THE LOCOMOTIVE MAGAZINE

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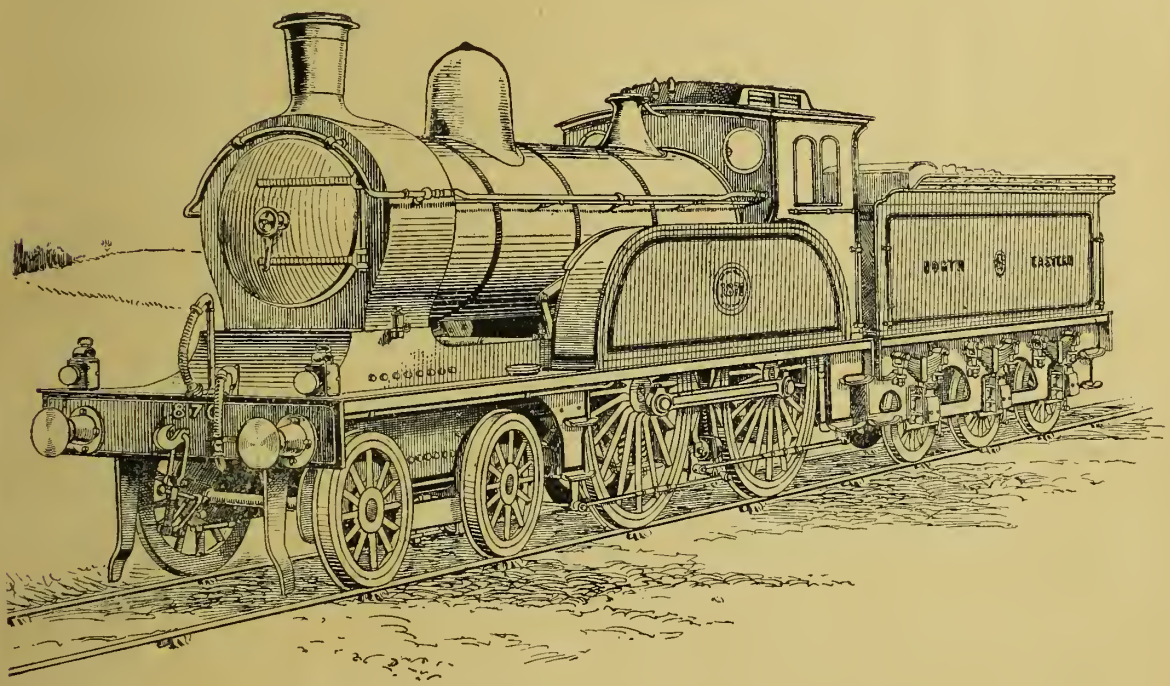

VOLUME XII.

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THE LOCOMOTIVE MAGAZINE.

Vol. XII. JANUARY 15th, 1906. No. 161.

RAILWAY NOTES.

GREAT CENTRAL RY.—As was recorded in a recent issue, Mr. J. G. Robinson is providing for the express service of this railway a new series of "Atlantic" type locomotives, of which 12 have already been delivered by the North British Locomotive Co., Ltd., whilst 12 are in course of completion at the railway's own shops at Gorton. These locomotives are practically identical with the first G.C.R. "Atlantic" No. 192, illustrated and described in our issue for Dec. 12th, 1903, except for a slight increase in the firebox heating surface, a higher boiler pressure and a certain accession of weight, and they are also provided with larger tenders.

But as regards two of the engines built at Gorton, Mr. Robinson has instituted an interesting experiment by constructing them as three-cylinder compounds, having one high-pressure cylinder below the smokebox, 19-in. in diameter by 26-in. stroke, driving the leading pair of coupled wheels, and two low-pressure cylinders outside the frames, 21-in. in diameter by 26-in. stroke, driving the trailing pair of coupled wheels. Otherwise, these engines are identical with the 22 simple engines, and Mr. Robinson has in view the fact that should an exhaustive test on similar traffic show the compounds to have the advantage of the simple engines, these latter can at small expense be converted into compounds, whilst on the other hand the compounds can as readily be reduced to simple working should extended trials show no advantages to compensate for their slightly greater initial cost.

The accompanying illustration shows No. 258, the first of the two compounds, and in addition to the cylinder dimensions, the following are the only important differences between these and the earliest type of "Atlantic" already referred to: heating surface, firebox 153 sq. ft., tubes 1,778 sq. ft., total 1,931 sq. ft.; boiler pressure 200 lbs. per sq. in.; weight in working order, on bogie wheels 17 tons, on four-coupled driving wheels 37 tons, and on trailing wheels 17 tons, total 71 tons; weight of tender, containing 4000 gallons of water and 5 tons of coal, 44 tons 3 cwt.

Photo by THREE-CYLINDER COMPOUND "ATLANTIC" LOCOMOTIVE No. 258, GREAT CENTRAL RY. *Loco. Pub. Co., Ltd.*

METROPOLITAN RY.—The steam locomotives, Nos. 10, 11, 12, 13, 15 and 66 have been sold to the Cambrian Rys. No. 14 has been fitted with a cab, has had the condensing apparatus removed, and is now the property of the South Hetton Coal Co., near Seaham, County of Durham.

One of the trains of bogie coaches built for the Aylesbury service has been equipped for electric working. The guards' compartments are fitted with the driving appliances for multiple unit

working, and two large plate glass windows provide a suitable look-out at the ends. The passenger compartments and side doors remain unaltered, but "second class" is now labelled "third." The new style of painting is adopted.

Two of the electric locomotives built for the Central London Ry. by the General Electric Co. of America, and removed from service on the introduction of the multiple-unit motor-driven trains, are now being used for experimental purposes by the Metropolitan Ry. at Neasden.

GREAT WESTERN RY.—Five new "Consolidation" locomotives are now out, Nos.2814-2818.

GREAT EASTERN Ry.—During the past year there were built at Stratford Nos. 1210 to 1219, six-coupled mineral engines of the 1150 class, but with Belpaire fireboxes, flat-topped steam domes and sandboxes for the middle pair of wheels, placed on top of the framing, the sand being applied by means of the apparatus described on pp. 8-9 of the current issue. Also 20 passenger double-end tank engines of the same type as No. 781, illustrated on page 7 of our last volume, of which the last 10 have been fitted with condensing apparatus.

GREAT SOUTHERN & WESTERN RY.—A new type of express locomotive, having six-coupled wheels and a leading bogie, is now being built at Inchicore, Nos. 362-365 being already completed.

LONDON & NORTH WESTERN RY.—The latest locomotives of the new "Precursor" type are: Nos. 811 "Express," 117 "Alaska," 127 "Snake," 229 "Stork," 1301 "Candidate," 1363 "Cornwall," 1396 "Harpy," 1439 "Tiger," 2007 "Oregon," 2012 "Penguin" and 2115 "Servia." There are now 80 of this type in service. It will be noticed that the "Teutonics" are now sharing the fate of the earlier three-cylinder compounds. Two more of the Ramsbottom 7-ft. 6-in. singles, Nos. 127 "Peel" and 229 "Watt" are also removed from service, and replaced. No. 3020 "Cornwall" has been withdrawn from service, but it is hoped that this historic veteran will not be consigned to the scrap heap.

SOUTH EASTERN & CHATHAM RY.—Five more bogie passenger tank locomotives are now running, Nos. 259, 261, 264, 269 and 500.

MESSRS. BEYER, PEACOCK & CO., LTD.—This firm is full of work at present, having the following orders on hand: six 4-6-0 freight locomotives with 19-in. by 26-in. cylinders, 5-ft. 8-in. coupled wheels, and a boiler 5-ft. 6-in. in diameter carrying a working pressure of 200 lbs. per sq. in.; for the Argentine Great Western Ry.; two side tank 2-6-0 outside cylinder engines and six 2-6-0 tender engines for mixed traffic on the Central Uruguay Ry.; 30 4-6-0 compound freight engines for the Buenos Ayres Great Southern Ry.; ten 4-6-0 "Fish" engines with large boilers, and ten 4-6-0 goods engines of a new type for the Great Central Ry.; two 4-4-0 express passenger engines for the Great Northern of Ireland Ry.; one 4-6-0 tank engine for the Cork, Bandon & S. C. Ry.; and a motor coach for the North Staffordshire Ry. The firm has recently delivered to the Dutch State Rys. ten 4-4-0 express engines similar to those illustrated in our issue for Sept., 1900, but with 19-in. cylinders and certain modifications in details.

STEAM RAIL MOTOR COACH, G. N. R.—On page 206 of our last issue one of a series of steam rail motor coaches for service on branch lines of this railway was illustrated. The leading dimensions are: length over buffers 66-ft. 5½-in., height from rail level to chimney top 12-ft. 6-in., extreme width over stepboards 8-ft. 10½-in., diameter of cylinders 10-in., diameter of wheels 3-ft. 7-in., total heating surface 505.64 sq. ft., working pressure 200 lbs. per sq. in., total weight 40 tons 2 cwt., seating accommodation for 57 passengers.

RECENT APPOINTMENTS.—Mr. Carlton Hurry Riches has been appointed locomotive superintendent of the Rhymney Ry. in succession to Mr. Jenkins, the change taking effect as from January 1st.

Mr. Surrey Warner, of the carriage department of the G.W.R., succeeds Mr. W. Panter as carriage and wagon superintendent of the London South Western Ry., from January 1st.

Mr. George Gillies, chief draughtsman of the locomotive department, L.B.& S C.R., retired on December 31st, and is succeeded by Mr. D. J. Spidy, his chief assistant.

Following on the death of Mr. Yerkes, Mr. Edgar Speyer, of Messrs. Speyer Brothers, has been appointed chairman of the Underground Electric Railways Co. of London, Ltd. Sir Geo. Gibb, the general manager of the North Eastern Ry., has resigned that position, and has accepted the chairmanship and general management of the Metropolitan District Ry., and has also accepted the position of deputy chairman of the Underground Electric Rys.

OBITUARY.—We learn with much regret of the death of Mr. George H. Wall, a member of the firm of Dewrance & Co., and inventor of the well-known water-gauge-glass protector.

THREE-CYLINDER COMPOUND EXPRESS LOCOMOTIVE No. 1000, MIDLAND RY.

NEW THREE-CYLINDER COMPOUND EXPRESS ENGINES, MIDLAND RAILWAY.

WE illustrate herewith one of the ten new compound engines, Nos. 1000 to 1009, recently built at Derby by the Midland Ry. Co. They are in most respects the same as the five previous engines Nos. 2631 to 2635, designed by Mr. S. W. Johnson, but have several modifications introduced by his successor, Mr. R. M. Deeley, the chief of which is an increase in the boiler pressure to 220 lbs. per sq. in., as against 195 lbs. per sq. in., in the previous engines. The other modifications are principally in the external appearance. The number plate of the engine is on the front of the smokebox, the tender being adorned with a huge painted number after the American style.

The coupled wheels are 7-ft. 0-in in diameter and the cylinders remain as in the 2631 class, viz.: one h.p. cylinder (inside) 19-in. in diameter, with two l.p. cylinders (outside) 21-in. in diameter, the stroke in both cases being 26-in. The slide bars are novel in design, having a section of ⊥ form.

The brass beading which has been a feature of all Midland splashers for the past 30 years has been replaced by a plain black beading.

The tenders are of latest standard six-wheeled pattern and contain 3,500 gallons of water. They are fitted with water pick-up apparatus.

WE have received from the Gloucester Railway Carriage & Wagon Co. a copy of the "Gloucester Diary" for 1906. Among the notes for visitors to Gloucester particulars are included of many features of interest, including the Severn "Bore," Gloucester "Mop" fair and the "Festival of the Three Choirs."

STEAM LOCOMOTIVES OF THE METROPOLITAN DISTRICT RAILWAY

(*Concluded from page* 206, *Vol. XI.*)

MR. THOS. S. SPECK was the locomotive superintendent from July, 1871, to December, 1879. He was succeeded by the Hon. S. A. Cecil, who held the office until December, 1884, when Mr. George Estall took charge.

Engines Nos. 31 to 48 were built whilst the Hon. S. A. Cecil was locomotive superintendent, and Nos. 49 to 54 under the superintendence of Mr. G. Estall. These had a G.N. type of chimney, and Nos. 37 to 54 had plain brass domes and Ramsbottom safety valves on the firebox The first 36 engines when rebuilt with new boilers, cylinders, etc., were given the cast iron chimneys introduced by Mr. Estall in Nos. 49 to 54. Nos. 25 to 36 were supplied with steel boilers, carrying a pressure of 160 lbs., reduced later to 150 lbs. Nos. 25 to 54 from the first had a bridge pipe with small outlet in the centre, instead of separate straight pipes from each tank to let the surplus steam escape when condensing, as were originally fitted to Nos. 1 to 24. All the later engines had Adams' type bogies, and the first 24 when rebuilt were also fitted with these bogies in place of the four-wheeled Bissel trucks originally provided. Engine No. 53 was fitted to burn liquid fuel (gas works residuals) in 1891, and ran for a time between High Street and Putney Bridge so fitted.

The following particulars of the last lot of engines will no doubt be of interest. The outside cylinders are 17-in. by 24-in., inclined 1 in 9, with D shape slide valves operated by Allan's straight-link motion. The boiler barrel is 10-ft.

3-in. long, 4-ft. diameter inside and contains 164 tubes, 2-in. in diameter. The firebox casing has an external length of 5-ft. 7-in. whilst the inside firebox of copper is 4-ft. 10½-in. at top, 5-ft. at bottom and 3-ft. 4½-in. wide at the centre.

The height of the boiler centre from rail is 6-ft. 7-in. and the working pressure is 130 lbs. per sq. in. The bogie wheels are 3-ft. in diameter and the coupled 5-ft. 9½-in. in diameter with new tyres. The boiler has a total heating surface of 903 sq. ft. and the firebox 90 sq. ft., the grate area being 16 sq. ft. The engine weighs in working order 46½ tons, of which 18 tons 1 cwt. is on the front pair of driving wheels, 17 tons 12 cwt. on the trailing, and 10 tons 17 cwt. on the bogie. The height from rails to top of chimney is 12-ft. 6-in. The boilers are fed by two gun-metal pumps having a 5-in. stroke,

The engines were latterly painted olive green without any lining, but until about two years ago they were picked out with black and red lining. The first 30 engines were originally painted bright green. The large bright brass dome covers gave the engines a smart appearance, in spite of the fact that they had to work in the dirt-laden atmosphere of the tunnels.

Since the opening of the Whitechapel and Bow Ry., three engines of the L. T. & S. R. worked in the passenger train service over the District Ry. District engines and trains worked on the Inner Rail only of the Circle during the steam era, but their new electric trains work on both sets of lines.

At the end of May, 1900, an experimental train was put into traffic on the short loop line between Earls Court and High Street, Kensington. The train consisted of two motor coaches, one at each

Standard Coupled Bogie Passenger Locomotive No. 10 (rebuilt), Metropolitan District Ry.

attached to the cross stays and worked by eccentrics on the driving axle; also by a No. 8 Gresham injector under the footplate.

The engines, as well as the carriages, are equipped with the Westinghouse automatic brake, but as long ago as 1875 some of the stock had the Westinghouse non-automatic brake fitted, as shown in the illustration of No. 1 on page 205 of our last volume. The side tanks attached to the framing by brackets are 15-ft. 6-in by 3-ft. 2½-in. and carry 1,200 gallons of water. It may be noted that Nos. 1 to 24 had narrower side tanks than the later engines and carried only about 1,000 gallons. The coal bunker is 8-ft. 7½-in. by 2-ft. by 3-ft. 7½-in. and carries 1 ton 7 cwt. The total wheelbase is 20-ft. 9-in., of which the rigid coupled wheelbase is 8-ft. 10-in. and that of the bogie 4-ft.

end of the train, and four ordinary bogie carriages. The electric equipment was supplied by Messrs. Siemens Bros. and the cars built by Messrs. Brown, Marshalls, of Birmingham. A small generating station was installed at Earls Court, the whole plant, which worked quite satisfactorily, being paid for jointly by the District and Metropolitan Railways. The generating plant was afterwards moved to Alperton.

Mr. Geo. Estall, the engineer and locomotive superintendent of the line, retired in October last, and the locomotive works are now being quite dismantled. A portion of Lillie Bridge yard will in the near future form the principal depot and repair shops for the rolling stock of the Great Northern, Piccadilly and Brompton Electric Tube Ry., the District Ry. retaining the remainder for one of their depots.

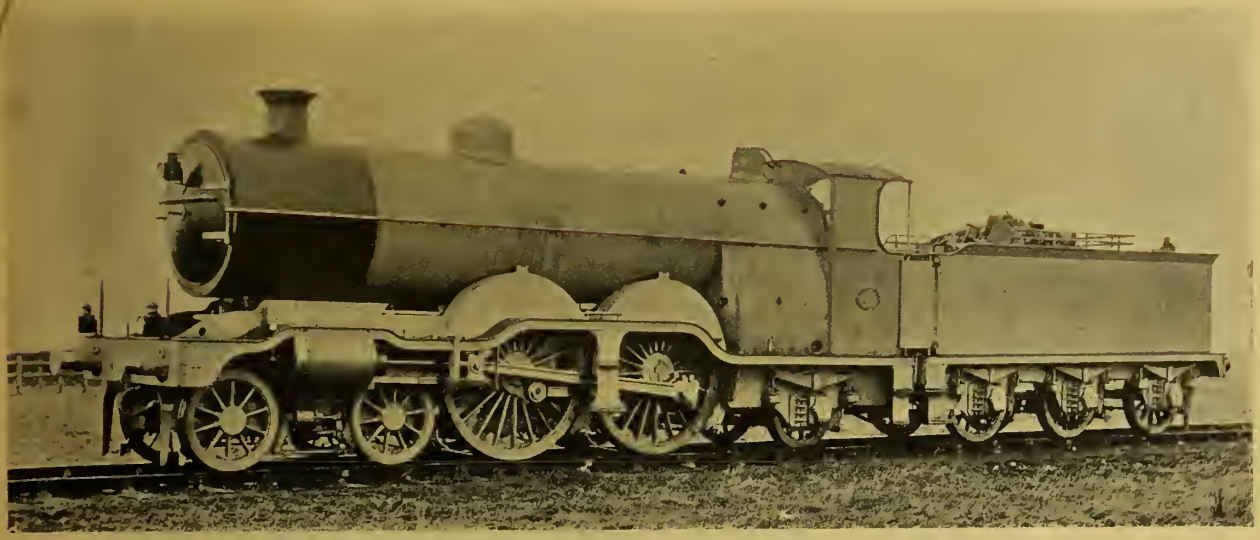


Photo by ATLANTIC-TYPE EXPRESS LOCOMOTIVE No. 37, LONDON, BRIGHTON & SOUTH COAST RY. *Loco. Pub. Co. Ltd.*

ATLANTIC PASSENGER LOCOMOTIVE, L. B & S. C. RY.

The accompanying illustration and diagram show the leading features of the new express passenger locomotives of the Atlantic type built by Messrs. Kitson & Co., Ltd., to the designs of Mr. D. E. Marsh, locomotive superintendent of the above railway. As can be seen, these locomotives, of which five are in course of delivery, Nos. 37-41, which will be known on the line as class B5, bear a strong resemblance to the No. 251 class on the G.N.R., and a comparison of the dimensions of the two classes shows that Mr. Marsh has, except as regards the cylinder dimensions and boiler pressure, closely followed the successful practice with which he was connected before leaving Doncaster. It will be noticed that L.B.& S.C.R. fittings are introduced, and that, in addition, there is some slight modification of the running plate and of the frames at the leading end, while the overhang behind the trailing wheels is also greater than in the G.N.R. design, to allow of a larger cab. The Westinghouse donkey pump is placed below the smokebox. Two of these fine locomotives have already been delivered, and the remainder are expected shortly. One of the five will differ from No. 37 here illustrated in respect to the chimney, cab, etc.

MR. RICHARD BELL has forwarded us a copy of his report to the Amalgamated Society of Railway Servants on the trials of the Great Western Ry. either-side wagon brakes near Dowlais, on Sunday, November 5th. The brake tried, which is the joint patent of the late Mr. Dean and Mr. Churchward, appears to have fulfilled all the requirements of the A. S. R. S. Committee.

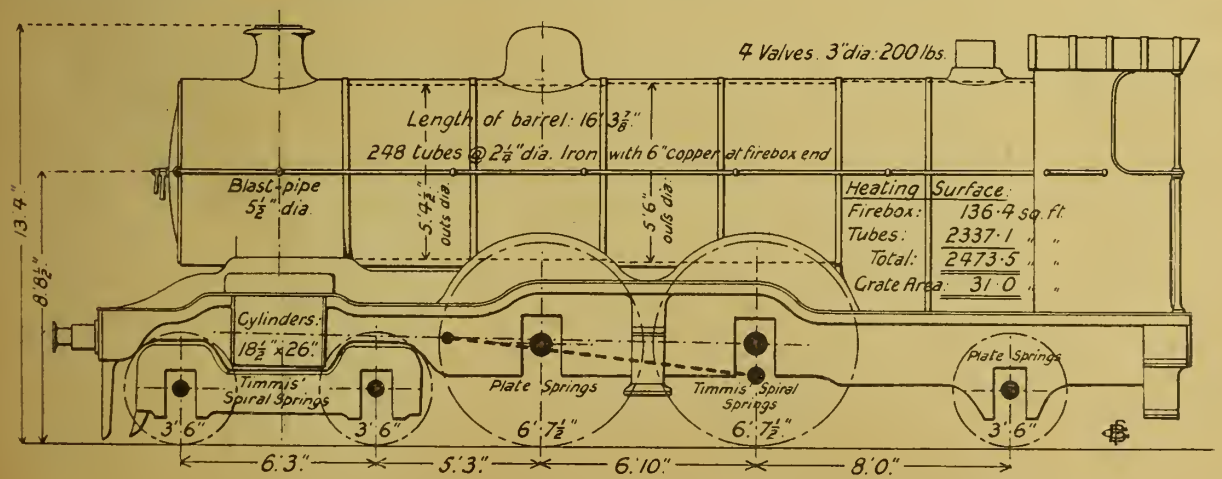
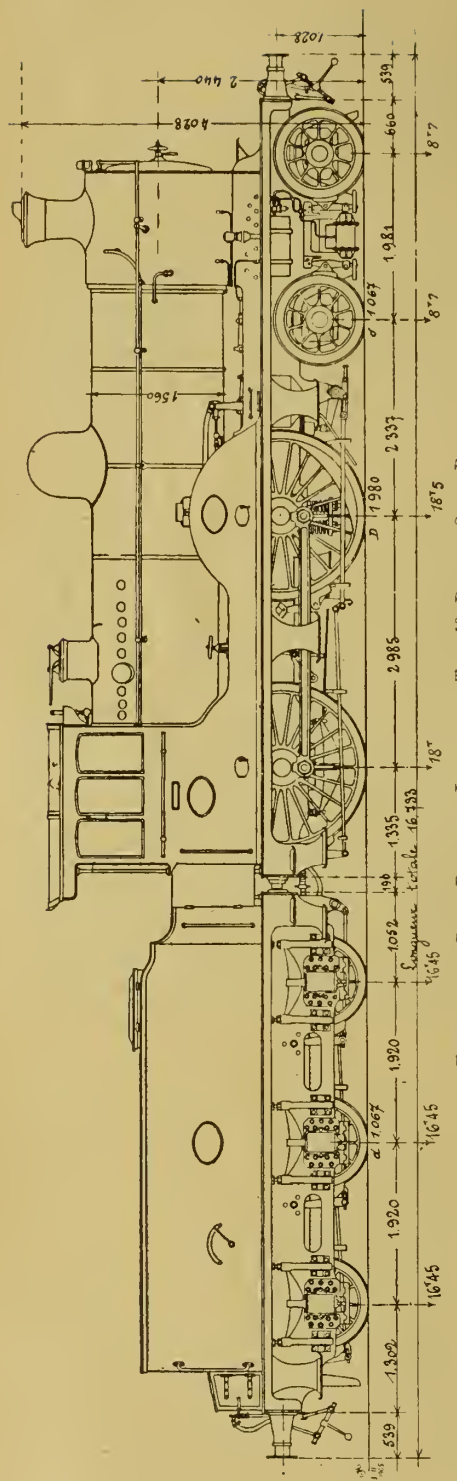


DIAGRAM SHOWING LEADING DIMENSIONS OF ATLANTIC-TYPE EXPRESS LOCOMOTIVE, LONDON, BRIGHTON & SOUTH COAST RY.

RECENT LOCOMOTIVES OF THE BELGIAN STATE RAILWAYS.



Four-coupled Bogie Passenger Locomotive, Type 18, Belgian State Rys.

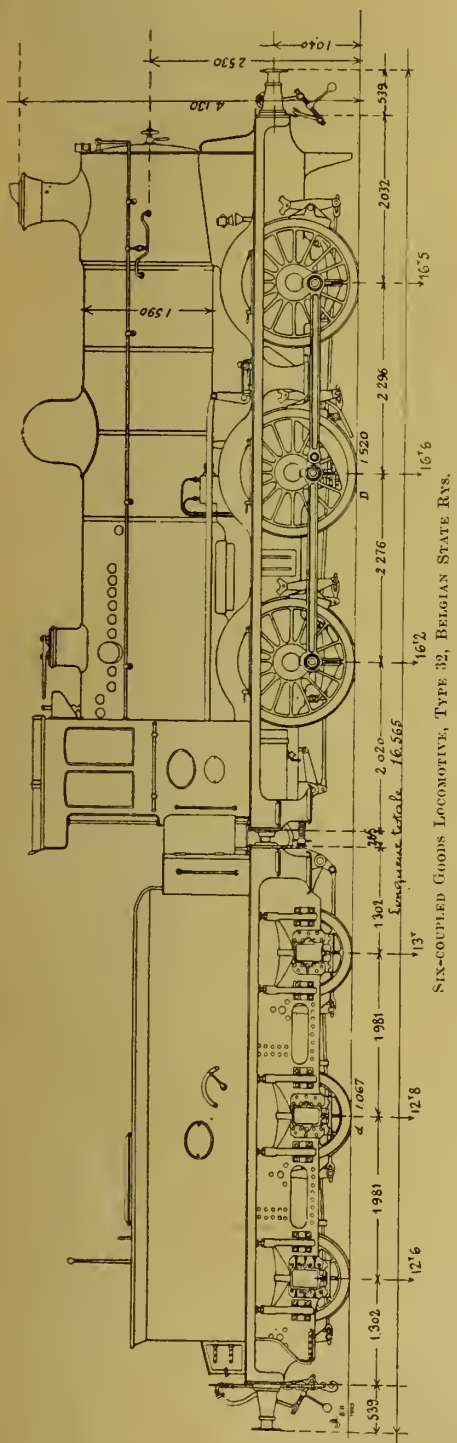
During the ten years from about 1890 to 1900, that is to say between the completion of the last Belpaire locomotives and the introduction of the well-known "Dunalastair II." type designed by Mr. J. F. McIntosh of the Caledonian Ry., the locomotive practice of the Belgian State system showed no very noteworthy characteristics.

In 1900 three new classes were introduced, respectively, Type 17 of the "Dunalastair II." pattern, Type 30, similar to the standard Caledonian six-coupled goods engines, and Type 15, ten-wheeled tank engines. Strictly speaking, Type 17 was introduced two years earlier, for Messrs. Neilson, Reid & Co., Ltd., of Glasgow, supplied in 1898, Nos. 2411-2415, the five prototypes of a numerous class, which were illustrated and described in Vol. IV, page 41. It was in 1900, however, that locomotives of this type were first built on the Continent, 40 being built in that year bearing Nos. 2463-2502. These were followed in the same and next year by a further series of 50, Nos. 2622-2671, making altogether a total of 95 engines of that class. Of Type 30, which was illustrated and described in Vol. VI, pages 92-3, no less than 82 were built in 1900, bearing Nos. 2503-2514, and 2823-2892. Type 15, also illustrated and described in Vol. VI. page 12, is represented by 107 locomotives built during the years 1900-3, bearing Nos. 2515-2621. Of the three classes mentioned, the last is the only one examples of which have been built during the last two years. The other classes, successful though they proved, have gradually been replaced on the fastest and heaviest main line services by more powerful locomotives of the same general design, particulars of which, with illustrations, we are able to present to our readers through the courtesy of our valued Brussels correspondent, M. Albert Jacquet.

The express locomotives which have replaced the original "Dunalastair II." type, and which were illustrated in Vol. VIII, page 81, are known as Type 18, and form a total of 140 engines differing only in respect to details. They were built as follows: Nos. 2672-2691 in 1902, Nos. 2692-2721 in 1903, Nos. 2722-2750 in 1903-4, and Nos. 3190-3200 and 3243-3292 in 1904-5. Nos. 3190 and 3288-3292 are fitted with the Schmidt superheater, and those built within the last year have been provided with six-wheeled tenders in place of those on double bogies, of the Caledonian pattern, which were previously in vogue. This new tender is now standard on the system. Fig. 1 shows an engine of this class, provided with the Schmidt superheater and the new six-wheeled tender.

There are certain differences between the engines equipped with superheaters and those without, as the following tabulated statement will show :—

Type 18.	With Superheater. ft. in.	Without Superheater. ft. in.
Diameter of cylinders	20	19
Stroke of cylinders	26	26
Total wheelbase	23 10½	23 6
Length over buffers	32 8¼	32 4¾
Number of tubes, 2-in. in diam.	153	265
Heating surface, firebox	131 sq. ft.	131 sq. ft.
,, ,, tubes	967 ,,	1242 ,,
,, ,, total	1098 ,,	1373 ,,
Grate area	22.3 ,,	22.3 ,,



Six-coupled Goods Locomotive, Type 32, Belgian State Rys.

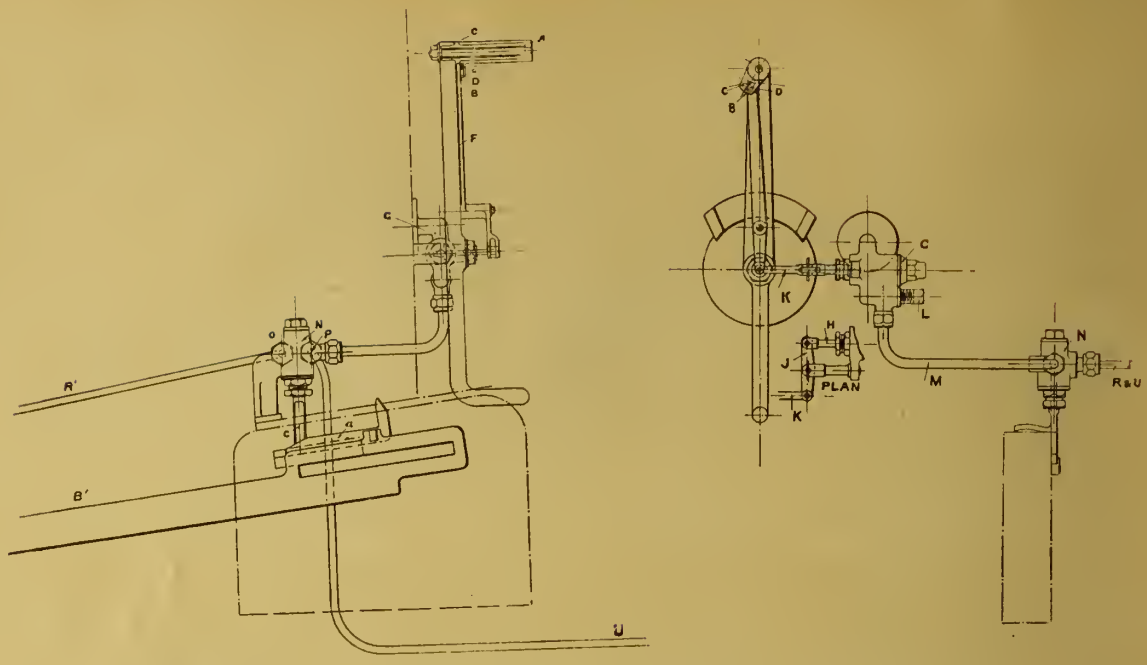
In the engines provided with superheaters there are, in addition to the 153 flue tubes, 18 larger ones of 5-in. diameter containing the superheater tubes which have a surface of 263.8 sq. ft These engines weigh 55 tons in working order, of which total 36½ tons are available for adhesion. In both descriptions of engines the ordinary Stephenson link motion is employed, with steam reversing gear as is usual in nearly all Belgian State locomotives, but they differ as regards the slide valves, those engines furnished with the superheater having piston valves, while the others have plain D valves. Among features common to both classes are Wilson-Klotz safety valves, pressed to blow off at a pressure of 190 lbs. per sq. in.; Gresham-Craven injectors and compressed air sanding apparatus; the quick acting Westinghouse brake, with blocks on all the wheels; and steam heating apparatus for warming the train. Engines of this type work trains of from 325 to 375 tons over the sections of the line having moderately easy gradients at speeds varying from 53 to 59 miles per hour.

A need for greater hauling power has resulted in the original six-coupled goods locomotives of Type 30, above referred to, being followed by others of the same general design, but more powerful. These, which are known as Type 32 and were illustrated in Vol. IX, page 64, now total 250, their numbers being as follows: 2893-3142, all built between 1902 and 1904. No. 3143, one of a new series, is shown in Fig. 2, and is provided with the Schmidt superheater, as will be a large proportion of those now in course of construction. The leading dimensions of the two series are here tabulated:—

Type 32.	With Superheater. ft. in.	Without Superheater. ft. in.
Diameter of cylinders	20	18½
Stroke of cylinders	26	26
Diameter of driving wheels	5 0	5 0
Wheelbase, leading to driving	7 6⅝	7 6
,, driving to trailing	7 5⅜	7 6
,, total	15 0	15 0
Length over buffers	31 0½	30 2½
Height of boiler centre above rails	8 3⅛	7 11
Number of tubes, 2-in. in diam	154	254
Heating surface, firebox	119 sq. ft	119 sq. ft.
,, ,, tubes	916 ,,	1133 ,,
,, ,, total	1035 ,,	1251 ,,
Grate area	27.17 ,,	27.17 ,,

The superheater tubes are contained within 18 tubes of 5-in. in diameter and have a surface of 231.5 sq. ft. As in the locomotives last described, D valves and piston valves are employed in the ordinary and the superheater locomotives respectively. The fittings, satety valves and accessories, are according to Belgian State standards, and they are equipped with the Westinghouse quick acting brake. The earlier engines weigh approximately 48½ tons, and those with the superheater about 51 tons. The tender, which has a capacity for 2860 gallons of water and 7 tons of coal, weighs about 39 tons. These locomotives are employed principally in working goods traffic on the main lines, where they have replaced the older Type 25, but they also run passenger trains on the sections between Brussels and Antwerp, Termonde, Mons, Charleroi and Tournai, on the Luxembourg line and on heavy gradients. On account of their greater haulage capacity, allowing of the despatch of heavier trains, they have effected a distinct gain in transportation facilities on over-crowded lines.

(*To be continued.*)

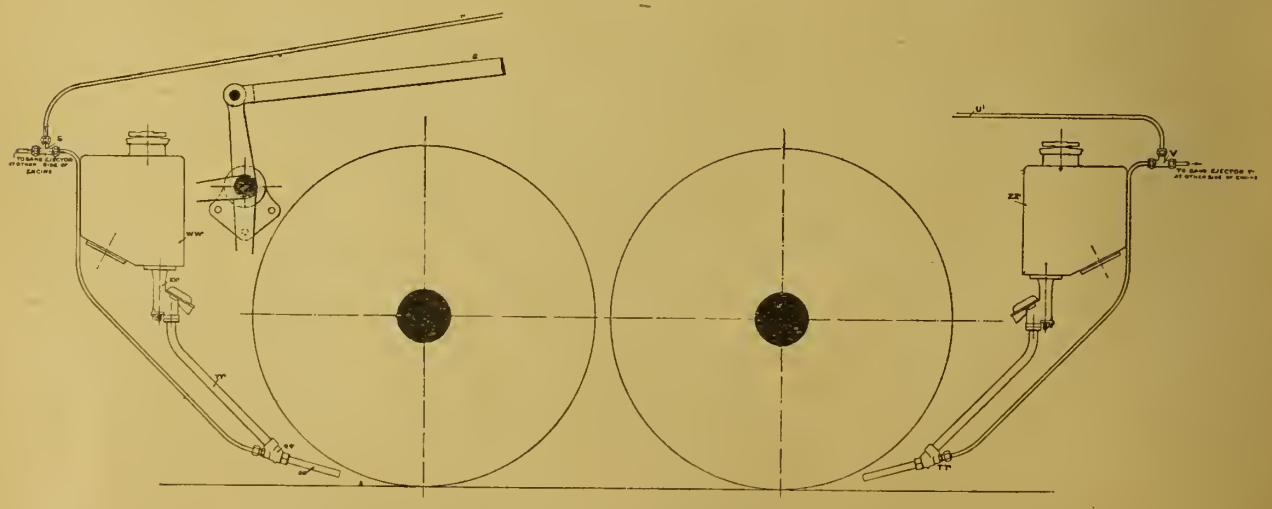


Driver's Combination Regulator Handle for operating Steam Sanding Gear, Great Eastern Ry.

STEAM SANDING GEAR, GREAT EASTERN RAILWAY.

THE accompanying illustrations show the method of sanding adopted on the above railway, whereby a locomotive fitted with this gear can have sand applied between the wheels and rails by means of the regulator handle, without having to operate a separate lever for the purpose. The following description, in conjunction with the diagrams, will make the method of working this gear quite plain to the reader. A tubular knurled handle A having a flat end B is fitted on a spindle C. A groove D is cut in the end B and a circular projection E on the lever F engages in this groove. The steam valve G is fixed on the back of the firebox and its spindle H is connected to the lever F by means of the lever J and link K. Steam enters this valve at boiler pressure but is reduced before leaving, the reduction being adjusted by the screw L. A pipe M is taken from the valve G to the reversing valve N, which has two outlets O and P. O is connected to the front sand ejectors QQ by a steam pipe R and a three-way piece S, and P is connected to the back sand ejectors TT by a steam pipe U and a three-way piece V.

The front sand boxes WW are fitted with traps



Arrangement of Front and Back Sand-boxes for Steam Sanding Gear, Great Eastern Ry.

XX, these being connected to the ejectors QQ by pipes YY. The back sand boxes ZZ are connected to the ejectors TT in a similar manner.

The function of the reversing valve N is to automatically regulate the direction of steam either to the front ejectors QQ or to the back ejectors TT. This valve is actuated by a sliding piece (a) which, when moved along by the reversing rod (b), causes the valve spindle (c) to rise or allows it to be forced down by steam pressure.

When the engine is running in forward gear, the valve spindle (c) is raised and steam can pass to the front ejectors; if the engine is running backward, the valve spindle (c) is forced down when the gear is operated and steam then passes to the back ejectors.

To operate the gear, the handle A is rotated and motion is thereby transmitted through the levers F and J and the link K to the steam valve spindle H which is pushed in against steam pressure and opens the valve G. Assuming the engine to be in forward gear, steam will pass along the pipe M, through the reversing valve N and the pipe R to the ejectors QQ, and will cause sand to be drawn from the traps XX down the pipes YY and (dd) on to the rails.

If sand is only required momentarily, as in the case of starting, the handle A is rotated through a short distance and sand is applied. Immediately the handle is free, the valve G automatically closes and the handle regains its original position.

If, however, sand is required continuously, as in the case of ascending a long incline, the handle A is rotated through a slightly greater angle and becomes locked in that position owing to the circular projection E on the lever F then being in part (e) of the groove D. The lock is sufficient to hold the steam valve G open as long as necessary, but the handle is easily unlocked at will by rotating it in the opposite direction.

THE KALKA-SIMLA RY., INDIA.

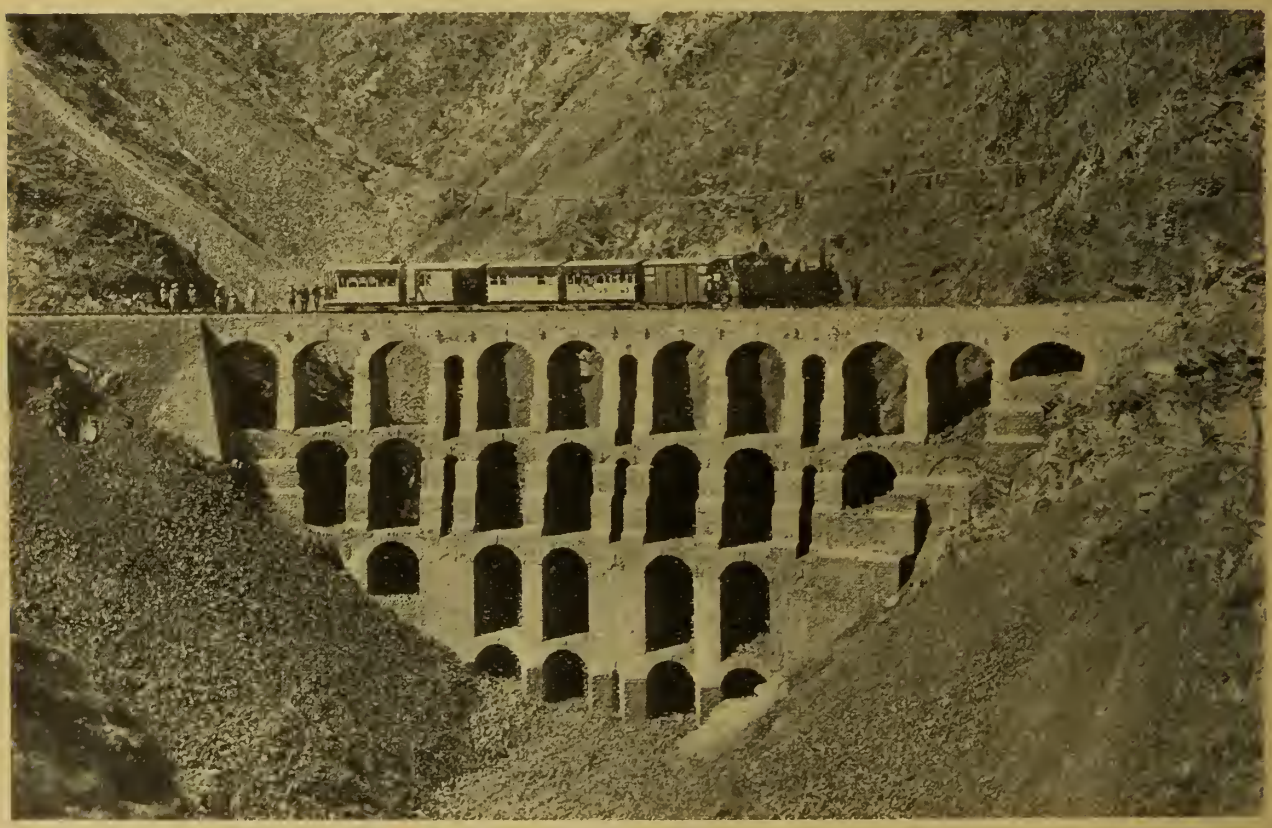
SIMLA, the headquarters of the Government of India during the hot weather, is situated among the foot-hills of the Himalayan Mountains at an altitude of 7,116 feet, and until November, 1903, it relied upon "tongas" or country carts for communication with the outer world. Now, all this is altered, and the railway here described connects Simla with the trunk railways of India *via* Kalka, the terminal station of the East Indian and Great Indian Peninsula Railways.

The line is laid to a gauge of 2-ft. 6-in., and is single track throughout, the rails weighing 41 lbs. per yard. The total length is 59½ miles, and many difficulties were met with in its construction, necessitating some ingenious and exceptional examples of the railroad builders' skill.

BAROGH STATION AND TUNNEL, KALKA-SIMLA RY.

On leaving the Kalka junction station, where the broad gauge trains stop, the line almost immediately commences to ascend the spurs of the mountains with a gradient of 1 in 33, taking all the turns continuously and without any reversing until Simla is reached. The spurs are for the most part of a favourable nature, and are taken advantage of when they lie in the right direction, but where they do not, tunnelling has to be resorted to. The ridges are connected by "saddles" of varying heights, not always progressive in favour of the ascent, so that the line

KALKA JUNCTION STATION, SHOWING NARROW-GAUGE TRAIN, KALKA-SIMLA RY.



THE HIGHEST VIADUCT ON THE LINE, KALKA-SIMLA RY.

having topped a ridge has sometimes to descend; however, as the mountains rise, so do the majority of the "saddles."

At Dhurrumpoor, about the sixteenth mile, the line proceeds along the side of a spur, runs round a lap and returns along the same face into the hollow angle of the hill, where it enters a horse-shoe tunnel and emerges through a second portal not far from the point of entrance, continuing its course for the third time along the same face of the spur.

In spanning mountain gorges and ravines, girder viaducts are not employed as a rule, but masonry structures called "galleries." These resemble Roman aqueducts, consisting of tiers of arches, rising one above the other until rail level is reached. They are generally on a curve, and the curvature is formed by making the piers wedge-shaped. The retaining walls are made of dry stone, hand set, of considerable width, varying from 10 to 15 feet, and bands of masonry about 2 feet wide are introduced at intervals of about 5 feet, according to circumstances.

Among the numerous tunnels there are three of considerable length. The Koti, 2,270 feet, has been driven through a shale hill. Such was the pressure on the heading timber used during construction that some of the verticals were driven 3 inches into the horizontals. The second tunnel is the Barogh, 3,752 feet in length, driven through basalt and trap by pneumatic drills. The Tara Devi, near Simla, is a third, 1,200 feet long.

The line has some beautiful scenery, and its alignment has been carefully laid and well studied by the late agent and chief engineer, Mr. Harrington, who has recently been succeeded by Mr. J. A. Kellie. The consulting engineers are Messrs. Duff Bruce & Co.

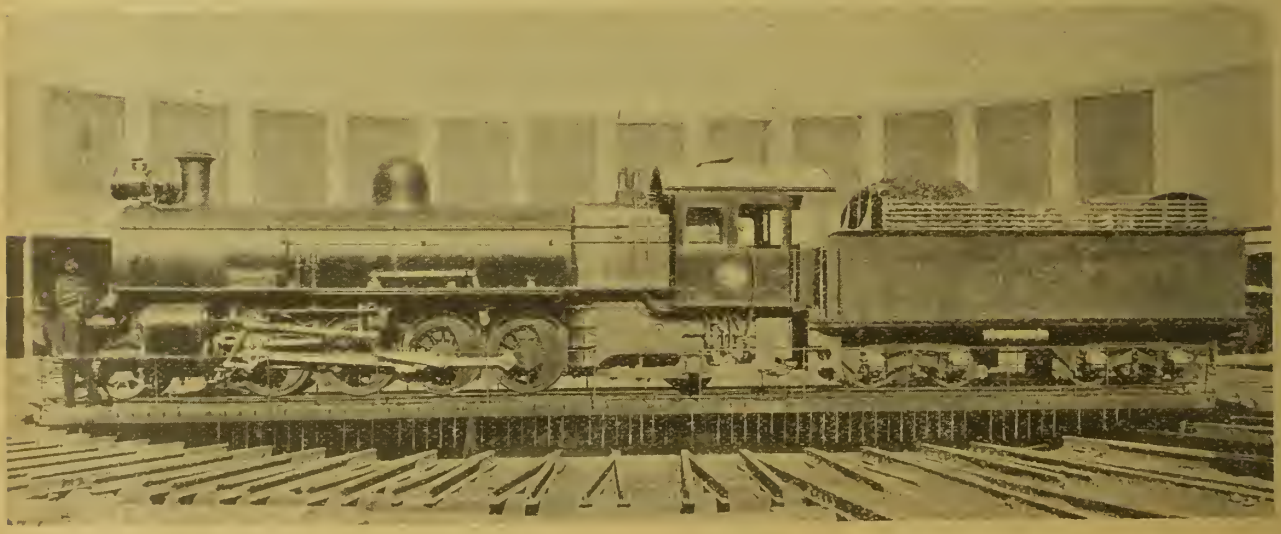
View of Simla from the Railway, showing Mountain Road on right side of Track, Kalka-Simla Ry.

There are at present 24 tank locomotives at work. The coaching stock consists of 74 passenger cars and 75 goods wagons, all fitted with the automatic vacuum brake. The carriages and wagons have a loose wheel on each axle to take the curves, which are as sharp as 120 feet radius. The axle carries a ring or collar welded on to it, the nave of the wheel carries a flange on its inner face, and this flange is bolted to a washer behind the collar.

The speed of passenger trains is limited to 15 miles an hour.

No. 603, 4-6-2 Locomotive, 9th Class, Central South African Rys.

No. 650, 4-6-2 Locomotive, 10th Class, Central South African Rys.



No. 729, 2-8-2 Locomotive 11th Class, Central South African Rys.

CENTRAL SOUTH AFRICAN RYS.

THE accompanying photographic reproductions show further and more modern examples of the locomotives supplied to the above system within the last two years—what is known as the 9th class having been built by the Vulcan Foundry, Limited, and the 10th and 11th classes by the North British Locomotive Co., Ltd. The first two have already been illustrated and described in our issues for January and June, 1904, respectively, but for the sake of continuity, the leading dimensions may be repeated here, for comparison with the 11th class, which latter represents a somewhat startling total of weight for a railway having only a 3-ft. 6-in. gauge.

No. 601, 4-6-2 PASSENGER LOCOMOTIVE, 9TH CLASS, WITH LOCAL TRAIN, CENTRAL SOUTH AFRICAN RYS.

	9th Class	10th Class.	11th Class.
Cylinders—diameter	18-in.	18½-in.	20-in.
,, stroke	26-in.	28-in	26-in.
	Ft. In.	Ft. In.	Ft. In.
Bogie wheels—diameter	2 6	2 4½	2 6
Coupled wheels ,,	4 9	5 2	4 0
Trailing wheels ,,	2 6	2 9	2 6
Boiler barrel—length	12 10⅜	18 1¼	17 8¼
,, diameter	5 1⅝	4 8	5 3⅝
Tubes: length between tubeplates	12 7	18 6½	18 1⅜
Heating surface—firebox	131 sq. ft.	128 sq. ft.	142 sq. ft.
,, ,, tubes	1350 sq. ft.	1714 sq. ft.	2136 sq. ft.
Total	1481 sq. ft.	1842 sq. ft.	2278 sq. ft.
Grate area	21·75 sq. ft.	35 sq. ft.	37 sq. ft.
	T. C. Q.	T. C. Q.	T. C. Q.
Weight of engine—working order	60 7 3	70 12 0	78 16 0
Weight of tender ,, ,,	48 18 3	49 7 0	49 7 0
Total	109 6 2	119 19 0	128 3 0
Tender capacity—water	4000 galls	4000 galls.	4000 galls.
,, ,, fuel	10 tons	10 tons	10 tons
Tractive force at 80 per cent.	23646 lbs.	24730 lbs.	34667 lbs.

The fourth illustration shows one of the engines of the 9th class attached to a local passenger train, from which the modern character of the rolling stock can be observed.

REVIEWS.

"THE LOCOMOTIVES OF THE NORTH EASTERN RY., 1854-1905." By J. S. Maclean. *Newcastle-on-Tyne:* R. Robinson & Co.

The author in his preface states that this book, although only just published, was prepared, to commemorate the Jubilee of the North Eastern Ry., in 1904, and he has endeavoured to achieve this object in a work of 142 pages with 63 illustrations embracing North Eastern locomotives of all descriptions built during the last 50 years. The volume teems with interest, as probably on no railway in this country has such an immense diversity in locomotive types been found as on the North Eastern Railway, and the contrast between the little rear-driver long boiler engine called the "Great A" and the mighty Atlantic, shown on page 116, is indeed striking. Of all the more recent classes full dimensions and complete lists of numbers, makers' numbers and dates are given, tabulated in a convenient form for reference; particulars of the various alterations in rebuilding are pointed out, and interesting historical details of individual engines are noted. Practically every class of passenger engine is illustrated, and a second picture is given where necessary to show extensive alterations in a later period of the engine's existence. We confess, however, we should have liked to have seen the various constituent railways which formed the N.E.R., and from which a very varied assortment of locomotives was received, more minutely dealt with, the reference, for instance, to the Newcastle and Carlisle Ry. being very brief, whilst the Blyth and Tyne is not mentioned although some 40 locomotives were taken over from the latter Company. As it is, however, an immense amount of labour must have been bestowed on this work and never before has anything like the same amount of matter concerning North Eastern locomotives been collected together.

