4 feet $7\frac{1}{2}$ inches diameter, and are well adapted for banking; the weight in working order is 44 tons 14 cwts., and they are numbered 51 and 52, and shown in Fig. 10, Plate 150.

The single-wheel tank engines were found unable to haul the increased length of trains consequent on the increase of passenger traffic. It was therefore decided to order a new class of passenger engine of more powerful design, shown in Fig. 11, Plate 150. They were four wheels coupled with leading wheels, cylinders 16 inches diameter by 20 inches stroke. All these engines were constructed by Messrs. Sharp, Stewart and Co. The first engines were delivered in 1870 and numbered 1 and 2, replacing the old Bury engines. Up to within recent years these have been the standard passenger engines of this company, and are still working. As in the goods class they have all been fitted with the automatic vacuum brake; some have also had new steel boilers of a modern type, giving a much better appearance, and with more economical results in working. The last two of these engines were numbered 57 and 58. At the same time 18 more of the standard goods engines were ordered, and were numbered 17 to 20, 43, 53 to 56, and 59 to 67. They were built in 1871. Two more six wheels coupled bank engines were delivered in 1872, being exact duplicates of the former ones. These were numbered 68 and 69. In the same year, nine of the four-wheeled coupled passenger engines were delivered, which were of the standard pattern already described and numbered 47 and 48, 70 to 75. Owing to the increase in passenger traffic on the branch lines of the company, it was decided in 1891 to convert Nos. 47, 48, and 70 to 74 into tank engines, this traffic up to then having been worked by the single-wheel tank

engines, which were becoming too light to deal with the heavy trains. The frames of the four-wheel coupled engines were lengthened, and a pair of radial wheels added, the tank having a capacity of 1,000 gallons. These engines are as shown altered in Fig. 12, Plate 151, and are still working.

Twelve new goods engines, four passenger engines and two bank engines, all of which were supplied by Messrs. Sharp, Stewart and Co., of the same designs as those previously described, were built for the company in 1873. Six goods engines were numbered 25, 26, 76, 77, 78, 79, two bank engines Nos. 82 and 83, then six goods engines Nos. 80, 81, 84 to 87, and finally four passenger engines Nos. 5 and 6 and 11 and 12. The two latter have since been numbered 3 and 4, replacing the old "copper-nob" engines, the vacant numbers being used for the new goods engines. Two years later six more standard goods engines were delivered, and numbered 88 to 93, and also four saddle-tank shunting engines similar in design to No. 23 class, but the dome was placed on the boiler instead of over the fire-box as in previous engines. They were numbered 94 to 97, and are still working.

Owing to the purchase of the Whitehaven, Cleator, and Egremont Railway, sixteen engines were taken over by the Furness Railway Co., and were numbered 98 to 113, and, with the exception of two, were all of the saddle-tank type six-wheel coupled engines, twelve of them built by Messrs. Stephenson and Co., of Newcastle-on-Tyne in 1878. Fig. 13, Plate 151, gives an outline of Nos. 98 and 99, the former built by the latter firm in 1855. The cylinders are 17 inches diameter by 24 inches stroke, coupled wheels 4 feet 6 inches. The weight in working order is 44 tons. The other engines of Messrs. Stephenson's design and build were Nos. 101 to 107, 109 to 111. All these engines have had new steel boilers fitted. The original boilers were of iron, and the longitudinal seams being lap-jointed were a frequent source of trouble; one gave way in 1890 whilst working, but fortunately without injury to any person. The back and front plates are stayed by gusset stays, and the frames are double with outside cranks. No. 100 was of a similar type, built by Messrs. Fletcher, Jennings and Co. in 1858; No. 102 was built in 1862, and

Nos. 103 and 104 in 1863, Nos. 105 in 1867, 106 in 1869, Nos. 107 and 109 in 1870 and 1871 respectively, and Nos. 110 and 111 in 1873. No. 112 was very similar to the latter engines, but was built by Messrs. Barclay and Co. of Kilmarnock in 1875. This engine has since been numbered 108. Both the engines Nos. 108 and 113 had side tanks, the former being a four-wheel coupled passenger engine with the outside cylinders 15 inches diameter by 20 inches stroke; the coupled wheels were 5 feet 3 inches diameter. This engine is shown on Fig. 14, Plate 152; it is the only outside cylinder engine on the Furness Railway, and was built by Messrs. Slaughter and Co., but at what period is not known. No. 113 was a six-coupled side-tank engine built by Messrs. R. and W. Hawthorn in 1857, Fig. 15, Plate 152, and sold in 1897, the number being taken by one of the new eight-wheeled tank engines. This is a fair general outline of the engines taken over from the Whitehaven, Cleator, and Egremont Railway.

Six standard goods engines were ordered from Messrs. Sharp, Stewart and Co. in 1881, which were numbered 114 to 119, all of which were duplicate in every respect to those already supplied. It will no doubt be of interest to know that it was one of these engines—No. 115—which was totally lost whilst shunting on Lindal Bank on 22nd September 1892, owing to the subsidence which took place. The tender was recovered, but the engine sank out of sight, the ground being subsequently made good above it. Following these it was found necessary in 1882 to replace Nos. 44 and 45, and 49 and 50 of the old Whitehaven class. Nos. 44 and 45 were replaced by 16-inch standard passenger type, and Nos. 49 and 50 by 16-inch standard goods, all built by Messrs. Sharp, Stewart and Co. There were also two more standard goods engines ordered, Nos. 121 and 122; but these were sold on arrival to the Liverpool, Southport and Preston Junction Railway.

No more new engines were added to stock until 1890, at which time four new four-wheel coupled bogie passenger engines of Messrs. Sharp, Stewart and Co.'s design were delivered, and were numbered from 120 to 123. These engines were the first on this railway to have the leading bogie. The principal dimensions are

cylinders 17 inches diameter by 24 inches stroke. The weight of engine and tender in working order is $60\frac{1}{2}$ tons; an outline of the engine is shown in Fig. 16, Plate 153. Owing to the increased weight of trains it was found necessary to introduce a still larger type of bogie passenger engine; these were delivered in 1896. They are shown in Fig. 17, Plate 153, and are of the following dimensions:—cylinders 18 inches diameter by 24 inches stroke; coupled wheels 6 feet diameter, bogie wheels 3 feet 6 inches diameter, total heating surface 1208·5 square feet, grate area 17 square feet, and weight of engine and tender in working order being $69\frac{1}{2}$ tons. In 1897 it was found to work the great increase in goods traffic economically in the Cleator district that larger engines were required, and it was decided to design a powerful tank-engine to replace those already shown in Fig. 13, Plate 151. Three of these were ordered from Messrs. Sharp, Stewart and Co., and were delivered in 1898, and numbered 112 to 114; they are eight-wheel side-tank engines, six of which are coupled, and are shown in Fig. 18, Plate 154. The cylinders are 18 inches diameter by 26 inches stroke, coupled wheels 4 feet 8 inches, and trailing radials 3 feet $8\frac{1}{2}$ inches, rigid wheel base is 14 feet 5 inches, and the total wheel-base 20 feet 8 inches. The boiler is 4 feet 4 inches diameter, and barrel 10 feet 6 inches in length. The length of fire-box casing is 6 feet 9 inches, giving a grate area of 20·5 square feet, heating surface being tubes 1,029 square feet, and fire-box 105 square feet, making a total of 1,134 square feet. Working pressure is 150 lbs. per square inch. The tanks have a capacity of 1,400 gallons, and the coal bunker 30 cwts. The total weight in working order is 55 tons.

By this time the main line goods traffic was severely testing the engines with cylinders 16 inches diameter, owing to the heavy gradients and great weight of trains, particularly between Plumpton and Lindal, which is $3\frac{1}{2}$ miles long with a gradient 1 in 76 on the down road, and from Salthouse Junction to Lindal on the up road, about $5\frac{1}{2}$ miles long with gradients 1 in 63, and in places with 8 and 10 chains curves. The trains consist of minerals, iron ore, pig iron, coal, coke, etc., all of which are very heavy to haul. It was therefore decided to design a much more powerful engine, duplicating as far as

possible the details of the six-wheel coupled radial tank engine. The boiler, cylinders, wheels, motion, etc., are all from the same drawing, the tender being a duplicate of those supplied with the 18-inch passenger engine, Fig. 17, Plate 153. The first six of these powerful engines were built by Messrs. Nasmyth, Wilson and Co., Patricroft, and six by Messrs. Sharp, Stewart and Co., and are shown in Fig. 19, Plate 154. The wheel centres are of cast steel with the balance weights cast solid. The boiler is steel throughout, with copper fire-box. The weight of engine in working order is 38 tons 3 cwt. The engines are fitted with automatic vacuum and steam brakes, making them suitable for working the heavy passenger excursion trains. The tenders carry 2,500 gallons of water, with a coal capacity of four tons. The weight of the tender in working order is 28 tons 5 cwt. Several of the engines are fitted with Macallan's variable blast pipe, the smaller diameter being $4\frac{3}{4}$ inches and the larger $5\frac{1}{4}$ inches diameter. Some of the engines are also fitted with the exhaust injector, which show an economy in the coal consumption compared with those not fitted. These engines, which have now been running nearly two years, are hauling the mineral traffic at a very much less cost per ton-mile than the older engines. It has also been found necessary to provide more powerful passenger engines, as the 16-inch four-coupled engines were practically no use for the greatly increased passenger traffic. The principal dimensions of the new engines are as follows:—cylinders 18 inches diameter by 26 inches stroke, four-wheels coupled 6 feet 6 inches diameter with the leading bogie 3 feet 6 inches diameter. The boiler barrel is 4 feet 4 inches diameter and 10 feet 8 inches long, and the fire-box 6 feet long. The tubes have a heating surface of 1,159 square feet, and fire-box 111.5 square feet, making a total of 1,270 square feet. The grate area is 18 square feet, and the weight of engine in working order is 43 tons, and the working pressure 160 lbs. per square inch. The tender is a duplicate of the other tenders, excepting the water capacity has been increased to 3,000 gallons, and the wheel base to 13 feet, instead of 12 feet. The tank is also being carried 2 feet above the platform at front end, and is provided with a fence for coal; this engine and tender are shown

in Fig. 20, Plate 155. It might here be mentioned that only four of this class were actually built, namely, Nos. 126 to 129. The first two—Nos. 124 and 125—were made duplicate, with the exception of alterations to the motion and valve gear, of the previous express engines, the reason being on account of delivery. The whole of these engines have now been delivered, and are proving equal in all respects to what was expected from them.