New "Standard" Passenger Locomotive used on Royal Train, Bombay, Baroda & Central India Ry.

View of Royal Train taken from the Cab of the Leading Engine, Bombay, Baroda & Central India Ry.

THE ROYAL VISIT TO INDIA

We are indebted to Mr. C. G. Cotesworth, district locomotive superintendent of the Bombay, Baroda & Central India Ry., for the accompanying illustration of one of the locomotives used on the Royal train during the trip from Bombay to Baroda and back.

The engine is shown as partially decorated, but in addition to the brass and white metal escutcheons of the Prince of Wales' device and the Royal Arms shown, the former insignia were displayed, painted and lined, on either side of the tender, and two draped white ensigns were also placed on the smokebox front. The locomotive shown is one of the series recently built by Messrs. Beyer, Peacock & Co., Ltd., to the new "standard" designs approved for general adoption on the State-managed railways of India. A full description, with dimensions, was given in our issue of April 15th, last year, Vol. XI, p. 61, to which we would refer our readers.

Before conveying the Royal party, the train had already made a trial run over the route.

Our second illustration gives a snap-shot taken from the footplate of the leading engine during the journey.

Mr. W. P. Johnson, locomotive superintendent of the B. B. & C. I. Ry., rode on the "train" engine, whilst Mr. Cotesworth rode on the first engine.

Sleeping Car built by the N. E. R. Co. at York for the East Coast Joint Service.

NEW CARRIAGE STOCK, E.C.J S.

THE new sleeping car shown above represents the latest improvements introduced on the E.C.J.S. It contains six sleeping berths for first class passengers, all single, but with sliding doors communicating between each pair. Each berth has a lavatory basin with hot and cold water supply, and a pull-out dressing table; they are wider than usual, and one compartment has been fitted with a bed, experimentally. The doors are louvre-ventilated, and torpedo extractors and electric fans are provided in the roof, which is made more roomy by the abolition of the clerestory. Dark curtains, wire screens to exclude dust, and Stone's electric lighting are among the features. The cars are on standard frames, with rubber insulation wherever possible, and are provided with Westinghouse and vacuum brake fittings, automatic couplings and Pullman vestibules. The York carriage works of the N.E.R. have also recently built dining cars of a similarly up-to-date character, and a special corridor excursion train.

CORRESPONDENCE.

An Object Lesson on the Belgian State Rys.

To the Editor of the "Locomotive Magazine."

DEAR SIR,—The two old model locomotives shown on p. 214 of your last issue are "Le Belge" (single) and "L'Elephant" (four-coupled goods). As to the originals of these, "Le Belge" was not built by Stephenson, as was stated, but was the first locomotive constructed by John Cockerill, Seraing, and therefore the first locomotive built on the Continent in general. It was put into service on December 20th, 1835, and numbered 6 in the books of the railway administration. Its dimensions and general design were practically identical with those of Stephenson's locomotives delivered to the Belgian State in 1834-5; cylinders 11-in. by 18-in., diameters of driving and carrying wheels 5-ft. and 3-ft. 6-in. respectively. In 1844 the cylinders of "Le Belge" were enlarged to 12½-in. diameter, and in 1858 the engine was rebuilt with cylinders of 15-in. diameter. It was scrapped in 1869.

The old goods engine "L'Elephant" is stated in the reports of the railway to have been built by Stephenson (makers' No. 100), but in reality was built by the Vulcan Foundry, as stated by you, and was put to work May 1st, 1835. It was No. 2 in the books of the railway administration, and had cylinders 14-in. by 18-in., and driving wheels 4-ft. 6-in. in diameter. It was scrapped in February, 1844, but some parts of it were used for building a new locomotive with a new boiler and cylinders 15-in. in diameter, which only made its appearance in 1850 and was scrapped in 1865.

As to the two models of modern locomotives, one is No. 2672 and the other No. 3201, built by Cockerill in 1902 and 1903 respectively.—Yours faithfully,

Gymn. Str. 11II F. GAISER.
Neustadt a. d. Haardt.

Steam Locomotives of the M. D. Ry.

To the Editor of the "Locomotive Magazine."

DEAR SIR,—When the District Company's trains ran to New Cross they ran to and from the L. B. & S. C. R. station there, not the S. E. & C. R. station, which latter was, and is still, used by the Metropolitan Company's trains.

Only engines No. 1 to 24 originally had a leading Bissel four-wheel truck, all the others, from the first, had Adams' bogie with a transverse sliding casting under the centre pin.

The statement that engines Nos. 1 to 30 were "all alike" should be modified by mentioning that Nos. 25 to 30, built in 1876, when Mr. Thos. S. Speck was locomotive superintendent, had fireboxes 1-ft. shorter, tanks 1½-in. wider, and longer bearing springs under the axleboxes of the coupled wheels, than engines Nos. 1 to 24 (as had also all engines subsequently built). These six engines (Nos. 25 to 30) when new had cabs over the whole length of the footplate and coal bunker, but after some months they were removed at the request of the enginemen, who said they would rather be exposed to all weathers when out in the open than have to endure the increased heat and want of air under the cabs when in the tunnels.

All later engines had the top of the weather plate turned backwards for a distance of about 16-in., and had a vertical plate about 15-in. high above the back of the coal bunker, and this arrangement was afterwards adopted on engines Nos. 1 to 30.—Yours truly,

Dec. 27th, 1905. FRANK S. HENNELL.

Reunion Dinner of Past and Present Staff of Locomotive Department, Great Eastern Ry.

1 James Holden	11 J. Cookson	21 F. Duce	31 D. Gillies	41 H. W. C. Drury
2 W. E. Dalby	12 J. Abbott	22 R. L. Soper	32 F. W. Dodd	42 H. Haylock
3 A. J. Hill	13 A. P. Turner	23 J. B. Corrie	33 C. Watchurst	43 A. G. Herbert
4 G. Elliot	14 C. W. L. Glaze	24 T. W. Ford	34 C. Adams	44 Henry Parker
5 W. Collingwood	15 A. W. Polley	25 E. F. Elliot	35 A. C. Kelly	45 A. P. Parker
6 Geo. Winmill	16 H. Rudland	26 T. O. Mein	36 L. Simpson	46 W. D. Craig
7 J. H. B. Jenkins	17 J. C. Mannooch	27 W. Pickersgill	37 F. V. Russell	47 J. W. Howard
8 E. Winmill	18 C. A. Robinson	28 R. H. Haylock	38 J. H. Adams	48 G. Macallan
9 J. Pollock	19 J. Wilson	29 M. A. Sclaverani	39 J. H. Bowles	49 G. B. Lawrence
10 J. Wild	20 A. Lansdell	30 W. F. Pettigrew	40 L. Meyrick-Jones	

REUNION DINNER OF LOCOMOTIVE DEPARTMENT, G. E. R.

A REUNION of the past and present staff of the locomotive department of the Great Eastern Railway Company was held in the Abercorn Rooms of the Liverpool Street Hotel, London, on Friday, December 8th, when a company numbering 49 sat down to dinner, under the presidency of Mr. James Holden, M.I.C.E., M.I.Mech.E., the locomotive superintendent of the Great Eastern Railway.

The toast list included: The King, Queen and Royal Family, proposed by the Chairman; "The Great Eastern Railway Company and our Chairman," proposed by Mr. G. B. Lawrence, responded to by the Chairman; "Old Stratfordians all over the world," proposed by Mr. A. J. Hill, responded to by Mr. W. F. Pettigrew; and "Present Stratford men," proposed by Mr. J. W. Howard, responded to by Mr. F. V. Russell.

A thoroughly enjoyable evening was spent, and so greatly was the opportunity of meeting together appreciated that it was decided to make the reunion an annual event, for which purpose a committee, with Mr. James Holden as president, was appointed to carry out the arrangements.

THE LOCOMOTIVE MAGAZINE.
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THE LOCOMOTIVE MAGAZINE.

Vol. XII. FEBRUARY 15th, 1906. No. 162.

RAILWAY NOTES.

SOUTH EASTERN & CHATHAM RY.—The accompanying illustration shows one of a new series of express passenger locomotives now in course of construction to the designs of Mr. Harry S. Wainwright, the locomotive superintendent at Ashford works. They have cylinders 19¼-in. in diameter, with a stroke of 26-in., and four-coupled wheels 6-ft. 6-in. in diameter. The boiler is provided with a Belpaire firebox and has a heating surface as follows: firebox 136 sq. ft., tubes 1396 sq. ft., total 1,532 sq. ft.; the grate area is 21.15 sq. ft. and the working pressure is 180 lbs. per sq. in. Stone's patent fuel economiser and spark arrester is fitted. The tender has a capacity for 3,450 gallons of water and 4 tons of coal.

Six new steam rail motor coaches are being built by Messrs. Kitson & Co., Ltd., similar in general design to No. 1, illustrated on page 46 of our last volume, but with sundry minor alterations in details.

CALEDONIAN RY.—Six new coupled bogie locomotives similar to No. 141, illustrated in our issue of July 15th, 1904, are now out, bearing Nos. 146-151.

LONDON & NORTH WESTERN RY.—The following are new locomotives of the "Precursor" type recently put into service:—Nos. 2576 "Arab," 2577 "Etna," 2578 "Fame," 2579 "Ganymede," 2580 "Problem" and 2581 "Peel."

In our January issue, mention was made of the fact that the historic engine No. 3020 "Cornwall" had been withdrawn from service. Shortly before this final condemnation, however, the old engine made a trip to Euston with a relief train.

One of Mr. Webb's "Precedent" class is now being rebuilt experimentally with a leading bogie, and if the engine thus converted proves successful, others will probably be similarly treated.

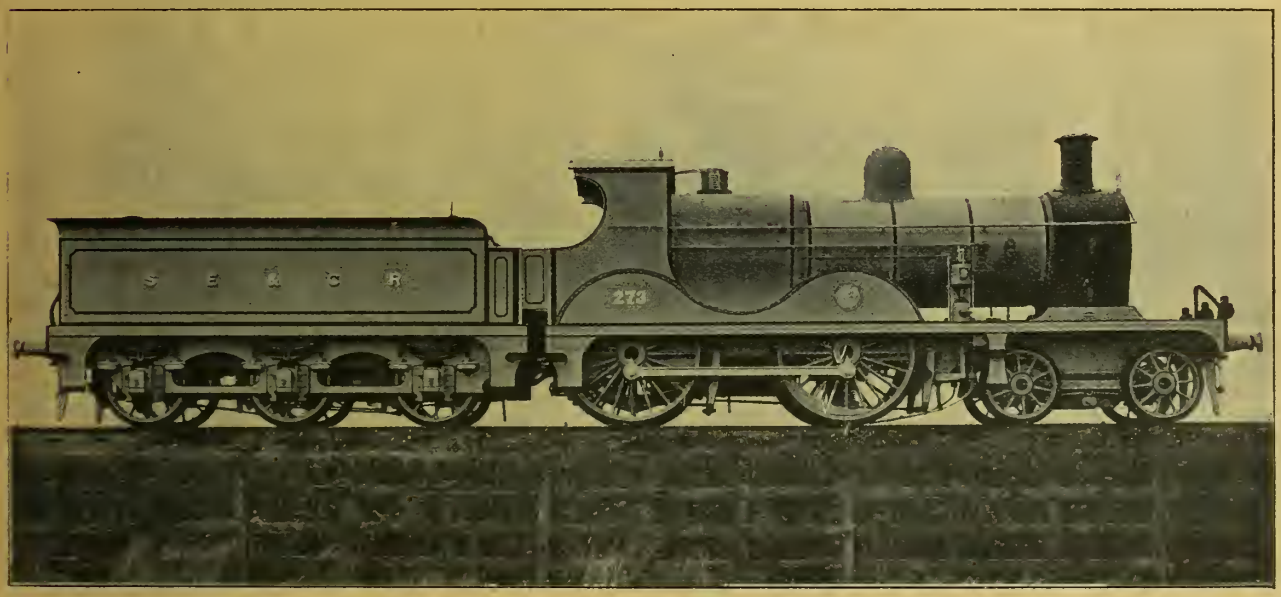


Photo by FOUR-COUPLED BOGIE EXPRESS LOCOMOTIVE No. 273, SOUTH EASTERN & CHATHAM RY. *Loco. Pub. Co. Ltd.*

LONDON, BRIGHTON & SOUTH COAST RY.—In our account of the new "Atlantic" type express engines, illustrated in our January issue, we omitted to state that these engines are fitted with the *quick acting* Westinghouse brake, and it will also be noticed that the brake is arranged to operate on the bogie wheels.

It should also be mentioned that the spiral bearing springs of the bogie are fitted with the Mc.Cord Spring Dampener. Details of this device were given in our issue of Oct. 16, 1905.

No. 37, the first of the series is now in service, painted the new standard brown color. The practice of naming the locomotives on the Brighton line is to be discontinued in future.

GREAT CENTRAL RY.—The new main line from Neasden to South Harrow stations will be opened for passenger traffic by a half-hourly steam rail motor service beginning on March 1st. The Metropolitan Ry. station at Neasden, and intermediate stations at Wembley and Harrow Road, Sudbury, will be used. The opening of this line will also inaugurate the commencement of the joint G. C. and Metropolitan workings of the latter company's line from Harrow to Aylesbury. We understand that 15 more engines are to be stationed at the G.C. sheds at Neasden in consequence.

LONDON & SOUTH WESTERN RY.—During the last six months of 1905, the output of Nine Elms in new locomotive stock comprised the five large four cylinder six-coupled bogie express locomotives illustrated in our October and December issues, five new bogie passenger tank engines, and four new steam rail motor coaches.

STEAM RAIL MOTOR COACH NO. 5, LONDON & SOUTH WESTERN RY.

One of the new steam motor coaches is here illustrated, and it will be noticed that the design is modified from those previously adopted. The leading dimensions are as follows; cylinders 10-in. by 14-in., boiler pressure 175 lbs. per sq. in.; heating surface: firebox 76 sq. ft., water tubes 119 sq. ft., flue tubes 152 sq. ft., total 347 sq. ft.; grate area 6¾ sq. ft.; capacity of tank 485 gallons and of bunker 1 ton, weight of coach complete 32 tons 6 cwt.; seating accommodation: 1st class 8 and 2nd class 32 passengers, total 40.

NORTH BRITISH RY.—Orders have been placed with the North British Locomotive Co., Ltd., for ten goods locomotives, and a similar number are in course of construction at the Cowlairs shops of the railway, in addition to 12 engines of new design for intermediate passenger and express goods traffic. The goods locomotives will be of the usual six-coupled type, with cylinders 18½-in. by 26-in., wheels 5-ft. in diameter, heating surface 1794 sq. ft., grate area 19.25 sq. ft., and a working pressure of 180 lbs. per sq. in. The mixed traffic engines will have four-coupled wheels 6-ft. in diameter, and a total heating surface of 1760 sq. ft. New tenders are also being built, to hold 3500 gallons of water and 5 tons of coal.

We understand that tenders are being called for to supply 14 express passenger locomotives for the East Coast and Waverley route express services between Aberdeen and Berwick and Carlisle respectively.

MIDLAND RY.—Mr. E. Talbot, district loco. superintendent, Normanton, has been appointed to succeed Mr. R. Weatherburn, district superintendent for London, who retires after more than 30 years' service. Mr. W. L. Mugliston, of Lancaster, succeeds Mr. Talbot at Normanton.

GREAT WESTERN RY.—Two new "consolidation" mineral locomotives are now out, bearing Nos. 2819 and 2820. These complete a series of 20 locomotives of this type, apart from No. 97, the original of the class.

On the 11th inst. an interesting run was made with No. 2806, one of these large mineral engines. Starting from Severn Tunnel Junction with a load of 54 coal wagons and a dynamometer car, a further 11 wagons were added at Stoke Gifford. At Swindon Transfer the train was made up to 100 loaded wagons, with the dynamometer car next to the tender, and this huge load was hauled to Southall, where some portion was left behind, and the remainder came on to Paddington goods yard. The timing of this train, ordinarily the 7.40 a.m. from Severn Tunnel Jn., was accelerated throughout, and every care was taken to secure an unchecked run between booked stopping-places.

THE BRADFORD CORPORATION NIDDERDALE LIGHT RY.

Pateley Bridge to Angram.

What is known as the Nidd Valley branch of the North Eastern Ry. commences at Ripley Junction, 3 miles outside Harrogate, and finishes at Pateley Bridge, 14 miles away, in the centre of one of the most picturesque parts of Yorkshire, as yet practically untouched by railways. Although the N. E. R. terminates at Pateley, the valley extends many miles further up to the dales.

In May, 1900, an application was made to the Light Railway Commissioners by "Power and Traction, Ltd.," in pursuance of the Light Railways Act, 1896, for an order to authorise the construction of a light railway of 2-ft. 6-in. gauge from the Pateley Bridge terminus of the North Eastern Ry. to Lofthouse, a village some seven miles further up the Nidd Valley.

The Company (who had the support of the Bradford Waterworks Committee at their application for the order) were unsuccessful in raising the money as quickly as they had anticipated, and the Bradford Corporation arranged with "Power and Traction, Ltd.," for the transfer to them of their powers with respect to the construction and working of the railway. This order, entitled "Bradford Corporation (Nidd Valley Transfer) Light Railway Order 1904," was passed on the 1st March, 1904. The first sod of the new line was cut in July, and the works are now being constructed under these powers. The line of the railway is laid down to the standard gauge with rails weighing 56 lbs. per yard.

The Corporation are bound to carry passengers and goods from Pateley Bridge to Lofthouse, but as Lofthouse is nearly seven miles from the site of the Angram Dam, river diversion works, etc., a carriage road from Lofthouse to Angram has been made on land bought by the Corporation, and on one side of this private road the 4-ft. 8½-in. gauge railway is laid, over which the contractor for the Angram reservoir is taking and will take the large amount of materials required for those extensive works.

In connection with the passenger length of the railway there are four substantial stations—Pateley Bridge, Wath, Ramsgill and Lofthouse—with houses in connection, and now under construction, and this part of the line will be worked on the tablet system. The whole of the railway works are well advanced, and will be completed in June or July.

Photo by Standard Metropolitan Ry. Locomotive No. 20, rebuilt as No. 1 "Holdsworth," Bradford Corporation. *Loco. Pub. Co.*

To work the passenger service the Bradford Corporation, on the advice of their engineer, Mr. Jas. Watson, have purchased two locomotives and ten four-wheel carriages from the Metropolitan Ry , as well as a number of mineral and goods wagons, brake vans, etc., so that they are fully equipped for meeting the needs of the districts to be served, as well as their own wants in connection with the work.

As already noted in these pages, a number of the steam locomotives used on the "Underground" services of the Metropolitan Ry. have found new owners owing to the completion of

most of the electrification scheme on that system. The two sold to the Bradford Corporation were Nos. 20 and 34, built by Messrs. Beyer, Peacock & Co. They are now numbered respectively Nos. 1 and 2 by the Bradford Corporation, and named "Holdsworth" and "Milner." These engines have been rebuilt and reboilered during their working career, and before leaving for their new work they were fitted with cabs, and the condensing apparatus for tunnel work removed, by the Metropolitan Co. at their works at Neasden. They have cast iron chimneys and polished brass dome covers, are painted the Metropolitan Co.'s standard color of red, but with a darker shade of yellow lining, with the Bradford coat of arms emblazoned on the side tanks, and brass number plates on the bunker, giving them a very smart appearance.

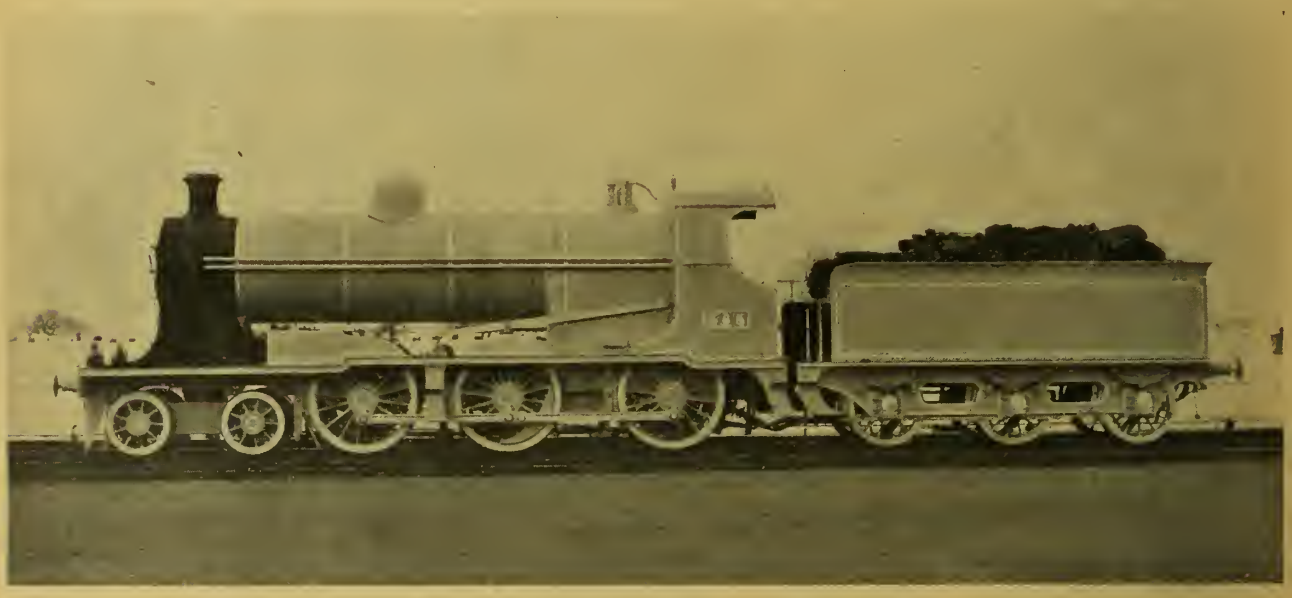
The carriages for the light railway have been repainted red and lined out in yellow to match the engines, with "Bradford Corporation" lettered on the panels.

All the arrangements in re-modelling these engines and carriages were made by Mr. T. F. Clark, who has just retired from the position of locomotive superintendent of the Metropolitan Ry., and he must be congratulated on the neat appearance of the stock.

Mr. Jas. Watson, M.I.C.E., is the waterworks engineer of the Bradford Corporation, and we are indebted to him for assistance in writing this article. Mr. John Best, of Edinburgh, is the contractor. The cost of the railways—Pateley Bridge to Lofthouse and Lofthouse to Angram—exclusive of land, was about £40,000.

TEN-WHEELED GOODS LOCOMOTIVE, GREAT SOUTHERN & WESTERN RAILWAY.

We are indebted to Mr. Robert Coey, the locomotive superintendent of the Great Southern and Western Ry., Ireland, for the accompanying illustration and particulars of a new type of goods engine recently built at the Inchicore works of the railway. It is known as Class No. 365 and has the following leading dimensions: cylinders 19¼-in. in diameter by 26-in. stroke; diameter of bogie wheels 3-ft. and of six-coupled wheels 5-ft. 1¾-in.; wheelbase: bogie 5-ft. 3-in., bogie centre to leading coupled axle 7-ft. 9-in., leading coupled to driving axle 6-ft. 9-in., driving to trailing coupled axle 7-ft. 9-in., total 24-ft. 10½-in.; height from rail to top of chimney 13-ft. 5½-in.; diameter of boiler barrel inside front ring 4-ft. 10½-in., maximum outside width of firebox casing 5-ft. 1-in.; internal firebox (copper) length 6-ft. 4½-in., width 3-ft. 10½-in., at level of grate; height of centre of boiler above rails 8-ft. 9-in.; working pressure 160 lbs. per sq. in.; number of tubes 227, length 14-ft. 1¼-in., diameter 1¾-in.; heating surface: firebox 133 sq. ft., tubes 1,466.75 sq. ft., total 1,599.75 sq. ft.; grate area 24.3 sq. ft.; weight of engine in working order 56 tons 19 cwt.; tender: wheels 3-ft. 9-in. diameter, wheelbase 12-ft. 4-in., equally divided; capacity 3,340 gallons of water 4 tons of coal; weight full 35 tons; total of engine and tender 91 tons 19 cwt.; total length of engine and tender over buffers 56-ft. 3¼-in.



Ten-wheeled Goods Locomotive No. 365, Great Southern & Western Ry, Ireland.

THE LOCOMOTIVES OF THE GREAT EASTERN RAILWAY.

(*Continued from page 189, Vol. XI.*)

TEN single-driver tank engines were put in hand at the Stratford Works in the year 1854 for working what was then known as the Tilbury

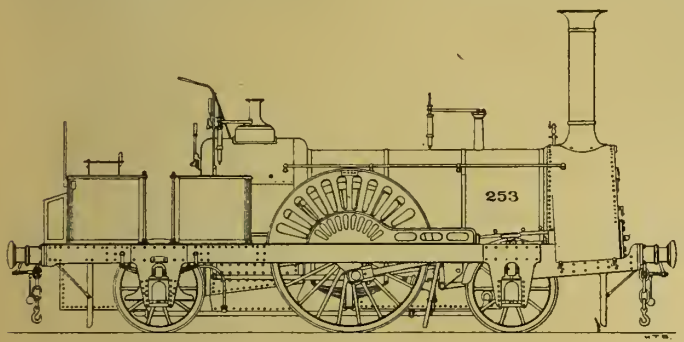


FIG. 88.

Fort line, which was opened in that year, and the working of which by the Eastern Counties Ry. had been arranged for by the lessees, Messrs. Peto, Betts & Brassey. These engines were similar in general design to the tank locomotives previously designed by Mr. Gooch, but were of increased dimensions; they were numbered 250 to 259 inclusive, and are illustrated as originally built in Fig. 88. The cylinders were 14-in. in diameter by 22-in. stroke, their centres being 5-ft. 11-in. apart. The diameter of the driving wheels was 6-ft. 6-in., and that of the leading and trailing 3-ft. 8-in. The wheelbase was 14-ft. 8-in., of this 6-ft. 9-in. separated the leading and driving centres, and 7-ft. 11-in. the driving and trailing. The boiler barrel was lap jointed, and had a length of 10-ft. and an internal diameter of 3-ft. $6\frac{1}{2}$-in. It contained 164 tubes of $1\frac{7}{8}$-in. outside diameter, and 10-ft. $3\frac{3}{4}$-in. long. The firebox shell was 4-ft. 2-in. long and 3-ft. 11-in. wide outside, whilst the inner box was 3-ft. $7\frac{1}{4}$-in.

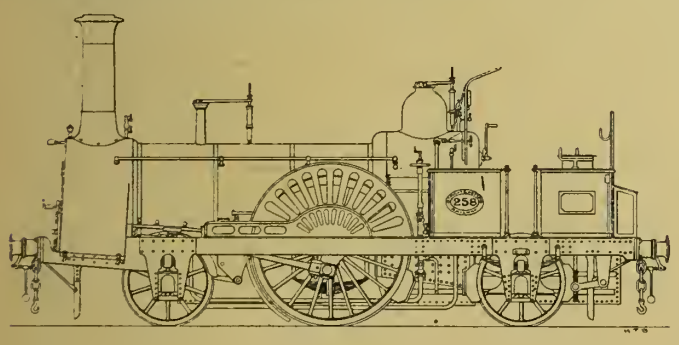


FIG. 89.

long, 3-ft. $1\frac{1}{4}$-in. wide, and had a grate area of 11.1 sq. ft. The heating surface was: tubes 772·4 sq. ft., firebox 86·8 sq. ft., total 859·2 sq. ft., and the working pressure was 120 lbs. per sq. in. In full running trim these engines weighed 27 tons 2 cwt., the leading wheels taking 9 tons 2 cwt. 3 qrs., the driving 9 tons 2 cwt. 2 qrs., and the trailing 8 tons 16 cwt. 3 qrs. In Mr. Sinclair's time a dome was added over the firebox, and Mr. Johnson fitted the engines with injectors and his standard pattern of chimney, number plate, etc. As thus altered they are shown in Fig. 89. In 1877 Nos. 255, 258 and 259 were renumbered 2550, 2580 and 2590, and in 1879 Nos. 250, 252 and 253 had a cipher prefixed to their numbers. None of this class were rebuilt, and the following list gives the dates at which they were turned out new and withdrawn from service:—

Engine No.	Date New.	Date Scrapped.
250, 0250 ..	Dec., 1854 ..	Dec., 1879
251 ..	,, ..	Aug., 1878
252, 0252 ..	,, ..	Dec., 1879
253, 0253 ..	,, ..	,,
254 ..	Jan., 1855 ..	May, 1873
255, 2550 ..	,, ..	Dec., 1879
256 ..	Feb., 1855 ..	Oct., 1875
257 ..	April, 1855 ..	Jan., 1876
258, 2580 ..	May, 1855 ..	Dec., 1878
259, 2590 ..	,, ..	,,

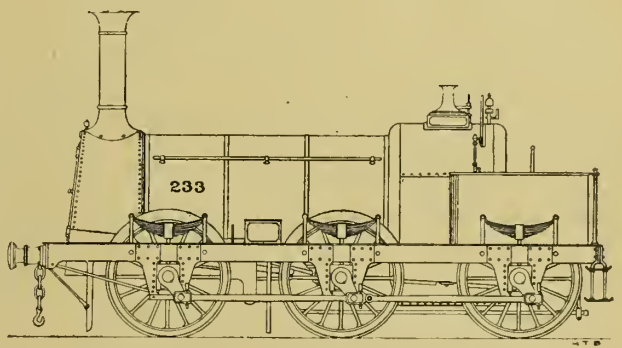


FIG. 90.

The five large Crampton singles, Nos. 108 to 112 (Fig. 57) having proved unsatisfactory owing to lack of adhesive weight, Mr. Gooch designed a class of six-coupled goods engines to take the boilers of the single-wheelers, these being almost as good as new owing to the engines having done but little work. The new goods engines were built at Stratford works and had outside bearings; they were commonly known as the "Floating Batteries." Fig. 90 illustrates one of this class, which were numbered 233 to 237. The wheels were 5-ft. in diameter spread over a base of 14-ft. 6-in., the leading and driving centres being 7-ft. 2-in. apart, and the driving and trailing 7-ft. 4-in. The cylinders were 15-in. by 24-in., and their centres were 2-ft. $6\frac{1}{2}$-in. apart. In working order these engines weighed 27 tons 2 cwt. 3 qrs., the leading wheels carrying 10 tons 13 cwt., the driving 9 tons 18 cwt. 2 qrs., and the trailing 6 tons 11 cwt. 1 qr. The tender was on four wheels and

had a wheelbase of 10-ft. 2-in. The leading wheels carried 8 tons 19 cwt. 2 qrs. and the trailing 8 tons 1 cwt. 2 qrs.; total weight 17 tons 1 cwt. 1 qr.; total of engine and tender 44 tons 4 cwt.

Mr. Sinclair designed new boilers for Nos. 234 and 236, which were constructed by Messrs. Neilson & Co., and of these the following were the chief dimensions: barrel 10-ft. 9-in. long by 3-ft. 11½-in. diameter inside; firebox shell 4-ft. 7-in. long by 4-ft. wide; inside firebox 4-ft. long by 3-ft. 5½-in. wide, grate area 14 sq. ft.; 160 tubes, external diameter 2-in., length 11-ft. 0½-in., heating surface: tubes 924·32 sq. ft., firebox 83·72 sq. ft., total 1008·04 sq. ft. Fig. 91 illustrates these engines as rebuilt.

The remaining three engines were rebuilt by Mr. Johnson with boilers of the following dimensions: barrel (telescopic) 9-ft. 11¼-in. long by 3-ft. 10-in. diameter inside smallest ring, 4-ft. diameter inside largest ring; height of centre line from rails 6-ft. 3-in.; firebox shell 5-ft. 1¾-in. long by 4-ft. 0½-in. wide; inside firebox, length at top 4-ft. 4½-in., length at bottom 4-ft. 6-in., width at top 3-ft. 5-in., width at bottom 3-ft. 5½-in., grate area 15·5 sq. ft.; 157 tubes, external diameter 2-in., length 10-ft. 3-in.; heating surface: tubes 841·5 sq. ft., firebox 89·65 sq. ft., total 931·15 sq. ft.; working pressure 140 lbs. per sq. in. Mr. Johnson also increased the cylinder diameter in these engines to 16-in., and fitted his standard cab, number plate and chimney. As thus altered, the weight of these engines was increased to 27 tons 7 cwt. 3 qrs., distributed as follows: on leading wheels 10 tons 0 cwt. 2 qrs.,

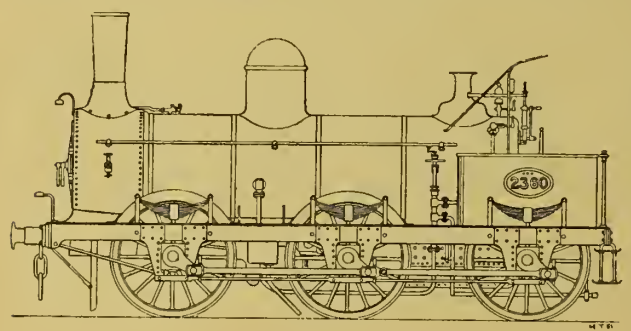


Fig. 91.

on driving 10 tons 15 cwt., and on trailing 6 tons 12 cwt. 1 qr. Fig. 92 shows No. 235 after being rebuilt by Mr. Johnson.

In 1880 these engines were put in the duplicate list, a cipher being added to their numbers. The following are the dates at which they were built, rebuilt and broken up:—

Engine No.	Date New.	Date Rebuilt.	Date Scrapped.
233 ..	Aug. 1855 ..	June 1869 ..	Jan. 1883
234 ..	Oct. 1854 ..	Oct. 1867 ..	April 1882
235 ..	Nov. 1855 ..	Dec. 1869 ..	Jan. 1883
236 ..	Sept. 1855 ..	Oct. 1867 ..	Nov. 1884
237 ..	Oct. 1854 ..	April 1870 ..	Oct. 1883

On October 9th, 1858, at 11.40 p.m., engine No. 233, driver Henry Ward, when working a special goods train from Newmarket, collided with a special horsebox train consisting of 21 vehicles which was standing at Six Mile Bottom, the guard of the horsebox train, Chas. Titch-

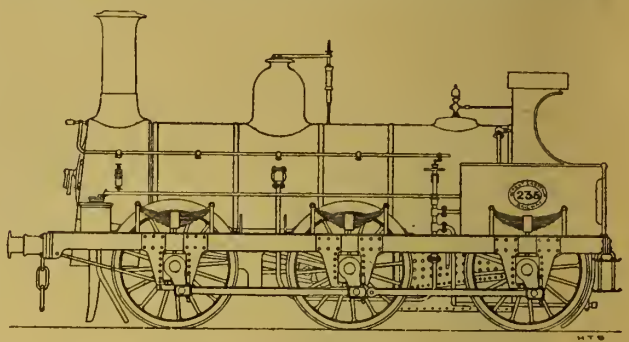


Fig. 92.

marsh, being killed. Ward was arrested and committed to the Assizes, but was eventually acquitted.

(To be continued.)

AMERICAN LOCOMOTIVE BOILERS

(*Concluded from page* 198, *Vol. XI.*)

HAVING dealt shortly with the different constructions of barrel, the next consideration is the arrangement of the firebox. The narrow, or as we should call them, ordinary boxes are of two kinds, viz., those which are deep and extend downwards between the frames, and the shallower type, which spread laterally above the frames to the extreme limit available between the tyres of the wheels, and in the Wootten type sometimes extend to the extreme width of the engine itself. With the first arrangement, which is not now so frequently used as formerly, it is necessary, in order to obtain a large grate, to arrange for a very long firebox, with all its inherent constructional and operative disadvantges. It may here be mentioned that owing to the thickness of the bar frames the outside width of such a box cannot exceed 3-ft. 6-in.; and, furthermore, if a large barrel is used the firebox is swelled out of all proportion in the upper parts, having a balloon-like appearance and causing very unsatisfactory stay arrangements.

With the second type a much better-designed firebox is obtained, but of course a considerable amount of heating surface is sacrificed owing to the decreased depth; the grate, however, is more extensive. It should be noted that this form of firebox is better suited to engines having bar frames than to those having plates, although there are engines of the latter description at work with this form of firebox. As to which of these types of firebox is preferable depends on the design and on the nature of the coal to be burned.

The Belpaire firebox finds great favour on American railways, though in many cases it is not of the square-topped pattern to which we are accustomed, all the plates, including the top, being curved to a large radius. It is difficult to see the immediate gain in this modification, and it is certain that the cost of rolling, drilling, topping, &c., is greatly increased, a point which in view of the satisfactory service rendered by the familiar form of Belpaire box, would seem to outbalance any small advantage, the difficulties of construction being indicated.

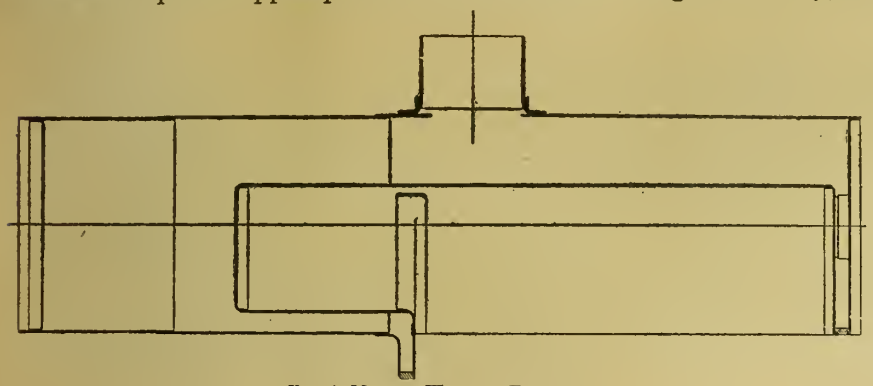


Fig. 4. Modern Wootten Firebox.

With regard to the second class, namely wide firebox boilers, these may be clearly subdivided into two types, those having very wide and shallow boxes and those with medium width deep boxes. These two forms are the direct outcome of the nature of the fuel to be burnt. The very wide and shallow, or Wootten, box and its modifications are by no means a recent innovation, having been in use for over 30 years. They are the result of the necessity for burning small anthracite or hard coal such as cannot satisfactorily be consumed on the ordinary grate. In its original form the Wootten box was, as is usually the case when a breakaway from traditional lines is made, full of faults, but these were rapidly remedied, and to-day this form of box and its modification, the "radial stayed firebox," are important factors in locomotive design, especially where a very low quality of fuel is to be burned. In fact, in anthracite or hard coal regions this type of boiler is practically standard for heavy engines.

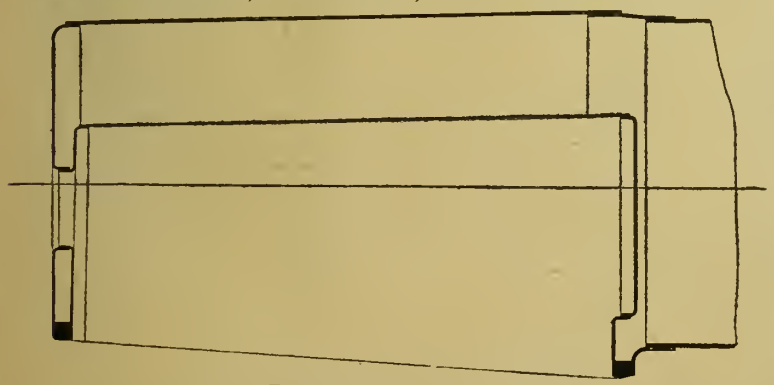


Fig. 6.—Earlier Pattern, Wootten Firebox.

Although this paper does not purport to deal with the development of any class of boiler, yet such has been the influence of the Wootten on boiler design in general that it may not be out of place to enumerate its salient characteristics. The essential features of the Wootten boiler are a very wide and shallow firebox and a combustion chamber let into the barrel of the boiler. In the earlier design a water leg was formed at the throat plate, and on this the brick arch was built; this, however, gave trouble, and is now abandoned. An example of recent design is given in Figs. 4 and 5. The modified form of Wootten boiler finds favour among some railway men where the regular type fails, and in order fully to understand the modification it is necessary again to go back to the early history of the boiler. The combustion chamber was held to be a disadvantage, and efforts were therefore made to abandon it. The first design was got out with a plain firebox tube plate, but owing to the proximity of the grate to the tubes, the absence of any brick arch and the shallowness of the fire, trouble was caused by cold air drawing through and entering the tubes, and straining the plates. To remedy this a compromise had to be made between this design and the Wootten combustion chamber, the result being a tube plate set a few inches in a throat

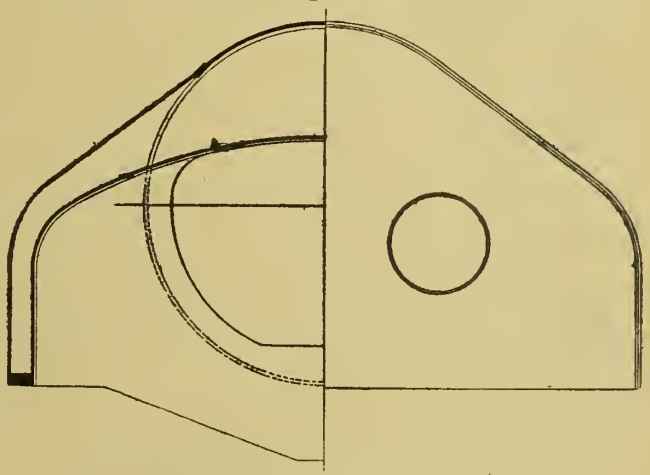


Fig. 5.—Cross Section and Elevation, Wootten Firebox.

plate; this, of course, is somewhat more costly than the plain plate, but it fulfills the object of stopping the cold air from striking the tube ends, which are also removed from actual contact with fire (see Fig. 6). It should be noted that owing to the huge grate area, amounting in some cases to as much as 75 square feet, and to the shallowness of the fire, a blast pipe of large diameter may be used. The labours of the fireman are consequently not so arduous as might be imagined.

Having reviewed the regular wide and shallow firebox, it remains only to examine the medium width deep firebox. It has already been mentioned that difficulties attend employment of a long and narrow grate, and now that boilers of such enormous power are required these difficulties are increased. The Wootten box is not altogether suitable for burning soft or bituminous coal, which has a long and smoky flame requiring a deep box to burn in with a good combustion space between the fire and crown. To satisfy these requirements boilers are now being built having fireboxes more or less square in plan, being about 6-ft. or 7-ft. wide; a grate area of 45 sq. ft. or more is thus easily obtained, and the grate is easily fired by any ordinary fireman; as a rule two fire holes are provided. A cross section of such a firebox is illustrated by Fig. 7. The good straight line of both internal and external plates is very noticeable as minimising stay troubles. This type of firebox is often made with the Belpaire style of staying, and as will be observed in Fig. 8, the plainness of the box is often very marked. As would be expected, this form of firebox is making more progress than any other, and has now reached huge proportions, a grate area of 55 sq. ft. being quite common. It is obvious that such a boiler cannot be placed over driving wheels of any size, and this fact has had a great effect on recent American locomotive design; in fact, it has perhaps done more to upset a great many old ideas than any other feature introduced in modern locomotive practice. Very long tubes are now in use, reaching to 20-ft., about which all sorts of evils were prophesied. Such a boiler as that described is illustrated in Fig. 9.

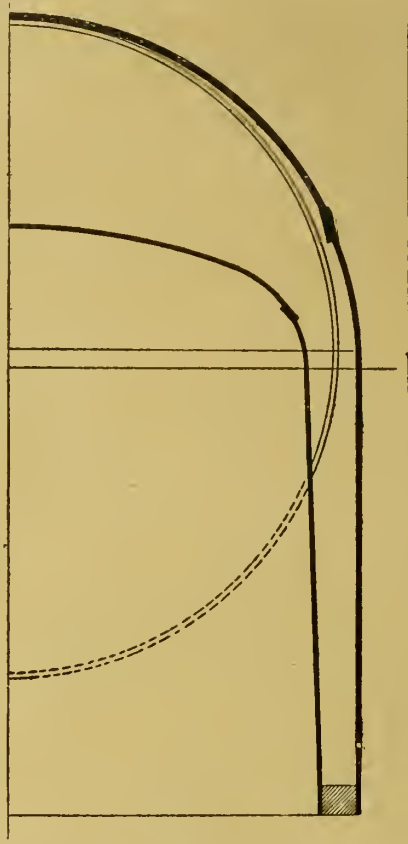


Fig. 7.—Wide Firebox.

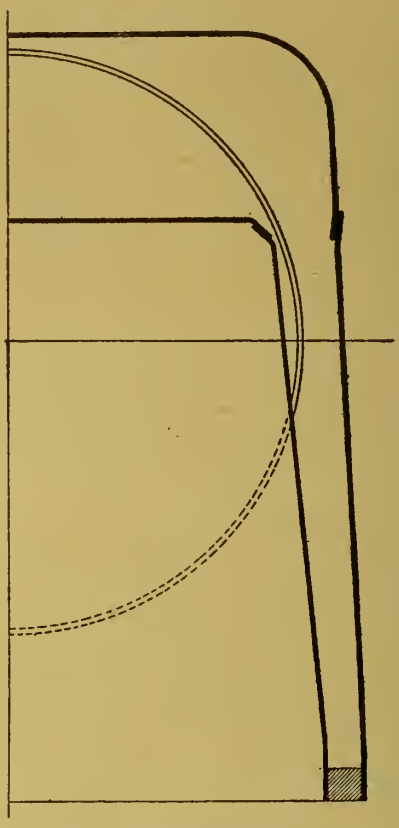


Fig. 8.—Wide Belpaire Firebox.

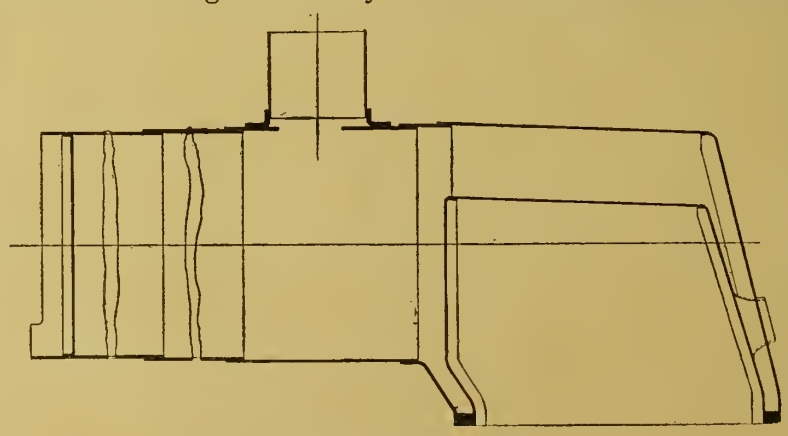


Fig. 9.—Modern Boiler with Belpaire Firebox.

In addition to these most usual types of boilers in use in America, there are others in sufficiently common use to justify brief mention here The principal is the Belpaire firebox combined with the "wagon top" or "extended wagon top" barrel. This combination presents no difficulties, and has some features to recommend it. Another form is the adaptation of the Belpaire firebox shell to the Wootten box.

EXPRESS PASSENGER LOCOMOTIVE No. 19, NORTH STAFFORDSHIRE RY.

EXPRESS PASSENGER LOCOMOTIVE, NORTH STAFFORDSHIRE RY.

THE accompanying illustration, for which and the subjoined particulars we are indebted to Mr. John H. Adams, locomotive carriage and wagon superintendent of the N.S.R., shows a new express passenger locomotive, which takes the place and running number of No. 19. In a brief article on this railway, published in our issue of November 7th, 1903, it was pointed out that No. 19 differed from the other standard express engines on the line in respect to having slightly larger dimensions. The new No. 19 shows a still further increase in certain respects, as the following comparison with its predecessor will demonstrate. The engine here illustrated has cylinders 18-in. in diameter, with a stroke of 24-in., in place of the earlier engine's 17-in. by 24-in. The boiler is considerably larger, and carries 10 lbs. more pressure, viz., 160 lbs. per sq. in. In consequence of its increased diameter, the boiler centre is placed 3-in. higher, or 7-ft. 9-in. from the level of the rails. The driving and trailing wheels have the same diameter as in the previous engine, 6-ft. 6-in., but have cast steel centres in place of the former wrought iron centres. The leading wheels are 4-ft. in diameter, as before. Gresham & Craven's combination injectors are provided in place of the old injectors and clack-boxes, and the N.S.R. standard steam brake cylinder is used for applying the brake blocks on the engine, and a 21-in. vacuum cylinder works the tender brake blocks.

The tender is of a new design and carries 2650 gallons of water and $4\frac{1}{2}$ tons of coal. The axleboxes are large and are packed with cotton-waste instead of the usual spring pads. A new feature in these tender axleboxes is that, in place ot the regulation white metal insertions in the brasses, the bearings are running on a $\frac{3}{16}$-in. white metal liner. This system was tried about three years ago, owing to the great trouble from failures through heating of journals experienced by Mr. Adams, and he informs us that he has never since had a failure.

It is his intention to rebuild more of the old passenger engines to the same dimensions as No. 19, and all future tenders will be of the new type here described.

Books, Catalogues, Pamphlets, Calendars, etc., received:—

"The British Railway Outlook," by W. J. Stevens. *London:* Effingham Wilson, 54, Threadneedle Street, E.C.

Accident Bulletin No. 16. Interstate Commerce Commission, Washington, D.C., U.S.A.—Showing collisions and derailments of trains during April, May and June, 1905, in the U.S.A.

The Tramways and Light Railways Association, —Official Circular, December, 1905. Price 6d. Clun House, Surrey Street, W.C.

Charles Winn & Co., Birmingham.—Winn's boiler and engine fittings, catalogue D38, 1905.

R. J. Nicholson & Co., 26, Cannon Street, Manchester, —Circulars describing the "Ideal" petrol engine, petrol electric lighting sets for country houses, workshops, stations, etc.

R. Y. Pickering & Co., Wishaw, N.B.—Calendar, 1906.

The Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, Westminster, S.W.—Calendar, 1906.

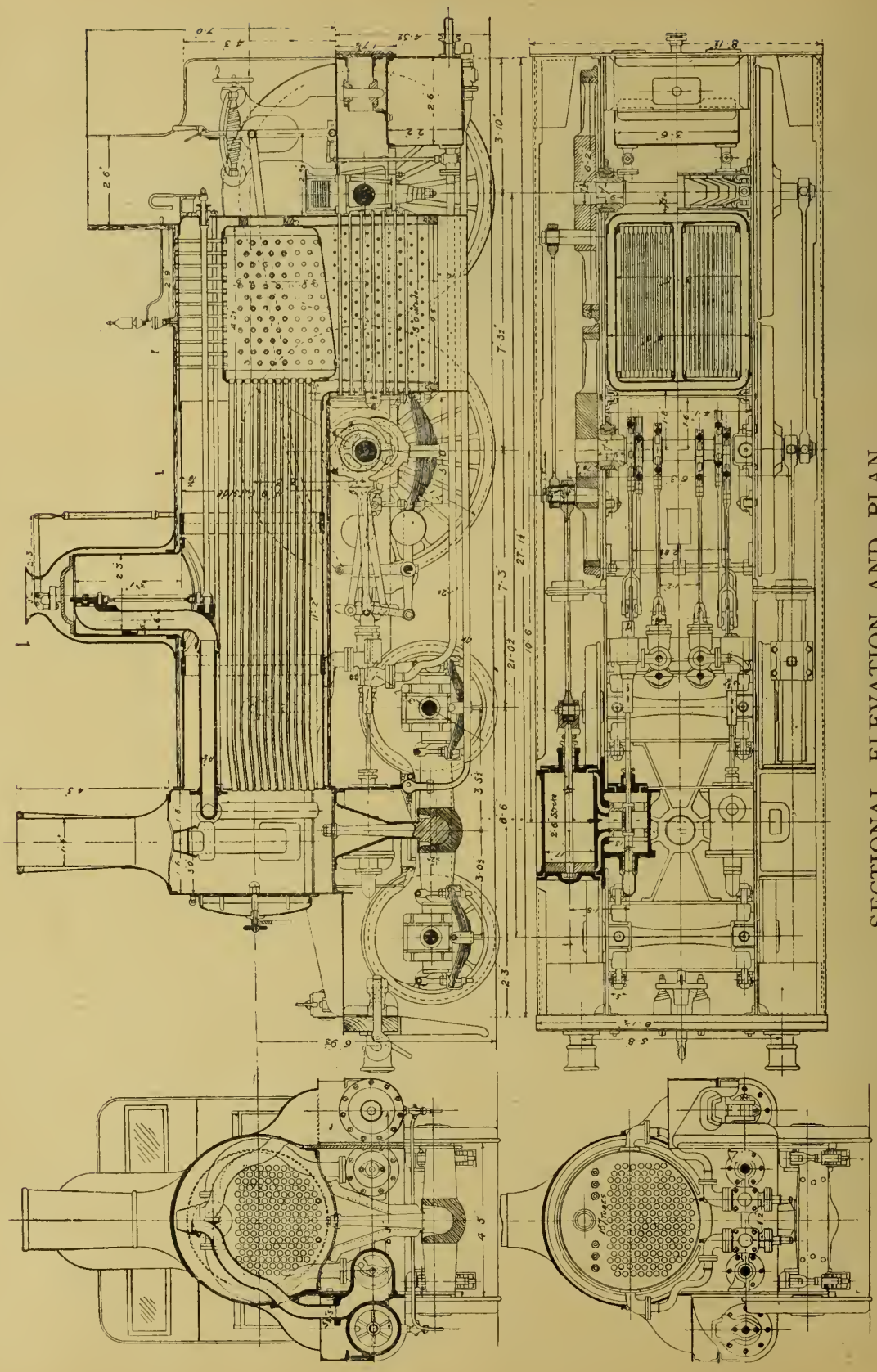
Standard Rolling Stock and Steel Rolling Stock.—Catalogues published by the Brush Electrical Engineering Co., Ltd., Loughborough.

Peckett & Sons, Atlas Locomotive Works, Bristol.—Calendar, 1906.

Andrew Barclay, Sons & Co., Ltd., Caledonia Works, Kilmarnock.—Calendar, 1906.

Sir W. G. Armstrong, Whitworth & Co., Ltd., Manchester.—Catalogue of hand-screwing apparatus.

Herbert Terry & Sons, Novelty Works, Redditch.—Springs and wirework specialities.



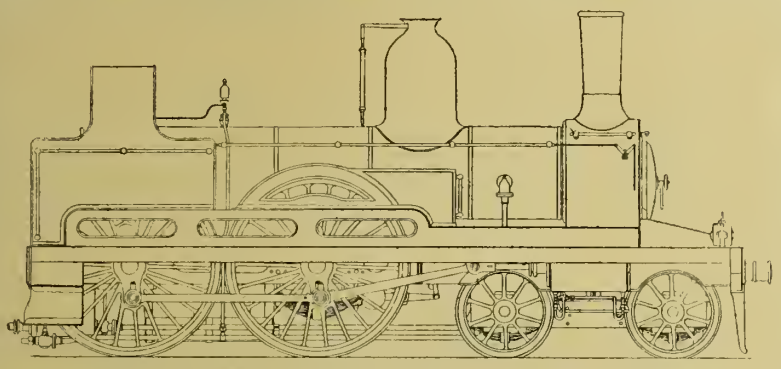
SECTIONAL ELEVATION AND PLAN.

FOUR-COUPLED BOGIE EXPRESS LOCOMOTIVE No. 238, STOCKTON & DARLINGTON RAILWAY.

EXPRESS ENGINE, STOCKTON AND DARLINGTON RAILWAY.

THE subject of our illustration is No. 238, the first of a series of 7-ft. 1-in. coupled engines designed by Mr. William Bouch, locomotive superintendent of the Stockton & Darlington Ry., and built at the Company's locomotive works, Darlington. It was completed in December, 1871, but did not proceed to actual work till the beginning of the following year.

The bogie wheels were 3-ft. 7-in. in diameter and those of the tender 4-ft. in diameter. It will be observed from the drawing that the outside cylinders had a diameter of 17-in. with the unique length of stroke—for that day—of no less than 30-in. For a period of 30 years no other type of passenger locomotive in Great Britain has been furnished with a stroke of this length. The boiler was of Low Moor iron $\frac{7}{16}$-in. thick, butt-jointed, and put together with inside and outside hoops and four rows of rivets. The total heating surface was 1217 sq.ft., and the weight in working order was 42 tons. Instead of the ordinary slide valves, Mr. Bouch determined to use solid brass piston valves 13-in. in diameter, which were unfortunately a continual source of trouble as well as the cause of a considerable waste of steam.



COUPLED BOGIE EXPRESS LOCOMOTIVE No. 238, STOCKTON & DARLINGTON RY.

The expansion of such large and heavy brass valves produced a great amount of friction, which had the effect of unduly wearing the links, and kept the drivers in a constant state of dread lest they should have to give up their trains through the valves sticking. Black lead was one of the many lubricants that were tried, but the results did not come up to expectation.

Mr. Bouch used every endeavour to make a success of his piston valves, but the result being unsatisfactory the engine was facetiously called "Ginx's Baby."

It should be explained in connection with this nick-name that in the same year a book on Poor Law Reform was written by Mr. Edward Jenkins, then M.P. for Dundee, with the above title and in the form of a story in which a Mr. Ginx was at his wits' end with regard to the approaching advent of his latest offspring, and had already informed Mrs. Ginx that whether "he were twins, triplets or otherwise, he would most assuredly drown him or her or them in the water-butt and take the consequences." The baby was, however, rescued and after "Philosophers, Philanthropists, Politicians, Papists and Protestants, Poor Law Ministers and Parish Officers" had tried their hands on him, he in despair jumped over old Vauxhall Bridge into the Thames and was drowned.

When the locomotive came under Mr. Fletcher's control he altered it into a six-wheeled engine with 17-in. by 26-in. inside cylinders and ordinary valves. He did away with the bogie, of which he not approve, because it was constructed with a simple cup and ball; the bogie pin did not go through the centre of the truck and there were no means of securing it below. He therefore altered the frames to allow of a pair of leading wheels taking its place, which in diameter and every other respect were the same as in the "Game Cock" class, illustrated on page 148 of our issue of February 28th, 1903. In this latter form the engine gave every satisfaction, and when the S. & D. engines were incorporated with those of the N.E.R., its number was altered to 1238.

THE PREVENTION OF SMOKE.

THE problem of burning coal in locomotives without giving off smoke still remains to be solved; numerous inventions and ideas have been tried with a view to stopping the smoke nuisance, but while they prevent the emission of smoke to a certain extent they also check the generation of steam.

Theorists say that smoke is unconsumed fuel, but in practice we find that a fire is not producing its maximum steam generation unless it is giving off a certain amount of smoke. Again, some theorists say that the stoker should not wait until the fire is bright before putting fresh coal on; but on the footplate it is soon found that unless the engine is an exceptionally free steaming one the pressure gauge will speedily show a reduction in the boiler pressure if this theory be tested; and again, some say that the blower should be kept on a little, but in these days of heavy loads and fast timing the driver cannot always afford to use steam and water in that way.

As a matter of fact, the prevention of smoke depends greatly upon the carefulness of the men in charge of the engine, allowing at the outset,

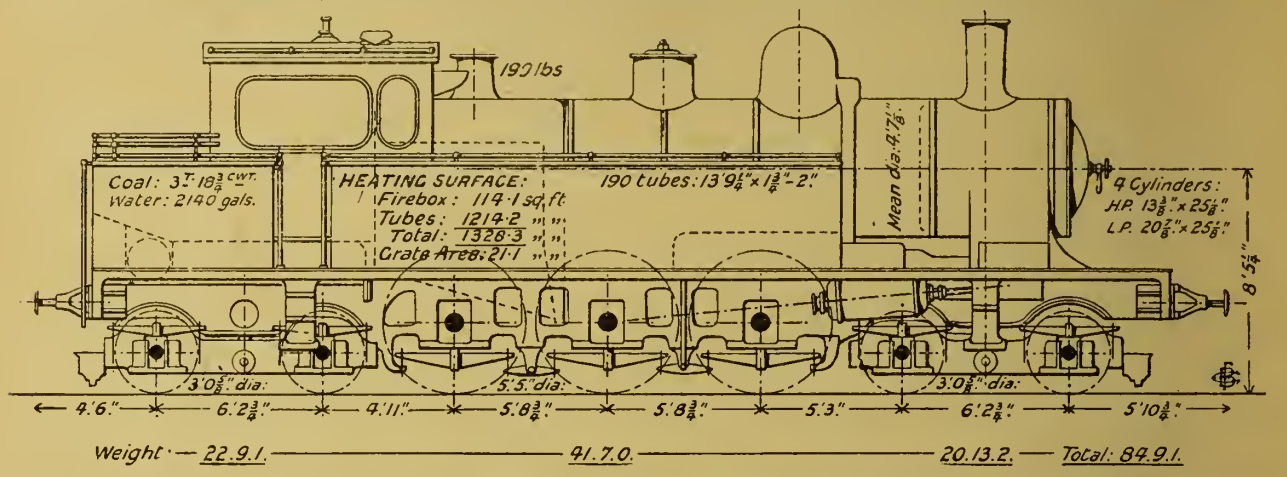
of course, that the engine is in good condition, free from leaks and blows, with the brick arch and baffle or deflector plate in good order and the coal not too poor in quality.

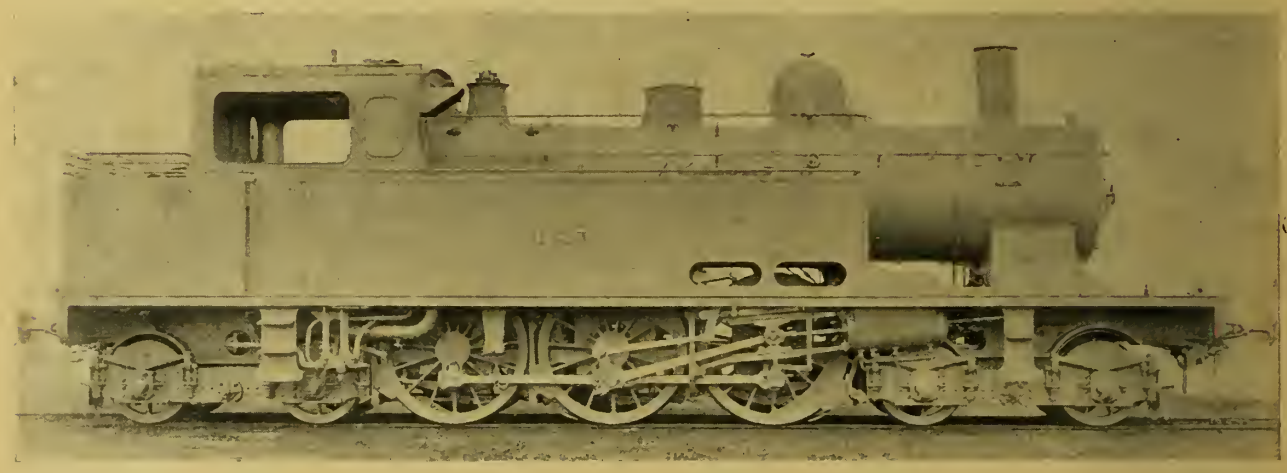
Before starting away with his train, the fireman should make up a good fire, but not too big, as by putting on a large quantity of coal just before starting the fire will probably require breaking up and it may also be necessary to keep the firehole door shut and consequently dense smoke will be emitted. The fire should, in fact, be made up to suit the engine (some work best with a thick fire and some do not) and when it is well alight (but before it has had time to become thin) the fireman should begin firing little and often, the coal having been well watered previously and broken up; the firehole door should be regulated so as to admit plenty of air without reducing the steam pressure, in accordance with the principle that the more air admitted the better for the prevention of smoke. The firing should be so arranged, also, that the fire is well burnt through by the time the driver shuts off steam at the end of the trip.

It is with stopping trains in suburban districts that the greatest care on the part of the enginemen is called for, but attention to the principles above-mentioned will generally give satisfactory results.

NEW LOCOMOTIVES, ALSACE-LORRAINE STATE RYS.

We are indebted to the builders, the Société Alsacienne de Constructions Mecaniques, for the photographs here reproduced, with dimensioned diagrams, of two powerful types of locomotives recently put in service on the above-mentioned railway system. They are both four-cylinder compounds on the well-known de Glehn system.



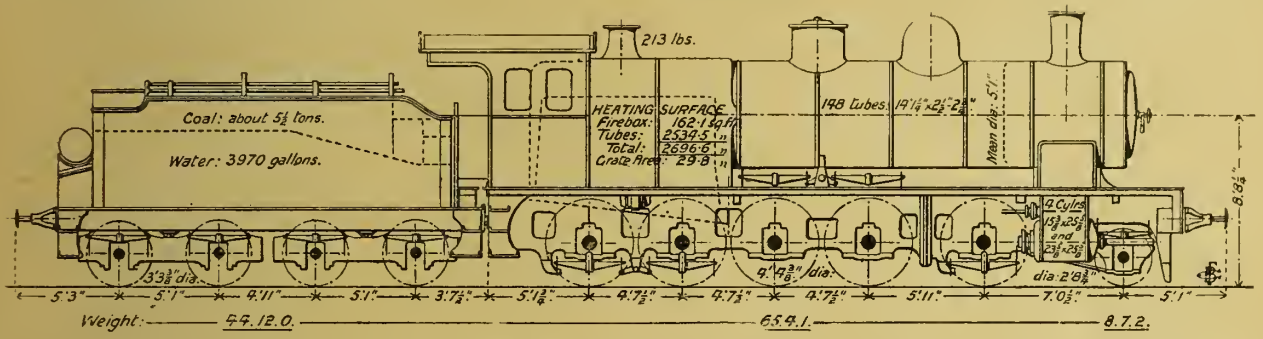


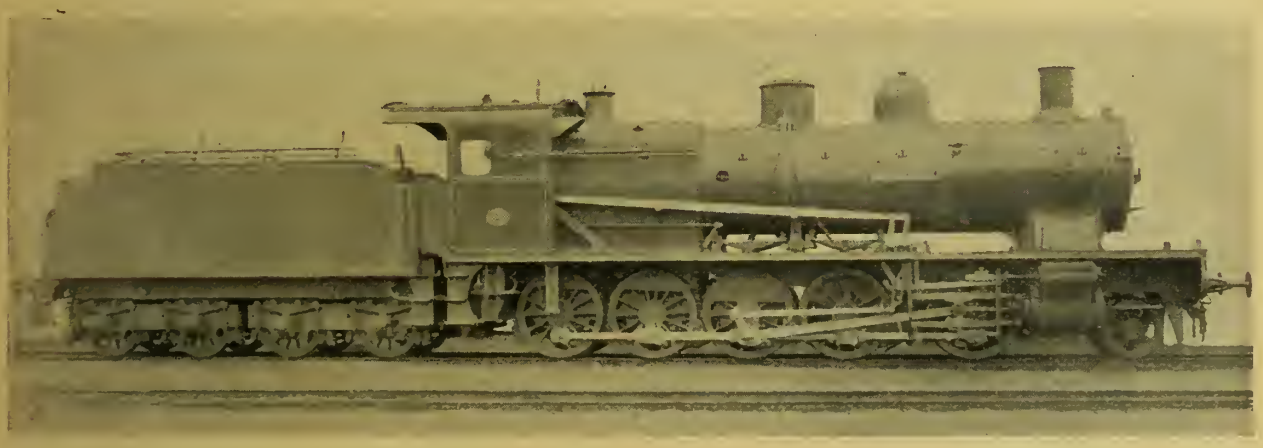
Six Wheels Coupled Double Bogie Tank Locomotive "Amanda," Alsace-Lorraine State Rys.

The 4-6-4 double bogie tank locomotive "Amanda" has high-pressure cylinders 340 mm. in diameter and low-pressure cylinders 530 mm. in diameter with a stroke of 640-mm., and six coupled wheels of 1,650 mm. diameter. It has a weight, empty, of 65,600 kg., and in working order of 85,800 kg. (about 84½ tons), and the extreme dimensions are: length over buffers 13,575 mm.

(44-ft. 6½-in.), extreme breadth 3,050 mm. (10-ft.), and height to top of chimney 4,252 mm. (13-ft. 11½-in.).

The "decapod," 2-10-0, goods locomotive "Rolandseck" has high-pressure cylinders 390 mm. in diameter, and low-pressure cylinders 600 mm. in diameter with a stroke of 650 mm., and ten coupled wheels of 1,330 mm. diameter. It has a weight, empty, of 67,250 kg., and in working order of 74,750 kg. (about 73½ tons), and the double bogie tender weighs 21,500 kg. empty, and 45,300 kg. (about 44½ tons) full. The extreme dimensions are: length over buffers





"Decapod" Goods Locomotive "Rolandseck," Alsace-Lorraine State Rys.

18,600 mm. (61-ft. 0¼-in.), extreme width 3,110 mm. (10-ft. 2⅜-in.), and height to top of chimney 4,237 mm. (13-ft. 10¾-in.).

It will be seen that both in dimensions and design these are noteworthy types of modern Continental locomotive practice.

Messrs. Cassell & Co. have published a new edition of the "Official Guide to the Great Western Railway" (1s.). It contains a number of wonderfully useful plans and maps of most of the large towns and places of interest served by the Great Western line and its connections. The guide is very fully illustrated and appears to be quite up to date.

LOCOMOTIVE ECONOMY.

Strict economy has been the order on all railway systems of late, and the question arises whether efficiency is not often sacrificed in order to show the desired economical working, a sacrifice which in the end can hardly be considered real economy.

It is remarked that the locomotives of some lines which were at one time noted for their good condition and smart appearance are now often to be seen running about half enveloped in steam from leaky joints and valves, with knocks and thumps from big and small ends, axleboxes, &c. All these defects mean considerable loss of power in running, and the driver often has to "thrash" the engine to get the required amount of work out of his machine, consequently a larger amount of coal and water is consumed, with increased wear and tear.

Engines are kept running longer now before being sent into shops for general overhaul and repair, therefore the renewals required are heavier and more numerous than was formerly the case. Very often an engine that has been out of the shops for some time becomes unfit for the road, and is put on shunting work—a practice which can hardly be economical, as an

1 Body.
2 Air Disc.
3 Shaft.
4-9 Large Ejector.
10-15 Small Ejector.
16 Large Nozzle.
17 Nozzle Carrier.
18 Small Nozzle.
19 Cap.
20 Drip Connection.
21 Vacuum Reducing Valve.
22-24 Air Clack.
25-27 Auxiliary Application Valve.
28 Steam Pipe Union.
29 Train-pipe Union.
30 Exhaust Union.
31 Release Valve.

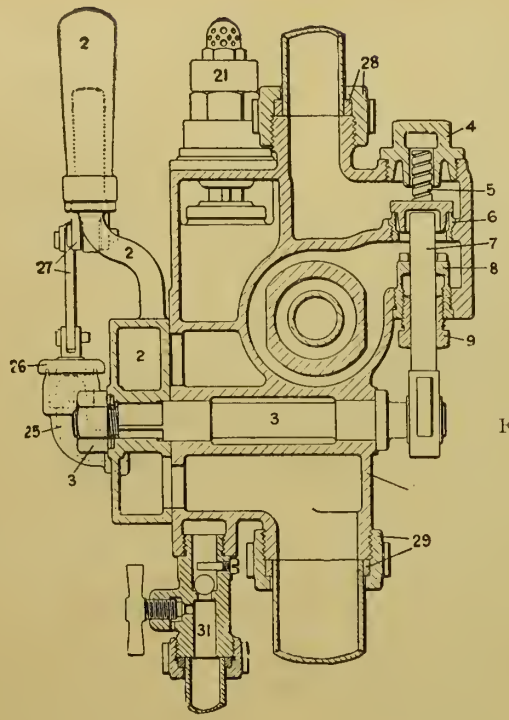
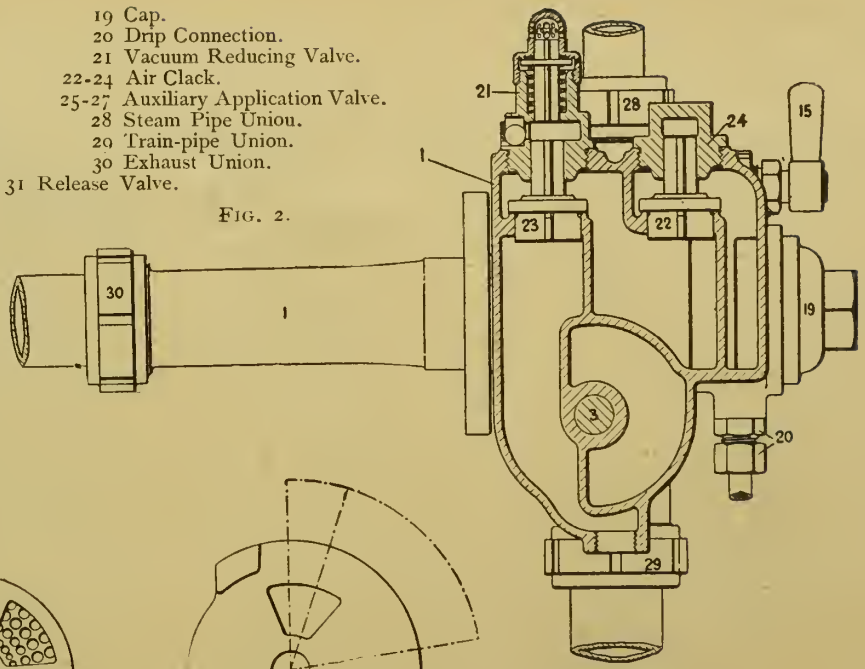
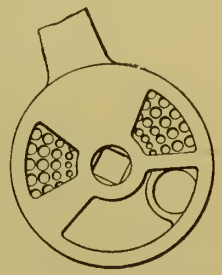


FIG. 1.

FIG. 2.





VIEW OF AIR DISC FACE

VIEW OF PORTS IN BODY

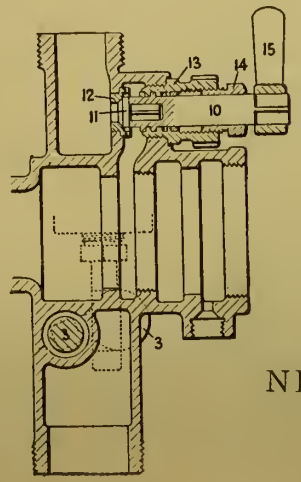
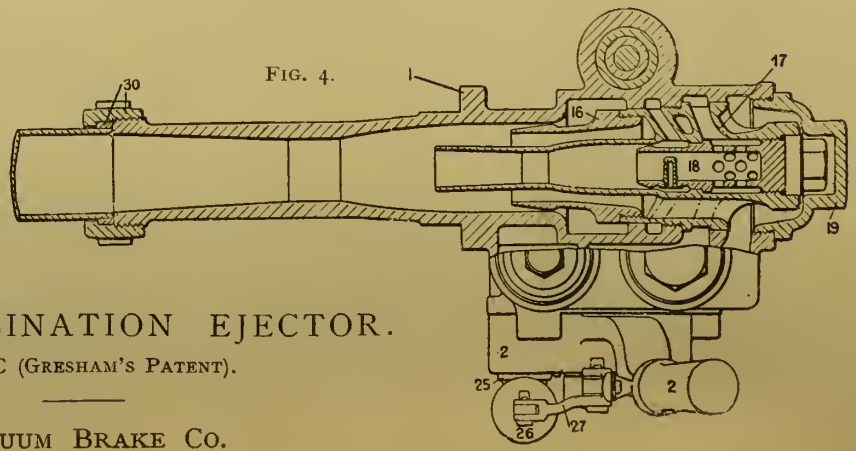


FIG. 3.

FIG. 4.



NEW COMBINATION EJECTOR.

TYPE C (GRESHAM'S PATENT).

VACUUM BRAKE CO.

engine in that condition is usually extravagant in comparison with a shunting engine built for that purpose.

Leaky fireboxes and tubes should not be allowed to work long without being attended to by the boiler-maker, as replacing the leakage of water raises the coal consumption and every drop of water is often of value in these days of heavier loads and shortened running times.

Some enginemen are keen on saving oil, forgetting that a well-lubricated engine runs more freely than one that does not get sufficient. Good lubrication assists in reducing the coal consumption; in fact, to be light on fuel a driver must keep his engine in as good a condition as he can.

Taking all things into consideration, real economy goes hand-in-hand with efficiency; no matter whether an engine is on express, goods or shunting work, it must be built of good material and kept in the best working order to get the most economical results.

NEW COMBINATION EJECTOR.

AMONG recent improvements in automatic vacuum brake apparatus is the new ejector and driver's valve illustrated. In the design two important features have been introduced, viz.: the provision of an auxiliary air valve for gradual application and "service" stops with "quick acting" brakes, and the isolation of the steam valve for the "large" ejector, thereby obviating any possibility of "drip" water passing to the main train pipe. The perfect accessibility of all parts, too, will appeal to practical men.

Fig. 1 gives a cross section through the body of the ejector, whilst Fig. 2 is an elevation with section through the air passages. Fig. 3 is a section of a portion of the body with cones removed, and Fig. 4 is a sectional plan.

The main handle (2) which carries the air disc valve, has attached to it a "grip" for operating the auxiliary air valve (26), and is also connected to it by a cross shaft. 6 is the steam valve for the large ejector. This latter is operated only whilst the handle is moved between "running" and "off" positions, and consequently little wear of the steam valve takes place, an improvement on the "steam disc" of former patterns of ejectors.

The small nozzle occupies a position at the base of the device and receives steam through the small valve (11). 31 is the release for engine brakes.

The drawings will enable the details of this new production of the Vacuum Brake Co. to be followed, and any further particulars can be obtained from the makers on application.

REVIEWS.

"THE AUTOBIOGRAPHY OF SAMUEL SMILES." *London:* John Murray. 15s. od. net.

The life of an author whose writings have held the attention of thousands of readers, and whose labours extend over practically the whole of the Victorian era, the age pre-eminently of mechanical progress, cannot fail to be of interest, for though nothing particularly eventful happened to the chronicler himself, his work brought him into touch with many interesting people famous in public life, to whom his great literary talents were of no small assistance in carrying through various reforms, notably the repeal of the Corn Laws.

Our readers will, of course, be most concerned with Dr. Smiles' connection with Railways in their early days, and particularly with that portion of his book which tells the many interesting stories connected with his search for information when preparing his great work "The Life of George Stephenson." He had the advantage of the help of Robert Stephenson, and of living at Newcastle at a time when memories of the early doings of Stephenson were still fresh. There is proof of the great pains Dr. Smiles took to collect his facts at first hand, not from other writers, but from actual observation and frequent intercourse with the people connected with the events he wrote about, and his books therefore have an historical value peculiarly their own. Many are the instances given of the care with which he collected his data.

It was in 1845 that Smiles became Assistant Secretary of the Leeds & Thirsk Railway, and very soon after he was promoted to the position of Secretary. On the amalgamation of the line with the North Eastern, a place was given him in the North Eastern Secretary's office at Newcastle. After being practically in a "siding" for nine years, during which he used his leisure to gather material for his "Life of Stephenson," he was successful in obtaining the post of Secretary of the South Eastern Railway, and the record of his 12 years service with this line contains many interesting reminiscences of early railway life. The book also contains much interesting matter in regard to his preparation of the "Lives of the Engineers," "Industrial Biographies," "Self Help," etc.

As the record of a life of continuous activity and industry, and a most successful career, the book deserves reading. It has been edited by Mr. Thomas Mackay, is excellently printed, and contains photogravure portraits of Dr. Smiles.

"ENGINEERING MATHEMATICS SIMPLY EXPLAINED." By H. H. Harrison. *London:* Percival Marshall & Co. 1s. 6d.

The purpose of this book is to enable engineering apprentices or artizans to have a sufficiently clear conception of the principles of mathematics to solve and understand the problems in practical work. Commencing with three chapters on arithmetic, there follow others on Algebra, Trigonometry and Mensuration.

The articles on the use of logarithms and squared paper, with the examples given, should enable the student to appreciate their utility in general as well as in engineering work. The concluding chapter is devoted to a sketch of the elementary and more useful parts of the differential and integral calculus.

The Carriage and Wagon Department.

STEEL PASSENGER CARS, GREAT NORTHERN & CITY RY.

We illustrate herewith different stages in the construction of the all-steel passenger cars, 18 in all, now being built by the Brush Electrical Engineering Co., Ltd., at their Loughborough works, for the above-mentioned "tube" railway. The system of construction is not altogether novel, since steel cars have been running on the Central London Ry. since the early part of 1903, but the cars here illustrated embody several new features and improvements dictated by experience. It may be said at once that cars of this construction secure practically absolute immunity from risk of fire, and a maximum of durability, with less weight than cars built of wood in the ordinary manner.

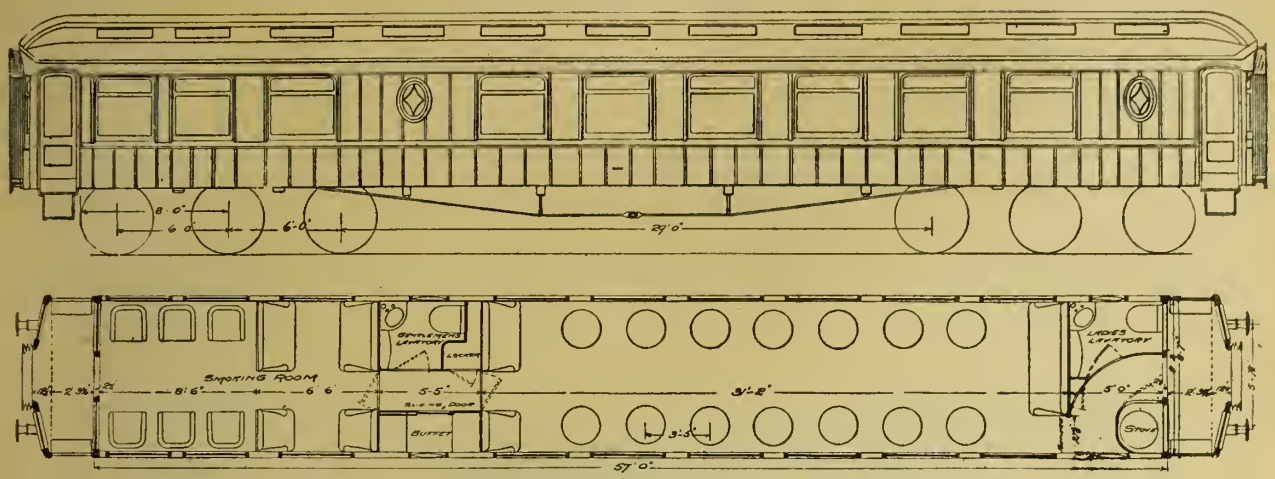
Outside View, All-steel Car, Great Northern & City Ry.

With a view to keeping the weight as low as possible, the full depth of the sides is utilised as longitudinal girders, and the result is ample stiffness with a minimum of material. The corner and door pillars are of angle-section steel, with intermediate pillars of channel section, and in addition to the top and bottom longitudinals, there are on each side, extending from the corners to the side-door pillars, two intermediate longitudinals which, besides stiffening the whole structure, serve also to support the window-frames. To these various frames are rivetted the side panels, $\frac{1}{8}$-in. thick, forming a very stiff girder on either side; the panels next to the corner and door pillars are each in one piece from floor to roof. The sides are stiffened also throughout their length, against lateral stresses, by diagonal braces concealed in the completed car at the backs of the transverse seats, these struts being rivetted to the waist-rail and the longitudinals of the underframes.

The underframe consists of longitudinals of girder section, supported by cross-bearers of the same section which are secured to the tension members of the side girders by angle iron knees. The main bolsters are designed to take the combined stresses of the weight of car and passengers, and of buffing and hauling, and are built up of heavy channels with side brace plates, strengthened at the centres by steel forgings that receive the bogie pins and also serve for the attachment of the draw-gear. Diagonal stresses are taken by a steel floor plate rivetted to the upper flanges, which is further reinforced by transverse flanged troughs. The draw gear is of the G. N. & C. R. standard type, slightly modified, the whole of the stresses being transmitted to the main bolster.

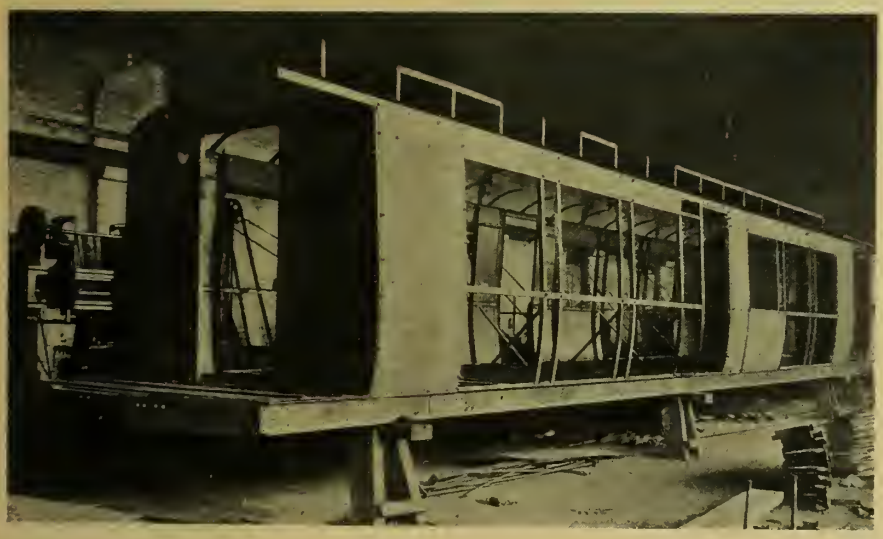
The interior fitting of the cars contains practically no wood except for decorative purposes. The floor is of sheet steel covered with a 1-in. layer of non-inflammable composition. The sides of the car are lined with sheets of aluminium, and the roof has no inside finish, the carlines being of channel section. Cross seats with legs of malleable iron are employed, to seat two on either side of a central gangway, the seats being of the spring type, built on an iron frame and covered with rattan. Brass is used for various fittings with highly ornamental effect. The seating accommodation per car is 64 passengers.

Leading dimensions of these cars are as follows:



Elevation and Plan of New Pullman Car, London, Brighton & South Coast Ry.

length over body 41-ft., and over platforms 49-ft. 6-in.; width over pillars 9-ft. $2\frac{7}{8}$-in., extreme width 9-ft. 4-in.; height from floor to roof 8-ft. 5-in., and from rail to top 12-ft. $4\frac{1}{2}$-in.; wheel-base of bogie 6-ft. 1-in.; distance between bogie centres 34-ft. 6-in.; diameter of wheels 3-ft.; weight of car body 10 tons 13 cwt. 2 qrs., weight complete with trucks, but without electrical equipment, 17 tons 11 cwt. 2 qrs.



All-steel Car in Course of Construction, Great Northern & City Ry.

Externally, there is little to indicate the metal construction of the cars, all rivets being countersunk or concealed by the ornamentation, and they are painted teak-color, picked out with Indian red and gold. The interior of the roof is painted white, and the sides cream, while the floor is the color of terra cotta. Owing to the thinness of the side walls, there is more room in these cars than in those of the same external dimensions built of wood. The bogie trucks are of the standard Brush type.

NEW PULLMAN CARS, LONDON, BRIGHTON & SOUTH COAST RY.

THREE new Pullman cars have recently been built for service on the London, Brighton & South Coast Railway. They are generally of the same dimensions and design as the previous ones running on this railway, being 63-ft. $8\frac{1}{2}$-in. long, over ends, and having a seating capacity for 32 passengers; 20 in the saloon and 12 in the smoking compartment. The interior decorations are very handsome, the seats being upholstered in green plush, and green leather in the smoking compartment. The carpets are of a rich green shade, and the ceilings painted white, picked out in gold. The interior woodwork is in vermilion wood inlaid. The lighting is given by four central electroliers and small brackets over each window. The toilet and buffet are arranged in the centre of the car. The exteriors are painted in the new style of painting adopted by the L.B.&S.C.R., umber lower panels and ivory white above, with gold lining. The three cars are named "Princess Ena," "Princess Patricia" and "Duchess of Norfolk," and were erected at Brighton under the supervision of Mr. Thos. Powell, secretary and manager of the Pullman Car Co., Ltd.

NORTH BRITISH RY.—Bogie corridor trains of up-to-date type will be ready for the summer service to Scotland, in competition with the "Grampian" express trains on the West Coast route.

STEEL DOUBLE HOPPER WAGON.

THE wagon here illustrated is one of a series of 12 constructed by the Brush Electrical Engineering Co., Ltd., of Loughborough, to the order of Mr. Hack, engineer-in-chief to the Birmingham Corporation Gas Department. It is built in accordance with the designs and patents of the Sheffield & Twinberrow Steel Car Co., constructed entirely of ordinary steel plates and sections, with standard details, such as wheels, axleboxes, spring and buffing gear, to meet the requirements of the railway clearing house. It has a capacity for 20 tons, with a tare of 8 tons 7½ cwt., and has the following leading dimensions: length over headstocks 20-ft. and over buffers 23-ft.; width over side-stiffeners 8-ft.; height from rail level, unloaded, 9-ft.; wheelbase 10-ft. 6-in.; from centre to centre of hopper doors and openings 5-ft. 9-in.; diameter of wheels 3-ft. 1-in.; size of axle journals 10-in. by 5-in. The two hoppers converge to openings having a combined area of 7 sq. ft., delivering at a distance of only 10-in. above rail level. These openings are closed by horizontal doors operated by chain gearing and winches at each end of the wagon, and the angle of inclination of the hopper plates is such as to ensure complete automatic discharge. A car of this type discharges in about 40 seconds, without labour, whereas an ordinary flat-floor wagon of the same capacity would require spade labour costing about 6s. to empty it. The wagon is provided with the Pearts' either-side compensated brake, with two blocks operating one wheel on each axle. If these wagons give full satisfaction, we understand that the original order for 12 will be increased to 100.

STEEL DOUBLE HOPPER WAGON, BIRMINGHAM CORPORATION.

STEAM HEAT TRIALS, NORTH EASTERN & GREAT NORTHERN RY.

IN connection with the steam heating trials—direct circulation *v.* storage system—of the above railways, N.E.R. locomotive No. 2024, with a train of ten bogie bars, came through to King's Cross on the afternoons of January 13th and 15th. The G.N.R. train used in the tests was made up of 15 six-wheeled coaches fitted with the storage system of heating. We understand that the direct method of using steam at a low pressure proved most efficient, the train being heated throughout in about a quarter of an hour, as compared with an hour and a quarter for the storage system.

ADMIRALTY CONTRACTS FOR ASBESTOS GOODS.—The Lords of the Admiralty have for the 20th year in succession awarded important contracts for the supply of asbestos goods for use in the Royal Navy to the United Asbestos Co. Ltd. These contracts comprise: "Salamander" rolled cloth packings and square block packings, "Victor" asbestos-metallic hydraulic and seamless joints, "Salamander" carded asbestos fibre, lagging materials for boilers and pipes, including "Salamander" asbestos mattresses and woven asbestos tape, etc. Nearly 1,000 miles in length of "Victor" metallic, "Salamander" block and other packings, and many millions of "Victor" metallic joints alone have been supplied by this company to His Majesty's Navy.

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THE LOCOMOTIVE MAGAZINE.

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RAILWAY NOTES.

LONDON & NORTH WESTERN RY.—The latest engines of the "Precursor" type are Nos. 2582 "Rowland Hill," 2583 "Teutonic," 2584 "Velocipede" and 2585 "Watt."

Four new "Experiments" are also out, Nos. 565 "City of Carlisle," 893 "City of Chester," 1074 "City of Dublin," and 1357 "City of Edinburgh."

GREAT WESTERN RY.—Nos. 3131-3138 are the latest engines of the No. 3111 class (2-6-2 tank engines). No. 3138 has its number on the bunker sides, and "Great Western" on the tanks similar to the new style of lettering the tenders.

MIDLAND RY.—Nos. 2185, 2196 and 2202, coupled bogie engines, have recently been rebuilt at Derby with large boilers and new cabs right over the footplate. The brass beading has been removed from the splashers and black beading substituted. The familiar brass numbers have also disappeared, and a white metal plate put on the front of the smokebox. The smokebox door is flat, instead of being dished, and the handrail runs straight across it. No. 163, a 6-ft. 6-in. coupled bogie engine has been similarly rebuilt. Nos. 172 and 175, 7-ft. 6-in. singles, have been altered externally to suit new ideas, but retain the old boilers.

Some half dozen of the old double-framed goods engines have recently received new boilers of the large new standard type, together with new cabs and side sheets. Nos. 380, 547 and 550 have been thus rebuilt.

STEAM RAIL MOTOR COACH, CAPE GOVERNMENT RYS.

Nos. 2603, 2605 and 2607, of No. 2601 class, have been rebuilt similar to No. 2621, with tapered boilers. Nos. 3298-9, 3302, 3305 and 3307 of the "Badminton" class are rebuilt with new large tapered boilers, with Belpaire fireboxes and no domes.

Mr. G. J. Churchward, the locomotive superintendent of the G.W.R., recently read an interesting paper on "Large Locomotive Boilers" before the Institution of Mechanical Engineers, illustrated with numerous examples from current practice.

Our readers will learn with regret that the two historic broad gauge veterans "North Star" and "Lord of the Isles" have recently been scrapped.

GREAT CENTRAL RY.—Commencing on the 1st inst., passenger traffic on the Neasden-Northolt new line has been worked by steam rail motor No. 3. Starting from Marylebone terminus (not Neasden as was first arranged) the first stopping station is Wembley (6½ miles), then follow Sudbury and Harrow Road and South Harrow stations at intervals of about 1¼ miles and 1 mile respectively. The time occupied on the journey is 25 minutes. The G.C. local service

from Marylebone to Metropolitan Ry. stations from Harrow on to Aylesbury, etc., was also inaugurated on the same date. Smart new trains, each made up of four bogie coaches with electric light and steam heat, and Mr. Robinson's ten-wheel tank engines, are employed on this duty.

SOUTH EASTERN & CHATHAM RY.—A new rail motor coach, No. 3, has lately been delivered, the engine built by Messrs. Kitson & Co., Ltd., (makers' No. 4376) and the car by the Oldbury Carriage & Wagon Co., Ltd. As a result of the successful services on the Sheppey branch, motor coaches are to be used on the following sections: Elmers End to Hayes, Dunton Green to Westerham, Otford to Sevenoaks, Gravesend to Port Victoria, and on the branch from Appledore to New Romney via Brookland, Lydd and Dungeness.

MIDLAND & GREAT NORTHERN JOINT RY.—Midland Ry. locomotive No. 144, and several others of the same class, are now working on this line, having been loaned to the Joint Committee to replace some of the earlier bogie tanks.

THE CAMPBELTOWN & MACHRIHANISH RY. Co. have ordered from Messrs. Andrew Barclay, Sons & Co., Ltd., Caledonia Works, Kilmarnock, a locomotive for their new narrow-gauge railway from Campbeltown to Machrihanish. The locomotive has six wheels coupled, with two-wheeled bogie, and is fitted with Walschaert valve gear. The railway is intended partly for minerals and partly to carry passengers across the Mull of Kintyre to Machrihanish and back to Campbeltown, in connection with the turbine steamers.

STEAM RAIL MOTOR COACH NO. 2, FINCHLEY AND EDGWARE SERVICE, GREAT NORTHERN RY.

LONDON & SOUTH WESTERN RY.—Nos. 50-60, standard trailing bogie tank locomotives, are now nearly all in service. Nos. 5-10, steam rail motor coaches, are rapidly approaching completion.

BAKER STREET & WATERLOO RY.—This new line of the London Underground Electric Rys. Co., was opened on the 10th inst., between Kennington and Baker Street, with a service at five minutes' intervals during the day, reduced to three minutes during busy hours. The cars are steel built, 50-ft. long, 8-ft. 8-in. wide and 9-ft. 5½-in. high, and the six coaches composing a train seat 300 passengers. The distance of 3¾ miles will be covered in 13 minutes, south to north, and 12 minutes in the reverse direction, gradients favouring the latter. Intermediate stations are at Regent's Park, Oxford Circus, Piccadilly Circus, Trafalgar Square, Embankment and Waterloo. Extensions to Paddington and the Elephant and Castle are in progress.

GREAT NORTHERN RY.—The accompanying illustration shows one of two steam rail motor coaches designed by Mr. H. A. Ivatt and constructed at the Doncaster works of this company. The car body is 49 feet long, and has seating accommodation for 53 passengers; it is carried on a standard carriage bogie at one end, and on four-coupled wheels of 3-ft. 8-in. in diameter under the engine. Other leading dimensions are: cylinders 10-in. by 16-in., diameter of boiler barrel 4-ft. 0½-in., firebox casing 3-ft. 6-in. by 4-ft. 0½-in., 178 tubes, heating surface 382 sq. ft., grate area 9½ sq. ft., boiler pressure 175 lbs. per sq. in. These cars are built to work local services, such as Finchley to Edgware, Hatfield to Hertford, Hatfield to St. Albans and Hitchin to Baldock, etc.

Nos. 1271-1280, six-coupled saddle tanks, and Nos. 127-136, eight-coupled side tanks of No. 116 class, have been put into service. Nos. 132-136 are stationed at Colwick to work coal trains over the Nottinghamshire branch lines.

THE ELECTRIFICATION OF THE SIMPLON TUNNEL RY.

THE electric traction of the Simplon Tunnel Ry. has for many years been the object of study and research by Swiss firms. The question came to a head when the firm of Brown, Boveri & Co., of Baden, Switzerland, in the latter part of last year, offered to have the whole of the electrical plant ready by the date of the opening of the tunnel,and to put this plant at the disposal of the Swiss Federal Railways, in order that a comparison between steam and electric traction could be made on a large scale, and on a line which is especially suited to show the special advantages of electric traction.

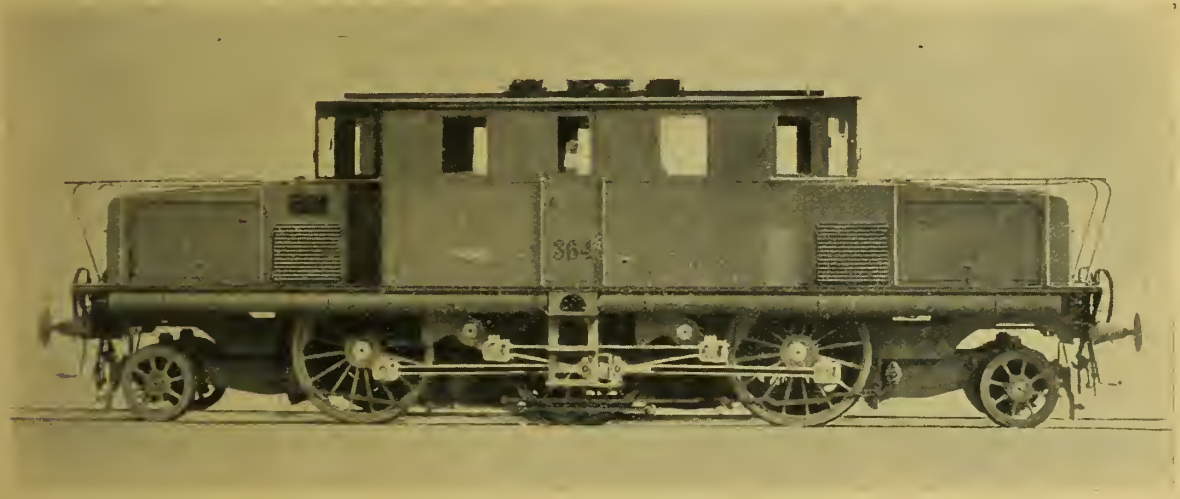
Of course it was quite impossible to construct entirely new locomotives, so that the existing material will have to be made use of. The firm mentioned were building two three-phase locomotives of 900-1,000 h.p. each for the Italian State Railways, and as there was a possibility of being able to transfer these locomotives to the Simplon tunnel line with the consent of the Italian railway authorities, the three-phase system was decided upon.

The basis on which the system is to be installed is briefly as follows: At each of the mouths of the tunnel, which is about 20 km. long, there are hydraulic power plants installed to supply power used in the construction of the tunnel. With a few alterations and enlargements it will be possible to use these hydraulic installations for the generation of current for electric traction.

As provisionally only the actual length of the tunnel which lies between Brigue and Iselle is to be electrified, the current generated will be conducted directly to the contact line, which runs through the tunnel without previously passing over a distance transmission line. There will be a rail switching station in the middle of the tunnel, which will be made use of when trains, in consequence of delay, should have to cross or overtake other trains. For ordinary service, no crossing of trains is supposed to take place.

On the arrival of a train from Lausanne at the Brigue station, the steam locomotive will be taken off and an electric one put on to the train, to haul it as far as Iselle, where a steam locomotive will again take the place of the electric one.

The electric locomotives constructed by Messrs. Brown, Boveri & Co., one of which is here illustrated, have three driving axles driven by two motors by means of a system of connecting rods, cog-wheels being omitted altogether. The motors are constructed for two speeds—viz., 34 and 68 km. The drawbar pull of the locomotive at the smaller speed amounts to 6 tons and at the greater $3\frac{1}{2}$ tons. The total weight is 62 tons and the weight on the driving wheels 42 tons.



SIX-COUPLED DOUBLE-END ELECTRIC LOCOMOTIVE, SIMPLON TUNNEL RY.

On the part of the line to be electrified, there are gradients up to 10 per cent. for very short distances. The up gradient on the north side from Brigue to the middle of the tunnel amounts to about 2 per cent., while on the south side, from the middle of the tunnel to Iselle, the down gradient amounts to 7 per cent.

It will be necessary to run passenger trains with a total weight of 365 tons and goods trains with a weight of 465 tons.

The time occupied on the journey by the passenger trains from Brigue to Iselle will be 20 minutes and in the reverse direction 30 minutes. The goods trains will take about 40 minutes in each direction.

Eight Wheels Coupled Bogie Four-cylinder Compound Tank Locomotive No. 4005, Ceinture Ry., Paris.

COMPOUND TANK LOCOMOTIVE, METROPOLITAN RY., PARIS.

The accompanying photo-reproduction illustrates one of a series of powerful four-cylinder compound tank locomotives built by the Société Alsacienne de Constructions Mecaniques for service on the "Ceinture" Railway, Paris. It has the following leading dimensions: diameter of cylinders, high pressure 14½-in., low pressure 22½-in., stroke 25½-in.; diameter of wheels, bogie 2-ft. 7½-in., coupled 4-ft. 8¾-in.; wheelbase 27-ft. 8¾-in.; mean diameter of boiler barrel 4-ft. 9-in.; 126 Serve tubes, 13ft. 5½-in. long by 2½-in. in diameter; heating surface, firebox 133.5 sq. ft., tubes 2055.4 sq. ft.; total 2188.9 sq. ft.; grate area 23.75 sq. ft.; working pressure 213 lbs. per sq. in.; weight of engine in working order 79 tons 8 cwt. 3 qrs., of which 60 tons are available for adhesion; weight empty 64 tons 19 cwt.; total length of engine 41-ft. 3¾-in.; breadth 9-ft. 10¼-in. The tanks contain about 1,300 galls. of water and the bunkers 3 tons of coal.

Railway Club.—The next meeting will be held at headquarters, 92, Victoria Street, S.W., on Tuesday, April 10th, at 7.30 p.m., when Mr. R. L. Robinson will read a paper on "Automatic Signalling."