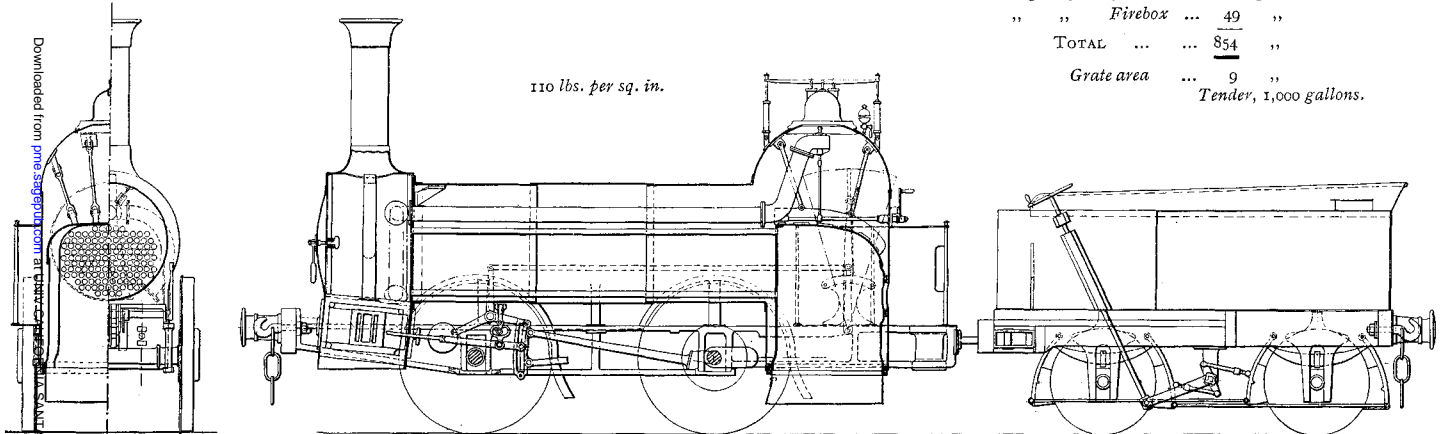
The Paper is illustrated by Plates 145 to 156.

FURNESS RAILWAY LOCOMOTIVES.

Plate 145.

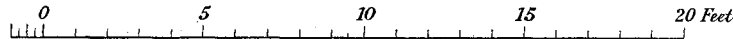
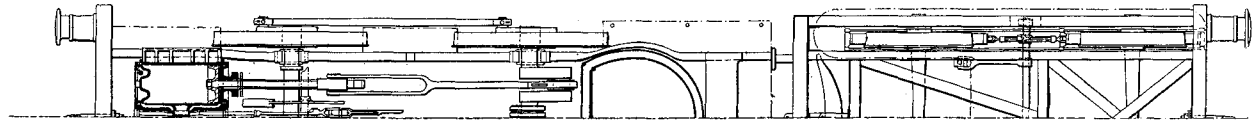
Fig. 1. *Bury's "Old Copper Nob," Passenger Engine, 1846.*

Heating Surface of Tubes ...	805 sq. feet.
" " Firebox ...	49 "
TOTAL ...	<u>854</u> "
Grate area ...	9 "
	Tender, 1,000 gallons.



	T. C.			T. C.		T. C.
Weight Empty ...	6 9	9 2	...	Total ... 15 11
" Working ...	7 13	11 17	...	" ... 19 10
" per foot run,	2.6 tons.					
<i>Total Weight of Engine and Tender in Working Order, 32 tons, 8 cwt.</i>						

T. C.		T. C.	T. C.
5 7	...	4 18	Tot. 10 5
6 18	...	6 0	" 12 18
<i>Weight of tender per foot run, 1.9 tons.</i>			



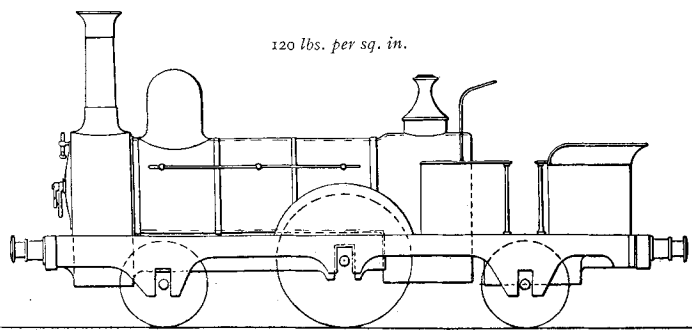
Mechanical Engineers 1901.

Pl. 145.

Fig. 2. *Tank Engine, 1852.*

Heating Surface of Tubes ...	780 sq. feet.
" " Firebox ...	55 "
TOTAL ...	<u>835</u> "
Grate area ...	9 "

Cyls. 14 in. x 18 in.

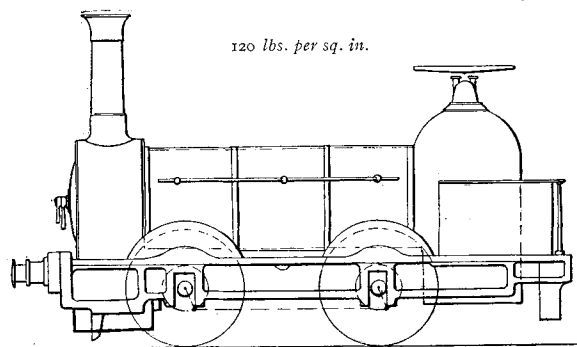


Weight Empty ...	T. C.	...	T. C.	...	T. C.	...	Total ...	T. C.
" Working ...	7 15	...	10 5	...	7 13	...	30 5	25 13
" per foot run, 2'07 tons.			Fuel, 25 cwt.		Tanks, 560 gallons.			