Locomotive Stock.—The following figures are reproduced from the official half-yearly reports of the railways mentioned:—

Railway.	Engines.	Tenders.	Rail Motor Coaches.
Midland	2790 ..	2245 ..	2
Great Northern ..	1279 ..	894 ..	7
Great Western ..	2355 ..	1244 ..	46
L. & N. W. R. ..	2560 ..	1907 ..	3
,, duplicate	475 ..	..	
L. & S. W. R... ..	736 ..	440 ..	7
L. B. & S. C. R. ..	535 ..	? ..	2
,, joint working with L. & S. W. R...	—— ..	—— ..	2

Four Wheels Coupled Tank Locomotive No. 457, G.W.R.—This was one of the first standard gauge Great Western engines used on the "Underground" Rys. The photograph was taken about 30 years ago, at or near where Earl's Court Station now stands. The old station was then on the east side of Earl's Court Road. It will be noticed that the track was laid with flat-bottomed Vignolles' rails, which remained in use until well into the "eighties."

Photo by SIX-COUPLED TANK LOCOMOTIVE No. 108, NORTH BRITISH RY. *S. A. Forbes.*

TANK ENGINES, NORTH BRITISH RAILWAY.

FOR the working of their suburban and short branch traffic the North British Railway possess an exceedingly smart class of six-coupled tank locomotives, one of which we illustrate.

Designed by Mr. Dugald Drummond for practically the same services, and to be performed under the same disabilities as the Brighton "Terriers," they are really an enlarged copy of that well-known class of engine, and possess a good many characteristics of Stroudley design and practice. For the past 30 years they have performed their duty to the entire satisfaction of all concerned, and though on some of the harder suburban sections they have recently been replaced by heavier tank engines, the greater number are still at their original posts.

When built they resembled their Brighton prototypes more closely than at present, by carrying names, which, however, were removed several years ago, and the letters "N.B.R." substituted, this latter style giving way to the present "N.B." and the Company's coat-of-arms about two years ago.

Through the kindness of Mr. W. P. Reid, the locomotive superintendent of the North British Railway, we are able below to give a complete list of their leading dimensions, original names and dates: cylinders 15-in. by 22-in.; six-coupled wheels 4-ft. 6-in. in diameter; the boiler contains 146 tubes, 9-ft. 2½-in. long; grate area 14 sq. ft.; heating surface, firebox 65 sq. ft., tubes 636 sq. ft., total, 701 sq. ft.; working pressure 140 lbs. per sq. in.; the tank carries 600 gallons of water, and the engine in working order weighs 33½ tons.

No.	Built.	Name.	No.	Built.	Name.
20	1877	Haddington.	162	1877	Loch Leven.
22	1877	Langholm.	165	1875	Boness.
96	1878	Arbroath.	166	1875	Bothwell.
97	1878	Bonnington.	240	1878	Polton.
106	1878	Tayport.	241	1876	Bervie.
107	1878	Leuchars.	274	1877	Dalkeith.
108	1878	St. Andrews.	284	1875	Grahamston.
123	1877	Westfield.	295	1877	Carnoustie.
151	1877	Guardbridge.	297	1876	Leith.
158	1877	North Berwick.	313	1878	Musselburgh.
161	1877	Buckhaven.			

All these engines were built at the Company's own works at Cowlairs.

THE HISTORY OF THE LONDON & SOUTH WESTERN LOCOMOTIVES.

(*Continued from page* 119, *Vol. XI.*)

FOLLOWING the engines last described, six more well tank passenger engines, built by Messrs. Beyer, Peacock & Co., were delivered in October, 1875. They were numbered 44 and 325 to 329 (makers' Nos. 1533 to 1538), No. 44 being named "Pluto," and were the last engines of the type built for the railway. The appearance and dimensions were practically the same as the preceding engines of the class. Only two of the six engines were rebuilt, viz., "Pluto" in December, 1887, and No. 329 in December, 1892. No. 325 was scrapped in 1888, 327 in November, 1892, 328 in September, 1898, and "Pluto" in November of the same year.

In May, 1876, Messrs. Beyer, Peacock & Co. supplied six saddle tank locomotives, Nos. 330 to 335, for shunting purposes; these engines were, with the exception of one or two L. & S.W. characteristics, of the makers' well-known design

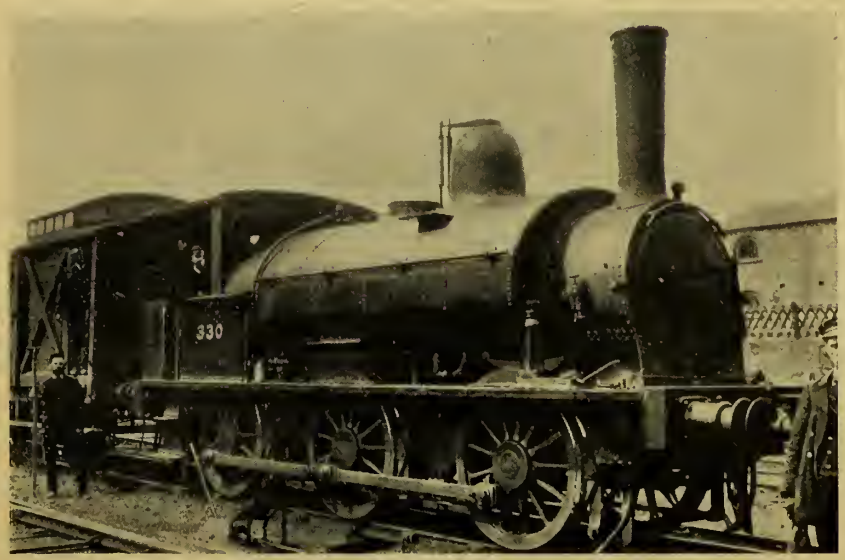


Fig. 49.

Fig. 52.

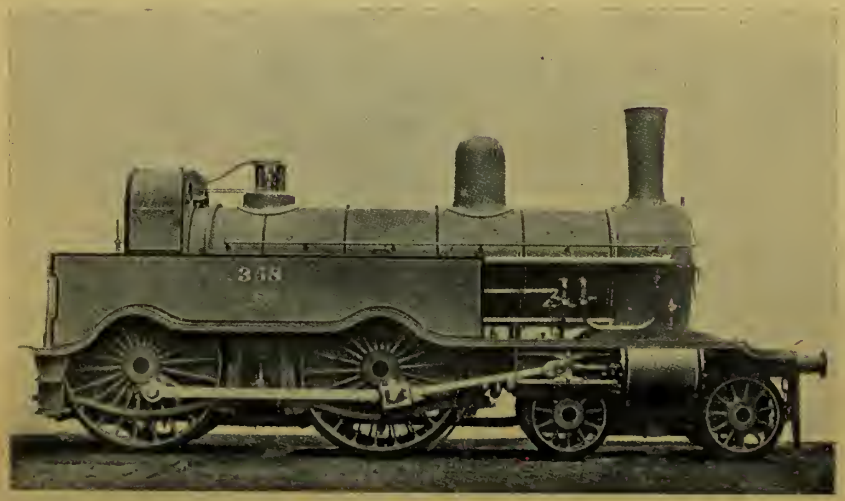


Fig. 50.

Fig. 51.

and bore works' Nos. 1591 to 1596. They had wheels 4-ft. in diameter and cylinders 17-in. by 24-in. All are still at work, but in the duplicate list. No. 330 is shown in Fig. 49.

During the latter half of 1876, twelve six-coupled goods engines were delivered by Messrs. Beyer, Peacock & Co. (makers' Nos. 1600 to 1611) similar to No. 302 class (see Fig. 46 in July issue) and were numbered 336 to 347 inclusive. All this class of engine had Ramsbottom safety valves and large brass domes.

No. 339 was broken up in August, 1891, and No. 346 in December, 1893; the remainder are still at work, but in the duplicate list, and are used for light goods traffic in the country and ballast work, &c.

Towards the close of 1876 Messrs. Sharp, Stewart & Co., Manchester, delivered the first of a new class of bogie passenger engines, No. 348 (makers' No. 2657), which was at that time the most powerful passenger engine yet built for the company, and which was followed early in 1877 by nineteen more of the same class, Nos. 349 to 367 (makers' Nos. 2658 to 2676).

The principal dimensions were as follows :—

Particulars.	Original Design.	As Rebuilt.
Cylinders	18½-in. by 26-in.	17-in. by 26-in.
Wheels—bogie	3-ft. 3-in.	3-ft. 3-in.
Coupled	6-ft. 7-in.	6-ft. 7-in.
Centres of bogie wheels	6-ft. 6-in.	Same as original.
,, bogie and driving wheels	10-ft. 3-in.	
,, coupled wheels	9-ft.	
Boiler—length of barrel	10-ft. 4-in.	11-ft.
,, diameter	4-ft. 2-in.	4-ft. 4-in.
Firebox	5-ft: high	5-ft. high, 6-ft. long
Tubes	218, 1⅞-in. dia.	216, 1⅝-in. dia.
Heating surface—tubes	889·64 sq. ft.	1,121 sq. ft.
firebox	145·7 sq. ft.	110 sq. ft
Total	1,035·34 sq. ft.	1,231 sq. ft.
Grate area	17·86 sq. ft.	17 sq. ft.
Working pressure	140 lbs.	160 lbs.
Height rail level to top of chimney	13-ft. 2¾-in.	—
,, centre of boiler	7-ft.	7-ft. 4-in.
Weight in working order (engine)—	T. C. Q.	T. C. Q.
Bogie	16 0 0	16 2 0
Driving	16 18 0	14 0 0
Trailing	13 18 0	14 4 0
Total	43 16 0	44 6 0
Weight in working order (tender)—		
Leading	6 12 0	11 0 0
Middle	8 16 0	9 14 0
Trailing	9 3 0	10 14 0
Total	24 11 0	31 8 0
Total weight of engine and tender in working order	68 7 0	75 14 0
Total wheelbase, engine and tender	40-ft. 1-in.	43-ft. 4-in.
Total length over buffers	47-ft. 4¾-in.	51-ft. 4¾-in.
Tender water capacity, galls.	2,250	3,000
Centres of tender wheels	5-ft. 1½-in.	6-ft. 6-in.
Tender wheels, dia.	3-ft. 9¾-in.	3-ft. 9¾-in.

No. 348 (with 2.50 p.m. express train, Portsmouth to London) 4th November, 1890, broke both side rods, running down Haslemere Bank, wrecking cab, splashers, boiler casing, etc., etc.

These engines for many years worked the fast express services between London and Exeter, London and Southampton, London and Portsmouth, but were later relegated to lighter duties in the Southern and Western districts. They were never really successful, the large cylinders requiring more steam than the original boilers could adequately supply, while the frames were of too light a section to stand a very much larger boiler; hence few of the engines were rebuilt by Mr. Adams, who decided that it would be more economical to scrap them.

Figs. 50 and 51 show these engines as originally built, and as Nos. 348-9, 351, 353-357 were rebuilt by Mr. W. Adams. They are now all broken up.

In December, 1877, the company purchased through Messrs. Alexander Shanks & Co., of Arbroath, two small tram or shunting engines, designed and constructed by that firm, for use on the Southampton Town Quay and Pier, where the restrictions of the Harbour Board prohibit the company from working with engines of more than a certain weight and wheelbase. These little engines were similar to some Messrs. Shanks had previously constructed to the order of Mr. A. Jiles, the engineer for the Southampton Dock Co., and in proof of their efficiency it may be noted that they are still actively at work upon the same duties after nearly 28 years' service.

These two engines were named respectively "Southampton" and "Cowes"; the former was built December, 1876, and the latter in November, 1877. They are of the saddle tank class, with outside cylinders made from hard cast iron 10-in. diameter, with a stroke of 20-in., and run on four wheels coupled 3-ft. 0-in. diameter. The boilers contain 62 tubes of 2-in. diameter; the boiler working pressure is 120 lbs. per square inch. The wheelbase is only 5-ft. 6-in., and total length over buffers 21-ft. 3-in. The boiler barrel is 8-ft. 2-in. long, with a diameter of 3-ft. 2-in. The tank capacity is 400 gallons. The weight of the engines in working order is as under :—

	T.	C.	Q.
On leading wheels ..	7	10	2
On trailing wheels ..	10	17	0
Total	18	7	2

The weight empty is 15 tons.

In August, 1898, the "Cowes" was numbered 108 and "Southampton" 109.

In December, 1879, the company purchased another engine of exactly similar type, named "Ritzebuttel," constructed in 1873, and shown in Fig. 52. This engine was numbered 110 in August, 1898. "Ritzebuttel" was one of six engines built for the old Southampton Dock Company by Messrs. Shanks & Co.; none of the others, however, were at work when the rolling stock belonging to the Docks were handed over to the South Western Company, and do not therefore appear in this history.

(To be continued.)

OIL GROOVES.

THE economical and effective use of oil in lubricating the various moving parts of the mechanism of a locomotive depends largely upon the means provided for its proper distribution over the wearing surfaces.

Satisfactory access is usually secured by cutting grooves or channels leading from the oil holes over the faces in contact. The correct arrangement of these is naturally a detail of considerable importance.

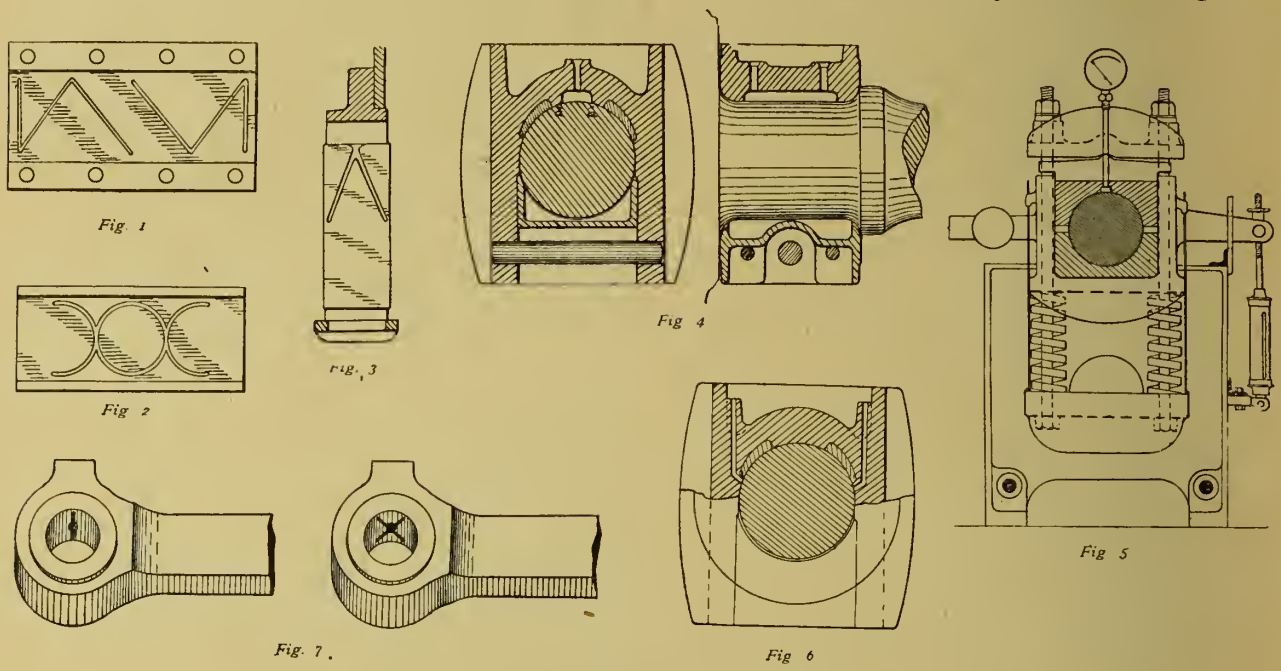
To lubricate a flat surface, such as one of the sliding faces of a crosshead, running upon the slide-bar, the usual method is to drill a hole from the oil cup or reservoir, and cut channels from the extremity of this over the face to be lubricated, in straight, zigzag, circular or semi-circular lines, as may be preferred. Fig. 1 shows straight grooves for the bottom slide of a cross-head running upon a single bar. It will be noticed that there is no oil hole from a syphon cup, as this face gets its supply by holes through the slide-bar itself, fed from the upper face.

Fig. 2 is the top slide of a two-bar crosshead, and has curved grooves, the oil in this case being also fed through the slide-bar, by a syphon cup fixed to the bar above.

With vertical wearing surfaces, such as those of the axlebox guides, in which the axlebox is held, the oil is applied along the top of the sliding face, which is cut back there to a long taper and has two grooves provided, shaped like an inverted V, as shown in Fig. 3, to assist it in working down between the faces.

To secure good lubrication of circular surfaces, such as those of the journals where they revolve under the bearings of the axleboxes, a large recess is usually provided in the latter, which extends nearly across the crown of the bearing, thus forming an oil reservoir, as shown in Fig. 4. The edges of this recess are filed out to a slight taper at *aa*, to facilitate the oil getting between the faces in contact. If these edges are left sharp, there is a probability of them acting as scrapers, thus preventing the oil from lubricating as it should.

Although the placing of the oil recess in the crown of the bearing is common practice, mention should be made here of the fact that the subject of the lubrication of heavily loaded bearings has been thoroughly and indeed exhaustively investigated by one of the highest British authorities on bearings and their lubrication, Mr. J. Dewrance, who has clearly demonstrated, by a series of most interesting experiments, the superiority of efficiency obtained by introducing the oil at the side, or rather at the commencement of the bearing area, in preference to the crown, where the weight is concentrated. These conclusions were arrived at after very careful trials on a machine devised for that purpose, which is shown more or less diagrammatically in Fig. 5. This consists of a shaft, carried on two plummer-blocks not shown in the illustration, with a central bearing provided for the purpose of the tests. This central journal or bearing is furnished with means for varying the load upon the axle at will, by means of long bolts passing through to the bottom carrier, with an arrangement of springs



THE USE OF OIL GROOVES IN LOCOMOTIVE DETAILS.

and indicators to show when an exactly equal pressure is exerted on each bolt. A spring balance at the side registers the pull upon the bearing caused by frictional resistance. By means of a gauge inserted in the oil recess at the top, it was possible to investigate the action of the revolving shaft upon the oil supply, and Mr. Dewrance found that any considerable pressure on the axle caused the oil to be scraped off, especially when in the course of wear the bottom edges of the oil hole had been brought to sharp angles. This showed the imperative necessity for the maintenance of inclined planes between the oil hole and the axle, to allow of the oil gradually working between the wearing faces, and this is a distinct difficulty where the oil hole is at the top of the bearing, as the greatest wear takes place at that point. The net result of the experiments was, in fact, to show that the ideal place for introducing the oil supply was just above the commencement of the bearing area on either side, and an axlebox so provided is shown in section in Fig. 6.

The big end of a connecting rod is provided with a similar but smaller recess, which is supplemented in some cases by grooves for the purpose of distributing the oil more effectively. In the same way, the small end of the connecting rod and the coupling rods will each have an oil hole, with a groove leading in each direction from it, either straight across or diagonally in X form, as shown in the two examples in Fig. 7.

The cutting of oil grooves is usually done by hand chisels of the "round nose" type, and they are mostly cut to a width of $\frac{1}{8}$ or $\frac{3}{16}$-in., with a depth of $\frac{1}{16}$-in. This method of cutting is especially applicable to the curved faces of bearings, and the flat faces of crossheads, etc., are often dealt with on a machine. A slot-drilling machine in which the drill is formed with a cutting edge of the required shape at the bottom, and set to the required height, is useful for this work, the oil grooves being cut by moving the table to which the work is fixed, in the required direction, thus "milling," as it were, the grooves in the metal.

All oil holes and grooves should have the sharp edges removed, and be wiped carefully, before the parts are put together on the engine, for the very obvious reason that any dirt or grit left on would be distributed with the oil, and work into the bearings or wearing surfaces, thereby causing a risk of heating and cutting by reason of the increased friction thus produced.

THE GLOBE PNEUMATIC ENGINEERING COMPANY, LIMITED, have executed a large order for the supply of pneumatic tools for the locomotive workshops of the East Indian Railway.

MR. R. WEATHERBURN.

MR. R. WEATHERBURN, whose retirement from the service of the Midland Ry. was recorded in our last issue, served his apprenticeship under Messrs. Kitson & Co., Leeds, and whilst in their employ had experience on nearly all the principal railways in the kingdom, and was personally known to nearly every engineer of the time. His experience was not confined to this country, but extended to Denmark, Russia, Germany, etc., where he had special opportunities of noting other systems of working. He joined the service of the Midland Ry. in 1874, and for some time held the position of inspector of new works at Messrs R. Stephenson & Co., Newcastle-on-Tyne, etc. After this he was appointed to Liverpool, Leicester and London respectively. He is the author of "Ajax Loquitur" and a well-known writer on nearly all subjects connected with locomotives, hydraulics and railways. He is a member of the Institution of Mechanical Engineers.

MR. R. WEATHERBURN, M.Inst.M.E.

OBITUARY.—The engineering world has sustained a severe loss by the demise of Professor August von Borries, of the Charlottenberg Technical School, at the comparatively early age of 54 years. Mr. Von Borries was for many years locomotive superintendent of the Hanover State Rys., and was associated with Mr. T. W. Worsdell in the Patent Compound system for locomotives. Mr. Von Borries had been in poor health for some time, but the end which occurred on the 14th February, at Meran in the Austrian Tyrol, was unexpected.

GREAT EASTERN RY.—The G.E.R. are fitting a number of covered goods wagons with the air brake for the fast goods trains which will shortly commence running between Bishopsgate and Whitemoor (March).

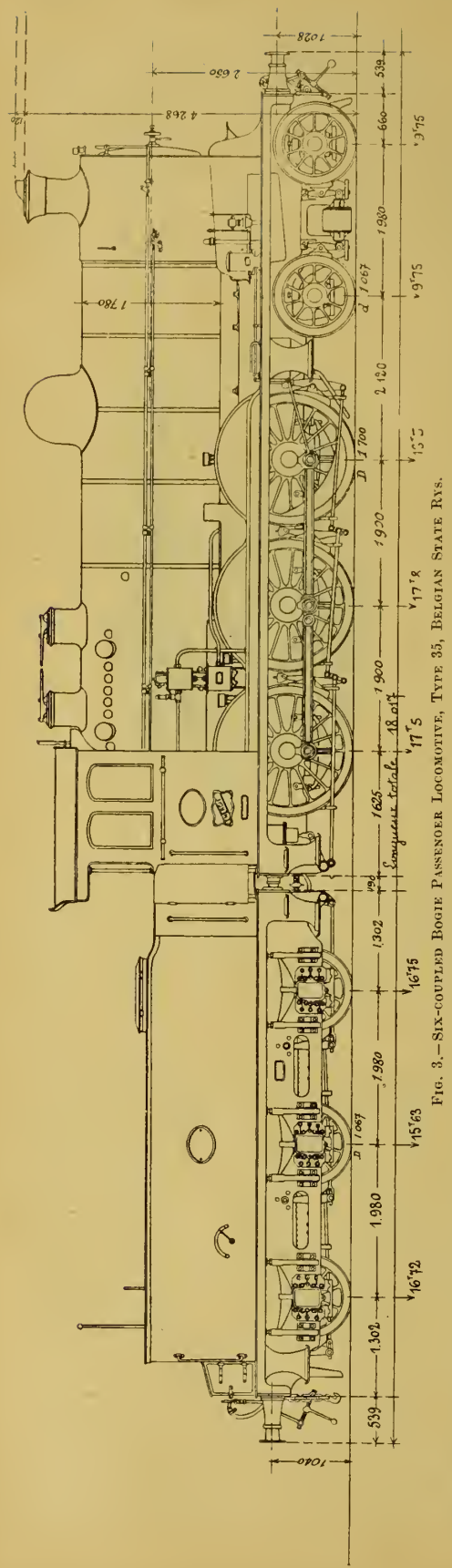


Fig. 3.—Six-coupled Bogie Passenger Locomotive, Type 35, Belgian State Rys.

RECENT LOCOMOTIVES OF THE BELGIAN STATE RAILWAYS.

(*Continued from page* 7.)

Fig. 3 represents one of the latest locomotives of Type 35, with the Schmidt superheater. On page 40 of Vol. XI. (March, 1905), we illustrated and described this class as originally introduced in 1903, but the second series were constructed with coupled wheels of increased diameter, 5-ft. 7-in., in place of the earlier 5-ft. 3-in., with a view to obtaining increased speed. At the same time, the centre-line of the boiler has been raised to 8-ft. 8½-in., 2-in. higher than in the earlier engines, and those engines fitted with the superheater have the chimney placed somewhat in advance of the centre-line of the smokebox. The leading dimensions of the locomotives of this type provided with 5-ft. 7-in. wheels and the Schmidt superheater are as follows, and may be compared with those already given in the previous notice already referred to, which apply to the other series :—Cylinders 20½-in. in diameter by 26-in. stroke; maximum internal diameter of boiler 5-ft. 3-in.; working pressure 200-lbs. per sq. in.; 168 ordinary flue tubes 13-ft. 6¾-in. long and 2-in. in diameter; and 21 tubes of 5-in. diameter containing the superheater tubes; heating surface: firebox 160.4 sq. ft.; tubes 1,399.3 sq. ft.; total 1,559.7 sq. ft.; grate area 30.6 sq. ft.; superheater surface 356 sq. ft.; weight of engine in working order 73.3 tons, of which 53.8 tons rest on the coupled wheels. It should be noted that both series of engines are approximately of the same weight, despite the difference in wheel diameter and the introduction of the superheater. This result is obtained by the extensive use of cast steel fittings in the later series.

There are now 42 locomotives of this type in service. Nos. 3201-3, which were built by the Société Cockerill in 1903, were used for exhaustive experiments with various forms of superheater, and the Schmidt system having proved the most successful, Nos. 3203, 3207-9 and 3222 of the first series, and Nos. 3233-42 of the later set, have been fitted with that appliance. Nos. 3201-22, all of which have wheels 5-ft. 3-in. in diameter, have the earlier type of tender, containing 4,625 gallons of water and 6 tons of coal. Nos. 3223-42, with 5-ft. 7-in. wheels, are provided with the new standard tender, which is rather shorter, and contains only 4,408 gallons. The illustration, however, shows the engine, though of the later type having 5-ft. 7-in. wheels, with the older and larger tender. All recently-built engines on the Belgian State Rys. are now provided with the new standard tender, except the six-coupled goods engines of Type 32, illustrated on page 7 preceding.

The 42 engines of Type 35 perform excellent service. They were originally intended to work express goods traffic, but are now generally employed in hauling heavy passenger trains having frequent stops. The series Nos. 3223-42, which were built by the Sociétés de Boussu, L'Energie of Marcinelle, and La Meuse of Liege, are chiefly used for heavy express passenger traffic.

In consequence of the marked success attending the introduction of four-cylinder compound locomotives on the de Glehn du Bousquet system, on other railways on the Continent and elsewhere, the Belgian State Rys. decided to make a trial

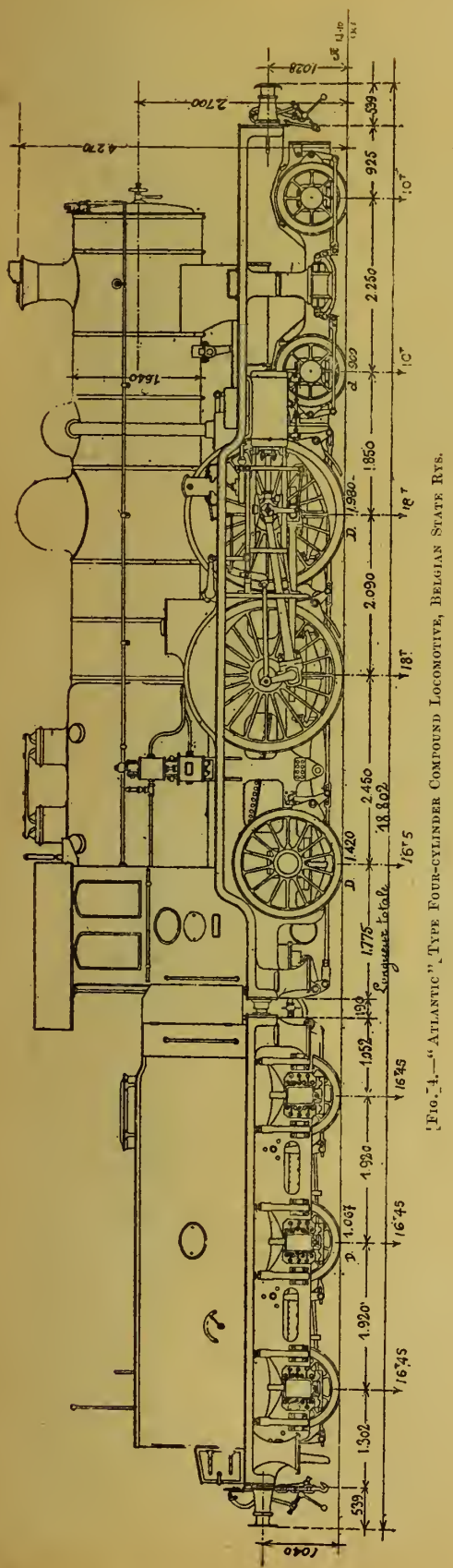


Fig. 4.—"Atlantic" Type Four-cylinder Compound Locomotive, Belgian State Rys.

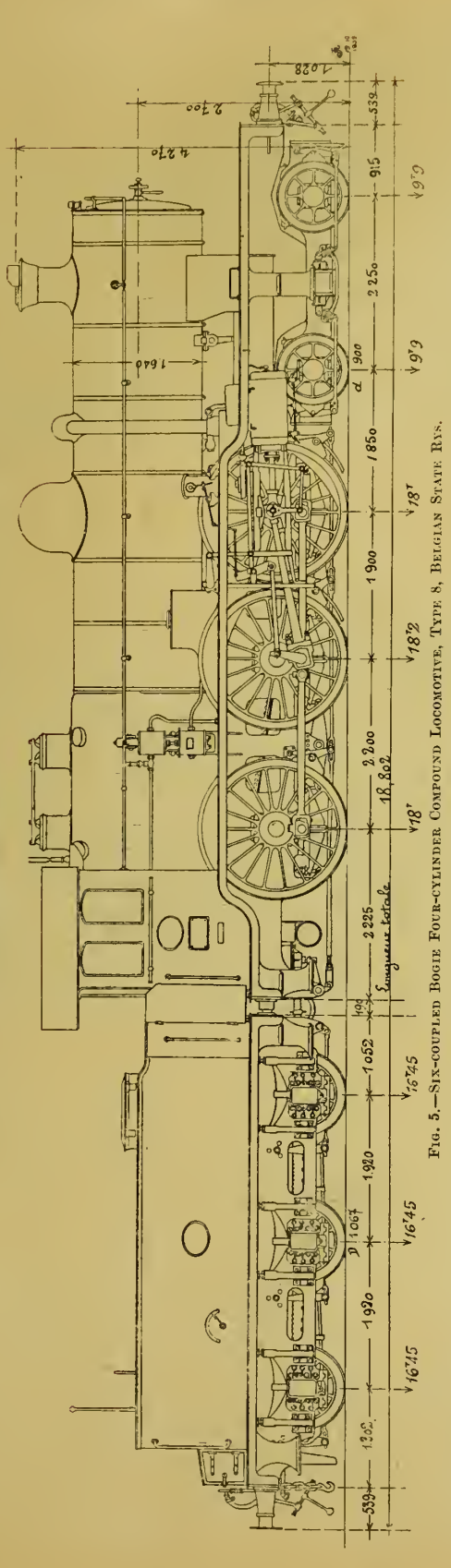


Fig. 5.—Six-coupled Bogie Four-cylinder Compound Locomotive, Type 8, Belgian State Rys.

of similar locomotives on its own lines, and accordingly introduced two types. The first of these, which consisted of two engines only, was the "Atlantic" type shown in Fig. 4, and in general dimensions these two engines, Nos. 3311 and 3312, which were built by the Société Cockerill, are very similar to Nos. 3001-8 of the Paris-Orleans, No. 2512 of the Pennsylvania, and Nos. 103-4 of the Great Western Rys. The boiler is of ample dimensions, containing 139 Serve tubes 14-ft. $5\frac{1}{4}$-in. long and $2\frac{3}{4}$-in. in diameter, the maximum internal diameter of the barrel being 4-ft. $10\frac{3}{4}$-in.; the heating surface is: firebox 174 sq. ft., tubes 2,403 sq. ft., total 2,577 sq. ft.; and the grate area is 33.15 sq. ft.; the boiler pressure is 225-lbs. per sq. in. The high and low pressure cylinders have diameters of $14\frac{3}{16}$-in. and $23\frac{5}{8}$-in. respectively with a stroke of $25\frac{3}{16}$-in. and the coupled driving wheels have diameters of 6-ft. 6-in., which is standard for express locomotives on the Belgian State Rys. The bogie is slightly different in construction to the Paris-Orleans model having a spherical pivot and the side-play being controlled by means of swing-links instead of springs. The bogie wheels are 2-ft. $11\frac{1}{2}$-in. in diameter, and the trailing wheels are 4-ft. 8-in. The reversing gear, which as in all new locomotives on the State Rys., is placed on the left side of the foot-

plate, is of the Flamme-Rongy type, permitting of separate or simultaneous movements of the two reversing shafts by means of steam gear. The cab, chimney, safety-valves and other fittings are of the Belgian State standard designs. Among other details are the Westinghouse quick-acting brake operating on all wheels, Friedmann injectors placed on the firebox front, Gresham-Craven compressed air sanding apparatus, and steam heating for the train; Bourdon mechanical "telescopompes" are employed for lubricating the cylinders. These engines, which are provided with the new standard tender, weigh 71 tons 12 cwt. in working order, of which about 35½ tons are available for adhesion. No. 3311 has been in service for upwards of six months on express trains between Brussels and Ostend, while No. 3312 was exhibited at the Liège Exposition. Luxembourg line, and frequently haul 400 ton trains on the Paris-Brussels service, between Brussels and Quevy, and between Brussels and Antwerp on Bourse days.

(*To be continued.*)

NEW TANK LOCOMOTIVES, HIGHLAND RAILWAY.

FOR the working of short branches, and the several light railways which have of late years been opened in the North of Scotland, Mr. Peter Drummond, locomotive superintendent of the Highland Railway, has designed an exceedingly neat class of tank locomotives illustrated herewith. These engines, several of which are to be built at Lochgorm works, have the following

Photo by FOUR-COUPLED BOGIE TANK LOCOMOTIVE No. 25 "STRATHPEFFER," HIGHLAND RY. *S. A. Forbes.*

The other type of de Glehn compound introduced on the lines of the State Rys. is known as Type 8, and is shown in the accompanying Fig. 5. In respect to cylinders, boilers, mechanism and details, these engines are identical with the "Atlantic" type already described, but they have six-coupled wheels 5-ft. 11-in. in diameter, and their weight in working order is 72 tons 17 cwt., of which about 53¾ tons rest on the coupled wheels. There are now 42 locomotives of this class in service, Nos. 3313-3354, built by the Société Metallurgique of Tubize, the Société St. Lèonard of Liège, the Société des Couillet and Haine, St. Pierre, and the Société Franco-Belge of La Croyère. They work main line express trains averaging about 300 tons, with frequent stops and a maximum speed of about 60 miles per hour between Brussels and Arloy on the

dimensions: cylinders, 14-in. by 20-in.; diameter of coupled wheels, 4-ft. 6-in. and of bogie wheels, 2-ft. 6-in.; boiler barrel, 8-ft. 2-in. long and 3-ft. 10¼-in. in diameter; heating surface, tubes 652 sq. ft., firebox 67.5 sq. ft., total 719.5 sq. ft.; grate area, 13 sq. ft.; working pressure 150 lbs. per sq. in. Capacity of tank 900 gallons, and of bunker 26 cwt. of coal; weight in working order 35 tons. For modern engines the above dimensions seem very small, but the work for which they are designed is of a light nature. Two are at present at work, No. 25 "Strathpeffer," and No. 40 "Gordon Lennox." They are painted the standard Highland dark green, without lining of any description, with the name in gold letters on the tank sides. The number plate, which is of cast brass, is a new pattern for the Highland Railway.

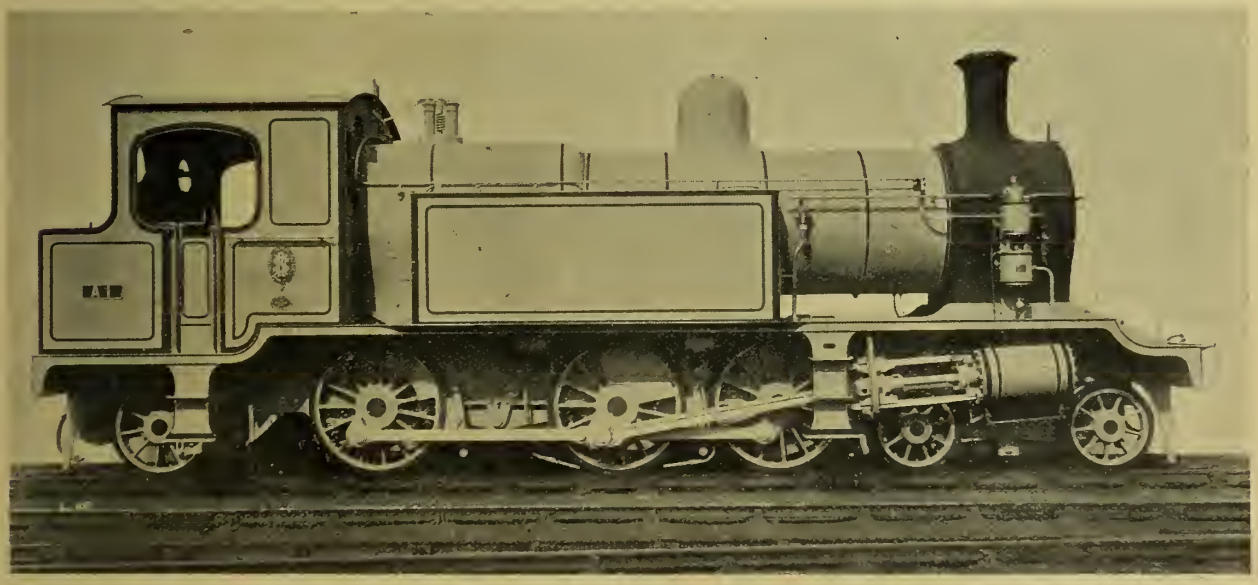
Four-coupled Bogie Passenger Locomotive, Shanghai-Nanking Ry.

LOCOMOTIVES FOR THE SHANGHAI-NANKING RY.

By the courtesy of the builders and of the consulting engineers to the railway, Messrs. Sir J. Wolfe Barry, Morrison & Barry, of 7, The Sanctuary, Westminster, S.W., we are able to illustrate herewith two new types of locomotives recently constructed for the above railway, which is of 4-ft. 8½-in. gauge.

The 4-4-0 express passenger locomotive which was built by Messrs. Robert Stephenson & Co., Ltd., has cylinders 18-in. in diameter by 26-in. stroke, and coupled driving wheels 6-ft. 7-in. in diameter; the total wheelbase of the engine is 25-ft. 2-in., of which 8-ft. 3-in. separates the coupled wheel centres; the total heating surface is 1,630 sq. ft., of which 162.61 sq. ft. are provided by the firebox, and 1,467.39 sq. ft. by the tubes; the grate area is 28 sq. ft., and the boiler carries a pressure of 180 lbs. per sq. in. The tender of this engine is exactly similar to that supplied with the goods locomotive built by the North British Locomotive Co., Ltd., described and illustrated in our issue of August 15th last.

The tank locomotive, as can be seen, is of the 4-6-2 type, and was built by the North British Locomotive Co., Ltd. The cylinders and boiler are exactly of the same dimensions as those of the passenger engine. The wheels have the following diameters: bogie 3-ft., coupled driving wheels 4-ft. 9-in., trailing radial wheels 3-ft. 6-in.; the rigid wheelbase is 13-ft. 9-in., and the total is 32-ft. 5-in. In working



Six-coupled Bogie Radial Tank Locomotive, Shanghai-Nanking Ry.

order this engine weighs 74 tons 7 cwt., having capacity for 1,120 gallons of water and $1\frac{3}{4}$ tons of coal; the weight empty is 61 tons 19 cwt.

It should be noted that the cylinders and boilers of these two locomotives are of the same dimensions as those of the six-coupled bogie goods locomotive already referred to, and that all fittings are arranged so as to be, as far as possible, interchangeable in each class.

A BROAD GAUGE BOILER EXPLOSION.

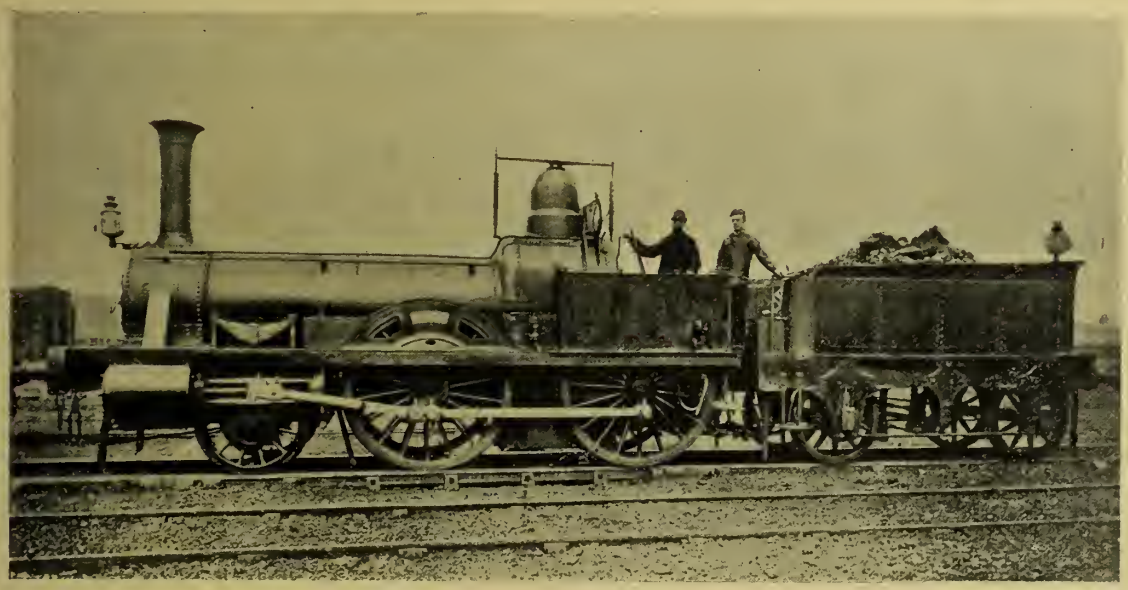
THIS explosion, attended with lamentable loss of life, of a locomotive boiler which had been neither thoroughly examined inside nor tested for strength for upwards of seven years, occurred at the Paddington engine shed of the Great Western Ry. on Saturday, November 8, 1862. The engine was one of the famous old Gooch broad gauge 8-feet singles, built at Swindon in June 1850, and named "Perseus." Train time was near at hand, about six o'clock in the morning, when the boiler gave way on the lower side with terrific violence. A large piece of the barrel, weighing 15 cwt., was blown through the roof across the main line into the carriage sidings 100 yards, striking and destroying two trucks in its way. The chimney also went up in the air, but fell in the shed not far from its point of departure. Nearly all the slates were sent flying from the roof for a length of over 150 ft., whilst for as least as much further they were shifted and the windows broken. The engine nearest "Perseus" was also badly damaged, a cleaner named Charles Thompson at work upon her being instantly killed. Another cleaner, James Eldridge, and a fire lighter named James Wilson were also killed, one of them being found under the engine with his clothes and limbs torn to pieces.

SINGLE-DRIVER BROAD-GAUGE LOCOMOTIVE "PERSEUS," G.W.R., AFTER EXPLOSION OF BOILER.

The engine had been standing just inside the door, ready to go out. When the smoke, steam and dust cleared away it was found to have jumped backwards some feet, driving the tender partly through the great wooden gate. It had apparently also leaped upwards to some extent, falling with the near side leading and driving wheels in the pit. The photograph reproduced, for which we are indebted to the courtesy of Mr. F. S. Hennell, of the locomotive department, Metropolitan District Ry., Lillie Bridge, S.W., shows plainly the tremendous violence of the explosion. The ancient method of enclosing the cylinders completely in the smokebox and attaching the latter to the frames by angle iron stays is well exhibited. Some accounts state that the explosion occurred about 5.40 or 5.45 a.m., and that the engine was going to take out the 6 o'clock passenger train; others that it happened about 6.15, and that she was intended to pilot a goods train. It seems unlikely that an express engine of this type would be used for such a purpose. Perhaps some Great Western reader who remembers that period can say if such a practice obtained.

The boilers of these engines were made of best Yorkshire iron plates, $\frac{3}{8}$-in. thick and worked at 120 lbs. In this case the boiler had been pressed at 115 lbs. the day before and then washed out. There was no suggestion of any abnormal pressure having been used. On examination, the bottom plates were found to be wasted to a thickness of only from $\frac{1}{10}$ to $\frac{1}{8}$ in. thickness; in fact it was a wonder the boiler had held out so long. It had last been inspected in June, 1861, when slight corrosion of the skin was observed, but the boiler, which was the original one of 1850, had apparently not been really overhauled since 1855. Since then it had run 175,000 miles, or about 23,330 miles per annum. It seems to have been assumed, because there were many engines on the line with boilers much more than 12 years old, that the boiler of "Perseus" was bound to be all right; in fact a boiler-maker from Swindon stated that there was no regular system or fixed period for examination or testing. At the final

enquiry, November 20th, 1862, when a verdict of accidental death was returned, Captain Tylor, R.E., Government Inspector of Railways, considered that to run an engine seven years without testing the boiler was most dangerous and that three years was the utmost length of time it was judicious to go without obtaining certain information as to the continued strength of the boiler. He advocated the use of hydraulic pressure of 180 lbs., which Mr. (afterwards Sir) Daniel Gooch, the locomotive superintendent, considered to be more dangerous than not testing at all, a statement which was somewhat strongly questioned by the technical press. The shed where the accident happened was the present one at Westbourne Park, a name which did not then exist, in fact there was no station between Paddington and Ealing. "Perseus" was rebuilt and ran till December, 1880, when it was condemned and scrapped, after running a total distance of 722,458 miles.



Four Wheels Coupled Passenger Locomotive, Lancashire & Yorkshire Ry.

OLD PASSENGER ENGINES, LANCASHIRE & YORKSHIRE RY.

We illustrate one of a class of four-wheels coupled locomotives which performed the greater part of the passenger service on the L.&Y.R. between 1847 and 1880. There were 82 of these engines, numbered from 37 to 118, all of which were originally built as "single" engines to the designs of Sir J. Hawkshaw, consulting engineer to the company. As originally constructed they had 5-ft. 9-in. single driving wheels, with cylinders 15-in. in diameter by 20-in. stroke, the total wheelbase being 13-ft. 2-in., and the weight 24 tons 3 cwt. of which the drivers carried 12 tons 8 cwt. It should be mentioned that the engines built by Messrs. Bury, Curtis & Kennedy had 5-ft. 10-in. wheels, and were the last engines constructed, as far as we know, by this once celebrated firm, whose works' numbers ran up to about 411, which was borne by engine 50 built in 1849. In the late sixties nearly all these engines were converted into coupled engines as shown in the illustration, and at the same time many of them were rebuilt with new boilers and 15½-in. cylinders. The original boilers, of which several were in service until 1880, had polished copper domes placed on raised fireboxes. The new boilers supplied between 1868 and 1872 were domeless, with flush fireboxes. The old L. & Y. engines had their numbers on the front buffer beam in brass figures, with painted numbers on the back of the tender, and were painted dark green with black and white lines. Nos. 37 to 39 were built by the Manchester and Leeds Ry. in December, 1846 and January, 1847, at Miles Platting Works, Manchester, and the others were constructed as follows: L.&Y.R. 1847, Nos. 62, 63, 76 to 82, 84; 1848, Nos. 85 to 87, 89, 92, 94, 95, 98 to 100, 103, 104.; 1849, Nos. 73, 74, 113, 116. W. Fairbairn & Sons, 1848, 105 to 108, 111; 1849, 41 to 44, 48, 53, 56, 58 to 61, 64, 71, 75, 88, 96, 117; all the others were by Bury, Curtis & Kennedy in 1849.

Two of these engines, Nos. 85 and 86, were exchanged for two engines on the East Lancashire Division, and became Nos. 665 "Giraffe" and 666 "Antelope." One of the last, if not actually the last to be broken up was No. 93, which was rebuilt in 1872 and ran until 1882. Owing to a renumbering of the L. & Y. engines in 1850, the above engines were not built in numerical order.

THE ARRANGEMENT OF LOCOMOTIVE SHOPS.

As with other manufactures, so with that of locomotives, the locality chosen and the arrangement of the different buildings comprised in the works will necessarily affect the economical production of the output, and therefore the value of careful consideration of the details of any scheme cannot be over-estimated when new shops are in contemplation or additions to existing works are about to be undertaken.

With new establishments, suitable provision for development and extension is of more than ordinary consequence, and although an increased outlay of capital may be called for, the timely thought for the future may result in very considerable reduction in annual expenditure later.

In deciding the locality best suited for such a factory, its size, the proximity of raw material and the labour market of the neighbourhood naturally hold controlling influences. Generally the site would appear to be the best chosen in the vicinity of a fair-sized manufacturing town, as near to the coal and iron headquarters as possible. It should be either adjacent to a main line of railway or in such a position as to be easily connected by a short branch, the lower price of land probably favoring the latter. The ground should be level and have a subsoil of gravel and clay, whilst a good water supply is imperative.

The labour question will always be a difficult one, but there is no reason why, assuming the opportunity exists, every effort should not be made to make the shops as accessible as possible to that portion of the community from which the workers will be drawn, and all modern conveniences installed for the comfort of the operatives will doubtless be appreciated. A long weary walk to work over a badly-kept road is not conducive to energy or discipline. The possibility of employment for wives and families also should not be lost sight of, a contented staff being one of the greatest influences toward success.

After the selection of the site for the new shops comes the laying out of area to secure the best results. The arrangement of the shops should as far as possible provide for the arrival of the raw material at one end and the dispatch of the finished locomotive from the other, with a minimum of transport and handling; in other words, the construction of the machine should be co-incident with a passage through the shops.

The type of shop, whether of one or more floors with the means of lighting, heating and ventilating, must be decided upon. The class of work which is to be dealt with in the various shops will to a large extent dictate the number of floors permissible. Where large machinery is to be employed a ground floor alone is convenient, but a shop producing small articles may have a gallery or be composed of more than one storey. The latter arrangement saves ground, and may be found convenient provided a good system of hoists and staircases is installed. The shops should be capacious and of good height, conditions which will facilitate good distribution of natural and artificial light, heating and ventilation.

Provision should be made for the shops, both relatively and individually, to occupy such positions and be so constructed that any extensions required can be carried out with as little disorganisation and at as small a cost as possible. With this in view it is often wise to substitute corrugated iron for masonry for the ends of shops.

On the type of roof employed largely depends the satisfactory lighting of the shop. Abundant light, with the absence of any glare or heavy shadows, is essential. The central monitor roof with side skylights is largely used, and besides distributing the light well allows plenty of head room where overhead cranes are used. The "saw tooth" is another satisfactory type of roof, but in adopting it care must be exercised, especially in a paint shop, that the light is projected in the same direction as the work stands, otherwise it will be found that one side of the work—say a locomotive—is in a very poor light. Whilst on the subject of light the method of artificial illumination may be briefly considered. In the majority of modern shops electric arc lamps are used. These should be hung high up so as to diffuse their light, and some convenient arrangement should be fixed for lowering them when requiring attention. It is questionable, however, whether well placed intensified incandescent gas jets are not more satisfactory, especially when the cost per candle power is taken into consideration. In any case gas may be laid on to the shops and a liberal supply of jets be provided in those where machinery for small work is performed, as gas jets are preferable to incandescent electric lamps for such work. Portable electric hand lamps prove useful in many cases, and suitable connections should be provided for them.

The heating of shops in cold weather is important. A cold shop hinders more than urges men to work hard, and consequently to provide no heating arrangements is false economy. A temperature of about 55 degrees F. is desirable, and this can be attained either by a supply of hot air, hot water pipes or steam pipes. The last method is often the most convenient, and can be made to work satisfactorily. Ventilation should be carried out by a plentiful supply of openings

New Pullman Car Train with "Atlantic" Type Express Locomotive, London, Brighton & South Coast Ry.

in the roof and side lights, and in some cases, such as a brass foundry, by fans. Sanitary arrangements must receive attention, and be dealt with according to circumstances.

(*To be concluded.*)

LOCOMOTIVE INJECTOR FAULTS AND FAILURES

Of all the different designs of injectors now in use, each particular type has its own peculiar characteristics, neglect to reckon with which may occasion serious trouble. With combination face-plate injectors, for example, it is most important that the injector should be properly fitted to the face-plate and a good joint be made between the live steam pipe from the dome and the internal delivery pipe; if there is leakage, trouble will ensue in getting the injector to start.

Another source of trouble is the leaking of union nut joints, which allows air to be drawn into the suction-pipe. One of the most common faults with some injectors is due to the steam valves and top clacks blowing through owing to defective seatings; the water in the feed pipe becomes heated and the injector will not lift it on account of a reduced vacuum in the combining cone, the result being a great waste at the overflow.

Over-twist of the feed-cock rods and handle is another reason for failure, as it prevents the feed-plug from opening properly, and the injector will then keep flying off on account of not getting sufficient water.

Another cause of unsatisfactory working is the impurity of the water supply, which leads to scale being deposited on the cones, with a consequent wastage at the overflow. Great care should be exercised in cleaning injector cones that the scale only is removed, as should they become enlarged in the process they will get out of proportion and cease to act properly.

Serious failure can result from the top-clack refusing to return to its seat; this is generally due to the dirty condition of the water in the tanks, and care should be taken to remedy this, as particles of rust, pieces of wood and waste, etc., if allowed to collect may work through the sieve and pass to the clack and jam it.

On those lines using the water pick-up another drawback is introduced by the tendency for fallen leaves and other matter to lodge in the water troughs; they are picked up by the scoop and deposited in the tender tank with the water, where they gradually accumulate about the outlet pipe and choke up the sieve; the injector then fails owing to a deficient water supply.

Contracts.—The Empire Roller Bearings Co., of Westminster, has secured an order for 320 axle-boxes to be fitted to 80 heavy goods wagons for Calcutta.

REVIEWS.

"The Engineers' Pocket Dictionary." French—English. By M. Lvoff. *London:* Percival Marshall & Co., 26-29, Poppins' Court, Fleet Street, E.C. Price 1s. 6d.

This is one of the most useful little desk companions we have received, and should prove of great value to engineers requiring its help. Arranged in a convenient form with reference letters at the margin, almost any French technical term can be translated immediately. We look forward to an English—French dictionary from the same author.

"Swingle's Modern Locomotive Engineering Handybook." *Chicago:* Frederick J. Drake & Co. *London:* The Locomotive Publishing Co., Ltd. Price 12s. 6d.

A useful handbook on the modern locomotive, consisting of 626 pages of reading matter and illustrations, besides numerous folded diagrams and charts. The primary features of the operation of the locomotive are first treated upon, and the discussion gradually progresses through the various stages necessary for the education of a young engineer. At the end of the book a number of questions are given, which the student should be able to answer after reading it. Although almost strictly American, we recommend this work to those desirous of following the construction of the up-to-date locomotive.

"A Tour over the Pioneer Railway of Canada." By John Wardle. *London:* The Railway Publishing Co., Ltd. 6d. net.

This is quite a sumptuous little book, printed on art paper and illustrated by many excellent photo. reproductions, giving a history of the Grand Trunk Railway from its incorporation in 1852 up to the present day, but dealing more especially with its great development during the last decade. There is an excellent large coloured map showing the present extent of the G.T.R. and the proposed route of the G.T. Pacific Ry., and the accompanying letterpress describes the large centres of population and commerce served by the system, with illustrations. The engineering feats accomplished in building the line are also described and illustrated, including the St. Clair Tunnel, the bridge over the Niagara Gorge, the "International" bridge at Fort Erie, Buffalo, the Victoria Jubilee bridge over the St. Lawrence at Montreal, etc. Separate chapters refer to Ontario as a summer province and a home for the settler, and these are amply illustrated by evidence of the prosperity of the Dominion, and that province in particular.

Messrs. George Newnes, Ltd., have forwarded Part XII. of "A Technological and Scientific Dictionary." This ranges in subjects from "Spring Balance" to "Tides," so that the whole work bids fair to conclude in the 14 parts originally planned. It will form a most convenient and useful volume for reference purposes when completed.

We have received "Practical Dynamo and Motor Construction," No. 5 of Messrs. Percival Marshall & Co.'s Practical Manuals, price 1s.

We have received from Messrs. Davis & Lloyd, the London representatives of the American Locomotive Co., New York, U.S.A., a further series of their little hand-books, similar to the "Records of Recent Construction," to which frequent reference has been made in these columns. This latest series comprises "Louisiana Purchase Exposition," a record of the various notable locomotives exhibited in 1904 by the company; two other booklets deal exhaustively with separate exhibits at St. Louis, namely, the "Cole Four-cylinder Compound," built for the New York Central and Hudson River RR., and others since supplied to the Erie and Pennsylvania Railroads, and the huge "Mallet Articulated Compound," built for the B. & O. RR. (this was illustrated in our issue of October, 1904). A fourth book deals exclusively with "Walschaert Valve Gear," and is copiously illustrated with locomotives so fitted and with detail drawings of the mechanism. One booklet is devoted to sets of most valuable and instructive tables, giving figures on "Train Resistance and Power of Locomotives," a compendium of matter that all locomotive engineers should file for reference. The last book of the present series deals with the "Atlantic Steam Shovel," a steam navvy built by the company for the Atlantic Equipment Co., of 111, Broadway, New York.

Consett Iron Company, Limited, Consett. A booklet advertising the specialities manufactured by this well known firm. Useful tables are included.

CORRESPONDENCE.

Steam Locomotives of the Metropolitan District Ry.

To the Editor of the "Locomotive Magazine."

Dear Sir,—With reference to the dimensions given near the bottom of the first column of page 4 of your issue of January 15th, the outside dimensions of the side tanks were as follows:—

Nos. 1-24—15-ft. 6-in. by 3-ft. $7\frac{3}{4}$-in. by 2-ft. $0\frac{1}{2}$-in.
,, 25-54—15-ft. 6-in. by 3-ft. $7\frac{3}{4}$-in. by 2-ft. 2-in.

The coal bunkers of Nos, 25-54 are also wider in proportion.—Yours truly, Frank S. Hennell.
Kensington, W.

The Locomotive Magazine.

No. 163. —:— **March 15th, 1906.**

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THE LOCOMOTIVE MAGAZINE.

Vol. XII. APRIL 14th, 1906. No. 164.

RAILWAY NOTES

GREAT WESTERN RY.—The latest engines of the No. 3111 class, large 2-6-2 double end tanks, turned out at Swindon are Nos. 3138-3148. This type was illustrated in our issue for August, 1905. Ten of the 4-4-2 class are in course of construction, No. 2221, which is here illustrated, having been already completed.

No. 97, the first of the "Consolidations," has recently been modified so as to be similar to the No. 2801 class.

The six-coupled shunting tank engine No. 2016 has recently been provided with a continuous handrail and footboard along the whole length of the engine, thereby enabling the use of a "shunting tender" to be dispensed with.

One side of the motion of the old broad gauge veteran "Lord of the Isles" has been presented to the Swindon Technical School, and has been set up in one of the class rooms.

The new engine sheds on Old Oak Common, referred to in our issue of August, last year, were occupied on March 17th, and the old sheds at Westbourne Park are now being demolished. It will be remembered that we illustrated and described them in our issue of May 30th, 1903.

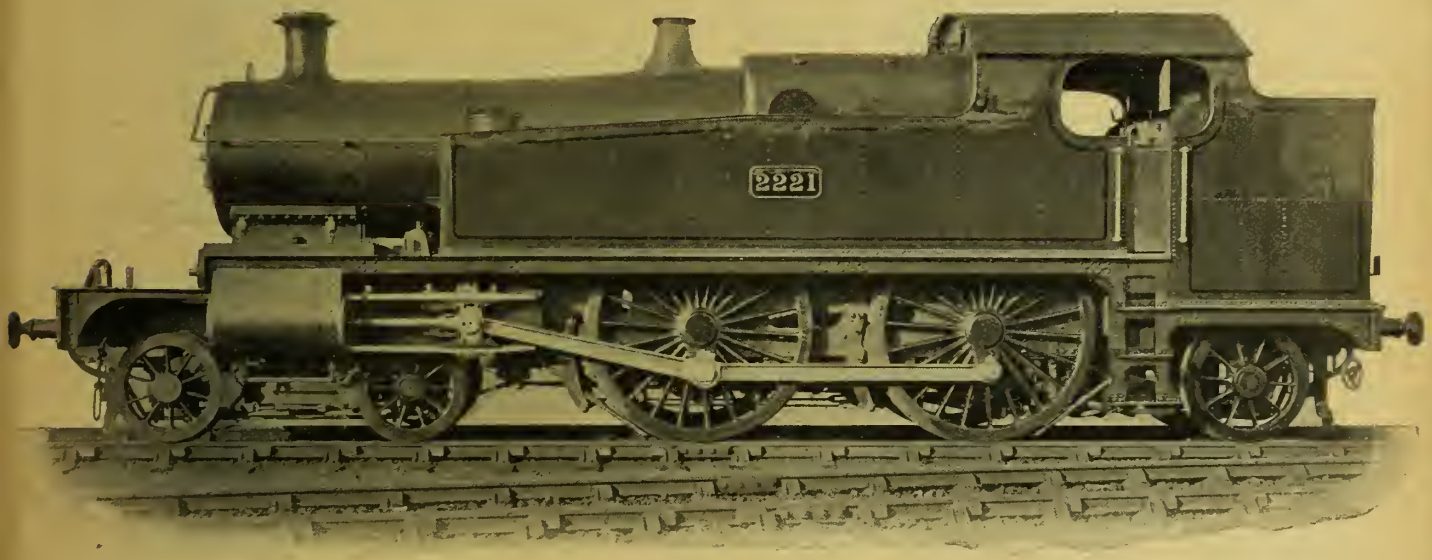
Messrs. Kerr, Stuart & Co., Ltd., have delivered nine of the twelve motor coaches they are building for the G.W.R., and the Gloucester Railway Carriage & Wagon Co., Ltd., have delivered three out of a total of eight.

LONDON & NORTH WESTERN RY.—The latest engines of the "Experiment" class are Nos 1669 "City of Glasgow," 165 "City of Lichfield," 828 "City of Liverpool," 978 "City of London, 1405 "City of Manchester," and 1575 "City of Paris." This completes an order for ten.

Following are the latest of the "Precursor" type: Nos. 723 "Coptic," 837 "Friar," 1312 "Ionic," 1387 "Lang Meg" and 1642 "Lapwing."

An entirely new type of passenger tank engine is contemplated, having "Precursor" dimensions, but with 6-ft. wheels. The first is expected in service during the current month.

Nos. 1038, 1223 and 1884 are the latest four-cylinder compound eight-coupled mineral engines to be converted into "Consolidations," as illustrated in our issue of March, 1905.



By courtesy of TEN-WHEEL 4-4-2 TANK LOCOMOTIVE No. 2221, GREAT WESTERN RY. *Gt. Western Ry. Magazine.*

The following 4-ft. 3-in. tender mineral engines of Mr. Webb's design have recently been converted to saddle tanks: Nos. 1348, 2071, 2079 and 2101.

Among recent withdrawals from service are the following: Nos. 165 "Star," 565 "Napoleon," and 723 "Clive" (7-ft. 6-in. singles); 1311 "Celtic" and 1312 "Gaelic" (7-ft. compounds); 526 "Scottish Chief" ("Greater Britain" class); 893, 878, 1074, 1357 and 2513 (4-ft. 6-in. double end tanks); and 1387, 1405, 1575 and 1642 (special Dx goods). A correspondent informs us that an old Dx goods engine is now working on the Malines-Terneuzen Railway in the Netherlands.

MIDLAND RY.—The accompanying illustration shows an interesting adaptation of old stock to the growing needs for a rail motor coach service on branch lines. It represents the motor train now working on the Melbourne, Ripley and Wirksworth branch of the above railway, and covering about 100 miles per day. The engine, No. 10, is one of the bogie tank locomotives built some years ago for the Yarmouth & North Norfolk (now Mid. & G. N. Jt.) Ry. by Messrs. Hudswell, Clarke & Co., Ltd., and is painted the original yellow colour, with a brass steam dome, though some Midland details have since been added. The coach is equally interesting, being an old Pullman car fitted with side seats. In order to be able to work the train in either direction a double wire cord runs through the car to the back end, which is connected to the regulator handle. There are other cords for the whistle and the vacuum brake, and a novelty consists in the introduction of a gong and dial similar to those used on shipboard, to allow of communication between driver and fireman when running coach first. Another engine, No. 40, has been similarly adapted.

Photo by] BOGIE TANK LOCOMOTIVE NO. 10, MID. & G. N. JT. RY., AND PULLMAN CAR, NOW WORKING A LOCAL SERVICE, MIDLAND RY. [*J. Watterston.*

Ten new compound passenger locomotives similar to No. 1000 are to be built, and ten goods engines of No. 240 class with large boilers are now being built at Derby, Nos. 275-279 being already at work. Nos. 156 and 2200, 7-ft. coupled engines, have been rebuilt with new boilers similar to that of No. 2185, described in our last issue.

GREAT CENTRAL & GREAT WESTERN JOINT RY.—On the 24th ult., by the courtesy of Mr. Ernest Benedict, the secretary of the Tramways and Light Railways Association, we had the pleasure of accompanying members of that body on their visit to the new railway constructed through Middlesex and Buckinghamshire, and joining the Great Central and Great Western main lines. The trip comprised a journey from Marylebone to Grendon Underwood, returning *via* Aylesbury to Neasden, where a stay was made for inspection of the power station of the Metropolitan Ry.

The construction of this new line was fully described and illustrated in our issues of November 7th, 14th and 21st, 1903, and other references to its progress have been made at frequent intervals since then. It was opened for goods traffic between Neasden Junction and Grendon Underwood on November 20th last year, but the inauguration of the line for passenger traffic did not take place until the 2nd of the present month.

Thirty-six locomotives and one rail motor coach are now stationed at Neasden. No. 1 rail motor coach runs between Aylesbury and Verney Jn.

ALEXANDRA DOCKS AND RY.—Eight of the ten-wheeled six-coupled locomotives of the Mersey Ry., some with leading and trailing pony trucks, and others with trailing bogies, have been bought by this company. They have been overhauled at Newport, the condensing apparatus removed, and cabs added over the footplates. These engines are numbered 6 to 11 and 22 and 23.

METROPOLITAN RY.—Ten of the electric locomotives built at the Saltley works of the Metropolitan Amalgamated Carriage Co. are delivered and in service on the St. John's Wood extension line to Harrow.

BARSI LIGHT RY.—An extension of this railway, from Barsi to Tadwala, a distance of about 30 miles, is shortly to be opened for passenger and goods traffic, the new portion lying almost entirely in the dominions of the Nizam of Hyderabad. Other extensions are also contemplated in addition to that from Barsi Road to Pandharpar which is in hand, the consulting engineer of the railway, Mr. Calthrop, being now on a visit to India.

GREAT NORTHERN RY. (IRELAND).—The numbers and names of the latest four-coupled bogie passenger engines built by the North British Locomotive Co., Ltd., are Nos. 113 "Neptune," 114 "Theseus," and 157 "Orpheus." Two new four-coupled bogie express engines have also been delivered by Messrs. Beyer, Peacock & Co., Ltd., Nos. 106 "Tornado" and 107 "Cyclone." They are enlarged examples of the No. 70 class, and are intended to work the Derry mail trains. Two others, but with 5-ft. 6-in. wheels, are Nos. 104 "Avoca" and 105 "Foyle." Several of the small four-coupled bogie tanks of No. 1 class are about to be converted into motor coach engines.

LONDON & SOUTH WESTERN RY.—The new mixed traffic engines now in course of construction will bear Nos. 174-5, 407-414. New tank engines rapidly approaching completion at Nine Elms bear Nos. 56-60.

Three new rail motor coaches, with vestibule trailer cars, have been ordered for the Plymouth district. They are to be suppled with Stone's system of electric lighting.

NEW LOCOMOTIVES, DUBLIN, WICKLOW & WEXFORD RY.

THE illustration shows one of two new passenger locomotives recently built for service on this railway. They are numbered and named respectively, 67 "Rathmore" and 68 "Rathcoole," and were designed by Mr. R. Cronin, locomotive superintendent of the line, for working the "Limited" mail between Bray and Wexford, making the double run of 161 miles every day. Following are the leading dimensions: cylinders 18-in. in diameter by 26-in. stroke; diameter of bogie and coupled wheels, 3-ft. 3-in. and 6-ft. 1-in. respectively; rigid wheelbase 8-ft. 10-in.; total 21-ft. 7-in.; diameter of boiler barrel, outside, 4-ft. $6\frac{7}{8}$-in., length 10-ft. 3-in.; outside firebox 6-ft. by 4-ft. $5\frac{3}{4}$-in.; number of tubes 223, diameter outside $1\frac{3}{4}$-in.; heating surface: firebox 118.5 sq. ft., tubes 1074.7 sq. ft.; total 1193.2 sq. ft.; grate area 20 sq. ft.; boiler pressure 175 lbs. per sq. in.; weight of engine in working order 45 tons 3 cwt.; on coupled wheels 29 tons 18 cwt. 2 qrs. Tender: diameter of wheels 3-ft. $8\frac{1}{2}$-in.; wheelbase 12-ft.; capacity of tanks 2600 gallons; coal $3\frac{1}{2}$ tons; weight loaded 30 tons 8 cwt. 3 qrs. A double-end tank of the same dimensions as No. 8 "St. Brendan," but with a Belpaire firebox, is in course of construction at the Canal Street Works to replace No. 29, old single wheel well tank. No. 57, one of the smaller bogie passenger engines, is being supplied with a Belpaire boiler. A steam rail motor coach service is being contemplated between Westland Row and Kingstown, to compete with the electric trams.

FOUR-COUPLED BOGIE PASSENGER LOCOMOTIVE NO. 67 "RATHMORE," DUBLIN, WICKLOW & WEXFORD RY.

THE SCHULL & SKIBBEREEN TRAMWAY & LIGHT RAILWAY CO. have ordered from Messrs. Peckett & Sons, Bristol, a new four-wheels coupled bogie locomotive for their increasing traffic. It has all the latest improvements.

CORRESPONDENCE.

Recent Locomotives of the Belgian State Railways.

To the Editor of "The Locomotive Magazine."

Dear Sir,—With reference to the description of the above-mentioned in your last issue, page 46, in which you state that Bourdon mechanical telescopompes are employed for lubricating the cylinders, I beg to state that 28 engines of Type 8 are furnished with my mechanical oil pump.—Yours truly,

Vienna, March 20th, 1906. Alex. Friedmann.

A Broad Gauge Boiler Explosion.

To the Editor of "The Locomotive Magazine."

Sir,—I read with great interest your account in last issue of the explosion of the "Perseus," which I very well remember. I have some records of the inquest and Government inquiry—the latter was held by Capt. (now Sir Henry) Tyler. The names of those killed were John Elridge, James Wilson and Christopher Thomas, cleaners. The engineman was John Thompson, a celebrated character on the G.W.R., commonly called "Hell Fire Jack," and he said he drove the engine up the previous day from Swindon to London with a pressure of 150 lbs., but did not observe anything wrong with the boiler, and made a note in the report book as to some slight repairs to other parts. The engine was being got ready for a passenger train and not a pilot.

Mr. Gooch's theory about hydraulic testing is surely a thing of the past. Former explosions I remember were those of the "Steropes," at Bull's Bridge—driver Richard Denham slightly injured; 7-ft. single passenger engine "Actæon," at Gloucester—driver J. Brown; and the third a similar engine, "Leopard," at Bristol I think, but I have not the dates. Anyway, they were all in the "fifties," before I left Swindon in 1857. In the two latter instances no one was injured.—Yours faithfully, T. Houghton Wright.

March 23rd, 1906.

To the Editor of "The Locomotive Magazine."

Sir,—With regard to the explosion of the boiler of my friend "Perseus," the following may be of interest. It was stated at the inquest that the engine had taken on the previous day the 9.00 a.m. or 9.15 a.m. express train from Paddington to Bristol—I forget the exact time at which that train then started—and that she had worked that train at a pressure of 135 lbs. On the day of the explosion she was to have piloted the 6 a.m. passenger train out, and afterwards the 10 a.m. train to Swindon. The 6 a.m. was nearly always piloted out, both engines being Gooch's 8-ft. singles

In those days the engine of that particular link took a later train each day, finishing with the 8.10 p.m. mail train, as it was called—though by that time a special Post Office train ran at 9.00 p.m. I think, reaching home at 4.00 or 4.30 the next morning. They had the next day for the shed, and began work on the following morning with the 6 a.m.

The driver of the "Lightning" was to drive the "Perseus" at the time, and owing to his being a few minutes late in coming to his work on the eventful morning his life was saved. His name was Thompson and he had a great repute as a fast driver. His engine "Lightning" was under repair and "Perseus" supplied its place.

An enterprising photographer, whose place of business was close to the Royal Oak, was speedily on the spot and took a photograph of the wreck, possibly this being one you have reproduced. It is said that he had only printed a few copies, when an official of the railway company called and politely asked if he might see the negative. When it was placed in his hands he promptly smashed it. If this be true you are to be congratulated on obtaining one of the few copies.

It is said also that a tarpaulin was quickly thrown over the engine that she might be whisked away to Swindon without further risk of being photographed, but the coroner sternly ordered her to be brought back, which was accordingly done.

Some of the brass work of the "Perseus" fell in Westbourne Terrace North, a distance I should imagine of three-quarters of a mile from the wreck. Before the building of Westbourne Park Station, the locality was known as Mileage, and a long ticket-collecting platform used by most of the trains stood there. One of the afternoon trains was always drawn up by a Swindon engine, which was booked to leave Paddington so shortly again that the shunting engine from Paddington used to be sent out to take the train in from Mileage, in order that the train engine might be taken off and so have time to turn and refill with coal and water.

Forgive this gossip of the day; it may assist some day in the writing of history.—Yours faithfully,

March 19th, 1906. G. S. E.

To the Editor of "The Locomotive Magazine."

Dear Sir,—I return the above interesting notes, and am obliged by your letting me see them.

I should say that the statement that the engine had worked at 135 lbs. the day before the accident was a misprint for 115 lbs. I collated several newspaper accounts, and they all said 115: besides, it is very unlikely that a boiler 12 years old and built for 120 would be run at 135.

I have looked up *Bradshaw* for November, 1862, and find that the morning express to Bristol and the west left Paddington at 9.15.

No such train as the 10.00 to Swindon can be traced. It was mentioned in some of the newspapers, but I left out the statement specially, because *Bradshaw* did not support it.

The 9.00 p.m. special Post Office train, afterwards known as the "Limited Mail," was not then running, or if it was it took no passengers, as *Bradshaw* has not got it. The up mail was due in at 4.35.

The 6.00 a.m. was the third class, or "Parly," stopping at all stations beyond Didcot, and was the only third class train by which one could get down to the West in the day. This accounts for the piloting, as it was probably the heaviest and most profitable train of the lot.

The distance from the shed to Westbourne Terrace North, on the map, is half-a-mile *good* measurement.

The afternoon trains alluded to were probably the up express "Dutchman," due at 3.00 p.m., and the 3.30 down.—Yours faithfully, W. B. Paley.

March 26th, 1906. (Writer of the article.)

NORTH EASTERN LOCOMOTIVE RUNNING.

By the courtesy of Mr. Wilson Worsdell, the chief mechanical engineer of the N. E. Ry., the writer recently had the privilege of travelling upon the footplate of the locomotive hauling the express leaving Newcastle for the South at 10.30 a.m. This train runs through to York with one stop at Darlington, in 1 hr. 35 min. As the distance is 80 miles 48 chains, the average speed, excluding the stop, works out at about 54 miles per hour. In practice, however, to keep time this speed is considerably exceeded, especially after leaving Darlington.

On the occasion referred to, the train, which consisted of 12 vehicles, six of them carried on six-wheeled bogies and four on four-wheeled bogies, left Newcastle, Central, sharp on time, hauled by the "Atlantic" type (class "V") locomotive No. 784, and driven by William Johnson, of Gateshead. No difficulty was experienced in getting away on the curve in the station, and the train accelerated rapidly over the High Level Bridge. Gateshead yard was passed at reduced speed owing to the awkward turn on to a temporary deviation of the main line necessitated by the construction of a big skew bridge over the Dunston to Gateshead extension line. After a little down grade comes an almost continuous 10 mile ascent to Plawsworth, but splendid headway was made, especially on the very stiff incline leading to Relly Mill Junction beyond Durham; Darlington was reached punctually at 11.14, an excellent stop being made with the quick-acting air brakes. The engine had evidently a large margin of power and easily maintained the speed with the heavy train behind, although the rate of expansion was kept at a low figure.

Soon after clearing Darlington at 11.18, water was taken from the troughs between Danby Wiske and Northallerton, and then a test of 784's speed capabilities was taken. We ran at over 79 miles an hour, with apparently but little visible effort on the part of the locomotive, the needle of the gauge keeping steadily about the 200 lbs. pressure per sq. inch. To maintain this with the 2,500 sq. ft. of heating surface available, the fireman naturally had to work pretty hard, but he was an old hand and kept his fire clean and bright, whilst he managed to find time to call attention to interesting objects along the line. The comfort of the men is well looked after on these engines; indeed this remark applies to all North Eastern locomotives. On each side of the cab is a comfortable wooden seat with cushions. The driver, with his seat on the right hand side, has all the handles he requires to operate within easy reach; when running, however, he seldom sits down, but keeps on the alert, watching for the signals, the high-pitched long boiler being an obstacle when seated.

Durham coal, which is fairly soft, was burned

with but little smoke, the result being no doubt due to a well-arranged brick arch inside the fire-box, with proper admission of air through the fire.

Thirsk was passed at 11.41 and Alne 11.52. Just before the latter we came on the 6 mile section of the line—Pilmoor to Tollerton—which is equipped with the "Hall" automatic signals, and it was curious to notice the semaphores fly to the horizontal position immediately the engine came abreast of the posts. York race specials in front accounted for two slackenings as we got near that city; finally we were pulled up outside the station at 12.03, the 44 miles from Darlington having just occupied 45 minutes.

The engines of this class are effective and economical and perform their share of the heavy traffic of the line, without the drawback of "double heading." It yet remains to be seen whether more work can be got from them by the adoption of compounding, and Mr. Worsdell will shortly put the problem to practical test by having two four-cylinder compound locomotives of the "Atlantic" type at work for the summer traffic of 1906, as we announced in our Notes some time back. We might add that one modification is being made to engines already running, which will no doubt tend to economise fuel and save work for the firemen, and that is the adoption of exhaust steam injectors. Several engines have already been so fitted. We can say from observation, and it is confirmed by the officials of railways where injectors of this type have been adopted, that a considerable economy of fuel is effected. Of course the apparatus must be well looked after to secure such excellent results.

Another interesting run was made from Newcastle to Edinburgh and back, on the footplate of one of Mr. Worsdell's "R" class of four-coupled bogie express engines, No. 2026, driver C. Gill, of Gateshead.

The down journey was made on the 11.08 a.m. ex Newcastle, which is a continuation of the 8.50 a.m. train from Leeds. The train started from Newcastle 17 minutes behind time, with seven bogie coaches on, but quickly began to pick up over the first 35 miles, which is a fairly easy stretch. At Morpeth there is a sharp curve, and steam was shut off, and a slight application of the quick-acting air brake brought speed down. There are some very curved portions on this line, and it hardly seems credible that this is the same road over which railway races have been run. Water was taken from the troughs south of Belford station. At Alnmouth the line forms nearly a semi-circle, and here, to make things worse, the 3½ mile Longhoughton bank starts at 1 in 170. There was a tremendous head wind all the way, and as we neared the Border Bridge heavy seas could be seen breaking over the Tweedmouth breakwater, but No. 2026 managed to make up six minutes in the 66 miles run, and to do this we had averaged a mile a minute so far.

Slackening for Berwick station at 12.24 we were soon on the North British metals, and the difference was noticeable. On the N.E.R. the elastic roadbed, and it may be the packing of the sleepers, tend to reduce shocks, while on the N.B. the large size broken stone ballast appears to make the line more rigid; the rail joints too seem to make themselves apparent, and inclined one to think the engine was not well balanced, whereas previous experience had proved this to be perfect. The climb, at 1 in 190 in places, to Grant's House, was spoilt by slowing for relaying, but over the summit a spurt was made down the steep bank through Dunbar. Getting into Haddingtonshire, the mining subsidences which have caused so much trouble of late, brought us to dead slow at Seton crossing between Longniddry and Prestonpans. We soon got away again and steamed into Waverley 12 minutes behind time.

On the return run with the same engine on the 6.25 (6.27 booked time) ex Waverley, the heavy fish traffic had necessitated the running of a relief special just 15 minutes before our train time. Although this spoilt the run, it reduced the load to only 9 coaches, and whilst the road is heavier for an up train than a down, we made such good speed that when we reached the foot of the heavy 1 in 96 four mile bank at Cockburnspath, the signal for the section to Grant's House was against us. The driver seized the opportunity to tighten up his smokebox door, and when we got the "signal," made a splendid run uphill to the summit. We then bustled into Berwick, 16 miles in 15 minutes. After leaving the Border City we had several checks for signals; in fact we were following the fish train so close that we were only able to obtain a small quantity of water at Belford troughs, but we made the most of our chances and got through to Newcastle only five minutes behind schedule.

Roller Bearings.—In a discussion upon a paper read before the Scientific Society of the Technical College of Glasgow on "Forced lubrication" on the 17th of last month, it was stated that the roller bearings supplied by the Empire Roller Bearings Co. for Messrs. Nobel's explosive factory were giving the greatest satisfaction. One of the bearings was taken out and examined the day before the lecture and was found in perfect condition, and this after about ten months hard running. It was also stated that Messrs. Nobel's were working 19 cartridge-packing machines from their engine, but by the addition of these roller bearings they had increased this number to 46 machines with only an increase of 2 h.p., while their oil bill had been only one-tenth of what it previously was.

Six-coupled Bogie Locomotive for 2-ft. Gauge, Cape Government Rys.

NARROW GAUGE LOCOMOTIVE, CAPE GOVERNMENT RAILWAYS.

The accompanying photo-reproduction, for which we are indebted to the builders, Messrs. W. G. Bagnall, Ltd., of Stafford, illustrates one of several locomotives built for service on the 2-ft. gauge Kalabas Kraal-Hopefield section of the C. G. Rys., to designs issued by Messrs. Gregory & Eyles, Sir Douglas Fox & Partners, and Sir Charles Metcalfe, Bart.; they were constructed under the supervision of Messrs. Sir Douglas Fox & Partners.

These engines have the following leading dimensions: cylinders 11$\frac{3}{4}$-in. diameter by 16-in. stroke, cast in the form of stays to carry the front end of the boiler; diameter of bogie wheels 1-ft. 10-in., and of coupled wheels 2-ft. 9-in.; rigid wheelbase 6-ft. 6-in., total wheelbase of engine 10-ft., total length of engine over buffer beams 21-ft. 4$\frac{3}{4}$-in., bar frames 3-in. by 3-in., length of boiler barrel 10-ft. 4$\frac{13}{16}$-in., diameter 3-ft. 3-in., built of $\frac{7}{16}$ plates; number of tubes 68, diameter 2-in.; heating surface: firebox 40.47 sq. ft., tubes 380.86 sq. ft., total 421.33 sq. ft.; grate area 7.6 sq. ft.; two Crosby "pop" safety valves to blow off at 180 lbs. per sq. in.

The tenders are carried on two four-wheeled bogies and have a capacity for 1,500 gallons of water and 5 tons of coal; the tank is fitted with a water gauge, and is of the horse-shoe type. Both steam and hand brakes are provided.

Other dimensions are: height of boiler centre above rails 4-ft. 8$\frac{5}{16}$-in., height from rails to top of chimney 10-ft. 4$\frac{1}{4}$-in.; weight of engine 20 tons 5 cwt., of which 16 tons 15 cwt. is on the coupled wheels; weight of tender, 19 tons; total length of engine and tender over buffers, 44-ft. 5-in.

The cabs are provided with seats for driver and fireman, sight-feed lubricators, and vacuum and steam brake fittings; two 6 mm. Holden & Brooks' combination injectors are provided. The valves are above the cylinders and are actuated by rocking shafts and ordinary Stephenson valve gear. It might be mentioned that, as originally designed, the engines were to be provided with two-wheeled Bissel trucks, but were afterwards altered to have four-wheeled bogies, as shown. The centre pair of driving wheels are flangeless.

The Royal Visit to India.—The Royal train leaving Bhatundo for Lahore on November 28th, headed by two of the S. P. class passenger engines, North Western Ry. of India.

THE DUKE OF PORTLAND'S TRAMWAY.

THIS line, which according to the *National Almanac* of 1843, was the earliest public railway in Scotland, and which, as the Kilmarnock and Troon Railway, was acquired some few years ago by the Glasgow & South Western Railway, was situated in Ayrshire and extended from the Duke

BRANCH LINE RAIL AND CHAIR, AND MAIN LINE TRAM PLATE, KILMARNOCK & TROON RY.

of Portland's collieries at Kilmarnock, to Troon Harbour, a distance of 9½ miles, following for the most part the course of the present line of the G.& S.W.R. from Kilmarnock *via* Drybridge to Barassie Junction, on the main line to Ayr. The date of the Act authorising the line was 1808, and the opening ceremony took place in 1810. The engineer of the line was William Jessop, famous for his canal building, and the originator of edge rails suitable for flanged wheels, which he first introduced as far back as 1789, at Loughborough in Leicestershire. At the time of laying the tramway now under notice, however, he was in partnership with Benjamin Outram, and it was no doubt owing to his partner's well-known predilection for flanged plate-ways, as allowing of the use both of rail road and ordinary road vehicles, that this Scottish tramway was laid with plate-ways. The cost of building the line was about £45,000, and the principal shareholders were the Duke of Portland, Lord Eglinton and Lord Justice General Boyle. The Duke, who owned the harbour at Troon in addition to the collieries at Kilmarnock, obtained at the same date powers to make graving docks, wharves and other works in connection with the railway terminus at Troon.

The line consisted of a double track, laid with flanged cast iron tram plates, each weighing about 40 lbs., and from 2-ft. 4-in. to 3-ft. long, bolted to stone sleepers. It is said that upwards of 70,000 sleepers were used, costing 6d. apiece, and each consisting of a solid whinstone block from 9-in. to 12-in. thick and about 12-in. square. The method of attachment of the rails was as follows: a circular hole was made in the stone into which a wooden wedge was driven, and this received an iron pin having a square head which fitted into slots made at the ends of the rails, each pin thus holding down the adjacent ends of two rails. The pins were countersunk so that the heads were level with the running surface of the rails when driven home. The accompanying photo reproduction shows a portion of one of the original tram plates, and illustrates the slotted end as described. The gauge of the railway was 4-ft. measured outside the flanges of the plates, and the plates had a width of tread of 4-in. There were no tie rods to hold the line in gauge.

A branch line about 2½ miles long joined the Fairlie collieries to Drybridge. This line had a gauge of 3-ft. 4-in., and differed from the "main" line in being laid with single headed fish bellied rails. These had their ends resting in cast iron chairs into which they were secured with wedges, the chairs themselves being spiked to stone sleepers. The photo reproduction above shows also one of these rails with its chair. Apart from the difference of gauge, which necessitated transhipment of loads as between the "main" and branch lines, the vehicles running on the former had plain tyred wheels, whilst those on the branch of course had flanged tyres.

BRIDGE, NOW DISUSED, WHICH CARRIED THE TRAMWAY ACROSS THE RIVER IRVINE BETWEEN GATEHEAD AND DRYBRIDGE STATIONS, G. & S. W. RY.

The line was originally intended for horse traction only, but it is of historic importance to mention that the first steam locomotive put to work in Scotland was supplied to this railway. It was built on the spot by George Stephenson to the order of the Duke of Portland, and was the fourth locomotive he had constructed. It had six wheels, the three axles being coupled by means of sprocket wheels and endless chains, and the cylinders, which were vertical, were partly sunk in the boiler and operated transverse

beams which transmitted motion to the wheels by long connecting rods. The engine, which was christened "Duke," was put into service in 1817, and apparently worked quite successfully, but its weight was far too great for the track, and after it had smashed a large number of tram plates it was laid aside. So far as can be ascertained, a similar engine afterwards worked on the Gloucester and Cheltenham plateway, with the name "Royal William," and it is more than probable that this was the engine built for the Duke of Portland.

FAIRLIE COAL TICKET FOR WAGONERS, K. & T. RY.

The wagons used on the main line weighed about ¾-ton empty and held about 1½ ton, and one horse was said to be able to haul three such wagons, or six of the smaller wagons used on the Fairlie branch line. On the main line, moreover, ordinary road carts and wagons were frequently used, but the roughness of their tyres and the stones kicked up by the horses from the ballast worked great havoc with the plate-rails. Though the original Act did not contemplate the use of the line for passenger traffic, two vehicles, one being Willie Wight's "Caledonia," and the other an open carriage known as "The Boat," somewhat similar to more modern tram-cars, were employed to convey passengers between Kilmarnock and Troon, shortly after the opening of the line, at fares of 1s. for a single journey.

In 1837 a new Act was obtained to authorise the conversion of the line for steam traction, and on August 5th, 1839, the Glasgow, Paisley, Kilmarnock and Ayr Ry. began to use a portion of the old line. This railway, by amalgamation with others, became the Glasgow and South Western Ry. as from October 28th, 1850, and after using this historic tramway for many years, finally purchased it from the Duke of Portland's trustees some few years ago.

Our illustrations show the two types of rails already referred to, the bridge carrying the line across the River Irvine, and one of the Fairlie coal-tickets supplied to the wagoners.

WEST LONDON RAILWAY.

AN interesting historical link will shortly disappear with the final filling in of the tunnel by means of which the West London line from Willesden formerly ran below the Grand Junction Canal and crossed the Great Western Railway on the level, 2¾ miles west of Paddington. According to Mr. G. P. Neele in his "Reminiscences," this line in its early days had a somewhat notorious existence and in the fifties was known as "Punch's Line," the ridicule poured upon it in the columns of that periodical being constant. The original title of the line was the Birmingham, Bristol & Thames Junction, its object being to unite the London and Birmingham and the Great Western with the South Western districts of the Metropolis and communicate with the Thames by means of the Kensington Canal at Warwick Road Basin, a junction being made with the L.& N.W.R. near Kensal Green Cemetery. The North Western & Great Western became joint owners and the line then started from near the present Willesden Junction and extended to Kensington High Road beyond Shepherd's Bush. At the level crossing two men were in charge of a short disc signal, and a bar of wood was lowered across the line to act as a stop whenever a Great Western train passed on the main line. The Great Western Co. also had a signalman and a very tall signal towards Ealing. The two signals were arranged to work relatively together.

TUNNEL UNDER GRAND JUNCTION CANAL AT THE WEST LONDON JUNCTION, THROUGH WHICH THE WEST LONDON RY. RAN.

A bad accident occurred at the crossing in 1855, owing to the employment of a signalman who had "only two month's experience and to whom the system of signalling had not been properly explained." The crossing was done away with in 1859 and now the North Western end of the line passes over the Great Western main line and the Great Western end, passing under the West London, curves to the right and joins at North Pole Junction. A detail with regard to this line which now belongs to forgotten history is the use that was made of it by Brunel in 1840 for experiments which resulted in the atmospheric system being tried on the South Devon Railway.

THE MECHANICAL CAUSES OF HOT AXLE BOXES

A BY no means infrequent cause of delay to both passenger and goods trains is the heating of an axle or other bearing, entailing the stopping of the train and changing of engine, or detaching the coach or wagon, as the case may be, at some convenient point. With regard to engines, the object of this article is to point out the usual mechanical causes of such heating—or rather overheating—for all bearings must heat to some extent through friction, though ventilation nullifies it before harm is done.

To understand the matter thoroughly it is necessary first of all to examine the means of lubrication usually designed for axle-box requirements. Fig. 1 shows in all its essential points a common type of locomotive axlebox, consisting of a cast-steel frame, or box, fitted with channels at the sides, so that it may move easily up and down in the horns, the "brass" filling, which forms the bearing, and a "keep" below to main tain the sides rigid and parallel and to form a receptacle for the oil pad. Lubrication is provided both from the wells in the top of the box and from the auxiliary box attached to the engine framing above. The oil is syphoned from each by means of "trimmings" which fit in the copper tubes, whilst their tails lie in the oil, which by absorption is continually fed on to the journal below. Now, if the trimming is not carefully and properly made it will either fit too tightly or too loosely in its tube, with the result that either the oil cannot syphon through or else it does so too quickly, the consequence in either case being the same, namely, that before an opportunity occurs for the driver to look at his boxes again the journal has overheated and begun to melt the white metal bearing, dragging the latter in its softened state over the oil holes and grooves, and so completing the damage. The size of the "trimming" is of course regulated by the size of the copper tubing, but it should be so made as to be a nice fit, easily movable up and down in the bore of the tube.

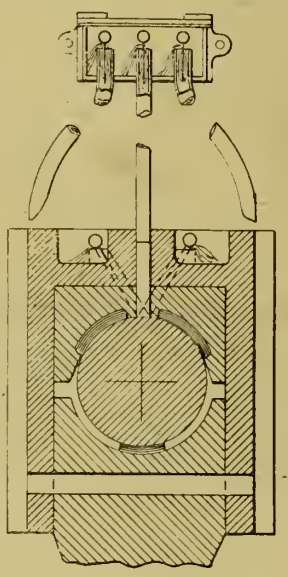


FIG. 1.

A second possible cause lies in the "brass" itself. As will be seen from Fig. 2, the actual bearing is composed of a pocket, or pockets, on either side of the centre strip of white or anti-friction metal. Now when the "brass" comes away from the moulder's hands as a rough casting it is subjected to a strong dry-blast in order to remove all the particles of sand which may adhere to it. Unless this is very carefully and thoroughly done, the lining of "tin," or white metal, with which the inside of the pockets is coated in preparation for the mass of white metal afterwards poured in, will not "take" uniformly and properly to the casting, though apparently the job would look all right. Then when the white metal is poured in and the "brass" finished off and set up in its place on the axle journal ready for work, there remain interstices between the white metal and the brass which should not be there. Probably after a bit the pockets of metal will become loose under the wear and tear they are subjected to, and the oil on the journal will work in between them and the casting (as indicated in Fig. 2 at *a a*) and work out again, bringing grains of sand and dirt along with it. Very soon these cut up the smooth surface of the bearing, increasing the grittiness, and so the bearing begins to heat, the white metal to melt and dry into the oil holes and channels, filling them up and putting a stop to further lubrication and so completing the damage.

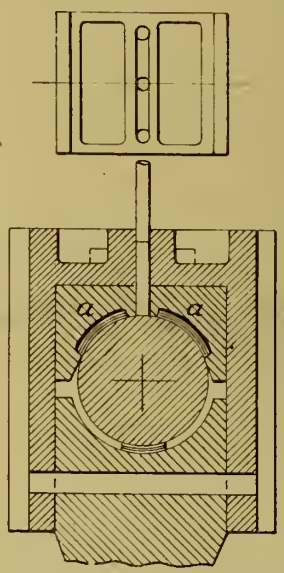


FIG. 2.

Even when the brass is clean and the "trimming" adheres thoroughly all over, the white metal will not, unless thoroughly heated to its proper heat, combine with the "trimming," and this again may be the cause of the pockets of metal working loose and making the oil gritty, with the same result.

Over-heating has been found to result from one of the bolts that secure the sandboxes to the framing working loose or being lost altogether. Of course the sand begins to trickle out and is caught by the wind and blown on to the boxes and motion, when it only requires a little time to work in with the oil and cause a hot bearing. A fourth cause will easily be improper or insufficient fitting on or "bedding on" of the brass to the journal, though this should never happen if the foreman fitter or person responsible is particular in the work he passes as sound and good. A

brass should fit and fit well on to about one-third of the circumference of the journal, which when trying the brass on should be wiped over with a very thin coating of red lead paint for "marking" until the desired fit is obtained, and then the remaining metal or brass beyond the one-third limit should be rasped away so as not to come into contact with the journal at all. A workman not over particular about his work will sometimes paint the red lead so thickly on the journal as to deceive a careless inspection by coming off on the "brass" as though the latter fitted the journal as an eyelid fits an eye, whereas probably it only "fits where it touches," as the saying is.

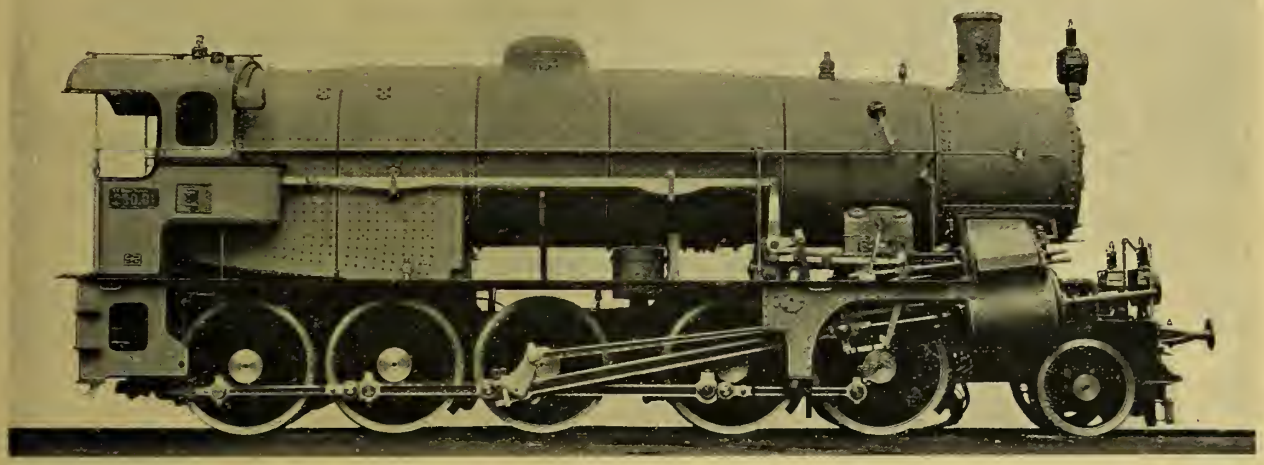
The oil groove should be made a good width, a very good gauge for the same being one's thumb, and the edges and those of the holes should be well rounded off and countersunk.

A brass, besides fitting on the journal, should also fit squarely on to it, that is to say, it should not cause the box to tilt sideways, otherwise the channels in which the hornplates fit will become the seat of undue friction through the cross corners of the box edges or wings rubbing against the hornplates, which in a long run is quite sufficient to start overheating, besides causing the engine to "ride rough."

COMPOUND TEN-COUPLED LOCO., AUSTRIAN STATE RYS.

We are indebted to our friend, Herr Gölsdorf, for the accompanying photo-reproduction and particulars of a large four-cylinder compound 2-10-0 type goods locomotive designed for passenger service over the Arlberg division of the Austrian State Rys. With the introduction of dining cars and the large bogie passenger cars in place of the older four-wheeled corridor stock, there has been a need for double-heading over the steepest section of that division, and Herr Gölsdorf has designed this huge machine, compounded on his well-known system, for the purpose of abolishing piloting.

The chief dimensions are as follows: diameter of high pressure cylinders 14½-in. and of low pressure 24¾-in., stroke 28½-in., diameter of leading truck wheels 3-ft. 4¾-in., and of ten coupled driving wheels 4-ft. 9-in., rigid wheelbase 21-ft. 5½-in., total wheelbase 28-ft. 5¼-in.; boiler, diameter of barrel 5-ft. 4-in.; height of centre line above rails 9-ft. 5¾-in.; height to top of chimney 15-ft.; 291 tubes 16-ft. 5-in. long by 2-in. diameter; heating surface, firebox 166.84 sq. ft., tubes 1932.15 sq. ft., superheater 678.14 sq. ft., total 2777.13 sq. ft.; grate area 49.5 sq. ft.; boiler pressure 235 lbs. per sq. in.; weight of engine, empty 68 tons 18 cwt., and in working order 76 tons, of which 67 tons rest on the coupled wheels. The cylinders, pistons, crossheads, valve gear, leading wheels and many other parts are interchangeable with those of the 2-6-2 passenger locomotive illustrated in our issue of March 15th, 1905.



Ten-coupled Gölsdorf Compound Goods Locomotive, Austrian State Rys.

This engine was built at the State Railway Works in Vienna, and after a steam trial in the shops, was painted and despatched to the Milan Exposition, where it is exhibited with four other types of Gölsdorf compounds, respectively of the 4-4-2, 2-6-2, 0-10-0 and 0-8-0 types, similar to engines already illustrated in the back issues of this journal.

The Locomotives of the Great Eastern Ry.—The continuation of this history is unavoidably held over until the next issue, owing to want of space.

COUPLING ROD BUSHES.

It used to be the universal custom to fit the side or coupling rods of locomotives with half brasses, held together in the eyes of the rod by cotters. With these, when wear took place, it was easy to take the brasses out and "let" them together a little for adjustment; the cotters could also be driven down. A rod of this description is shown in Fig. 1.

Owing to the possibility of altering the centres and thus doing harm by careless or improper adjustment, and further on the score of economy in material as well as in manufacture, it has now become the almost invariable practice to fit the ends with plain bushes, fitting in circular holes in the rod ends; this practice was started by the late Mr. John Ramsbottom, who was responsible for many improvements in locomotive design, especially in the matter of details. The only precaution necessary with this class of rod end is the prevention of a possibility of the bush turning round in the hole, and thus obstructing the oil-hole. Many and various methods of removing this possibility are in vogue, as will be seen from the accompanying sketches. Fig. 2 shows a key dove-tailed into the rod and projecting into a keyway in the bush. The form of key illustrated can be fixed firmly in the rod, and there is then little risk of its working loose in running. Sometimes the bushes are provided with flanges which project over on the outside and cover the key. In the example given, a set-screw also projects up into a hole drilled in the bush, to further secure the bush from revolving. It is not customary to use both key and set-screw together, although it is done on some railways.

The next design, represented in Fig. 3, has also a key, square in section, which is invisible from either side of the rod end, as the keyways do not go through. The groove in the rod is made equal in depth to the flange on the bush, and the key, being fixed in the bush, is forced into place with it. Great care is needed in fitting such a key, since, as it cannot be seen whether the fit is good or not, there is a temptation on the part of the fitter to make it a free fit, in order to ensure the bush being forced home. There is, however, the incidental advantage that it is practically impossible for the key to work out in running.

Set screws in one form or another seem to be the favourite means of securing bushes. Fig. 4 shows a plain set screw without a key, and this method is largely used. Fig. 5 shows a variation in which the oil-cup is loose, being screwed into and not forged on the rod, as is the general custom. The shank upon the oil-cup forms the

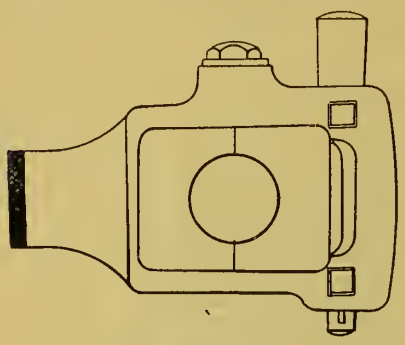


Fig. 1.