Fig. 3. *Fairbairn's Coupled Engine, 1854-5.*

Heating Surface of Tubes ...	891 sq. feet.
" " Firebox ...	49 "
TOTAL ...	<u>940</u> "
Grate area ...	9 "

Cyls. 15 in. x 24 in.



Weight Empty ...	T. C.	...	T. C.	...	Total ...	T. C.
" Working ...	7 12	...	10 7	...	17 19	21 9
" per foot run, 2'76 tons.			Tender, 1,000 gallons.			

Scale
(for all Locomotives except Fig. 1.)

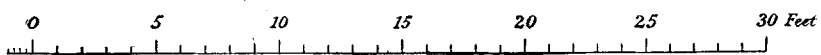


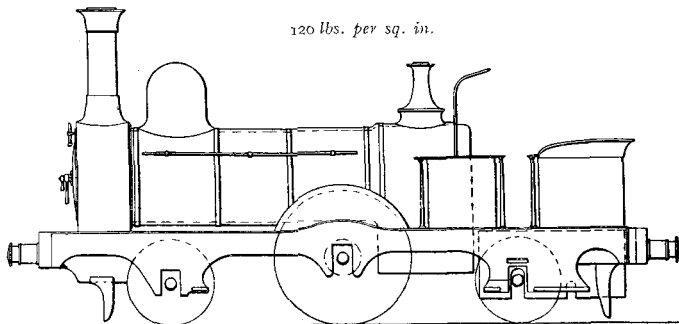
Fig. 4. *Passenger Tank Engine, 1864.*

Heating Surface of Tubes ...	788	sq. feet.
" " Firebox ...	70	"
TOTAL ...	<u>858</u>	"

Cyls. 15 in. × 18 in.

Grate area ... 11.5 "

120 lbs. per sq. in.



Weight Empty ...	T. C.	...	T. C.	...	T. C.	...	Total ...	T. C.
" Working ...	7 19	...	10 6	...	7 14	...	" ...	25 19
" per foot run, 2'12 tons.	8 4	...	11 14	...	10 7	...	" ...	30 5
			Fuel, 25 cwts.		Tanks, 560 gallons.			

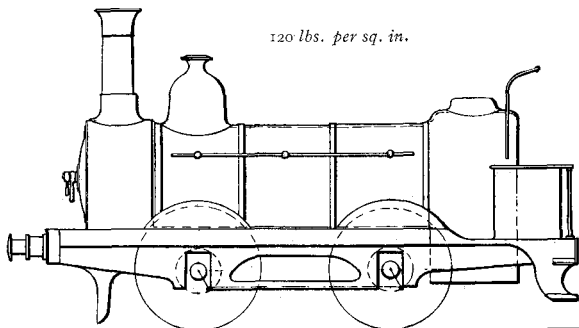
Fig. 5. *Goods Engine, 1866.*

Heating Surface of Tubes ...	870	sq. feet.
" " Firebox ...	56	"
TOTAL ...	<u>926</u>	"

Cyls. 15½ in. × 24 in.

Grate area ... 9.2 "

120 lbs. per sq. in.



Weight Empty ...	T. C.	...	T. C.	...	Total ...	T. C.
" Working ...	9 0	...	13 15	...	" ...	22 15
" per foot run, 3'2 tons.	9 18	...	15 0	...	" ...	24 18
					Tender, 1,500 gallons.	

Scale

(for all Locomotives except Fig. 1.)

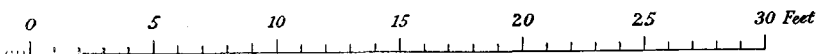
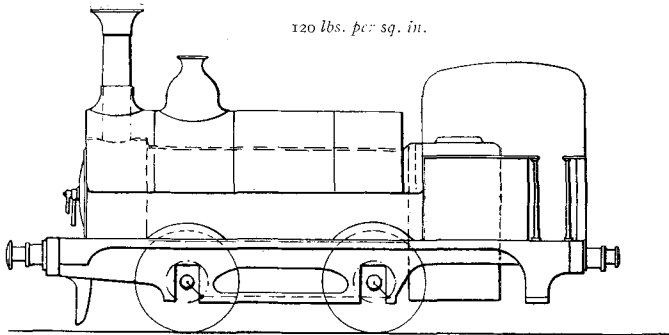


Fig. 6. *Saddle-Tank Shunting Engine, 1864.*

Heating Surface of Tubes ...	613.5 sq. feet.
" Firebox ...	55.5 "
TOTAL ...	<u>669.0</u> "
Grate area ...	9.9 "

Cyls. 14 in. x 20 in.



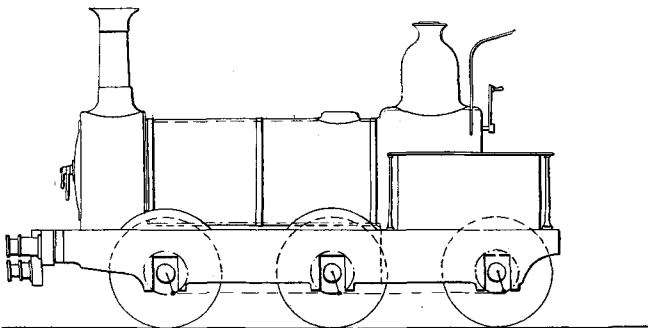
120 lbs. per sq. in.

	T. C.		T. C.		T. C.
Weight Empty ...	6 19	...	14 10	...	Total ... 21 9
" Working ...	8 18	...	15 12	...	" ... 24 10
" per foot run, 3.26 tons.			Fuel, 12 cwts.		Tank, 600 gallons.