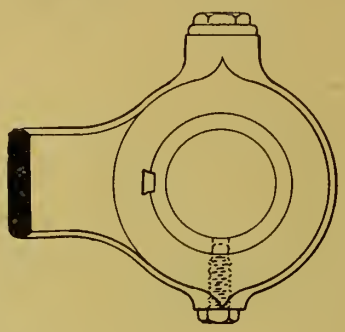


Fig. 2

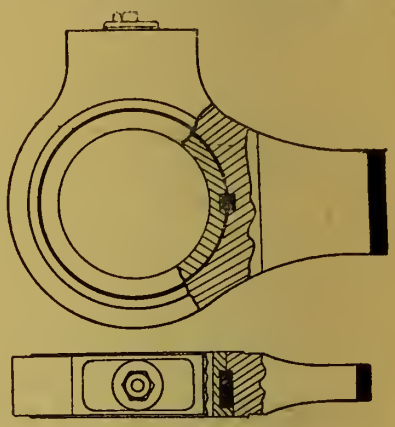


Fig. 3

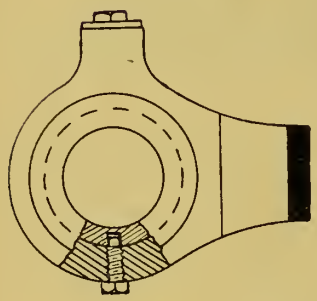


Fig. 4

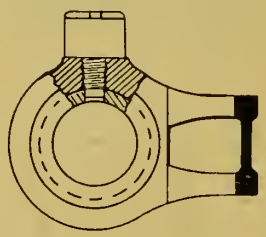


Fig. 5

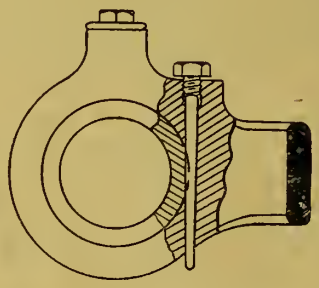


Fig. 6

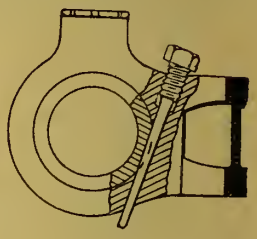


Fig. 7

Examples of Coupling Rod Bushes.

pipe for conveying the oil, in addition to acting as a set screw to hold the bush.

Another method of securing the bush is by means of a taper pin fitting into a hole bored half in the bush and half in the rod end. The pins can be separate from the locking set screw, as in Fig. 6, where the pin would be carefully turned so as to be a good fit in the hole, which itself would be rimered out after the bush had been forced into place. The pin is made sufficiently long to stand up a little into the tapped portion at the upper end of the hole, so that the end of the set screw presses it home and locks it there.

Another pin has the set screw in one piece with it, as shown in Fig. 7. The fitting would be as carefully done as in the last described, but would of course be effected by screwing the pin home by means of the threaded upper portion. Pins of this kind can be used in both vertical and slanting positions.

Coupling rod bushes are usually of gunmetal, generally quite plain, but sometimes fitted with strips of white metal, or a lining of that metal about $\frac{3}{16}$-in. thick all over the wearing area. The bushes should be pressed into position by hydraulic power, and should require a pressure of about 12 tons to force them home.

MORE RAILWAY REMINISCENCES.

In the diary of the late Sir Daniel Gooch, the writer relates an experience he had at the opening of the Great Western Railway through to Bristol. There was but a single line of rails through the Box tunnel and he started from the Bath end on a locomotive to pass through and inspect works at the other end. He had got well inside when he saw the lights of a down train approaching him. He immediately shut off steam, stopped and reversed, just managing to run back in front of the oncoming passenger train. The narrator remarks that it was the closest shave he had ever had.

In connection with the above-mentioned gentleman's period of superintendence at Swindon an amusing story is told of an old driver who had been out one evening with his fireman and had unfortunately been tempted to imbibe too freely. Returning from their "bout" they came to a doctor's red lamp which was shining out brightly in the darkness. Our hero pulled up sharply and refused to respond to his mate's endeavours to get him along. "No, mate," he said "you won't get me to pass that red light! I've had enough of being on the carpet before old Dan. for passing signals at danger."

In the early days of oil firing on the G.E.R., coal gas tar in an undiluted state was often used as fuel, and on one occasion old No. 251, the experimental locomotive, got into difficulties one night at ——— owing to the flexible hose pipe between the engine and tender becoming disconnected. As soon as he had stopped at the station, Driver H. proceeded to lift the running board to get at the pipes below and restore the connection. The footplate of course was flooded with tar, and whilst the driver was attempting to couple the pipes a country porter came up to the engine, mounted the cab and made an inspection to ascertain the cause of the delay in restarting the the train. Being in a jocular mood he thought he would announce his presence by pushing Driver H.'s cap off; he did this and it fell on to the footplate and became saturated with tar. "Hullo! what's up?" cried out the driver. "Nothink, only a bit of a joak," simpered the yokel. "Oh," said Driver H., "that's one bit of the joak; here's the other bit," and suiting the action to the words, he took up his tarred cap and rubbed it across the countryman's face. There was a lot of bath-brick, oil, and soap used at —— during the following few days.

An amusing and interesting incident occurred during the hearing of a rating appeal by one of our railway companies in connection with the assessment in a parish near London a few years ago. An official of the company who had given evidence in Court as to the value of the tenant's capital in the shape of the rolling stock was being cross-examined by Counsel for the parish; the case of a first class carriage supplied to the Company 16 years previously at a cost of £425 and shown as of a value of £400 was gone into, and Counsel asked as to whether the value ought not to be much less after 16 years wear and tear; the witness replied that the carriage had been well kept up and only a few years previously had been thoroughly repaired and fitted with continuous brakes, compressed gas fittings, spring roller blinds and other recent improvements and turned out in as good condition as when new. After several other pertinent questions, Counsel, who was well coached, asked if it was not a fact that the tenons of the door and side pillars and the mortices in the bottom sides became decayed and loose between wind and water as it were; the answer was "yes" and that was carefully looked into and where any defect existed the end of the pillar was spliced with sound timber and the tenon and mortice made good. Counsel then said "Let us take the case of a tradesman's horse," and asked if after 16 years work its value would not be less than half what it was when a four year old. Counsel for the Company then rose and said that it was not a fair comparison, since one could not splice the legs of a horse. The cross examination as to the carriage stock was continued no more on that occasion.

LOCOMOTIVE FIRING PAST AND PRESENT.

THE complaints, often made by young firemen, of the increased work required of them on the large locomotives of to-day compared with that demanded from their predecessors of the shovel on the smaller engines of 30 years ago induces us to offer a few remarks on the subject.

At the outset we would remark the fireman's post in the "good old" days was no bed of roses, no matter what old-time enthusiasts may declare to the contrary. Without referring back to ancient history and to locomotives with fire-boxes unprovided with ashpans, minus sandboxes and with cylinder cocks operated from the buffer beams, we would make comparisons with the engines running in the "seventies," when rail-roading was rapidly assuming the scientific phase it presents to-day. A cab was a rarity, the foot-plates were inconvenient and uncomfortable, the fittings badly arranged, lubrication was by plain oil-cups and tallow-boxes requiring frequent attention, the injector feed was a constant source of trouble due to very "touchy" injectors, and the boilers were often very "shy" of steam owing to the limited firegrate and heating surface they possessed. The signalling, too, being in an imperfect stage necessitated an anxiety quite unknown in these days of automatic block sections. It is doubtless true that the locomotive of 1870 did not consume anything like the quantity of fuel per mile run that is used by the larger machine of 1905, but on the other hand it was out on the road longer, the fireman's hours were uncertain and his trips irregular.

The locomotive of to-day, the result of great experience and technical research, differs from its precursor of yesterday in being a more refined specimen of mechanism, much larger and more powerful, and built with a commercial object in view—the haulage of a maximum tonnage at a minimum of expense. With its commodious and well-arranged cab and footplate, from which every movement can be directed, it offers comfort to the enginemen. Its large boiler with ample heating surface ensures good steaming qualities and if only a little skill is used in the firing, the total of the duties demanded of the fireman will barely exceed those required for the earlier examples. It will haul double the load with ease and maintain a uniform speed. Its day's work is a heavy but short one.

As noted above, to fire a modern giant requires a skill on the part of the fireman quite uncalled for years ago, and he should know something of the elementary principles of combustion if he would give satisfaction to his driver and save his own labour. The fire must be kept to as uniform a condition as possible. Medium applications of coal at short intervals will prove the best system to adopt and to keep a grate 8-ft. long well covered it is necessary to adopt a methodical round of firing. The fire should be carefully built up at the start of the day's work, the corners of the grate well filled and sides evenly coated, but the centre left thin until the last. When the final layer of coal is thrown in, care should be taken to leave sufficient space under the brick-arch; the latter, if kept well hot with a bright fire below it, will ensure the upper portion of the firebox being at a high temperature—a necessary condition for good combustion. The brick-arch really forms a highly heated "baffle" in the firebox, past which the imperfectly consumed products of combustion of the fire are drawn for further admixture and consumption prior to entering the tubes of the boiler. When once the gases have entered the tubes a reduction of temperature ensues due to the surrounding water, and if combustion is not completed before this occurs, partial condensation takes place and smoke results. Smoke prevents steaming, as it means such a low temperature of the gases in the tubes. The firebox tubeplate should always be distinctly visible from the firedoor through the incandescent gases passing above the brick-arch. A bright and hot brick-arch will assist in keeping the tubes clean, an important condition now small tubes are so much used to secure large heating surfaces.

A good supply of nicely broken coal should be prepared ready to hand before the start of the train, and the fire worked into an even condition early. It should be added to, a minute or two before the regulator is opened, and again just after that event, for the heavy blast of the engine in full gear at starting will tend to lift and "tear" the fire. It can, however, be relied upon to "clean it" if the coal is not thrown on too "heavy" and thus make a good commencement for steady and continuous firing over a long run.

Whilst it is quite true the shovel will rarely be out of the fireman's hands during the trip, the 150 miles or so of the average non-stop run of the modern passenger train is soon "reeled" off. The monster goods, although consuming perhaps 70 lbs. of coal per mile, takes it gradually and continuously; it does not pay to have these engines standing in sidings for hours at a stretch.

Lubrication is all but automatic and the feed water can be set to meet constant requirements; a steady feed will assist the good steaming of the engine.

A heavy train will, as a rule, call for a heavy fire, the later cut off in the cylinder augmenting the blast and consequently the draught. The grate should be kept as clear of clinker as is possible and every attempt made to get rid of dirt and ashes. When nearing the end of the journey the fire should be allowed to burn off,

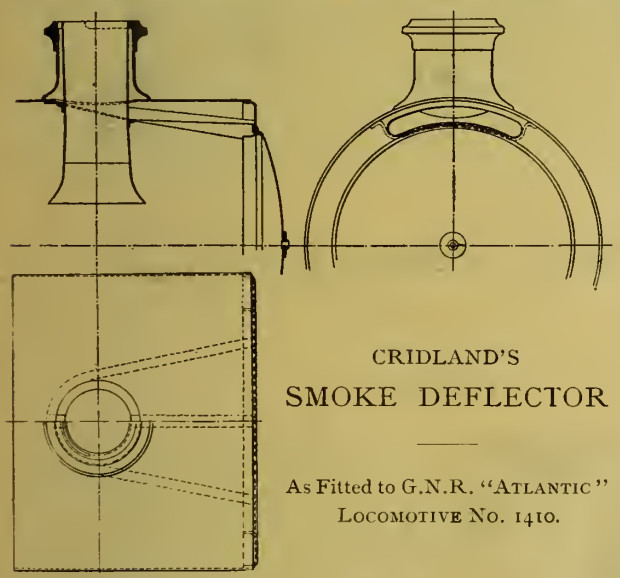
but care should be taken to prevent any holes developing for the admission of cold air, or leaky tubes, stays, etc., are certain to result.

On arrival at the journey's end the fireman should throw out the rubbish as soon as he can and get the ashpan cleared.

Necessarily the grade of coal used will materially affect the fireman's work, so also will the amount of skill he employs in the use of it. As much depends on the man and his methods as on the fuel and the locomotive.

A SMOKE DEFLECTOR FOR LOCOMOTIVES

ONE of the troubles of enginemen in charge of modern locomotives with large boilers placed high above the rails is the difficulty of maintaining a lookout ahead through the cab windows.



CRIDLAND'S
SMOKE DEFLECTOR

As Fitted to G.N.R. "ATLANTIC" LOCOMOTIVE No. 1410.

Owing to the shortness of the chimney necessitated by the conditions mentioned above (in conjunction with a limited loading gauge, and the use of high expanded steam) the cab windows become quite obscured by the steam and smoke that swoop down over the edge of the chimney, and the driver of a big engine (such as the G.N.R., N.E.R., L.B. & S.C.R. "Atlantics," and others of extreme boiler dimensions) has to spend most of his time with his head outside the shelter of the cab in order to catch sight of the signals properly. To obviate this necessity, the device shown above has been patented by Mr. J. F. S. Cridland, whereby air is admitted into the outer casing of a double chimney, from an opening in the front of the smokebox, and drives the steam and smoke well upwards, with a force more or less proportioned to the speed of the engine. The air exit is only at the hinder half of the circumference of the chimney top, where it is most needed.

REVIEWS.

"PRACTICAL PATTERN MAKING." Edited by P. N. Hasluck. *London:* Cassell & Co., 2/-.

This book presents the whole story of pattern making in a convenient form of every day use, and comprises the information recently published in a series of articles in the columns of *Work*. The editor has been careful to include the general principles and most practical factors to be kept in view, and this gives a value the workman will appreciate. The examples chosen are those most likely to be met in every day practice in general engineering, while the large number of very clear illustrations enable the descriptive matter to be condensed without detriment. As a text book it can be understood by anybody, and can be recommended to pattern makers, foundry men and engineers in general.

"INJECTORS: THEIR THEORY, CONSTRUCTION AND WORKING." By W. W. F. Pullen. The Technical Publishing Co., Ltd. Price 3/6 net.

This valuable little work has now reached its third editon. Several additions have been made to the descriptive matter, and the illustrations have been brought thoroughly up to date.

"EMINENT ENGINEERS." By Dwight Goddard. *New York:* The Derry Collard Co. *London:* The Locomotive Publishing Co., Ltd. Price 7/6.

This beautifully produced book contains brief biographies of 32 of the inventors and engineers who did most to further mechanical progress. The book is divided into two parts—European and American.

"THE LOCOMOTIVE HANDBOOK, 1906." *London:* The Locomotive Publishing Co., Ltd.

This little book consists of 99 pages of matter containing useful memoranda and data for the use of enginemen and others having to do with locomotive running and management. Some proportion of the subject matter is a revised reprint of a series of articles that ran through early numbers of this magazine under the title of "Locomotive Running," and in addition a number of tables and other memoranda are included in the book, together with reproductions of the most recent locomotive practice on the S. E. & C. R., and of the popular chart of the G. C. R. Atlantic engine. It is an eminently practical treatise on locomotive running, written by a practical man.

Trade Catalogues, Pamphlets, etc., received:—

Kynoch, Ltd., Lion Works, Birmingham.—"Advantages of the Kynoch suction gas plants."

Escher, Wyss & Co., Zurich, Switzerland, and Ravensbury, Germany. — Illustrations of turbines, pumping engines, steam engines, launches, machines, and refrigerators.

Brush Electrical Engineering Co., Loughborough.—"The Brush Budget," March, 1906.

London & North Western Ry.—"Four Welsh Spas"; Horse and Cattle Shows and Fairs.

Edward Baker, 14-16, John Bright St., Birmingham.—Catalogue No. 232 "Railroadiana," consisting of books, pamphlets, maps, guides, time tables, etc., connected with the origin, rise and development of railways.

NEW PASSENGER BRAKE VAN, GREAT INDIAN PENINSULA RY

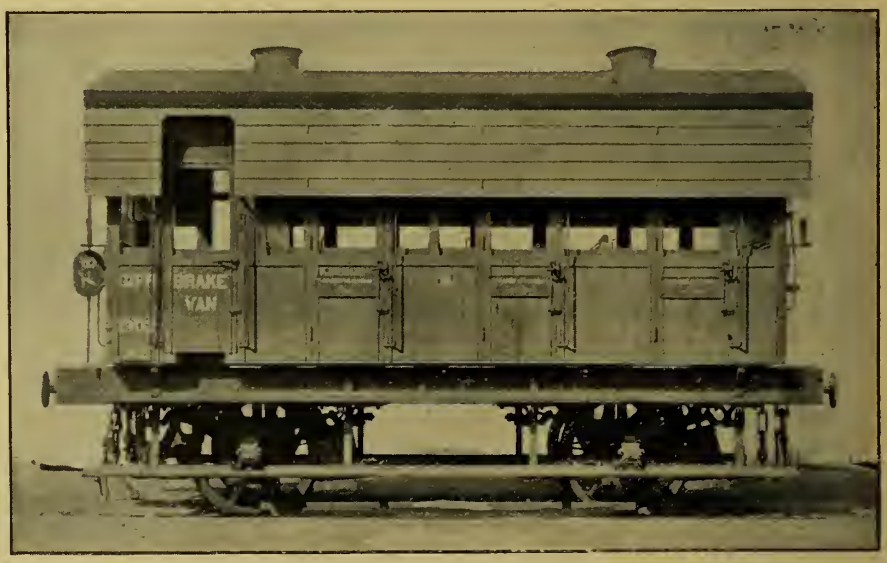
A NUMBER of new carriages for main line service have recently been put into traffic on the G.I.P. road, some having been built at the Jhansi shops and others at the head establishment in Bombay.

NEW PASSENGER BRAKE VAN GREAT INDIAN PENINSULA RY.

These carriages are characteristic of the new type of passenger stock adopted by the Great Indian Peninsula Railway, and have been built from the designs of Mr. A. M. Bell, M.I.M.E., the carriage and wagon superintendent.

We illustrate a composite brake, luggage, and third class, which is typical in outside appearance to other vehicles of different class.

The body is 62-ft. long over ends and 9-ft. 6-in. wide, framed in Moulmein teak, with outer steel panels and an inner lining of teak and deal. Sunshades are no longer used, as the roofs are of the new double construction adopted by the railway, with an inner lining of deal $\frac{5}{8}$-in. thick and the outer of teak $\frac{3}{4}$-in. thick; between there is an air space of 2-in., with intervening sheets of asbestos slate $\frac{1}{8}$-in. thick to act as a non-conducting layer. The latter material is also carried down the sides and ends to the "waist" line. Internally, the seats of the passenger compartment are arranged longitudinally and accommodate 68 passengers; they are made after the "garden" seat style and have rifle racks below. Filtered water for drinking is provided, and a latrine and lavatory for the guard. All doors open inwards, and being constructed of teak and steel, are only $2\frac{1}{2}$-in. thick; this minimises any obstruction to the 2-ft. 4-in. doorways when open. The doors of the luggage compartments are made to slide after the style of the East Coast Joint Stock, closing flush with the sides of the car. Gas light is installed, with tail and side lamps. The steel underframe is of channel section 9-in. by $3\frac{1}{2}$-in., 60-ft. long; it rests on bogies having 10-ft. wheelbases and has compensating buffers.



PASSENGER BRAKE VAN, GREAT INDIAN PENINSULA RY.

The appearance of these cars is strikingly handsome. The lower panels are painted a rich

Fig. 1.—Rail Loader in First Position with Rail lifted on to supports.

red brown, whilst the upper panels are cream white. The "trade mark" of the G.I.P. is in scarlet and gold. It will be noticed the class designation is by Roman characters, which are well understood by the natives, and they are painted on the body panels, not on the doors; this always keeps them in evidence, whether the doors are open or shut.

By the way of comparison, we illustrate also one of the older type of vehicle these new cars are replacing; the change in appearance of the trains can be realised from an inspection of the two.

NEW RAIL "LOADER."

The two photographs here reproduced show a novel appliance for the easy loading up of rails into permanent way wagons, in service. Very little description is necessary to make the operation of this neat device readily understood. A cranked arm having two rests on it, to receive the rails at different heights, is hinged to the side of each of the wagons, as shown in Fig. 1. When the rail has been lifted on to the supports, two men take each cranked arm and lift it to a horizontal position, thus bringing the rail on the rests, level with the top of the wagon or cross support on which it is to be laid, see Fig. 2. Railway men of the way and works department will appreciate the facility with which the staff can deal with the loading up of rails if provided with appliances like this to attach to the sides of the wagons. This device is the invention of one of the permanent way inspectors of the Midland and Great Northern Joint Railways and has been brought to our notice by Mr. Wm. Marriott, the chief engineer and locomotive superintendent.

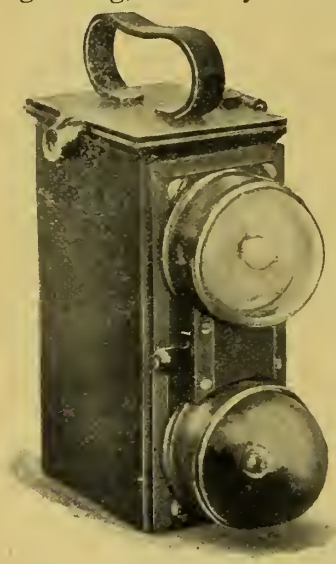
Midland Ry.—The carriages on this line now have the word "Midland" painted along the top panel.

Fig. 2.—Rail Loader in Operation: Rail lifted on to Cross Supports of Wagons.

Composite Coach designed by Mr. D. Earle Marsh, Loco., Carriage & Wagon Supt., L. B. & S. C. Ry., Length 54-ft., Width 8-ft. 6-in.

ELECTRIC SIGNALLING LAMP.

In the accompanying illustration is shown a hand lamp for railway use, shunting, and signalling, made by the Electric Power Storage Co., Ltd. It is provided with two lamps of 2.5 candle power, for showing red and white lights as required, lighted by means of storage batteries, having a capacity for 10 amp. hours and a voltage of 4. The approximate time of burning for one charge of the batteries is 27 hours per lamp. The example shown has an enamelled outer case, but another type, in which the position of the red and white lights is reversed, is cased in polished wood.



Electric Signalling Lamp.

Electrification of Hammersmith & City Ry.—For the joint Metropolitan and Great Western service between Hammersmith and the City, there are 120 cars now being built at the Saltley works of the Metropolitan Amalgamated Carriage Company.

Great Eastern Ry.—The rolling stock for the new service of fast goods trains mentioned in our last issue—covered wagons and brake vans—is being fitted with the vacuum brake.

A Large Testing Machine.—Messrs. W. and T. Avery, Limited, of the Soho Foundry, Birmingham, have now under construction for the engineering section of the Birmingham University a machine for testing whole members of constructional work, such as complete girders, columns, roof principals, and every part used in the construction of bridges, roofs and machinery. The machine is designed to test specimens for tension up to 25-ft., compression up to 30-ft., and transversely up to 20-ft. long. The maximum capacity is 300 tons, the total length 70-ft., and the weight of the metal in the machine is about 85 tons. This machine is one of the largest testing machines ever made, and is so arranged that an official can govern from one position the hydraulic power applying the strain and the recording steelyard.

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NORTH EASTERN RAILWAY. FOUR-CYLINDER COMPOUND EXPRESS LOCOMOTIVE.

THE LOCOMOTIVE MAGAZINE.

Vol. XII. MAY 15th, 1906. No. 165.

RAILWAY NOTES.

LONDON & NORTH WESTERN RY.—The accompanying illustration shows No. 1866, a three-cylinder compound mineral engine, built by Mr. F. W. Webb in 1899, as converted recently by Mr. G. Whale into a simple engine with two inside cylinders 19½-in. by 24-in. As can be seen, the engine now resembles in appearance No. 2524, the simple eight-coupled engine built experimentally by Mr. Webb in 1892, prior to the introduction of the three-cylinder compounds of the same general design. A number of these compounds have already undergone conversion, and we understand that in due course they will all be similarly treated.

THREE-CYLINDER COMPOUND COAL ENGINE No. 1866, REBUILT AS TWO-CYLINDER SIMPLE ENGINE, LONDON & NORTH WESTERN RY.

The latest engines of the "Precursor" type are Nos. 234 "Pearl," 2513 "Leven," 526 "Ilion" and 1311 "Napoleon."

GREAT NORTHERN RY.—The letter signifying the class distinction of the G.N.R. locomotives is now painted in white on the leading brake pipe just below the swan neck for the coupling hose pipe. Following are some of the letters adopted: T—Stirling and Ivatt 4-coupled passenger; W—large coupled bogie engine of No. 1321 class; Y—"Klondike," or No. 990 class of Atlantics; and Z—large Atlantics of No. 251 class.

The new Atlantics of No. 251 class, Nos. 1411-1420 are now running. In these engines the spaces below the extra hand rails on either side of the cab are filled in with small panels.

No. 1533, ten-wheel condensing tank engine, is now at work fitted with brake blocks to the wheels of the leading bogie.

The first of the eight-coupled mineral engines, No. 401, is now painted green instead of black, and only differs from the rest of the class in retaining the brass beading round the splashers.

MIDLAND RY.—Of the twenty new three-cylinder compounds now in course of construction, Nos. 1010-1016 are at work. The new series differs from Nos. 1000-1009 in having extended smokeboxes.

The ten large-boilered goods engines Nos. 575-584 are now all at work. Nearly all the 6-ft. 6-in. bogie express engines of Nos. 1808 and 2203 classes have now been rebuilt with the new large boiler; and No. 1563, 6-ft. 9-in. bogie, has been similarly supplied, and in addition now has the cab and splashers similar to the No. 1000 class of compounds. All recent rebuilds are fitted with deflectors on the chimney caps.

GREAT CENTRAL RY.—No. 259, the second of the 3-cylinder compound Atlantics, is now at work. Three of the simple Atlantics of the same general dimensions are also at work, bearing Nos. 260-262. All these were built at Gorton.

On Thursday, April 12th, a special excursion train was run from Manchester to Plymouth, the timing being practically the same as in the run last year. Engine No. 1094 took the train to Leicester, and No. 1031 went forward from there to Bristol, Pylle Hill, *via* Banbury, Didcot West curve and the Badminton line. G. W. R. engine No. 3305 "Samson" took the train on to Plymouth.

The G.C. train returned from Plymouth the same evening as an excursion to Sheffield, No. 1031 again working on from Pylle Hill.

GREAT WESTERN RY.—A new series of 6-ft. 8-in. bogie six-coupled express passenger locomotives is now in course of delivery from Swindon Works, Nos. 2901-3 being already at work. They are similar to the earlier engines of this type, except that they are equipped with the Schmidt superheater and are reversed by levers. The style of painting adopted is green above the footplate, and black below with yellow lining.

Nos. 3701-3 are the first of a new series of 5-ft. 8-in. 4-4-0 passenger locomotives of the "Dominion of Canada" class. These engines and the new 4-6-0 series will both be supplied with new tenders having a capacity of 3,500 gallons.

Several of the "Metropolitan" passenger tank engines have recently come out of the shops provided with cabs and with the condensing apparatus removed. This change foreshadows the approaching electrification of the Hammersmtth and City branch of the "Underground."

No. 3067 "Duchess of Teck" has recently been rebuilt with a large Belpaire boiler similar to that fitted to No. 3027 "Worcester," as illustrated in our issue of February, 1901.

GREAT EASTERN RY.—Ten new six-coupled mineral engines Nos. 1220 to 1229, of the 1150 class, but with the latest modifications, are now running. They are all stationed in the Peterborough district.

All the coal traffic from Peterborough for the London suburban stations on the Colchester line, i.e., Romford, Ilford, Forest Gate, &c., is now worked *via* Ely, Bury, Haughley and Ipswich, thus relieving the congestion on the Cambridge line and at Temple Mills sorting yards.

The engine of the 11.10 express, Norwich to London, which was derailed on April 7th at Shippea Hill, was No. 466.

Restaurant cars for Hunstanton are to be attached to the 5.15 Cambridge line express from Liverpool Street, this summer.

INNER CIRCLE TRAINS.—The introduction of electric traction has reduced the running time of the "Circle" trains to 60 minutes for the round trip. To provide a ten minutes service there are therefore six trains running on each set of rails, four on each being supplied by the Metropolitan Company and two by the District. It will be remembered that, in the days of steam traction, the District "Circle" trains used the inner set of rails only, five District and two Metropolitan trains being used, while seven trains of the Metropolitan Co. worked the outer lines.

NORTH LONDON RY.—The characteristic sharp whistle of the N.L.R. locomotives is to be superseded by one of a deeper tone.

METROPOLITAN RY.—The Oxford & Aylesbury Tramroad is now worked by the Metropolitan Co. between Quainton Road and Brill. The two Manning Wardle engines, "Wotton No. 1" and "Brill No. 2," working alternate weeks, have been painted Metropolitan standard colors, with "M.R." on the buffer beams. One of the old eight-wheeled "Underground" carriages with oil roof lamps provides the passenger equipment. Continuous brakes are not used.

LONDON & SOUTH WESTERN RY.—Ten small four-wheels coupled motor engines are now in course of construction at Nine Elms, for use with six vestibule cars building at Eastleigh. By having engine and car as separate units, failure of one part does not involve withdrawal of the whole car from service.

CALEDONIAN RY.—Large new turntables, 72-ft. in diameter, to accommodate the new six-coupled engines now under construction at St. Rollox Works, are being installed at Perth, Aberdeen, Dundee and Carlisle.

The Bankfoot Light Railway, about 3½ miles in length, from Strathord Station on the main line from Perth to Forfar, to a village of that name, has been opened for traffic. The line, which is standard gauge, is to be worked by the Caledonian Ry. for the local company who have built the line. A small tank engine, No. 230, one of a class built by Mr. Drummond in 1886, has been sent to work the traffic.

HIGHLAND RY.—Three engines of the "Ben" class are under order from the North British Locomotive Co. Ltd., at the Glasgow Locomotive Works, to be ready for the summer traffic.

A TURBINE LOCOMOTIVE.—Mr. Hugo Lentz, of Berlin, has recently devised a method of applying a turbine to locomotive design, for which it is claimed that the usual disadvantages consequent on the provision of suitable flexibility in the connections are successfully avoided. The turbine is mounted on the driving axle between the wheels, and the method of obtaining play for the steam pipes without loss of power constitutes a chief feature in the invention.

RAILWAY MOTOR COACHES.—Messrs. Manning, Wardle & Co., Ltd., of Leeds, are at present engaged in executing orders for steam rail motor coaches, four being in hand for the Great Northern Ry. (Ireland), two for the Dublin, Wicklow and Wexford Ry., and three for the Taff Vale Ry. The carriage portion in each case is being built by the Brush Electrical Engineering Co., Ltd.

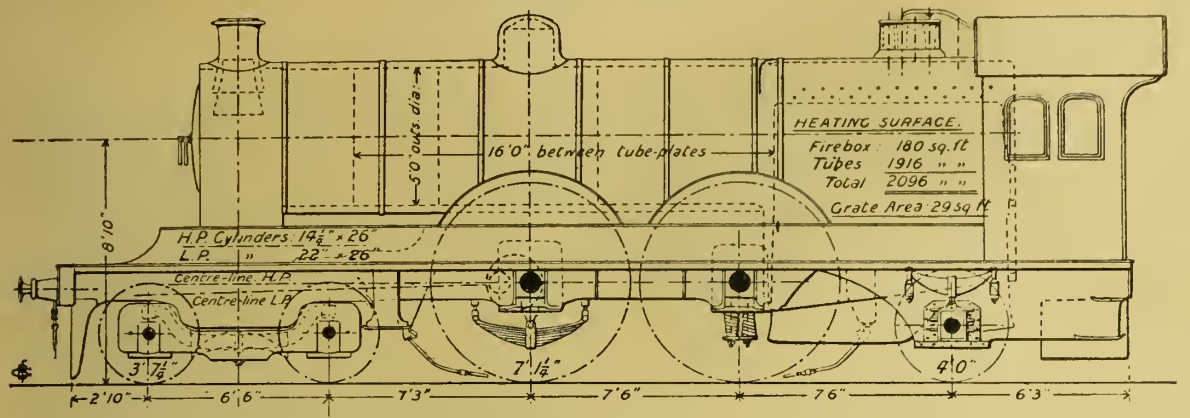


Diagram of Four-cylinder Compound Atlantic Locomotive No. 730, North Eastern Ry.

FOUR-CYLINDER COMPOUND LOCOMOTIVES, NORTH EASTERN RY.

We are indebted to Mr. Wilson Worsdell, chief mechanical engineer of the above railway, for the photograph reproduced as a special supplement with this issue, showing one of two four-cylinder "balanced" compound Atlantic locomotives recently built at the Gateshead Works of the company for express passenger traffic between York and Edinburgh. The engines are Nos. 730 and 731, and the former, after working a stopping train for a few trips, proved so successful that it was almost immediately employed on main line traffic, and has shown its capacity to haul heavy loads at high speeds. One special quality is its quickness in starting. The system of compounding is that introduced by Mr. W. M. Smith, which in its 3-cylinder form has already proved so successful, and the cylinders have the following dimensions: high pressure, placed outside, 14½-in. by 26-in.; low pressure, inside the frames, 22-in. by 26-in. Piston valves are used, actuated by a modified form of Walschaert gear in No. 731 and by Stephenson link motion in No. 730. Leading dimensions of these locomotives are shown in the above diagram. The weight of the engine in working order is 73 tons, and of the tender 42 tons.

Mr. C. H. Grinling.—We regret to record the death of Mr. Charles H. Grinling on the 11th ulto., at the early age of 35. He was a well-known writer on railway topics, his early training and family connection with the G.N.R. having given him considerable experience in the working and management of railways.

Messrs. Davies & Metcalfe, Ltd., have issued a well-printed supplementary catalogue giving detailed description and diagrams of their speciality, the patent exhaust steam injector, together with numerous illustrations of locomotives fitted with the apparatus.

NEW LOCOMOTIVES FOR THE GREAT INDIAN PENINSULA RY.

The progress that is being made in the working of the Indian railways is well illustrated in the latest additions to the rolling stock of the Great Indian Peninsula Railway. This, the first railway to be opened in India, is seriously handicapped on its through routes by the Ghat inclines which occur on both main lines soon after leaving Bombay. The high ground of Central India possesses a bordering fringe of mountainous heights which run parallel with the west coast and have an abrupt fall on that side, and it is up and down this natural barrier that all traffic to and from Bombay over the G.I.P. must pass. When the lines were originally surveyed many routes were discussed before the two selected ones were finally decided on. The so-called North-east main line reaches the plateau by means of the Bhore Ghat inclines whilst the South-east section traverses those of the Thul Ghat. These grades are representative of early attempts at carrying railroads up steep hillsides, and to secure planes suitable for traction by adhesion with as small an initial outlay as possible, the well-known "reversing" stations were introduced. These were no great detriment in the young days of railways in India, but they seriously affect economical working now and many proposals have been made to supplant them. The opening in the near future of another and more direct through B.G. route, without such obstacles, between Bombay and the Punjab has brought the problem again to the front and it is quite possible that some attempts will soon be made at improving the inclines. The "reversing" stations necessitate the employment of tank locomotives over the mountain sections, as they must operate in both directions; this in itself is objectionable as it calls for special engines and corresponding depôts for them.

The traffic has gradually grown until now it has all but reached the limit of capacity of the

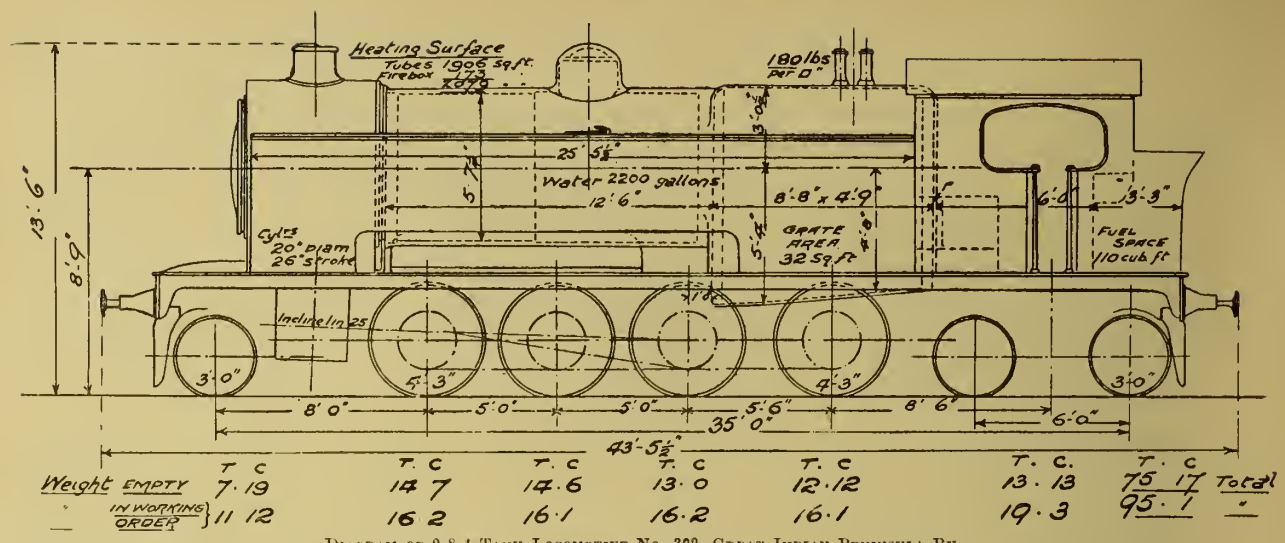


Diagram of 2-8-4 Tank Locomotive No. 322, Great Indian Peninsula Ry.

double line of rails of the Bhore Ghat, and the new engines just sent out, which by the courtesy of the builders, the North British Locomotive Co., Ltd., we are enabled to illustrate, represent practically the last word in motive power before some modification to the road and its grades becomes necessary.

The new engines have cylinders 20-in. in diameter by 26-in. stroke, and eight-coupled drivers 4-ft. 3-in. in diameter; the leading truck and the trailing bogie have wheels 3-ft. in diameter. The boiler has 2,079 sq. ft. of heating surface with a firebox grate area of 32 sq. ft.; the total wheel-base is 35-ft. and the weight in service 95 tons. The tanks carry 2,200 gallons of water and the bunker can accommodate $2\frac{3}{4}$ tons of coal.

The maximum grade of the Ghat inclines is 1 in 37, and up these, these engines are intended to haul trains of 350 tons at a speed of 10 miles per hour. This ability to deal with a heavy load unaided will obviate the necessity for a considerable amount of "double heading" now resorted to to cope with the traffic. The automatic vacuum brake is fitted with the new pattern ejectors illustrated on page 30, as it is operated on all trains, passenger and goods; on the latter the special 20 tons incline brake vans are marshalled in front of the wagons, next to the engine, to enable communication to be established.

(To be continued.)

Metropolitan District Ry.—Mr. Arthur Collinson, formerly of the N.E.R. locomotive department, has taken up the office of General Manager of the M.D. Ry. as from the 1st inst.

Mr. D. G. Slatter has been appointed Honorary Secretary of the G.W.R. Mechanics' Institution Junior Engineering Society, in place of Mr. O. Barker, who has recently resigned the position.

Eight-coupled Tank Locomotive No. 322, for the Ghat Inclines, Great Indian Peninsula Ry.

THE LOCOMOTIVES OF THE GREAT EASTERN RAILWAY.

(*Continued from page 22.*)

THE next class with which we have to deal were designed by Mr. Gooch for goods traffic, but were largely used on passenger trains as well. They were usually known as the "Butterflies," and consisted of 18 engines in all, of which Nos. 214 to 219 were built by the Canada Works, Birkenhead, Nos. 238 to 243 by Messrs. Sharp, Stewart & Co., and Nos. 244 to 249 by Messrs. Kitson & Co. Fig. 93 illustrates one of the engines built by the last-named firm, whilst Fig. 94 shows one of those built by Messrs. Sharp, Stewart & Co. with certain alterations subsequently introduced. They were four-wheels coupled outside cylindered engines with four-wheeled tenders, and the following were their principal dimensions: cylinders, 15-in. in diameter by 24-in. stroke, distance between centres

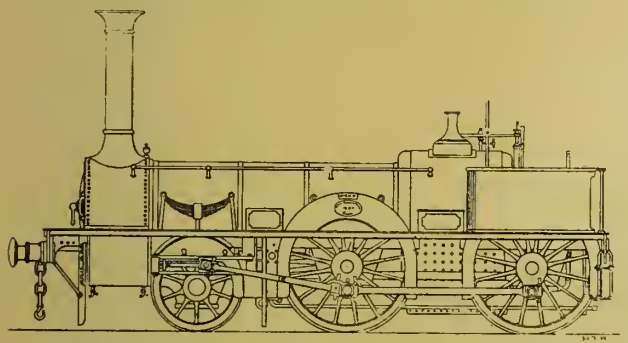


FIG. 93.

6-ft. 2-in.; diameter of leading wheels 3-ft. 8-in., and of coupled wheels 5-ft. 6-in.; wheelbase: leading to driving 6-ft. 3-in.; driving to trailing 7-ft. 9-in.; total 14-ft.; boiler (lap jointed), length of barrel 10-ft. $5\frac{9}{16}$-in., internal diameter 3-ft. $6\frac{1}{8}$-in.; number of tubes 175, outside diameter $1\frac{7}{8}$-in., length 10-ft. $10\frac{1}{4}$-in.; outside firebox, length 4-ft. $6\frac{7}{16}$-in., width 4-ft.; inside firebox, length 4-ft. $0\frac{3}{16}$-in., width 3-ft. $6\frac{1}{8}$-in.; grate area 14 sq. ft.; working pressure 120 lbs. per sq. in.; heating surface: tubes 921.5 sq. ft., firebox 80 sq. ft.; total 1001.5 sq. ft. The weight in working order was 27 tons 13 cwt. 2 qrs., of which 10 tons 8 cwt. were on the leading wheels, 8 tons 12 cwt. on the driving, and 8 tons 13 cwt. 2 qrs. were on the trailing wheels. None of this class was provided with a new boiler and the following is a complete list of the dates at which they were built and broken up:

Engine No.	Maker.	Makers' No.	Date New.	Date Scrapped.
214	Canada Works	—	Jan., 1856	Aug., 1879
215	,,	—	,,	April, 1878
216	,,	—	Feb., 1856	June, 1874
217	,,	—	,,	Feb., 1879
218	,,	—	April, 1856	Sept., 1874
219	,,	—	June, 1856	Jan., 1876
238	S. S. & Co.	853	May, 1855	Jan., 1873
239	,,	854	,,	Dec., 1875
240	,,	855	,,	,,
241	,,	865	July, 1855	July, 1875
242	,,	866	,,	Jan., 1873
243	,,	867	Aug., 1855	Dec., 1875
244	Kitson & Co.	434	May, 1855	Jan., 1876
245	,,	435	June, 1855	Jan., 1875
246	,,	436	,,	Jan., 1873
247	,,	437	July, 1855	Aug., 1875
248	,,	438	,,	Oct., 1873
249	,,	439	Aug., 1855	Dec., 1879

In 1875 Nos. 214, 215, 217 and 219 were altered to 2140, 2150, 2170 and 2190 respectively and in 1879 No. 249 was altered to 0249.

One of these engines was the first to be fitted with Frodsham's patent smoke consuming apparatus.

On the night of Thursday, September 10th, 1874, engine No. 218 was working forward from Norwich to Yarmouth the down express which had left Bishopsgate at 5 p.m. At this time there was only a single line from Norwich to Yarmouth, the first crossing place being at Brundall ($5\frac{3}{4}$ miles from Norwich), and at this station the down express should have crossed the up mail from Yarmouth to London. Owing, however, to the down train being late on this occasion a message was sent to Brundall to send the mail on. The express having in the meantime arrived at Norwich, the officials thought that it could be got through to Brundall without seriously delaying the mail, and it was therefore despatched as quickly as possible and another message sent to Brundall cancelling the previous instructions. In reply came the ominous telegram "Message received too late, mail gone."

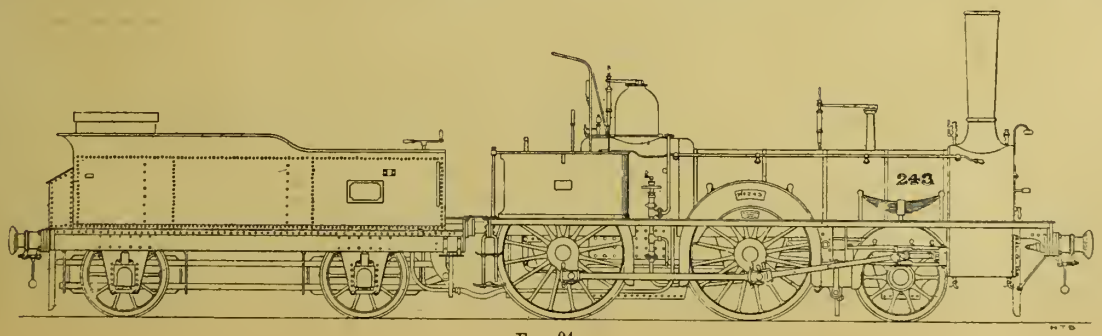
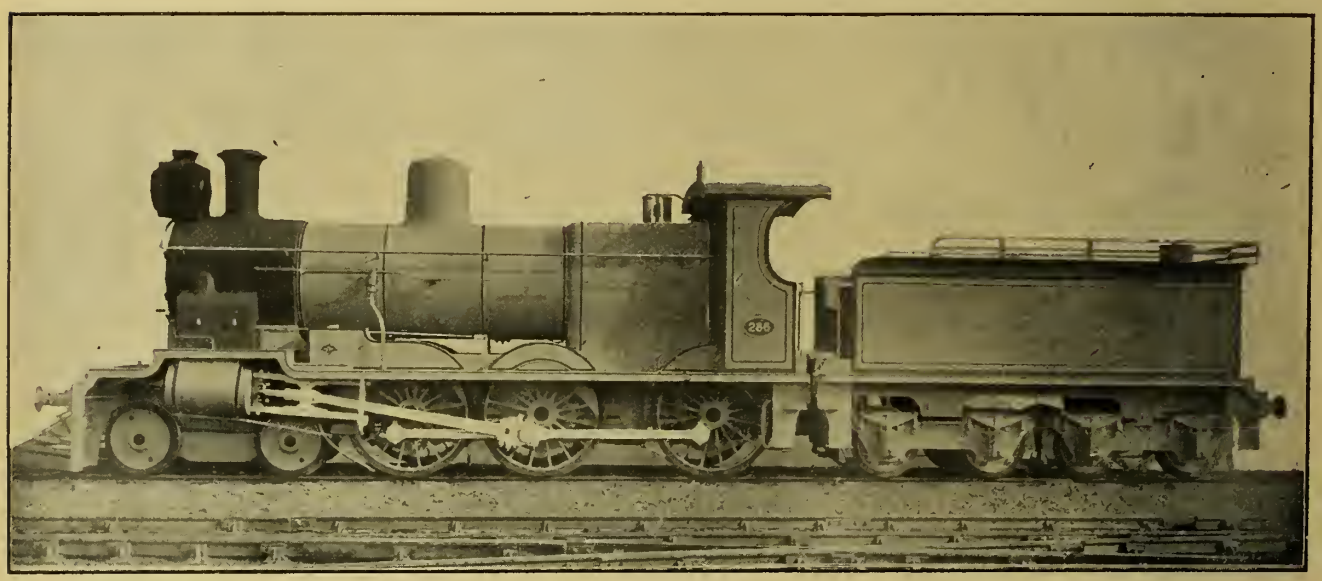


FIG. 94.

The officials at Norwich being thus made aware of the impending disaster, they commenced their preparations for the succour of the wounded before the catastrophe had actually taken place. In the meantime, each driver being under the impression that the other train was waiting for him, made speed to clear the section, and when opposite Thorpe Village and a few yards from the river bridge near to what is now Whitlingham Junction No. 218 struck No. 54, a 7-ft. single express engine of Mr. Sinclair's design, which was working the up mail, wrecking both engines and trains, killing all the enginemen on the spot and causing a total casualty list of 25 killed and 73 injured. As the regulators of both engines were found shut, and the reversing lever of No. 218 was in mid-gear, it is supposed that the drivers had seen what would occur, but too late to prevent the most disastrous head-on collision in the annals of British railways.

(To be continued.)



Bogie Six-coupled Two-cylinder Compound Locomotive No. 286, Buenos Ayres & Rosario Ry.

COMPOUND LOCOMOTIVE FOR THE BUENOS AYRES & ROSARIO RY.

The locomotive we illustrate is one of a number of six-coupled bogie passenger engines which have recently been sent out to the Buenos Ayres and Rosario Railway in the Argentine Republic, having been built at the Atlas Works of the North British Locomotive Co., Ltd., Glasgow, to the designs and specification of Messrs. Livesay, Son & Henderson, the consulting engineers for this line. The 6-coupled wheels are 5-ft. 8-in. diameter, and the leading bogie wheels are 3-ft. 2-in. diameter, all having steel axles and tyres. These engines are two-cylinder compounds, the high pressure, on the left hand side of the engine, being 19-in. diameter and the low pressure 27½-in., which gives a ratio of approximately 1 : 2·09; the stroke is 26-in. The cylinders are placed outside the frames, according to the usual custom on Argentine Railways.

It will be noticed the piston rods are arranged to work through the front cylinder covers, a practice often adopted in the case of large cylinders, but in the present instance the high pressure is also treated in the same way. The front rods work through glands and hollow sleeves, closed at their extremities to exclude dust, there being, however, a few small holes for the air to escape.

The valve chest shown on the side of the smokebox is a special starting valve, worked from the reversing shaft, and arranged in such a way that when the engine is in "full gear," in starting a train or working slow up heavy gradients, high pressure steam is admitted to both cylinders and the engine works "simple"; and when the valve gear is "notched up," the engine works "compound."

The heating surface is 1,495 sq. ft. in the tubes and 139 in the Belpaire pattern firebox, making a total of 1,634 sq. ft.: the grate area is 25 sq. ft. The smoke box is large to allow of a spark arrester and deposit of ashes. The boiler is fed by one No. 9 mm. and one No. 10 mm. injector, and one long stroke pump.

The coupled wheelbase of the engine is 13-ft. 7-in., and the total 25-ft. 3½-in., and the weight empty is 56 tons 2 cwt., and full 61 tons 4 cwt.

The tender, which runs on two four-wheeled

Four-wheels Coupled Bogie Passenger Locomotive No. 107 "Cyclone," Great Northern Ry. (Ireland).

bogies, carries 3,526 gallons of water and 5 tons of coal. It weighs empty 20 tons 2 cwt., and 40 tons 17 cwt. when loaded. The total wheel-base of engine and tender is 47-ft. 7½-in.

The gauge of the Buenos Ayres and Rosario Railway is the standard of the Argentine Republic, *i.e.*, 5-ft. 6-in.

PASSENGER LOCOMOTIVE, G. N R. (IRELAND)

Mr. Charles Clifford, locomotive engineer of the above railway, has kindly supplied the photograph here produced, showing one of the "Tornado" class passenger engines, which has the following leading dimensions: cylinders 18-in. by 24-in., centres 2-ft. 7-in. apart; diameter of bogie wheels 3-ft. 1½-in., and of coupled wheels 6-ft. 7-in.; length of boiler barrel 10-ft. 2-in.; maximum internal diameter 4-ft. 4-in.; working pressure 175 lb. per sq. in.; heating surface: firebox 106.5 sq. ft., tubes 1,013 sq. ft., total 1,119.5 sq. ft.; grate area 18 5 sq. ft.; weight of engine in working order 42½ tons.

COMPOUND GOODS LOCOMOTIVE, AUSTRIAN STATE RYS.

We are indebted to Herr Gölsdorf for the illustration here given of a powerful type of goods locomotive, of which 23 have been built during 1905 and 1906 for service on the Arlberg Tunnel section, Austrian State Rys. They have the following dimensions: diameter of high pressure cylinder 22-in. and of low pressure cylinder 32½-in.; stroke 24¾-in.; diameter of ten-coupled wheels 4-ft. 3¼-in., total wheelbase 18-ft. 4½-in.; boiler, mean inside diameter 5-ft. 1⅝-in.; height of centre above rails 8-ft. 7-in.; number of tubes 264, diameter 2-in.; heating surface: firebox 143 sq. ft., tubes 2045 sq. ft.; total 2188 sq. ft.; grate area 36.8 sq. ft.; boiler working pressure 206 lbs. per sq. in.; weight, empty, about 58¾ tons, and in working order about 65½ tons. These engines are of series No. 180, Gölsdorf two cylinder compounds, and their numbers range from 95 to 117. No. 180·117, which is here illustrated, is now exhibited at the Milan Exposition prior to being put into service.

Ten-coupled Two-cylinder Compound Goods Locomotive No. 180·117, Austrian State Rys.

The Blakesley Hall Miniature Railway.

Steam Locomotive and Train.

Miniature American Type Locomotive.

Motor Engine "Petrolia" and Goods Train.

Private Station adjoining East and West Junction Ry., Blakesley.

BLAKESLEY HALL MINIATURE RAILWAY.

THIS miniature railway is situated at Blakesley Hall, the seat of Mr. C. W. Bartholomew, about twelve miles from Northampton.

As will be seen by the accompanying view, it is used for both goods and passenger traffic. The road, which is of 15-in. gauge, is constructed with flat-bottom rails on iron sleepers, and is well laid with slight gradients (1 in 100), cuttings and embankments being made as required.

The rolling stock, originally supplied by the Miniature Railway Co., 301, Broadway, New York, was built with two pairs of wheels to each carriage, but the owner soon improved upon this by building four-wheeled bogies and fixing frames to them so as to carry three carriage bodies for every four pairs of wheels. By this means the fixed wheelbase was considerably reduced, and gave much better running on curves and the circle tour, as well as reducing the number of wheels for a full train by one-third. With the surplus wheels, etc., more bogies were made, and a light trolley built for goods and general traffic. On the arrival of a new electric light plant, weighing 8 tons, the whole was taken from under the crane in the Railway Co 's goods yard to the engine house on the trolley, including a 18 horse power gas engine weighing 5 tons. This was considered to be a fair test for the road and the trolley too.

C. W. BARTHOLOMEW, ESQ.

The goods trains are worked by the "Petrolia" motor engine having a single cylinder 4-in. in diameter by 8-in. stroke, built at Blakesley Hall from the designs and under the entire supervision of the owner. It is very powerful considering its size, and can take a full load of six wagons laden with coal or coke from the East and West Jn. Railway sidings to the Hall coal cellars. This engine is also used for passenger trips, Blakesley Hall to the railway station, and *vice versa*, being more readily available than the steam locomotive, and sometimes has reached a speed of 30 miles per hour.

The passenger rolling stock is composed of one steam locomotive and four bogie carriages, which will seat 20 adults.

The track at present laid down is over half a mile long, including several branches. Starting from the engine sheds, or Hall terminus, there is a good and practically straight run (crossing the river once) for about a quarter of a mile to the East & West Junction Ry. Co.'s Blakesley station on the main line from Blisworth (L. & N. W.) and Olney (Mid.) westwards to Stratford-on-Avon and Broom Jn., on the Evesham and Redditch line of the Midland.

The two platforms are close together and joined by a private way. At the station there are points connecting with the goods yard, and it is there that the transfer of coal, coke, etc., takes place. The private station is a pretty structure with booking office, used generally by the family and their friends, whilst on certain occasions trains are run from the station to the Hall, and *vice versa*, in connection with the various functions held in the park. The line is fitted with telephone and electric light, and is worked with Sykes' electric signals on a similar system to that in use at the St. Enoch Station, Glasgow.

From the Hall terminus there are also other tracks through the park, one of which is a circle passing twice over the river amongst chestnut trees by an old ruin. The other track leads off the top side of the circle, and, wandering between an avenue of chestnut and other trees, joins the main line about 200 yards on the way to the railway station; from there a "triangle" is run off the circle, and by this arrangement it is easy to turn an engine or carriage without the use of a turntable.

Picnic parties are numerous during the season, and on one occasion about 40 visitors, all railway employees, from the District Manager downwards, from one of the large trunk lines, held their annual picnic in the park. The steam locomotive and coaches were placed at their disposal for the whole day, and the various trips were much enjoyed, several preferring the miniature train trips to cricket or other sports.

NEW LOCOMOTIVES, SWISS STATE RAILWAYS.

TO work the express services on their system the Swiss State Rys. have put into service a new series of locomotives of the type built in 1902 by the Jura-Simplon Co., which were illustrated in Vol. VIII. of this magazine. The latest series, one of which is here shown, is numbered 703-729, and belongs to what is known as Class A^3_5, four-cylinder compounds of the 4-6-0 type. The high pressure cylinders, which are $14\frac{3}{8}$-in. by

Ten-wheel Four-cylinder Compound Passenger Locomotive No. 704, Class A^3_5, Swiss State Rys.

26-in., are actuated by Walschaert gear, and the low pressure, which are 22½-in. by 26-in., are actuated by Joy's valve gear. The bogie and coupled wheels have diameters of 2-ft. 9½-in. and 5-ft. 10-in. respectively. In order to secure a good supply of steam, the amount of heating surface has been carefully considered, the firebox and 229 boiler tubes giving a total of 1,792.22 sq. ft., while the grate area is 28·0 sq. ft.; the working pressure of the boiler is 213 lbs. per sq. in. The locomotive weighs 63 tons 8 cwt. in working order, and the tender, which has a capacity for 3,742 gallons of water and 5 tons of coal, weighs 38 tons. These engines are equipped with "Pop" safety valves, Friedmann lubricators, Langer smoke consumers, the Hasler speed indicator, hand and compressed air sanding apparatus, and the Westinghouse-Henry air brake. They work express trains on the Geneva-Berne-Olten, Lausanne-Brigue and Basle-Lucerne

Mogul Locomotive No. 1301, Class B^3_4, with Schmidt Superheater, Swiss State Rys.

Mogul Locomotive No. 1707, Class B^3_4, Swiss State Rys.

sections, and run at a maximum speed of 62 miles per hour.

The "Mogul" locomotive shown in our second illustration is one of two, Nos. 1301-1302, of Class B^3_4, built to work heavy passenger and goods trains. It is simple, with cylinders 21¼-in. by 23⅝-in., the truck and six-coupled wheels having diameters of 2-ft. 9½-in. and 4-ft. 11⅞-in. respectively. The heating surface of the firebox is 132·39 sq. ft., the total being 1,484·37 sq. ft., and the grate area is 24·75 sq. ft. Schmidt's superheater is fitted in the smokebox. The boiler pressure is 170 lbs. per sq. in. The engine has piston valves actuated by Walschaert gear, and is equipped with the Westinghouse brake. It has a six-wheeled tender carrying 4 tons of coal and 3,521 gallons of water. The maximum speed permitted to engines of this type is 46½ miles per hour. The weight of these engines is about 54¾ tons.

The third illustration shows a somewhat similar type of engine, but built on the three-cylinder compound system. The numbers of this class range from 1601 to 1699, and from 1701 to 1727. There is one h.p. cylinder 19⅜-in. by 23⅝-in. placed inside, and two low pressure cylinders outside the frames, 21¼-in. by 23⅝-in., all actuated by Walschaert valve gear. The coupled wheels are 4-ft. 11⅞-in. in diameter, and the leading wheels, which are mounted on an Adams' radial truck, are 2-ft. 9½-in. in diameter. The total heating surface is 1,617 sq. ft., and the grate area is 24·75 sq. ft.; the boiler pressure is 199 lbs. per sq. in. The engine weighs about 54 tons in working order. These engines have Friedmann injectors, and are equipped with the

Viaduct near Lausanne, Swiss State Rys

Geneva Fast Train, Swiss State Rys.

Westinghouse brake. They work trains of 200 tons on gradients of 1 in 50, and 160 tons on gradients of 1 in 40, at speeds of 18½ miles per hour.

All the engines illustrated are provided with steam heating apparatus for passenger train service, and were built at the Swiss Locomotive Works at Winterthur.

Our other illustrations show the viaduct near Lausanne, with the Geneva-Basle-Zurich express train running over it, and the Geneva express train at full speed.

Bogie Tank Locomotive No. 79, North British Ry., at the Jubilee of the Selkirk Ry.

JUBILEE OF THE SELKIRK RY.

The Jubilee of the Selkirk branch of the North British Ry. was celebrated on Thursday, April 5th last. The first passenger train was run on April 5th, 1856, and special interest was attached to the Jubilee celebration in view of the fact that the 10.45 a.m. train from Selkirk and back was driven by Willie Gow, the veteran engine driver who ran the first train, and has remained at Selkirk ever since. For the long period of 42 years Gow officiated as driver of the Galashiels and Selkirk train, retiring on May 4th, 1898.

The line when first opened was the property of the Selkirk and Galashiels Ry. Co., and at the celebration dinner the seals of the company were on view. Our photo shows the branch engine No. 79 N. B. R., a four-coupled bogie side tank, decorated with flags and streamers and with a placard in front bearing the inscription, "Jubilee of the opening of the Selkirk branch, 1856-1906." The group of officials, reading from right to left, are W. Gow, the first driver; N. Paton, present fireman; T. Lamb, Galashiels locomotive foreman; A. Stewart, present driver; E. Grossart, former guard on the branch, and W. Ormiston, present guard.

The Selkirk branch is five miles long from the junction, with the main line one mile from Galashiels. Leaving the main line at Selkirk Junction the line crosses the river Gala almost at once, then along an embankment, through a cutting near Abbotsford—the home of Sir W. Scott—to Abbotsford Ferry Station, 2 miles 44 chains from Galashiels. The Tweed is next crossed on an iron viaduct resting on five piers; then Lindean Station is passed 1 mile 31 chains from Abbotsford. Between Lindean and Selkirk the main road from Selkirk to Galashiels is crossed. There are 11 trains each way daily, one a through train from Edinboro' *via* Peebles, and two goods trains, one being from Portobello.

LUBRICATION.

The lubrication of a locomotive is an important matter that requires careful attention from the men in charge of it. A painstaking driver will rarely be troubled with a warm bearing, although sometimes a bearing will mysteriously get hot. Cases have been known where a bird has been knocked down by the engine, caused the ballast to fly up into the gear and play havoc with the slide bars, but such cases are rare.

In order that bearing surfaces should run cool and easily a thin film of lubricating medium is required between those surfaces to prevent them coming into actual contact. If the lubricant is not there, friction will follow which will generate heat, causing the soft metal parts to melt and the harder parts to expand, and if not attended

to in time is liable to cause delays and damage. The large ends of the connecting rods in inside cylinder engines are the most dangerous parts to get hot. When a large end gets very hot and the metal expands there is the liability of the front cylinder cover being knocked out, or the connecting rod breaking and knocking a hole in the firebox, needless to say, with extremely serious results.

The kinds and qualities of oil used by the different companies varies. For the axleboxes, motion, etc., rape oil alone or mixed with a little mineral oil is much used. Tallow is not used so much now as formerly; it is a good lubricant for axleboxes when running warm, but if they are behaving satisfactorily it is best to keep it out of them, as it will thicken the oil, causing it to pass too slowly through the trimming—more so of course in cold weather.

For use in sight feed lubricators for the cylinders and slide valves, a thick mineral oil (sometimes nicknamed "Black Jack" by enginemen) is commonly used; it will stand the heat and is not so corrosive as tallow, which at one time was employed so much for these parts.

Trimmings to fit in the syphon pipes are usually made with wire plaited and with a loop at the end for strands of worsted to be held in. For the rotating parts, such as coupling rods, etc., short trimmings, known as "plug" trimmings, as required, the worsted barely reaching to the top of the pipe, so as to leave a small space to catch the oil when it is thrown about by the movement of the engine. A piece of cane or cork should be screwed in the hole in the oil cup to prevent the oil being thrown out, and, being porous, will admit air to replace the oil as it is used. In some cases a spring button fits the oil hole, then a small hole is drilled through the button to admit air.

For the axleboxes, slide-bar cups and other stationary oil vessels, "tail" trimmings are used; the worsted in these is required long enough to reach to the bottom of the oil recess; the oil will work its way through the trimming to the bearing by capillary attraction.

The number of strands of worsted required for the trimmings must be determined by the thickness of the oil used; if a trimming is found to syphon too large a quantity of oil more strands should be added, and the number lessened if not using enough. A note should be taken of the number of strands required, for future guidance. Some trimmings ready made, also some pieces of cane or cork, should always be kept by enginemen.

A driver when getting his engine ready for the day's work should see that all lubricator and oil-cup covers are not loose; if they are left loose they are liable to work out when running and be lost.

If any part is found not to take much oil it should be inspected at once, the trimmings cleaned or renewed or the oilcup cleaned out as required. Tail trimmings should be adjusted and gland "swabs" or "mops" seen to be properly in their places.

Mops for the glands are made of worsted or lamp cotton, plaited and tied into a ring to fit on the gland nuts. The ends of the cotton or worsted after being tied should not be left hanging round the rods; mops with straggling "tails" conduct half the oil to the ground, consequently wasting it and causing the driver to wonder why the rods do not run a bright color.

The parts with plug trimmings should be oiled before leaving the shed, as the engine cannot always be placed in the right position when standing on a train. The horn-blocks require a little oil, especially on a line with many curves, and the engine will ride easier with horn-blocks greased. The slide bar and gland cups should be the last to be filled up, so as to save going round to them while the engine is moving. The pins in the link motion require a little rape oil in the holes made for the purpose. Neglect to oil these small but important parts is likely to cause them to get hot and sieze.

It is difficult to fix a rule as to how many drops of oil per mile any particular part should use, owing to the fact that different kinds and qualities of oils are used by the different companies, also that engines work under greatly dissimilar conditions. An engineman should make himself well acquainted with the character of the material he is supplied with, so as to know just how to deal with it.

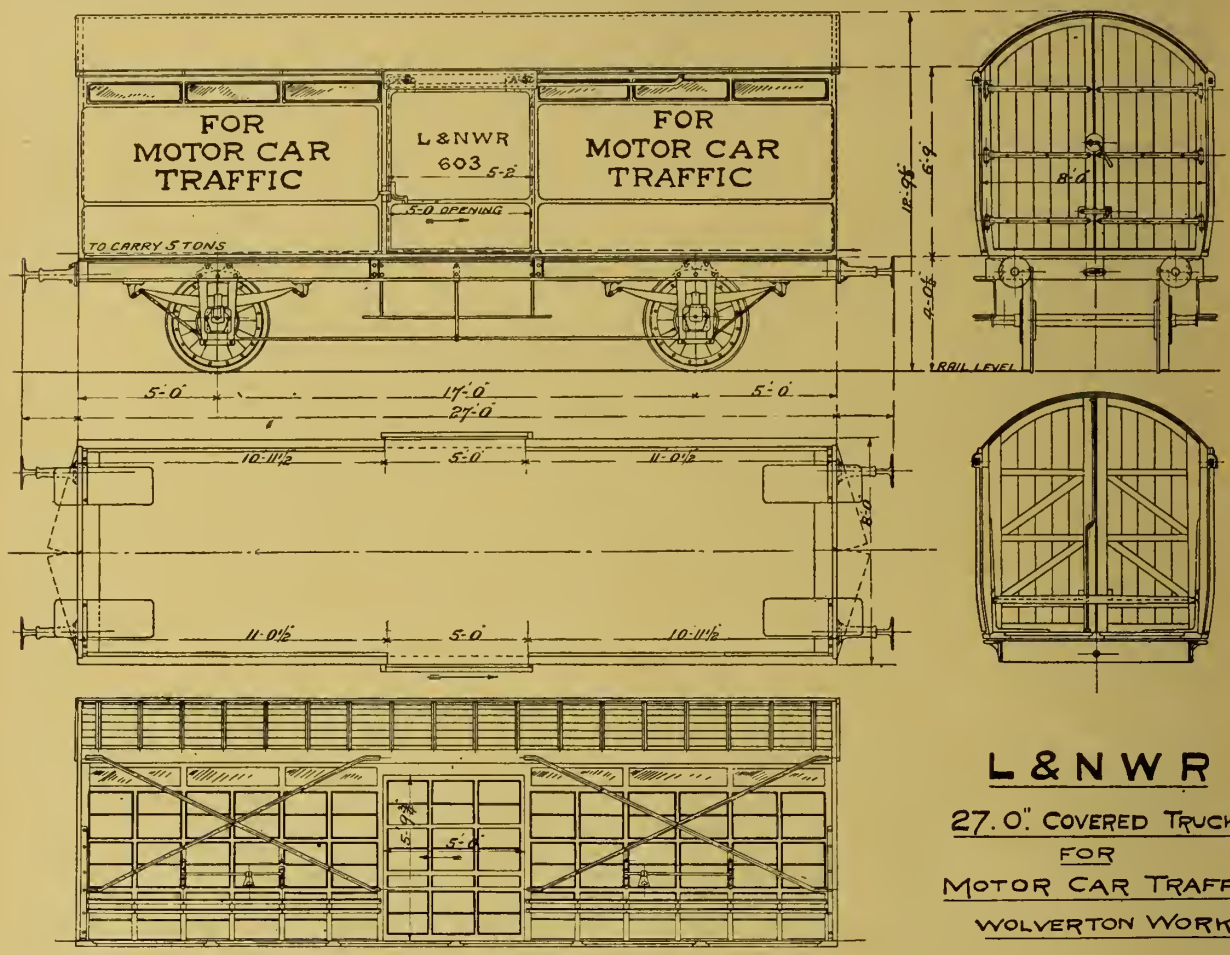
When an engine is running its first trips when new or after coming out of the repair shops, it is the best plan to be rather generous with the lubrication until everything is in good order, for once a bearing gets hot it is often a source of trouble and anxiety for some time after.

Some enginemen are in the habit of putting cylinder oil in the axleboxes; this is a practice that is not at all advisable, especially in cold weather. In warm weather a little of it helps to check the rape oil from being used too quickly, but if a large quantity of mineral oil is put into the axleboxes, it will not syphon through the trimmings until the axlebox begins to run warm. If a driver finds that someone else has been working his engine and has served the axleboxes with the thick oil, the best way is to clean the trimmings and dose the thick oil with paraffin, which will help it to get through the trimmings and also soften the pads, which may have become almost solid with the thick oil.

In conclusion it can be said that a well lubricated engine should be lighter on coal than one that is marked light on oil consumption.

SPECIAL COVERED TRUCKS FOR MOTOR CAR TRAFFIC, L.& N.W.R.

THE covered trucks here illustrated, designed by Mr. C. A. Park, M.I.C.E., carriage superintendent of the London & North Western Ry., were built at the Wolverton works of the Company. They are 27 feet long by 8 feet wide, 8 feet 9 inches high at centre and 6 feet 9 inches at side cornice, all outside dimensions of body. When mounted on four-wheeled underframe the height from rail level at centre is 12 feet 9½-in. and at the side cornice 10 feet 9½ inches.



They are built specially for motor car traffic and have double folding doors at each end, giving openings the full width of the inside of the truck. Also on each side at the centre there are sliding doors with 5 feet clear openings, so that after loading the motors these doors are available to allow of securing the cars in place.

The framing of the body of the truck is in oak and teak, panelled outside with planished steel plates, 14 gauge, secured in position with screws and joints covered with 1¾-in. mahogany moulding, which gives good length panels without a joint between the ends and centre doors. Over the top of these panels and under the cornice are glass framed lights, moulded in, which give a good light to the interior.

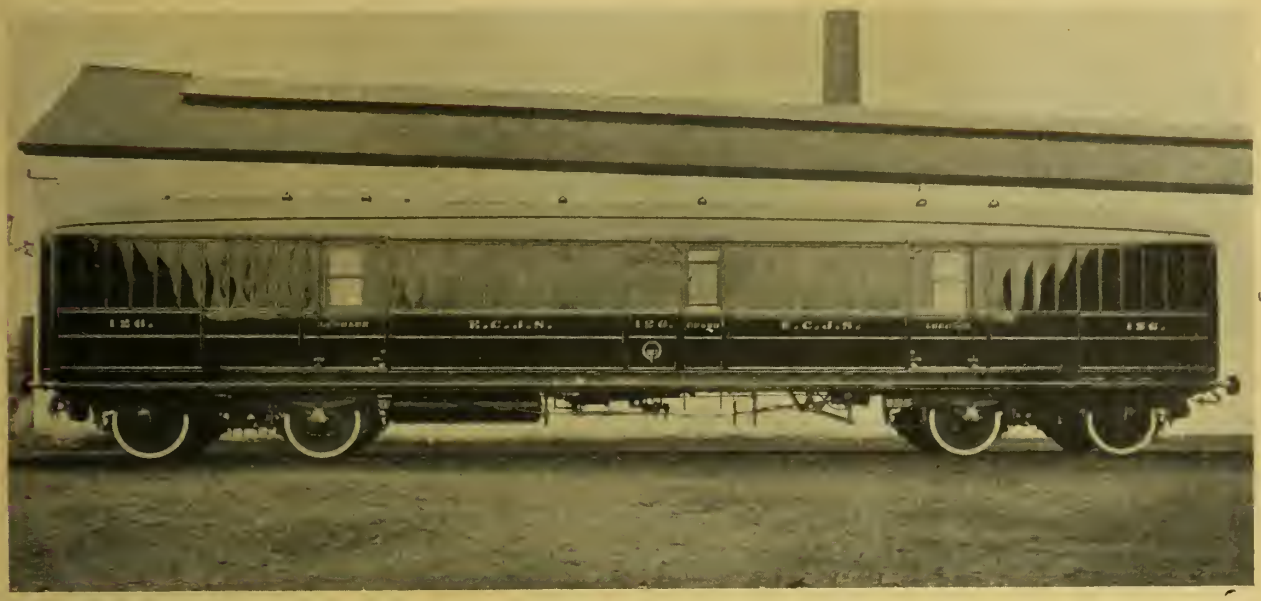
The inside is cased between pillars with ⅝-in. deal casing boards, with spaces between boards for ventilation.

The end folding doors are of the usual standard pattern, framed and panelled outside with vee-jointed boards and hung to corner pillars with wrought iron band hinges, three to each door, with all fastenings complete.

The floors are laid with 1¼-in boards, with oak wearing-slats laid crossways and spaced between.

Wheel-bars are provided, which are carried on 2-in. by 2-in. by ⅜-in. angle iron and space-drilled for securing the bars in different positions.

The underframe is 27-ft. long, or over buffers 31-ft., and is made of steel throughout, the sides being of bulb-section angles with longitudinals and diagonals of channel steel, all rivetted together with corner knees and plates. It is mounted on two pairs of wheels of standard pattern, having a 17-ft. wheel base, with 5-ft. 6-in.



Vestibuled Luggage Brake Van, East Coast Service.

bearing springs, and is also fitted with the "rolling ring" automatic vacuum brake.

The painting of the exterior of the truck is in chocolate, with lining and lettering in gold colour, all varnished. The inside is painted throughout a light green.

LUGGAGE BRAKE VAN, E. C. J S.

The accompanying illustration shows a new steel framed luggage brake van built for the East Coast Joint Service at the Doncaster works of the G.N.R. It has the following leading dimensions: length over vestibules 57-ft. 11-in., over body 56-ft. 6-in., and over frames, 55-ft.; width over body 8-ft., and over the guard's projections 9-ft.; wheelbase of each bogie 8-ft., distance between bogie centres 39-ft.; extreme height from rail level 13-ft. $3\frac{5}{8}$-in.; total weight 23 tons 15 cwt.

35-TONS OPEN GOODS WAGON, GREAT NORTHERN RY.

The wagon here illustrated is one of a new type recently introduced on the above railway by Mr. H. A. Ivatt, locomotive, carriage and wagon superintendent. The body of the wagon is of wood, having two doors on each side 5-ft. 5-in. wide, and four bottom doors measuring 4-ft. 10-in. by 2-ft. 1-in. The underframe is constructed of steel channels, strongly trussed. Leading dimensions are as follows: length over buffers 38-ft., and over body 35-ft.; width over body 8-ft.;

35-Tons Open Goods Wagon, Great Northern Ry.

internal capacity 786 cubic ft.; floor level 4-ft.; extreme height over coping 7-ft.; bogies: diameter of wheels 2-ft. 6-in., wheelbase 5-ft. 6-in.; distance between bogie centres 25-ft.; tare weight 14 tons 1 cwt. The diamond frame bogies are designed to turn completely round on their pivots, so that the wagon can be worked from track to track on ordinary wagon turntables without uncoupling the brake work; for this reason the pull rod is arranged to pass vertically through the centre casting. The wagon is fitted with the vacuum brake, and with a wheel hand brake that can be applied or released from either side.

This railway has recently put into service a number of six-wheel bogie passenger coaches. They differ in some respects from those previously built in several details, the most noticeable being the use of mahogany in the interior decoration of the first class compartments in place of polished teak. Improvements have also been made in the lighting, a larger burner being used. These cars will probably be the last to be fitted with the clerestory roofs, as several coaches with four-wheel bogies and high elliptical roofs are in service. These roofs are brought down at the ends to match the clerestory roofs and we understand that all new stock for the East Coast route will in future, also be so built.

The first class dining cars are having their interiors enamelled white and electric light fitted.

THE FOOTBALL SPECIALS.

THE "Final Cup Tie" at the Crystal Palace on Saturday, the 21st ult., between the Everton and Newcastle teams brought a record number of excursions from the North of England to the Metropolis.

Euston headed the list with 43 return specials, and they were despatched homewards at 5 min. intervals up to about 4.00 a.m. on Sunday. Paddington with 20 specials was not so busy.

Marylebone had 16 specials to send on their return journey at about 10 minutes' intervals from 10.10 p.m. to 1.15 a.m. These all went *via* Quainton Road, and were non-stop as far as Leicester. To make up these trains, saloons belonging to the L.B. & S.C., S.E. & C. and L. & S.W. Rys. were requisitioned.

The bulk of the St. Pancras special traffic came from the Birmingham district, and 22 special trains were booked, saloon parties being conveyed in Pullman drawing-room cars, Somerset & Dorset, Midland & Great Northern Joint, and G. & S.W. Ry. coaches.

There were 27 specials booked into King's Cross, of which six ran in duplicate, making 33 in all, mostly from Newcastle and that district, and the trains consisted generally of the new excursion stock of up-to-date bogie coaches, and E.C.J.S. coaches, with a few trains also of North British, Lancashire & Yorkshire, and North Staffordshire Rys. saloons. As on the same occasion last year, the No. 2 road from Finsbury Park to Wood Green was reserved for working empty trains close together to Bounds Green, block working being temporarily suspended.

The Great Eastern Ry. for once seemed to appreciate the possibilities of the situation, and this year ran three specials, as against two in previous years. All came *via* Cambridge from Doncaster, Norwich and the district served by the Lancashire, Derbyshire & East Coast Ry.

CORRESPONDENCE.

THE LOCOMOTIVES OF THE GREAT EASTERN RY.

To the Editor of "The Locomotive Magazine."

Dear Sir,—The Gooch tank engines Nos. 250-259, when they first came out, had no safety valve on the middle of the boiler barrel, as shown in the illustration, Fig. 88, but only Gooch's standard valve casing over the firebox. Subsequently this was replaced by another in Sinclair's style, and it was not, I believe, until a dome was added over the firebox that the safety valve on the boiler barrel was added, as shown in Fig. 89.

I may mention further that the original Gooch valve-column was of brass, unlike those of the earlier engines of that type, which were of copper, all painted over except in the case of No. 20. When Nos. 250, etc., first began to run the Tilbury trains, the brass valve casing was burnished and unpainted. Subsequently it was painted green, like those of Nos. 4-12, 21-5, also of the Express class Nos. 27, 94 and 274-9; all, however, subsequently received the Sinclair casing.

I may also add what does not seem to be generally known or remembered, that when the Tilbury line was first opened, and until the Gooch tanks were ready, the trains were worked by the Sharp single-wheel tender engines, Nos. 260-270. All this I state of my own personal knowledge and observation.—Yours truly,

March 5th, 1906. C. ROUS-MARTEN.

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THE LOCOMOTIVE MAGAZINE.

Vol. XII. JUNE 15th, 1906. No. 166.

RAILWAY NOTES.

GREAT CENTRAL RY.—The accompanying illustration, reproduced from a photograph taken at Chorley Wood, shows the Atlantic three-cylinder compound No. 258 hauling the Sheffield express, which runs without stop between Marylebone and Sheffield in 2 hours 55 minutes. Of the two-cylinder Atlantics, No. 358 is the latest out.

Messrs. Beyer, Peacock & Co., Ltd., have begun delivery of the new series of six-coupled bogie locomotives with 6-ft. 6-in. wheels, Nos. 1095-1098 being already out, whilst the others are progressing rapidly.

GREAT WESTERN RY.—Nos. 2904-2910 complete the series of new six-coupled bogie locomotives referred to last month. At present only No. 2901 is provided with a superheater. These ten engines have all appeared during one month.

Other new engines recently out are Nos. 3704-3707 of the new 4-4-0 "Dominion of Canada" class; Nos. 3149-3150, large 2-6-2 tank engines of the type illustrated in August last year; and Nos. 3101-3108, small 2-6-2 tank engines built at Wolverhampton, similar to No. 115 illustrated in December, 1904.

Photo by THE SHEFFIELD NON-STOP EXPRESS TRAIN (GREAT CENTRAL RY.) PASSING CHORLEY WOOD, METROPOLITAN RY. *Loco. Pub. Co.*

LONDON & NORTH WESTERN RY.—New engines of the "Precursor" type have recently been put into service, Nos. 282 "Alaric," 261 "Antæus," 675 "Adjutant," 772 "Admiral," "Faerie Queene," "Richard Trevithick," and 2017 "Tubal." No. 2513, by the way, is named "Levens," not as printed in our last issue.

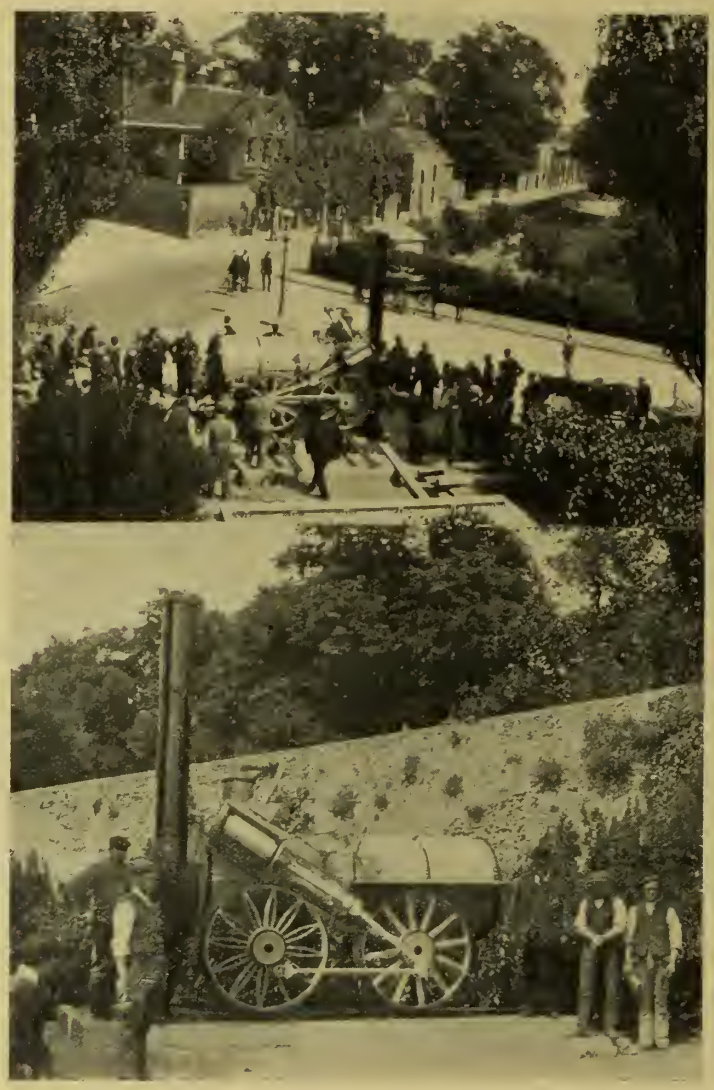
No. 1845 is another three-cylinder compound mineral engine which has been converted to an eight-coupled simple, with a boiler of the "Precursor" type, as illustrated on page 71 of last issue.

The coal trains between Severn Tunnel Jn. and Old Oak Common, and empty wagons on the return journey, are now worked by the Consolidation engines exclusively, with accelerated schedules, and increased loads, the minimum being 50 wagons and van between Stoke Gifford and Severn Tunnel Jn., and the maximum (on Sundays only) being 80 wagons and van between Swindon and Old Oak Common.

GREAT EASTERN RY.—The connection with the new Norfolk and Suffolk Joint Railway, from Mundesley to Cromer, about half-a-mile on the Norwich side of Cromer G.E. station, to Runton West Junction on the M. & G. N. joint line, giving

the G.E. Co. a through route from London to Sheringham, will be opened for traffic about the middle of July. The Mundesley to Cromer (Beach) line (Norfolk and Suffolk Joint Committee) *via* the coast, with stations at Trimingham and Overstrand, will be opened about the first week in August.

MR. F. W. WEBB.—We regret to announce the death, on 4th inst., of Mr. Francis William Webb (aged 71), who was for upwards of 30 years chief mechanical engineer of the London & North Western Ry. His connection with that railway really extended over more than half a century, for he first entered Crewe Works as a pupil in 1851 under Mr. Francis Trevithick, then chief of the northern division loco. department. After serving his time, Mr. Webb became chief draughtsman and subsequently works manager under Mr. John Ramsbottom. For five years, from 1866 onwards, he left Crewe to join the Bolton Iron & Steel Co., but in October, 1871, he returned to the L. & N. W. works as chief mechanical engineer, on the retirement of Mr. John Ramsbottom from that position. As a warm and practical advocate of compounding locomotives, Mr. Webb has at times been severely criticised, and it is significant also that within barely three years of his retirement from office his successor has removed from service or reconstructed all but a very few of the several hundred three and four-cylinder compound locomotives of his design. But apart from that disputed practice, Mr. Webb justified his appointment by constituting Crewe Works into one of the largest and most self-contained railway factories in the world. Almost every requisite, both of the running and permanent way departments, was made from the raw material by the railway company itself, and the "chief" not only secured efficiency by this system, but effected economies which, on the turnover of a huge organisation such as he controlled, can only be characterised as immense. Mr. Webb retired from office in June, 1903, and since that date had suffered from failing health. He was twice elected mayor of Crewe, a town which during his association with it increased in population from 18,000 to 40,000—almost all railway employees. Upwards of 4,000 locomotives were built at the Crewe works during his term of office, apart from the other details of railway material already referred to.



A Railway Relic.—Placing "Invicta" in the City Moat Garden, Canterbury. *(See page 91 following)*

CALEDONIAN RY.—No. 903, the first of five new six-coupled bogie locomotives, is now engaged on steam trials. In general appearance these engines are similar to Nos. 49 and 50, but the boiler barrel is of larger diameter and the arrangement of safety valves is different.

In addition to the six-coupled "Oban" bogie engines, Nos. 51-54, recently built, which are similar to No. 55, illustrated in our issue of July 1902, Mr. McIntosh is about to construct 15 more of the same type, but with larger boilers.

MESSRS. BEYER, PEACOCK & CO., LTD., have on hand six 4-4-4 and six 2-6-2 tank engines, five 2-4-0 passenger engines for the Buenos Ayres Western Railway, 13 saddle tank locomotives for the Buenos Ayres & Rosario Ry., two six wheels coupled bogie engines for the Tasmanian Government Rys., and a further 10 four-coupled express locomotives for the Dutch State Rys.

THE HISTORY OF THE LONDON & SOUTH WESTERN LOCOMOTIVES.

(Continued from page 41.)

WITH Nos. 368 to 373 the Beattie period of locomotive history of the L. & S. W. R. terminates, these six engines being the last to the order of Mr. W. G. Beattie. They were six-coupled goods engines with cylinders 17-in. by 24-in., and wheels 5-ft. in diameter, and were identical to Nos. 336 to 347, described in our March issue. Messrs. Beyer Peacock built and delivered them in April and May, 1878 (makers' Nos. 1781 to 1786).[18] These engines were rebuilt at various dates from 1888 to 1892, and No. 368 was scrapped in March 1893, whilst all the rest are still at work but in the duplicate list.

shown in Fig. 53, had leading bogie disc wheels 2-ft. 6-in. in diameter, and driving and trailing wheels coupled 5-in. 7-in. in diameter. The cylinders were placed outside the frames slightly inclined from the horizontal, and were 18-in. in diameter with a stroke of 24-in. The centres of the coupled wheels were placed 8-ft. 6-in. apart, and from centre of bogie to centre of driving wheel was 9-ft. 11½-in. The bogie centres were 6 ft. 6-in. apart. The total wheelbase was 21-ft. 8½-in. The boilers of these locomotives were 10-ft. 0¾-in. in length, with a diameter of 4-ft. 2-in., and were pressed to work at 140 lbs. per sq. in. The firebox was 5-ft. 8-in. from back to front, and 4-ft. 8¼-in. high in centre. The boiler contained 199 tubes of 1¾-in. external diameter. The heating surface was: tubes 947 sq. ft., fire-

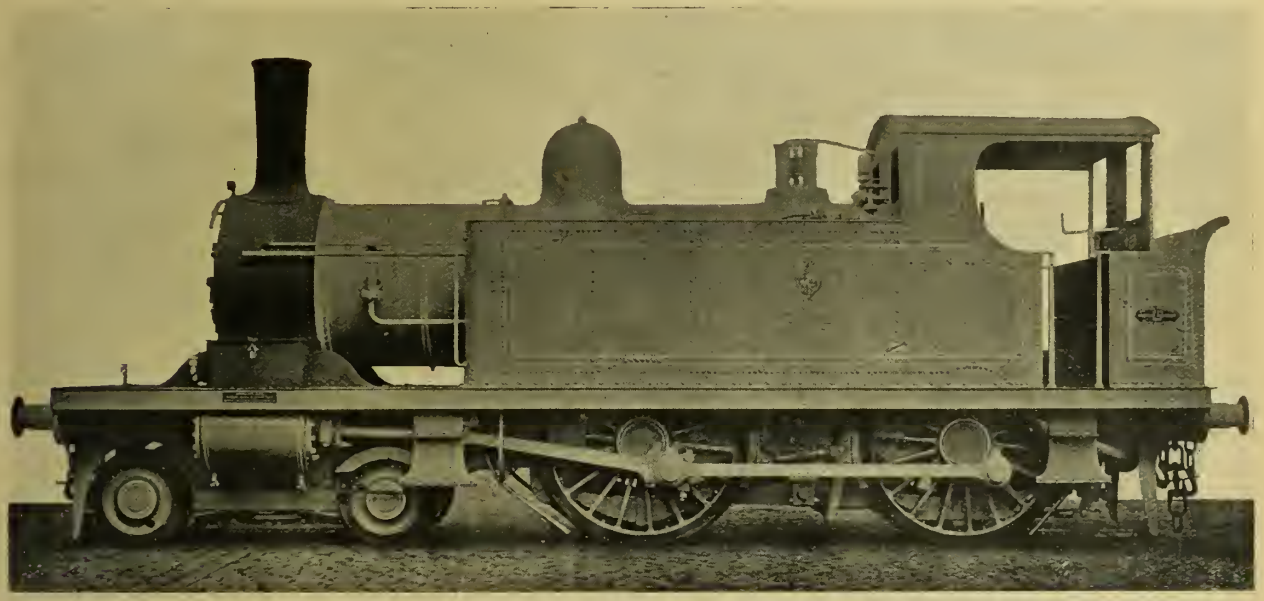


FIG. 53.—FOUR-WHEELS COUPLED BOGIE PASSENGER TANK LOCOMOTIVE NO. 379, LONDON & SOUTH WESTERN RY.

Mr. Wm. Geo. Beattie retired from the position of locomotive and carriage superintendent in 1877 owing to failing health, and the directors then appointed Mr. William Adams, M.I.C.E., M.I.M.E., to the post. Mr. Adams had previously been engaged as locomotive and carriage superintendent of the North London, to which he was appointed in 1854, and in 1873 he succeeded to a similar position on the Great Eastern Ry.

Mr. Adams's advent brought about the introduction of much larger and heavier types of locomotive, but nearly ten years elapsed before any were constructed at the Company's workshops at Nine Elms. The first engines designed by Mr. Adams were 12 large bogie passenger tank engines, constructed by Messrs. Beyer, Peacock & Co., Manchester, and delivered by them in the year 1879. These engines, as

box 100 sq. ft., total 1,047 sq. ft. The grate area was 16 sq. ft. The height of chimney from rail level was 13-ft. 2¾-in., and the boiler line was placed 7-ft. above the level of the rails.

The weight of these engines in working order was originally about 52 tons, but they have now all been altered by the addition of a trailing or radial pair of wheels beneath the coal bunker, and the extension of the water space by the construction of a bunker tank, increasing the carrying capacity to 1,650 gallons. The fuel space is now 84 cubic feet. The present weight of these engines in working order is 58 tons 19 cwt., distributed as follows: on bogie wheels 17 tons, on driving wheels 17 tons 6 cwt., on trailing wheels 16 tons 9 cwt., and on radial wheels 8 tons 4 cwt., total 58 tons 19 cwt. The radial wheels were added by Mr. Adams at Nine

Elms between the years 1883 6. These engines were numbered as follows:—

Railway Nos.	Makers' Nos.	Radial wheels added.
46	1832	April, 1886
123	1833	Jan., 1886
124	1834	Mar., 1883
130	1835	June, 1885
132	1836	Nov., 1885
133	1837	Jan., 1885
374	1838	Dec., 1886
375	1839	Oct., 1884
376	1840	Dec., 1883
377	1841	July, 1886
378	1842	Aug., 1885
379	1843	Nov., 1884

Ever since their delivery these engines have been engaged in the London district, and are all still actively employed on the local services, taking turns with the modern tank engines working the suburban traffic. None of them have been rebuilt since their modification to ten-wheeled tank engines, except by the provision in cases of new fireboxes, and they have in every way proved themselves most excellent locomotives. Some of these engines have recently been fitted by Mr. Drummond, the present locomotive superintendent, with the standard cast iron ornamental pattern chimney.

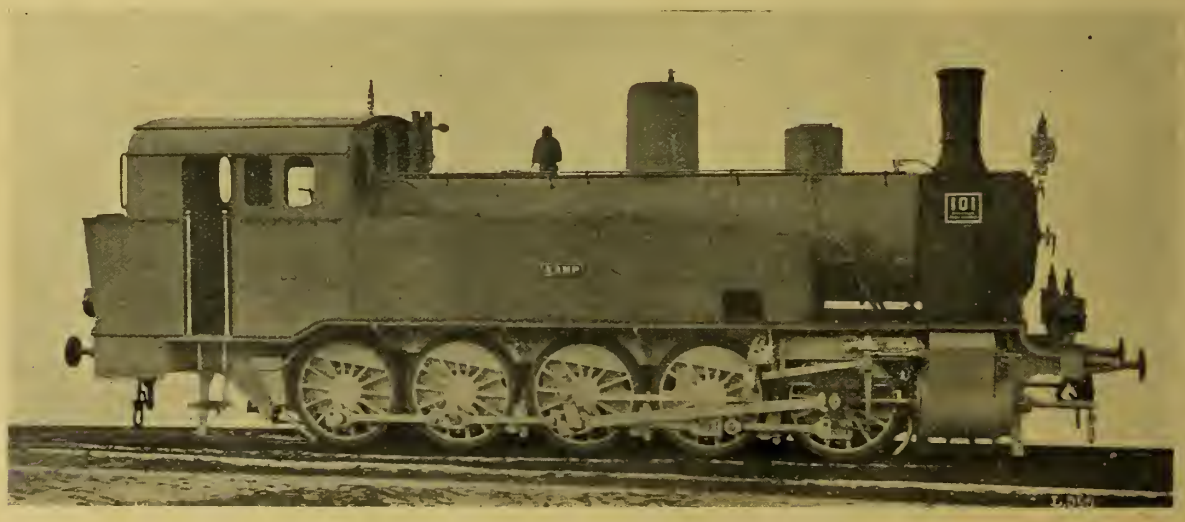
(*To be continued.*)

"DECAPOD" TANK LOCOMOTIVE, WESTPHALIAN RAILWAY.

By the courtesy of the builders, the Hannoversche Maschinenbau Actien Gesellschaft (*vormals* Georg Egestorff), of Hannover-Linden, we show the accompanying photo-reproduction of a powerful 0-10-0 goods tank locomotive constructed for the Westfälische Landes Eisenbahnen, a line of normal gauge abounding in sharp curves and gradients as steep as 1 in 50. The leading dimensions are as follows: cylinders 20½-in. in diameter by 23⅞-in. stroke; diameter of wheels 4-ft. 3¼-in.; total wheelbase 18-ft. 4½-in.; 184 tubes 14-ft. 9¼-in. long and 1¾-in. in diameter; boiler pressure 176 lbs. per sq. in.; heating surface, firebox 90 sq. ft., tubes 1,147.5 sq. ft., total 1,237.5 sq. ft. grate area 21.5 sq. ft.; weight, empty 49¾ tons, and in working order 63 tons. The leading and trailing axles are provided with side play to ease the negotiation of curves, and for the same reason the drawbar gear has its centres extended well inwards at back and front, with a swinging motion across the centre line of the engine at either end.

North British Ry.—A series of "Atlantic" locomotives are in course of construction for this railway to work the East Coast traffic.

North Eastern Ry.—The new high-level bridge over the Tyne between Gateshead and Newcastle, which has been more than 3½ years in construction, is now rapidly approaching completion and will be opened by H.M. the King in July. The bridge comprises four spans having a total length between abutments of 1,150-ft. and a clear height above high water mark of 83-ft. It will carry four tracks as compared with three on the older bridge, but its chief advantage consists in the fact that the converging lines are so arranged that in future trains will run through the Newcastle Central Station, and will no longer have to continue their journey North or South with what was originally the leading vehicle converted into the last coach, a reversal of order which was a source of great inconvenience alike to railway officials and passengers. The work of constructing the new lines leading to the bridge, and the erection of the bridge itself represent an enormous amount of work and the placing in position of a vast quantity of material.



Ten-wheels Coupled Tank Locomotive "Kamp," Westphalian Ry.

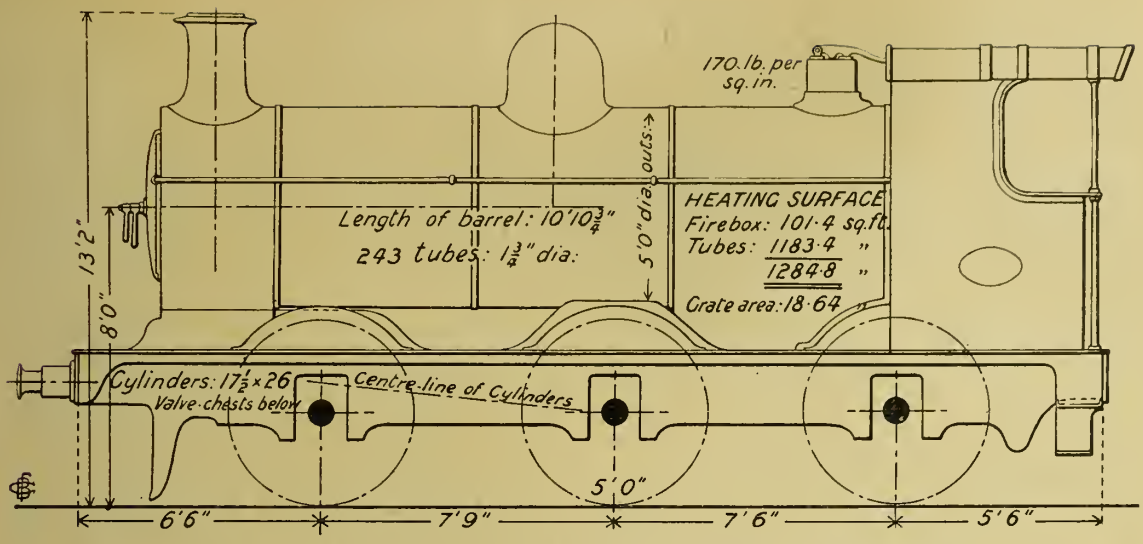
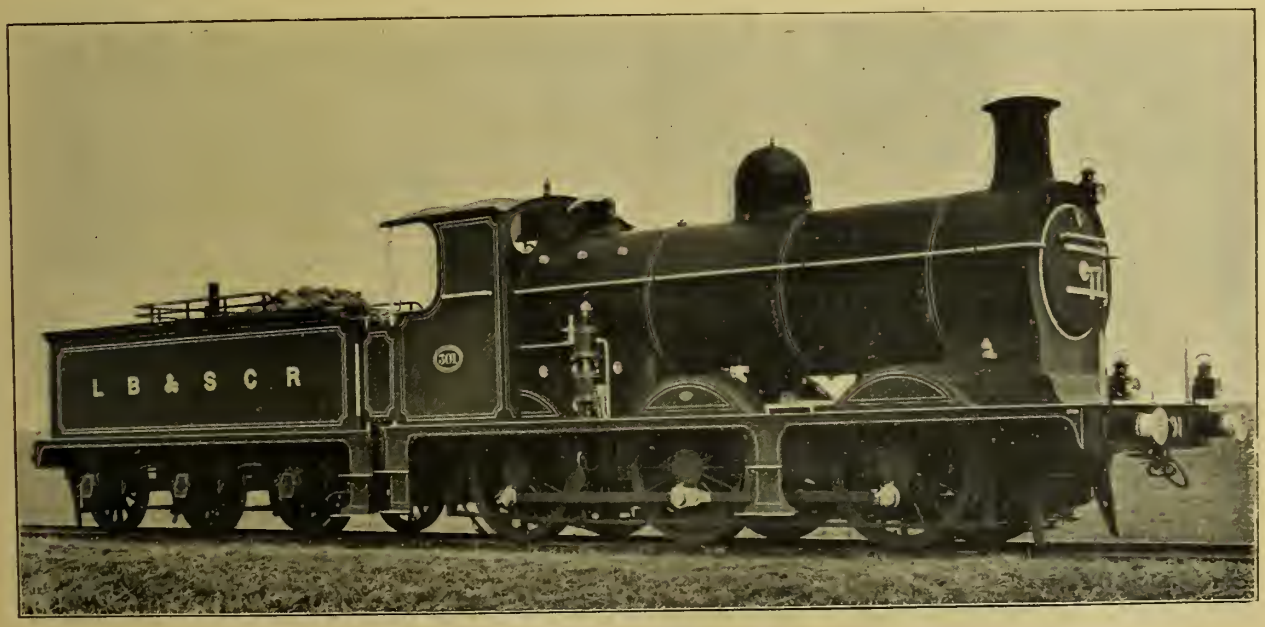


Diagram of Six-wheels Coupled Goods Locomotive, London, Brighton & South Coast Ry.

NEW GOODS LOCOMOTIVES, L. B. & S. C. R.

The accompanying diagram shows the outline and leading dimensions of a new series of goods locomotives recently designed by Mr. D E. Marsh, the locomotive engineer of the above railway. These engines, of which ten are now in course of construction, will bear Nos. 300-309, and among other details they will be equipped with the Westinghouse brake, steam sanding gear for the leading wheels going forward and for the trailing wheels when running tender first, and the boiler will be fed by two pumps worked off the crossheads.

A Railway Relic.—After deploring the fate of the G.W.R. veterans "North Star" and "Lord of the Isles," now broken up, and of the L. & N.W.R. "Cornwall" and other famous engines, it is satisfactory to learn that through the good offices of Sir David Salamans, a home has been found for the S. E. Ry. veteran "Invicta" in the City Moat Garden at Canterbury. "Invicta" was supplied to the Canterbury and Whitstable Ry. in 1830, by Messrs. R. Stephenson & Co., and has for many years been stored at Ashford Works, pending the finding of a suitable last resting-place. It took part in the Darlington Jubilee of 1875 and the Stephenson Centenary of 1881.



Six-wheels Coupled Goods Locomotive No. 301, London, Brighton & South Coast Ry.

THE ARRANGEMENT OF LOCOMOTIVE SHOPS.

(*Concluded from page* 51.)

THE position occupied by one shop relatively to another is the next and most important point. For convenience the shops and yards may be grouped together.

Group 1—Timber yard, pattern and joiners' shop, brass, iron and steel foundries and yards.

Group 2—Fitting and machine shop, forge, smithy, wheel shop.

Group 3—Boiler shop, erecting shops, paint shop.

Group 4—Electrical shop, millwrights' shop, tinsmiths' shop and other small shops.