Fig. 7. *Goods Engine, 1864.*

Heating Surface of Tubes ...	846 sq. feet.
" Firebox ...	72 "
TOTAL ...	<u>918</u> "
Grate area ...	11.5 "

Cyls. 16 in. x 24 in.



120 lbs. per sq. in.

	T. C.		T. C.		T. C.		T. C.
Weight Empty ...	7 15	...	9 0	...	7 10	...	Total ... 24 5
" Working ...	10 10	...	9 14	...	8 2	...	" ... 28
" per foot run, 2.3 tons.							Tender, 1,600 gallons.

Scale
(for all Locomotives except Fig. 1.)

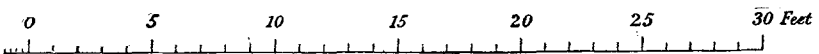
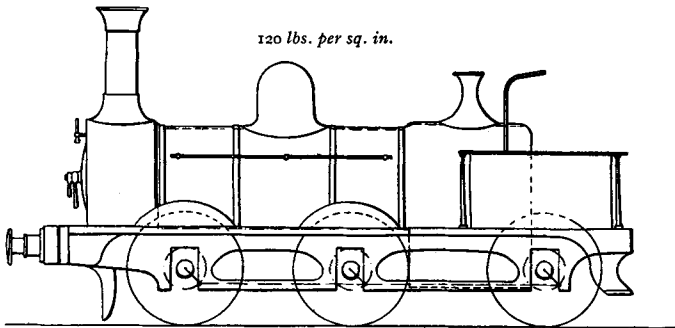


Fig. 8. *Six Wheels Coupled Goods Engine, 1866.*

Heating Surface of Tubes ...	871'27	sq. feet.
" " Firebox ...	88'0	"
TOTAL ...	<u>959'27</u>	"
Grate area ...	13'8	"

Cyls. 16 in. x 24 in.



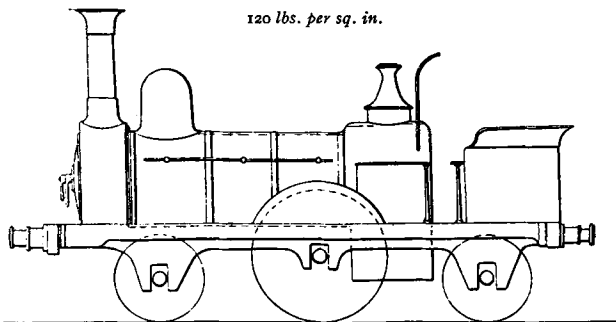
	T. C.		T. C.		T. C.		T. C.
Weight Empty ...	7'19	...	10'14	...	9'1	Total ...	27'14
" Working ...	10'11	...	11'10	...	8'18	" ...	30'19

.. per foot run, 2'1 tons. Tender, 1,500 gallons.

Fig. 9. *Tank Engine, 1861.*

Heating Surface of Tubes ...	690	sq. feet.
" " Firebox ...	49	"
TOTAL ...	<u>739</u>	"
Grate area ...	8'5	"

Cyls. 12 in. x 18 in.



	T. C.		
Total Weight Empty ...	23	10	
" " Working ...	27	0	

Weight per foot run, 2'03 tons. Fuel, 25 cwt. Tanks, 500 gallons.

Scale
(for all Locomotives except Fig. 1.)

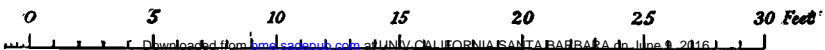
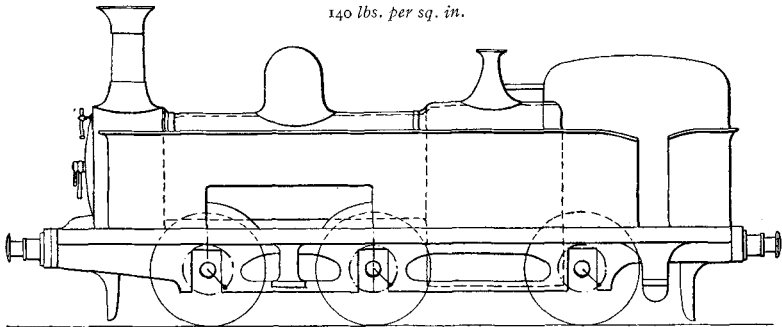


Fig. 10. *Bank Engine, 1867.*

Heating Surface of Tubes ...	1,016 sq. feet.
" " Firebox ...	95 "
TOTAL ...	<u>1,111</u> "
Grate area ...	15.67 "

Cyls. 18 in. x 24 in.

140 lbs. per sq. in.



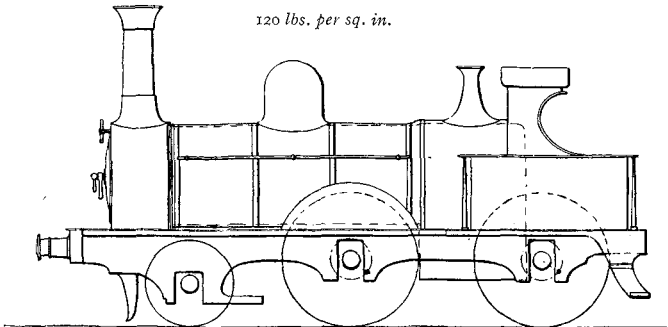
Weight Empty ...	T. C.	12 6	...	T. C.	11 6	...	T. C.	12 2	...	Total	T. C.	35 14
" Working ...		13 13	...		16 6	...		14 15	...	"		44 14
" per foot run, 2'98 tons.				Fuel, 30 cwt.			Tanks, 1,000 gallons.					

Fig. 11. *Passenger Engine, 1870.*

Heating Surface of Tubes ...	839'5 sq. feet.
" " Firebox ...	71'0 "
TOTAL ...	<u>910'5</u> "
Grate area ...	11'5 "

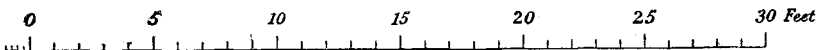
Cyls. 16 in. x 20 in.

120 lbs. per sq. in.



Weight Empty ...	T. C.	7 13	...	T. C.	9 10	...	T. C.	10 1	...	Total	T. C.	27 4
" Working ...		8 10	...		11 10	...		10 5	...	"		30 5
" per foot run, 2'12 tons.							Tender, 1,200 gallons.					

Scale
(for all Locomotives except Fig.1.)



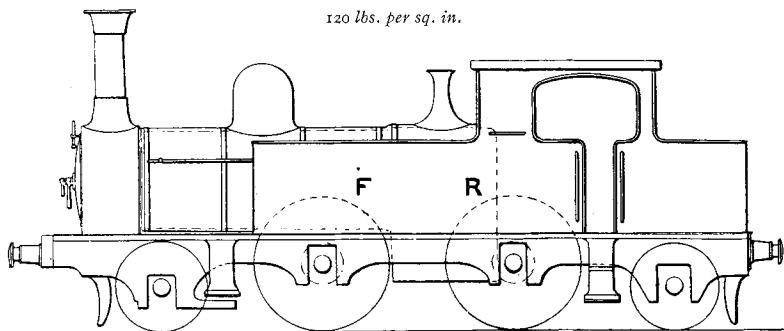
FURNESS RAILWAY LOCOMOTIVES. *Plate 151.*

Fig. 12. *Passenger Tank Engine (Converted), 1891.*

Heating Surface of Tubes	...	839'5	sq. feet.
" " Firebox	...	71'0	"
TOTAL	...	<u>910'5</u>	"
Grate area	...	11'5	"

Cyls. 16 in. x 20 in.

120 lbs. per sq. in.



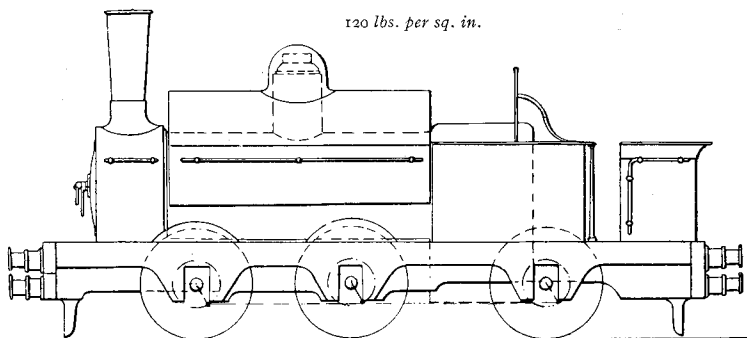
Weight Empty	...	T. C.	...	T. C.	...	T. C.	...	T. C.	Total	...	T. C.
" Working	...	7 7	...	11 10	...	9 10	...	7 5	"	...	35 12
" per foot run,	2'14 tons.										44 11
				Fuel, 32 cwts.				Tanks, 1,000 gallons.			

Fig. 13. *Saddle Tank Goods Engine, 1855.*

Heating Surface of Tubes	...	920	sq. feet.
" " Firebox	...	75	"
TOTAL	...	<u>995</u>	"
Grate area	...	13'3	"

Cyls. 17 in. x 24 in.

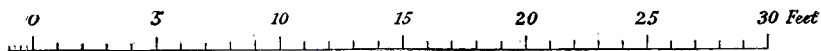
120 lbs. per sq. in.



Weight Empty	...	T. C.	...	T. C.	...	T. C.	...	Total	...	T. C.
" Working	...	10 6	...	11 16	...	9 0	...	"	...	31 2
" per foot run,	3'03 tons.									44 0
				Fuel, 25 cwts.				Tank 1,000 gallons.		

Scale

(for all Locomotives except Fig.1.)

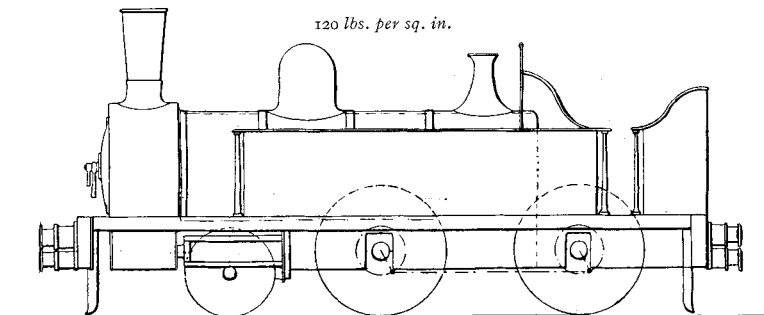


FURNESS RAILWAY LOCOMOTIVES. *Plate 152.*

Fig. 14. *Passenger Tank Engine, 1875.*

Heating Surface of Tubes	...	840 sq. feet.
" " Firebox	...	71 "
TOTAL	...	911 "
Grate area	...	11'0 "

Cyls. 15 in. x 20 in.

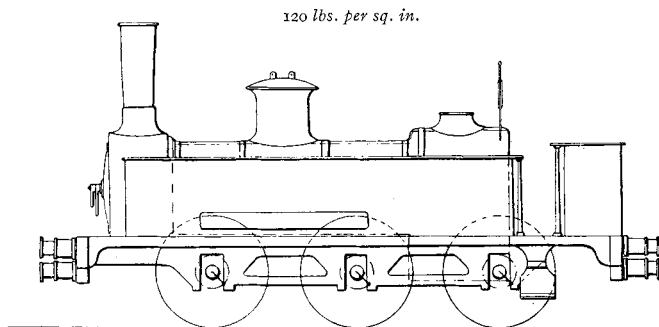


	T. C.	T. C.	T. C.	T. C.
Weight Empty	... 8 10	... 10 0	... 10 10	Total ... 29 0
" Working	... 10 0	... 13 0	... 13 0	... 36 0
" per foot run	2.5 tons.	Fuel, 25 cwts.	Tanks, 1,000 gallons.	

Fig. 15. *Side Tank Engine, 1857.*

Heating Surface of Tubes	...	718 sq. feet.
" " Firebox	...	69 "
TOTAL	...	787 "
Grate area	...	10'8 "

Cyls. 14 in. x 22 in.



	T. C.	T. C.	T. C.	T. C.
Weight Empty	... 8 0	... 10 0	... 10 0	Total ... 28 0
" Working	... 9 0	... 12 10	... 12 10	... 34 0
" per foot run	2.9 tons.	Fuel, 25 cwts.	Tanks, 800 gallons.	

Scale
(for all Locomotives except Fig. 1.)

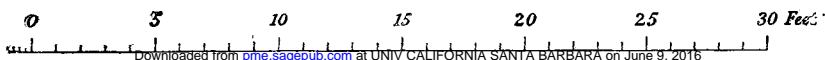


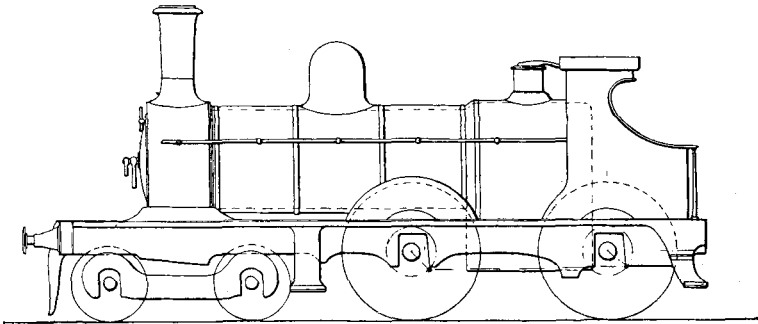
Fig. 16. *Bogie Passenger Engine, 1890.*

Heating Surface of Tubes	...	955	sq. feet.
" " Firebox	...	86	"
TOTAL	...	1,041	"

Cyls. 17 in. × 24 in.

Grate area ... 14'2 "

140 lbs. per sq. in.



Weight Empty	T. C.	...	T. C.	...	T. C.	Total	T. C.
" Working	9 16	...	13 7	...	9 13	32 16	
" per foot run,	11 12	...	12 16	...	11 14	36 2	

1,78 tons.

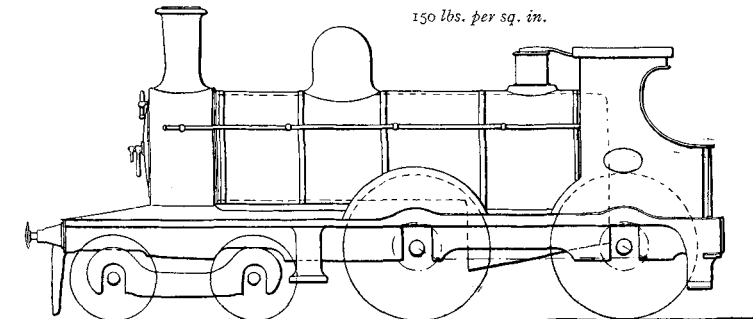
Fig. 17. *Bogie Passenger Engine, 1896.*

Heating Surface of Tubes	...	1,109	sq. feet.
" " Firebox	...	99'5	"
TOTAL	...	1208'5	"

Cyls. 18 in. × 24 in.

Grate area ... 17 "

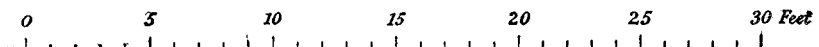
150 lbs. per sq. in.



Weight Empty	T. C.	...	T. C.	...	T. C.	Total	T. C.
" Working	12 0	...	13 10	...	11 15	37 5	
" per foot run,	13 12	...	14 10	...	13 4	41 6	

Tender, 2,500 gallons.

scale
(for all Locomotives except Fig. 1.)



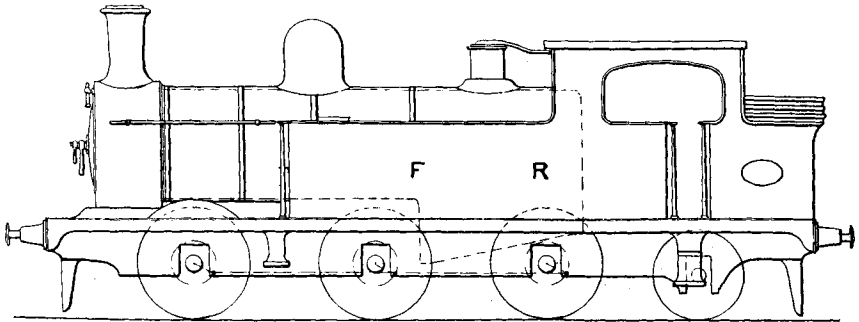
FURNESS RAILWAY LOCOMOTIVES. *Plate 154.*

Fig. 18. *Side-Tank Engine, 1898.*

Heating Surface of Tubes	...	1,029	sq. feet.
" " Firebox	...	105	"
TOTAL	...	<u>1,134</u>	"
Grate area	...	20.5	"

Cyls. 18 in. × 26 in.

150 lbs. per sq. in.



Weight Empty	...	T. C.	...	T. C.	...	T. C.	...	T. C.	...	T. C.	...	Total	...	T. C.
" Working	...	11	10	...	15	10	...	10	0	...	7	0	44	0
" per foot run,	...	13	17	...	16	1	...	14	12	...	10	10	55	0

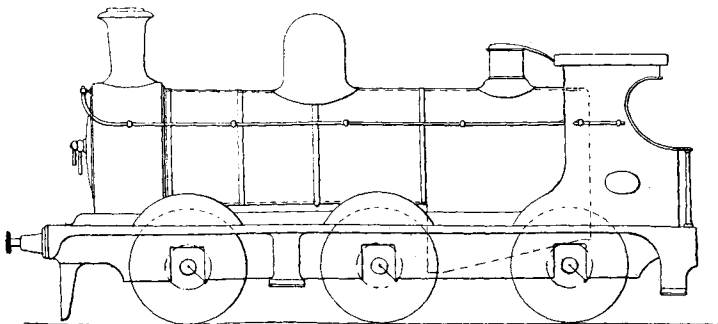
Fuel, 30 cwts. Tanks, 1,400 gallons.

Fig. 19. *Goods Engine, 1899.*

Heating Surface of Tubes	...	1,029	sq. feet.
" " Firebox	...	105	"
TOTAL	...	<u>1,134</u>	"
Grate area	...	20.5	"

Cyls. 18 in. × 26 in.

150 lbs. per sq. inch.



Weight Empty	...	T. C.	...	T. C.	...	T. C.	...	Total	...	T. C.	
" Working	...	11	13	...	12	15	...	11	2	35	10
" per foot run,	...	13	0	...	13	8	...	11	15	38	3

Tender, 2,500 gallons.

Scale
(for all Locomotives except Fig. 1.)

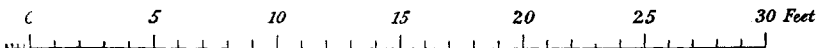


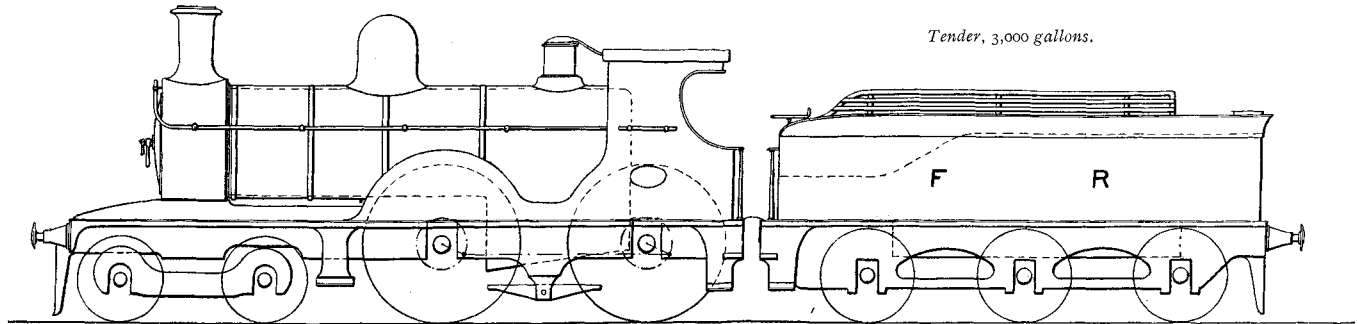
Fig. 20. *Four Wheels Coupled Bogie Passenger Engine, 1901.*

Heating Surface of Tubes ...	1,159 sq. feet.
" " Firebox ...	111'5 "
TOTAL ...	<u>1,270'5 "</u>
Grate area ...	18 "

Cyls. 18 in. x 26 in.

160 lbs. per sq. in.

Tender, 3,000 gallons.



	T. C.		T. C.		T. C.		T. C.	T. C.		T. C.		T. C.		T. C.		T. C.		T. C.		T. C.			
Weight Empty ...	13	6	...	12	18	...	12	9	...	Total 38	13	...	6	2	...	5	7	...	5	7	...	Total 16	16
" Working ...	15	1	...	14	4	...	13	15	...	43	0	...	10	18	...	11	8	...	10	8	...	32	14

per foot run, 2'0 tons.

Weight of Tender per foot run, 2'5 tons.

Total Weight of Engine and Tender in Working Order, 75 tons, 14 cwt.

Scale
(for all Locomotives except Fig. 1.)

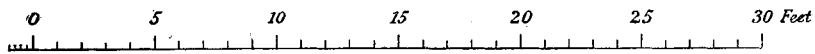


Fig. 21. Plan of Furness Railway Company's
Loca. Carriage and Wagon Works.