Taking the groups in order and in detail, there should be a yard set apart for the storage of timber, with sheds for drying purposes, close to the pattern shop, a portion of which may be occupied by joiners. Floor space will be required for some machinery, and the shop should be provided with a gallery for the storage of patterns. Next should come the brass foundry, then the iron and steel foundry, having all its furnaces along one side and provided with numerous lifting hoists and a good floor run for the carriage of ladles of molten metal. If cupolas are used in the manufacture of steel, they should be partitioned off from the foundry so that the impurities not required in the metal may be discharged in the outside atmosphere. The foundry must be well provided with overhead electric cranes, the combined capacity of which should be capable of dealing with the largest quantity of metal likely to be required for any big casting. They also ought to be able to deal with the moulding boxes, which should be stored in a yard at the end of the foundry. The gas producers in connection with the steel melting furnaces should be in close proximity to the point of consumption. A portion of the shop should be set apart for the cleaning of castings, and the ovens for dealing with cores and malleable castings should be conveniently situated, preferably somewhere near the gas producers. Around the foundry there should be a yard for the storage of pig iron, steel and iron scrap, coke, sand, etc., and an enclosed yard with loading facilities for the storage of castings.

As to Group 2, the bulk of castings will be required in the fitting and machine shop, so this shop should be near to the casting storage yard. The size and design of the shop will depend on the number of machines to be installed, and this in turn will be governed by the quantity and type of work to be dealt with. It is customary now to group the machines together, viz., drills, lathes, milling machines, etc. The idea of a circular shop with all the machines around and the fitting benches in the centre is worthy of passing consideration, but in adopting this plan what are often known as "walking" cranes would have to be used instead of overhead cranes. In the machine shop there should be a grind shop, tool room, tool stores, template stores, and a smith's fire, partitioned off from the remainder of the shop. Work from the forge and smithy will be required in the fitting and machine shop, so these two shops should be near at hand. Due regard should be paid to the arrangement of steam hammers, hydraulic press, bending, punching, and shearing machines, etc., in the forge, and both in this shop and the smithy there should be plenty of floor space. Near these shops should be left a yard for storing steel and iron of various sections.

It is a good plan to deal with axles and wheels and side frame plates in a shop apart from the fitting and machine shop, and such a shop should be near to the forge. It will probably be known as the wheel shop, and should contain all machinery necessary for dealing with this work.

Group 3.—The boiler shop should be self-contained, i.e., having its own drills, punches, shears, bending rolls, etc., and every facility for quick and convenient rivetting. Overhead cranes should be provided. The erecting shops should be in close proximity to the boiler, fitting and machine and wheel shops. No erecting shop can be complete without overhead cranes and sufficient machinery to deal with light repair jobs, and traversers by means of which locomotives can be expeditiously taken in and out of the shops, are practically a necessity.

The paint shop, with a special room for paint mixing, should be situated and constructed with a view of securing the best means of lighting, heating and maintaining in a state of cleanliness.

Group 4 calls for no special mention here, but when being planned should receive careful thought in all details. All sources of power, steam and electricity for the main drive, hydraulic pumps and accumulators, air compressors, etc., for various operations should occupy a central position in a suitable power house in the works area, and isolated boilers, etc., should be avoided as much as possible. The general stores should be in a central position and easily accessible by road and rail.

The necessity for a good water supply in such works may be mentioned, with high pressure mains for supplying fire hydrants, etc., whilst a narrow gauge railway connecting every shop and yard, a telephone system, and a proper number of entrances, are adjuncts to good turn out which no engineer can afford to neglect.

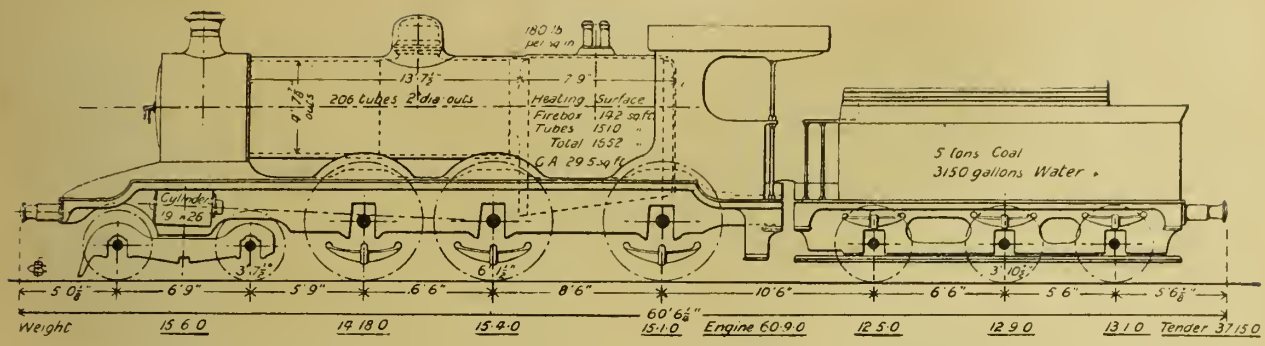


Diagram of Six-coupled Bogie Express Passenger Locomotive, East Indian Ry.

EXPRESS LOCOMOTIVE, EAST INDIAN RAILWAY.

On page 281 of our eighth volume, April 25th, 1903, were given illustrations and a description of some of the early locomotives built by Messrs. Kitson, Thompson & Hewitson, of Leeds, and Messrs. Slaughter, Grüning & Co., of Bristol, for service on the above railway, which has just lately celebrated its Jubilee. Originally single-wheel tanks with 14-in. by 22-in. cylinders and 6-ft. wheels, these were afterward converted into tender engines and in that condition for many years ran the mail trains and light passenger traffic. One on being withdrawn from service in 1901 was placed on a pedestal outside the Jamalpur loco. shops, with a suitable inscription, and the last survivor as a tank engine was until recently still at work shunting in the yard of the Lilloah carriage and wagon shops at Calcutta.

To point the advance made in 50 years, we offer for comparison with the original engines illustrated in the issue already referred to, the accompanying photo-reproduction and dimensioned diagram, for which we are indebted to the courtesy of the consulting engineers, Messrs. Sir A. M. Rendel & Robertson, of Westminster, S.W., of one of the large six-coupled bogie express locomotives recently built for the East Indian Ry. by the North British Locomotive Co., Ltd. The leading particulars are all detailed on the diagram and it will be seen that these fine engines are quite in line with modern ideas and represent what may be called the XXth century type of express passenger locomotive.

RECENT LOCOMOTIVES OF THE BELGIAN STATE RAILWAYS

(*Continued from page* 46.)

The five types of locomotives already referred to present no great feature of novelty and have prototypes on many European railways. One can scarcely claim for them as novelties the increased size of the boilers and the application of the superheater to some of them. But in 1904 the officials of the Belgian State Railways made a study of three entirely new types of express locomotives supplied by the La Meuse and John Cockerill Companies, and have now examples of these machines in actual service. The engines built by the former works are of the six-coupled bogie type, with four simple cylinders, and the two other examples, built by the Société John Cockerill, having the same arrangements of wheels, are both four-cylinder compounds.

Fig. 6 shows the four-cylinder simple engine No. 3303, built by La Meuse; it is provided with

Six-coupled Bogie Express Passenger Locomotive, East Indian Ry.

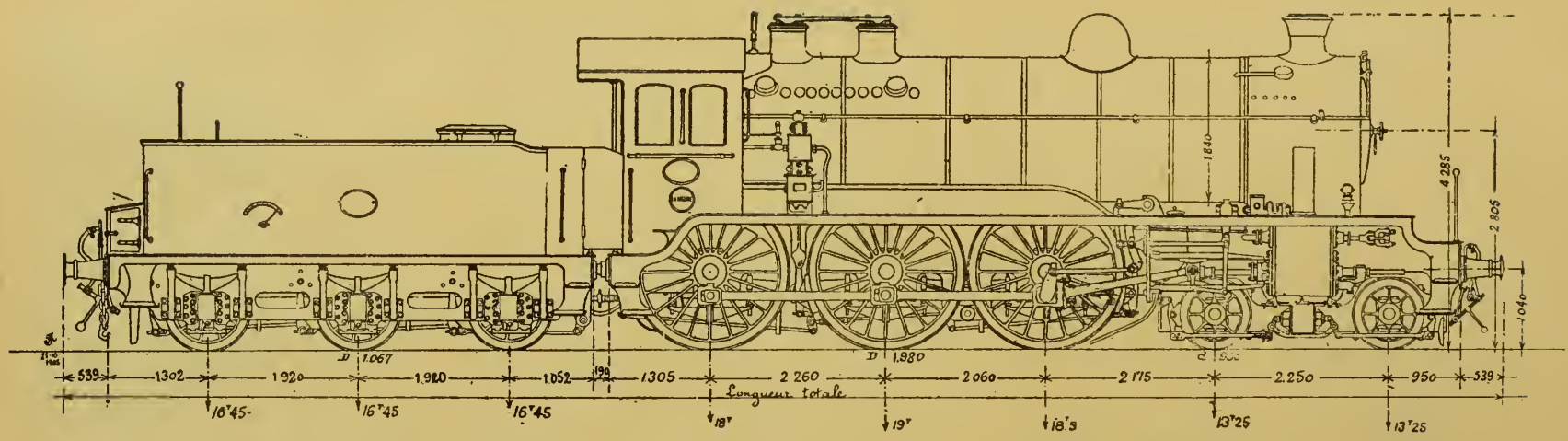
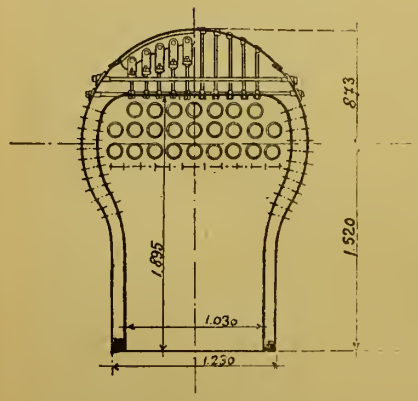
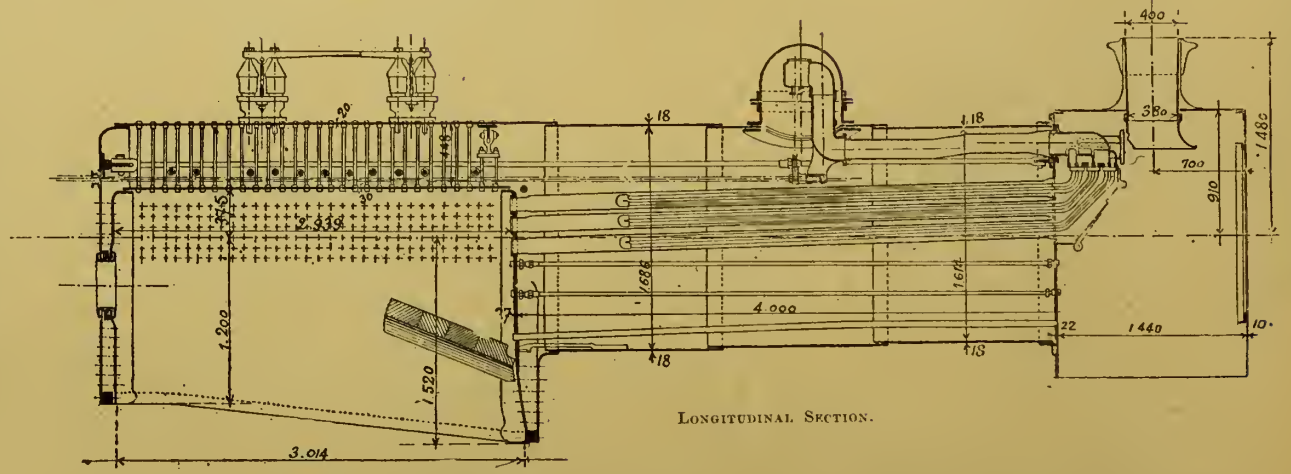


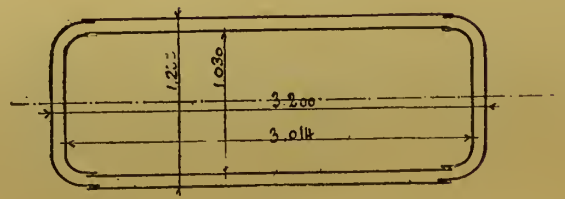
Fig. 6.—Six-coupled Bogie Four-cylinder Simple Locomotives Nos. 3302 3303, Belgian State Rys.



Transverse Section.



Longitudinal Section.



Plan.

Fig. 7.—DETAILS OF BOILER.

Four-cylinder Locomotive No. 3303.

Belgian State Rys.

the Schmidt superheater, whilst No. 3302, also by the same firm, is of similar type, but has no superheater, and is fitted with cylinders of smaller diameter. The principal dimensions of No. 3303 are as follows: diameter of cylinders 17⅛-in., stroke 24-in., diameter of bogie and coupled wheels 2-ft. 11½-in. and 6-ft. 6-in. respectively, wheelbase of bogie 7-ft. 4⅝-in., total wheelbase 28-ft. 8-in., total length over buffers 38-ft. 4⅜-in.; diameter of boiler 5-ft. 6½-in., height

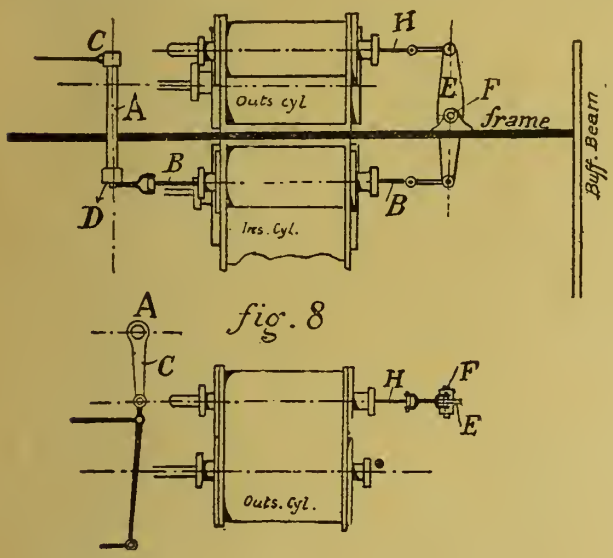


fig. 8

Diagram of Valve Motion of Four-cylinder Locomotives Nos. 3302-3303, Belgian State Rys.

of centre above rails 9-ft. 2 3/16-in., containing 180 flue tubes of 2-in. diameter and 13-ft. 1½-in. long between tube plates, and 25 of 5-in. diameter for the Schmidt superheater; heating surface: firebox 181.16 sq. ft., flue tubes 1,494.83, total 1,675.99 sq. ft.; superheater 446.7 sq. ft., grate area 32.4 sq. ft., boiler pressure 200 lb. per sq. in., weight of engine in working order 82 tons, of which 55 tons are available for adhesion.

Details of the boiler of this engine are shown in the sectional views in Fig. 7, and the general arrangements of the four cylinders and motion may be understood from the diagrammatic sketch reproduced in Fig. 8. The four cylinders, which are all fitted with piston valves, are placed in line transversely and actuate the leading coupled axle. Each pair of cylinders on either side of the centre line of the engine is controlled by one set only of Walschaerts valve gear placed outside the frames. The travel of the radial lever of the motion is transferred to the rocking shaft A by means of the crank C, and another crank D transmits the motion to the inside cylinder valve spindle B. The spindle is extended through the front end of the valve chest, as shown, with a link attachment to a vertical rocking shaft F, furnished with balance cranks, and a similar means of attachment causes the motion given to the valve-spindle B of the inside cylinder to be transmitted in the reverse direction of travel to the valve-spindle H of the outside cylinder. It should be mentioned that the inside and outside cranks on the same side of the engine are set at angles of 180°, and that all four cranks are therefore quartered, and this arrangement renders the use of two sets of radial motion possible and indeed considerably simplifies the details of the motion.

The other locomotive, No. 3302, is exactly similar to No. 3303, as described above, except that the cylinders are of smaller diameter, 16 9/16-in. instead of 17⅛-in., and that the Schmidt superheater is not adopted. There is a slight diminution in weight, owing to these modifications, and the heating surface is also different, owing to the absence of the superheater tubes; the firebox surface is 181.16 sq. ft., but the tube surface is increased to 1863.4 sq. ft., thus making a total heating surface of 2,044.56 sq. ft. Fig. 9 shows the front elevation of Nos. 3302-3303.

These two engines have been subjected to a series of exhaustive comparative trials, which have so far shown a slight advantage to the one provided with the Schmidt superheater. On a line having gradients of 1 in 200 for many miles together, No. 3303 has hauled without difficulty trains weighing 327 tons, at speeds varying between 40 and 56 miles per hour, reaching a maximum at times of 60 miles per hour, and it is possible that even better results may be attained later. With such large boilers there seems to be no difficulty in keeping the four cylinders supplied with steam, and these two are therefore interesting examples of simple locomotives with balanced motion.

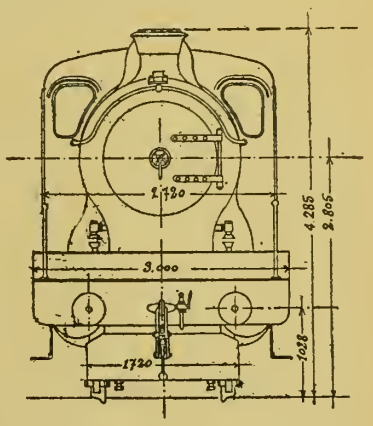


Fig. 9.—Front Elevation of Nos. 3302-3303, Belgian State Rys.

(To be continued.)

We have received from Messrs. Wm. J. Brooks & Co., of Letchworth, Herts., an ingenious little corner curve for draughtsmen. The instrument is a circular templet of transparent sheet celluloid provided with a number of notches cut in the periphery with curves of different radii. To hold it when in use, a wooden peg is riveted to the centre, while a circular ridge on the underside raises the working edge enough to prevent the ink running under. It should be a useful substitute for compasses for rounding-off fillets, etc., in machine drawing.

TENDER WATER SCOOP, G.E.R.

By the courtesy of Mr. James Holden, the locomotive, carriage and wagon superintendent of the Great Eastern Railway, we are able to show herewith a series of detail drawings illustrating the gear for picking up water applied to the tenders of main line locomotives on that railway. The scoop is operated by means of compressed air supplied from the air reservoir of the brake apparatus, which is for this purpose divided into two compartments, one of which receives compressed air from the Westinghouse pump, and supplies power to the scoop and other gears, whilst the other compartment stores air for the brake only, which is delivered from the first compartment through a non-return valve placed on a pipe connecting the two reservoirs. Both reservoirs are therefore available for the supply of brake power, but only the first portion can be drawn upon to supply power for the scoop and other gears, thus preventing risk of an unintentional application of the brake.

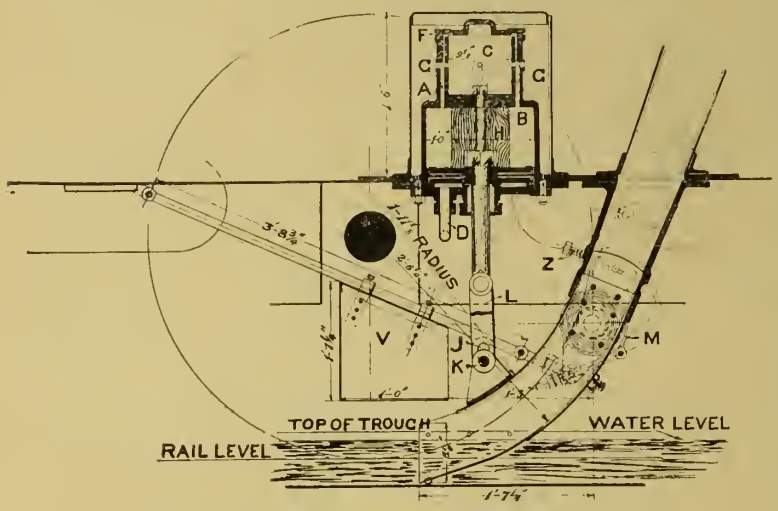


Fig. 1.—Details of Cylinder and Water Scoop.

The operation of picking up water is performed as follows: The handle T of the control valve is moved from the normal position as shown, to the position marked "down." This causes air under pressure to be admitted by the pipe S from the air reservoir, through the control valve and pipe I to the top of the piston in the cylinder A; the scoop is then pressed down into the trough by the descending piston, and, the engine being in motion, the water in the trough is forced up the scoop N and uptake O into the tender tank.

Enough water having been gathered up, the handle is now placed in the position marked "up." This opens the top side of piston to exhaust and permits pressure to be transmitted through the pipe U to the underside of the piston, which ascends and lifts scoop out of trough. By then replacing the handle in the central or normal position, the air is allowed to pass freely from the cylinder, and the scoop is maintained in the "up" position by means of the coil springs M.

The air cylinder A, Fig. 1, consists of two parts, a working portion B and a dashpot C. Passages D and E admit pressure to the bottom and top of the cylinder respectively. In the top of the dashpot are two small ports F, and lower down four larger ones marked G. A piece of wood H is interposed between the pistons to reduce the volume of air used. The reason for forming the dashpot at the cylinder instead of at the control valve is to provide a quicker action in working. To make the down stroke and lower the scoop, air is admitted to passage E, Fig. 2, and the piston in its descent pushes the scoop, to which it is attached by links L, into the trough. These links L are provided with a slot J, and when the scoop is first lowered into the trough the pin K is at top of slot, but as the resistance of the water increases the scoop is drawn deeper into the trough, with the result that more water is supplied to the tender.

The "up" stroke is performed by opening the passage E to exhaust through the control valve

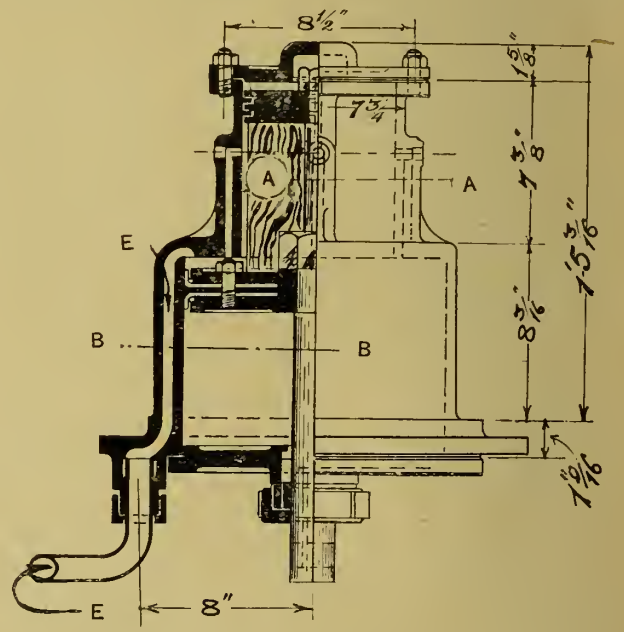


Fig. 2.—Enlarged View of Cylinder.

and admitting air to the bottom of the piston through D. As the piston ascends it lifts the scoop out of the trough. During this stroke the air above the piston is exhausting through the

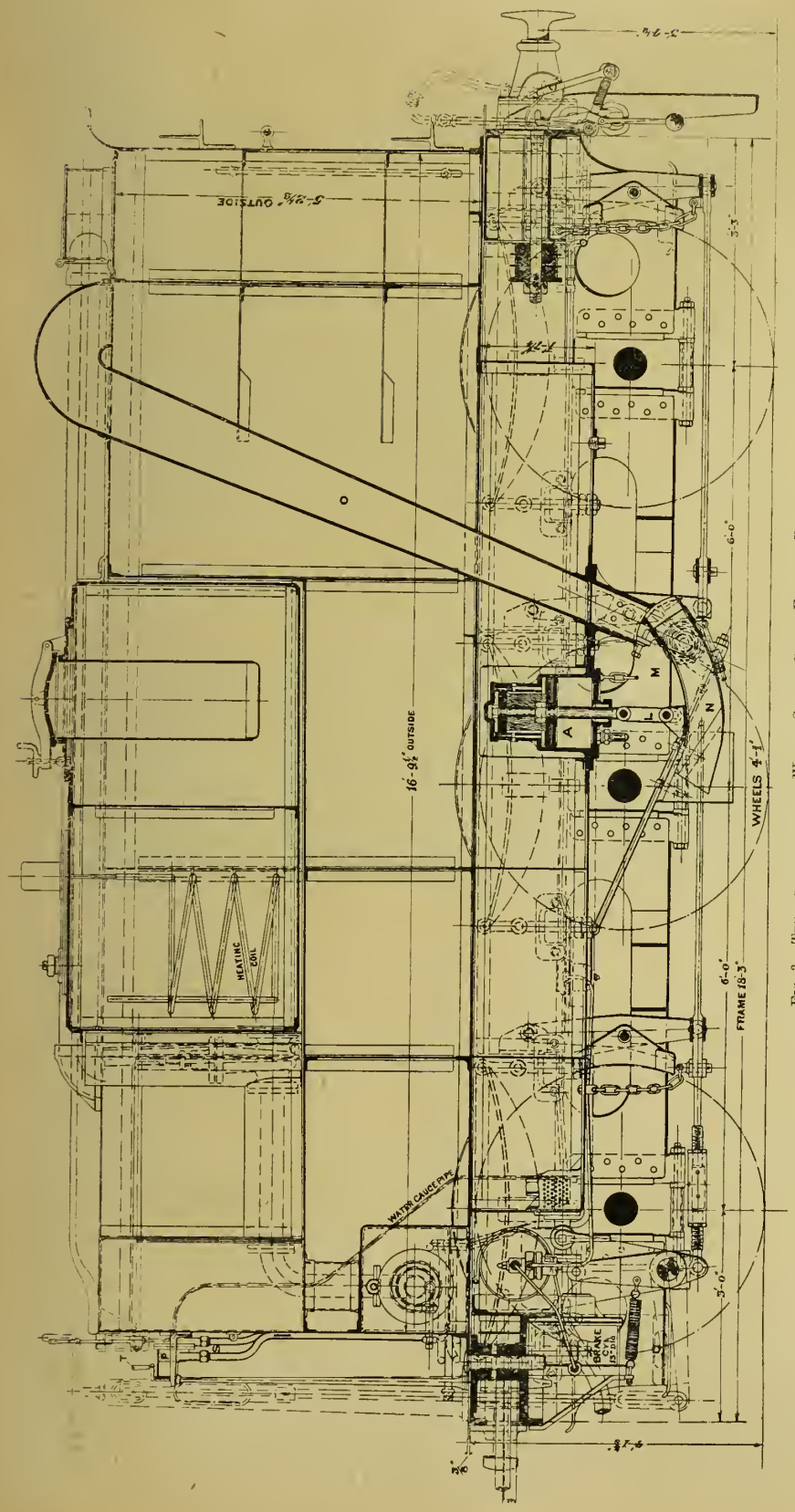


FIG. 3.—TENDER FITTED WITH WATER SCOOP, GREAT EASTERN RY.

passage E and port G. As soon as the ports G are covered up, the remaining air escapes slowly through ports F and provides the cushioning necessary to prevent damage to the pistons from shock.

In the normal position, when there is no pressure in the cylinder, the scoop is held up into the shield V by coiled springs M. The set bolts Z are to maintain the scoop in its correct position with relation to the bottom of the trough, having regard to the wear of the tender wheels. The average amount of water picked up on passing over a trough is 1,900 gallons.

THE CALEDONIAN RAILWAY have issued a handsome and useful guide book, entitled "Through Scotland." Everything a tourist wants to know is set forth. It is a high class publication both as regards letterpress and the illustrations. "The Hotel and Lodging-house Guide" for 1906 contains full information regarding accommodation at all the favourite holiday and pleasure resorts throughout Scotland. A most artistic booklet on "Oban, and the Land of the Gael," by G. Eyre-Todd, describes all that is romantic and beautiful in the West Highlands. The illustrations are reproduced exquisitely. The three publications can be obtained from Mr. Calthrop, superintendent of the line, 302, Buchanan Street, Glasgow, for the cost of postage, 6d.

MESSRS. W. G. BAGNALL, LTD., of Stafford, have sent us a copy of their new illustrated catalogue of locomotives, rolling stock and equipment generally for railways. Designs of locomotives are shown for all purposes—branch line service, collieries, iron and steel works, contractors, etc. Special attention is given to the rolling stock for narrow gauge and light railways. The list also includes tip wagons, colliery plant, crossings, switches, turntables, rails and sleepers of all types. A reprint of an interesting article on the Camber & Rye Light Ry., illustrated from photographs, is included, and a steam rail motor car is also illustrated.

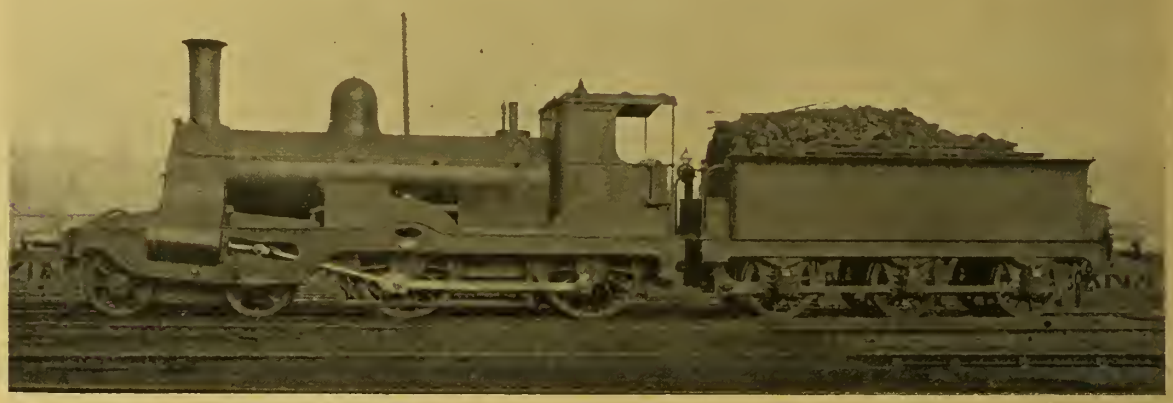
BOGIE PASSENGER LOCOMOTIVES, HIGHLAND RAILWAY.

When Mr. Peter Drummond succeeded Mr. D. Jones as locomotive superintendent of the Highland Ry., in 1897, there were in course of construction at the Lochgorm works of the Company four locomotives intended for service on the Dingwall and Kyle section. Begun by one and completed by another superintendent, they represent a period of transition in locomotive design, their chief dimensions and general outline being of Mr. Jones's standard, whilst the minor details were Mr. Drummond's.

The principal alterations as compared with already completed "Skye" bogies consisted in the abolition of compensating levers between the coupled wheels, which were a feature in all the engines of Mr. Jones's design, and the introduction of the Drummond chimney in place of that with the copper cap and louvred front. When built, three were given the numbers 5, 6 and 7, formerly carried by small Sharp goods engines, and the other, No. 48, replaced an old passenger engine named "Dingwall." On the appearance of the "Ben" class, No. 5, 6 and 7 were renumbered 32, 33 and 34, replacing "Cluny," the last single wheeler on the line, and "Birnam" and "Perthshire," old 6-ft. four-coupled passenger engines built by Neilson & Co., in 1863 and broken up in 1896-7.

With Nos. 70 and 85-88, already illustrated in these pages, the four engines under notice constitute Class L of the locomotive stock. They have the following leading dimensions: cylinders 18-in. by 24-in.; diameter of bogie wheels 3-ft. 2-in., and of coupled wheels 5-ft. 3-in.; coupled wheelbase 8-ft. 9-in., bogie 6-ft.; total 21-ft. 6-in.; height of boiler centre above rails 6-ft. 6-in.; heating surface: firebox 93-ft., tubes 1,123 sq. ft.; total 1,216 sq. ft.; grate area 16.2 sq. ft. The tender is carried on six wheels of 3-ft. 9-in. diameter, and has a capacity for 2,100 gallons of water. The total wheelbase of engine and tender is 42-ft. 9-in., and the length over buffers is 58-ft. 7-in.; the total weight of engine and tender in working order is 73 tons.

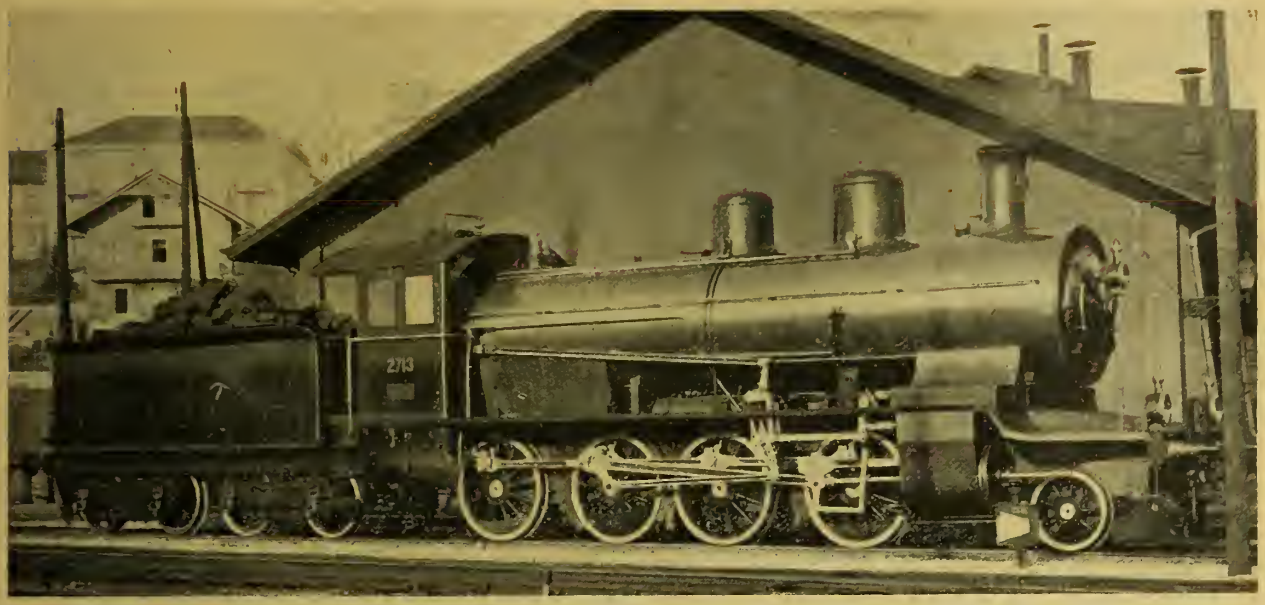
No. 48 is one of the engines employed upon the Invergarry and Fort Augustus Ry., a line entirely separate from but worked by the Highland Ry. The other locomotives of the class work between Kyle and Inverness. Class L is the only series on the Highland Ry. the whole of which have been built in the Company's own workshops.



Four-coupled Bogie Mixed Traffic Locomotive No. 32, Highland Ry.

NEW LOCOMOTIVES, SWISS STATE RAILWAYS

In our notice of recent locomotives put in service on the above railway system, on pp. 79-82 of our last issue, we omitted to mention that we were indebted for the illustrations and particulars to M. O. Guiguer de Prangins, of Lausanne, who has also courteously sent further details of yet another new class of locomotive for the same State railways, with the accompanying photo-reproduction. The locomotives, of which one is here shown, were built at Winterthur shops, and are known as series $C^{\frac{3}{4}}$, Nos. 2701-2732. They are, as can be seen, of the Consolidation, or 2-8-0, type and are four-cylinder compounds, the high pressure cylinders, $14\frac{1}{2}$-in. in diameter with a stroke of $23\frac{5}{8}$-in. being inside, and the low pressure, $23\frac{5}{8}$-in. in diameter with a stroke of $25\frac{1}{8}$-in. being outside the frames. The heating surface is 1875.1 sq. ft., the grate area



Consolidation Locomotive, Class $C\frac{5}{5}$, No. 2713, Swiss State Rys.

$26\frac{1}{4}$ sq. ft., and the boiler pressure 199 lb. per sq. in. In working order the engine weighs $65\frac{1}{4}$ tons, and the tender, which carries 3,700 gallons of water and 5 tons of coal, weighs 39 tons. These engines are provided with Friedmann injectors and lubricators, Pop safety valves, the Langer smoke consumer, the Hasler speed indicator and the Westinghouse brake. They work principally on the Basle-Olten (Hannestein), Lausanne-Vallorbe, Domodossola-Iselbe and new Simplon routes, both with goods and passenger traffic, up to maximum speeds of 40 miles per hour.

GOODS TANK LOCOMOTIVE, SLIGO, LEITRIM AND NORTHERN COUNTIES RAILWAY.

The accompanying photo-reproduction, for which we are indebted to Mr. S. Murphy, the locomotive superintendent, illustrates one of two new goods locomotives supplied to the above railway by Messrs. Beyer, Peacock & Co., Ltd., "Sir Henry" being delivered in 1904, and "Enniskillen" in 1906. They have the following leading dimensions: cylinders 17-in. in diameter with a stroke of 24-in.; diameter of six-coupled wheels

Six-coupled Trailing Bogie Tank Locomotive "Sir Henry," Sligo, Leitrim & Northern Counties Ry.

4-ft. 8-in., and of bogie wheels 3-ft.; wheelbase: coupled 11-ft. 6-in., bogie 5-ft. 6-in.; total 24-ft. 7-in.; boiler: length of barrel 13-ft. 3-in., diameter (outside) 4-ft. $\frac{1}{4}$-in.; working pressure 160 lbs. per sq. in.; firebox: 4-ft. $11\frac{5}{16}$-in. long, by 3-ft. $7\frac{1}{2}$-in. wide by 5-ft. $7\frac{3}{8}$-in. high; 158 tubes of $1\frac{7}{8}$-in. diameter; heating surface: firebox 98.3 sq. ft., tubes 1,049.9 sq. ft., total 1,148.2 sq. ft.; grate area 18 sq. ft.: capacity of side and end tanks 1,300 gallons; bunker space 68 cubic ft.; weight of engine empty 41 tons, and in working order $52\frac{1}{2}$ tons. These engines have proved very successful in service, and are economical in coal consumption. The gauge of the railway is 5-ft. 3-in.

rigid 6-ft. 4-in., total 12-ft. 9-in.; transverse play of truck wheels $1\frac{1}{2}$-in. in either direction, controlled by check springs; boiler: length of barrel 9-ft., diameter 3-ft.; firebox shell: length 3-ft. $10\frac{3}{4}$-in., width 3-ft.; number of tubes 86, diameter $1\frac{3}{4}$-in.; heating surface: firebox 44 sq. ft., tubes 310 sq. ft., total 354 sq. ft., grate area 8 sq. ft.; working pressure 160 lbs. per sq. in.; capacity of tanks 600 gallons, and of coal bunker 15 cwt.; weight of engine empty 17 tons, full 20 tons 10 cwt. It will be noticed that central spring buffers and couplings are provided, and that the valve gear is of the Walschaerts type. The line is the only narrow-gauge railway in Scotland, and will not be open for traffic for some time.

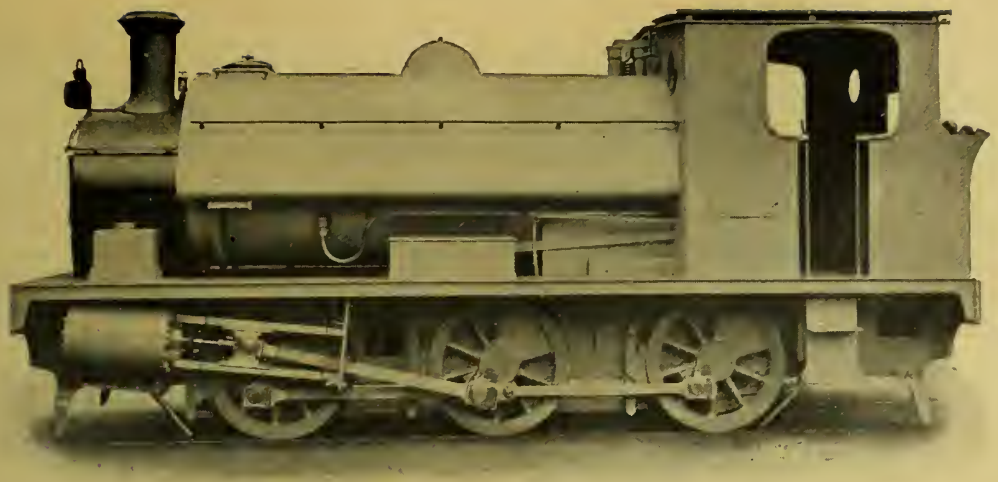
Six-coupled Trailing Radial Tank Locomotive "Argyll," Campbeltown & Machrihanish Light Ry.

SIX-COUPLED TANK LOCOMOTIVE, CAMPBELTOWN & MACHRIHANISH LIGHT RY.

We are indebted to the builders, Messrs. Andrew Barclay, Sons & Co., Ltd., of Kilmarnock, for the accompanying illustration and description of a side tank 0-6-2 locomotive supplied to the above railway, as was noted in our March issue. The gauge of the line is only 2-ft. 3-in., but the frames of the engine are made so as to admit of a subsequent widening to 2-ft. 6-in. should that course prove desirable for any reason. Leading dimensions of this engine are as follows: cylinders $11\frac{1}{2}$-in. in diameter by 18-in. stroke; diameter of coupled wheels 2-ft. 9-in.. and of radial truck wheels 1-ft. 10-in.; wheelbase:

Messrs. Percival Marshall & Co. have forwarded us "The *Model Engineer* Screw-cutting Indicator," which consists of two cards revolving on one centre and combining to show what wheels should be used in a lathe to cut any desired thread with guide screws of 2, 4 and 8 threads per inch respectively, a separate card being supplied for each size of guide screw at 2d. each. The rule for calculating wheels not included in the tables is also given.

Messrs. Cochran & Co., Annan, Ltd., issue a novel card indicator with revolving disc to show the size of Cochran patent boiler required for engines ranging up to 300 i.h.p., and of varying degrees of efficiency from 20 to 30 lbs. per i.h.p. It should be a most useful guide to steam users, as it includes tables showing the size of boiler required for winch engines on board ship. The price of the card is 6d.



Contractors' Six-coupled Tank Locomotive, Shanghai-Nanking Ry.

CONTRACTORS' TANK LOCOMOTIVE, SHANGHAI-NANKING RY.

The builders, Messrs. W. G. Bagnall, Ltd., have supplied the accompanying illustration of one of two six-coupled tank locomotives supplied to Messrs. Matheson & Co., the contractors for the Shanghai-Nanking Railway. They were built to the approval of Sir J. Wolfe Barry, Morrison & Barry, the consulting engineers of the railway, and have the following leading dimensions: cylinders 15-in. in diameter by 20-in. stroke; diameter of coupled wheels 3-ft. 7-in., wheelbase 11-ft., total length over buffers 23-ft. 2½-in.; boiler: length of barrel 9-ft. 1-in., diameter 3-ft. 7-in.; outside firebox 4-ft. 7·in. long by 4-ft. 1-in. wide, 152 tubes of 1¾-in. diameter; heating surface: firebox 68.25 sq. ft., tubes 653.5 sq. ft., total 721.75 sq. ft.; grate area 14 sq. ft., working pressure 160 lbs. per sq. in., capacity of saddle tank 720 gallons and of bunker 60 cubic ft., weight of engine in working order 32½ tons. Stephenson link motion is used, and the engines are equipped with Holden & Brooke's injectors and steam and hand brakes. The total height above rail level is 11-ft., and the gauge is 4-ft. 8½-in. Central couplers are provided.

We have received from the publishing department of the London & North Western Ry. a tastefully prepared little pamphlet entitled "Four Welsh Spas," dealing with the wells at Llandrindod, Builth, Llangammarch and Llanwrtyd respectively. In addition to elaborately illustrated descriptions of these health resorts, there are also full particulars of the means to reach them, and various other particulars of the services on the L. & N.W.R., the whole constituting a most interesting addition to railway literature. An accompanying leaflet gives useful information respecting the different hotels under the management of the railway in question.

REVIEWS.

"Modern Steam Road Wagons." By W. Norris. *London:* Longmans, Green & Co. 7s. 6d. net.

This work deals exclusively with the subject of heavy steam motor wagons. The author has been careful to include particulars of some of the latest designs of road wagons, embodying the modifications necessitated by the recent Board of Trade regulations, the text of which he gives in the book. He has condensed in practical shape the experience of the various builders in overcoming the difficult problems of designing road wagons, and also furnishes a useful guide to prospective users, to enable them to select the best possible vehicles to suit their particular requirements, without going too deeply into technicalities.

"The Chemistry of the Materials of Engineering." By A. Humboldt Sexton. *Manchester:* The Technical Publishing Co., Ltd.

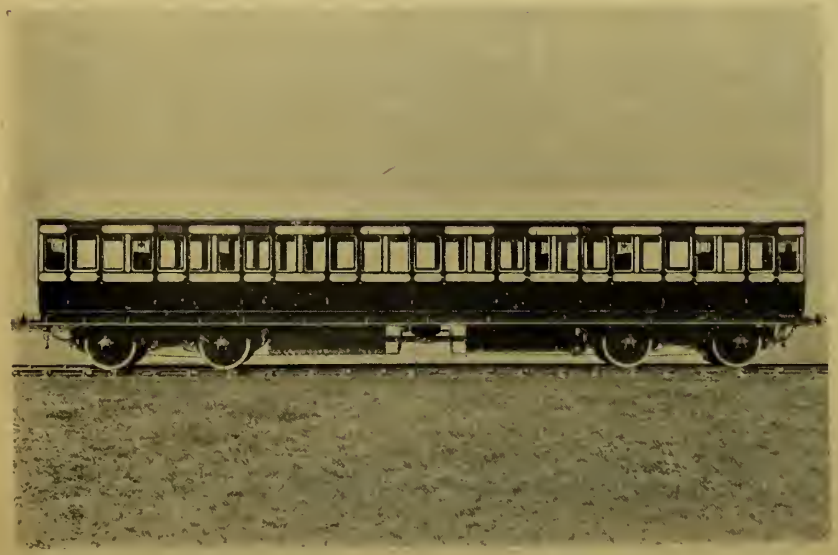
The important part played by chemistry in all branches of engineering is now thoroughly recognised, and the volume under notice gives in a concise and handy form the chief facts that are likely to be of use to engineers. The chapters on the various forms of iron and steel, copper, brass, and other materials, and the description of their production and manufacture will appeal mostly to the works manager's department, but the information given under the respective heads of fuel, water and lubricants might be studied with advantage by all connected with the running shed. The arrangement of the various subjects under their respected headings is particularly clear, and the complicated formulæ and analyses so frequently found in works of this description have been kept to a minimum, whilst the illustrations, though not numerous, are carefully and accurately drawn.

Contracts.—Amongst the recent contracts made by the Empire Roller-Bearings Co., Ltd., are the fitting of 60 additional heavy goods wagons with roller bearing axleboxes, making 140 wagons thus fitted for one Company, and 100 tramcar axleboxes for Peckham trucks for Brazil.

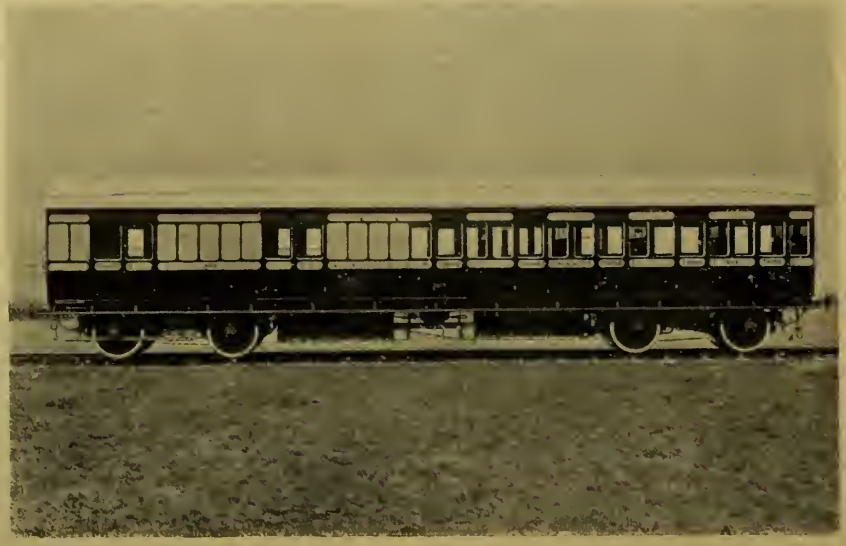
New Bogie Carriage Stock, London, Brighton & South Coast Ry.

1st Class Bogie Brake Carriage, London, Brighton & South Coast Ry.

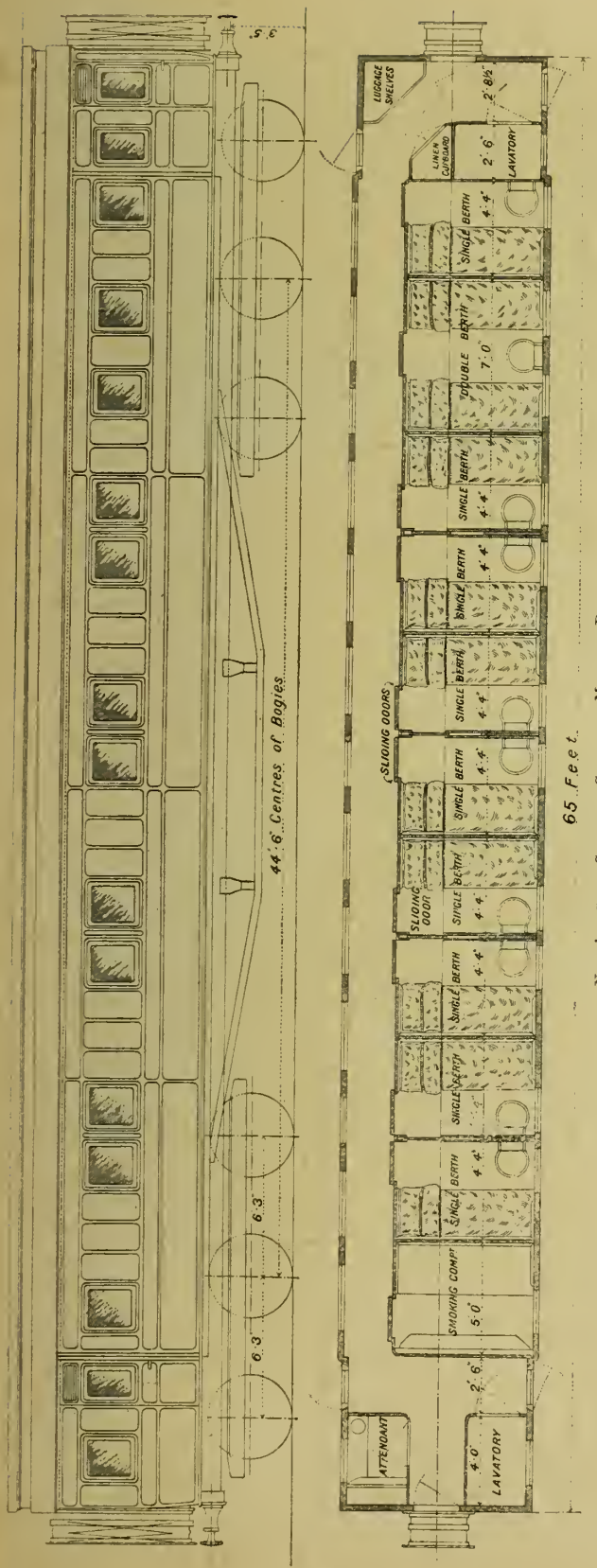
2nd Class Lavatory Bogie Carriage, London, Brighton & South Coast Ry.



3rd Class Bogie Carriage, London, Brighton & South Coast Ry.



3rd Class Bogie Brake Carriage, London, Brighton & South Coast Ry.



New 1st Class Sleeping Carriage, Midland Ry.

NEW BOGIE CARRIAGE STOCK, L. B. & S. C. R

On the facing page we illustrate a series of new bogie carriage stock recently introduced on the above railway by Mr. D. E. Marsh, the locomotive, carriage and wagon superintendent, which is well-abreast of modern ideas. The four examples chosen for illustration, with two others —a composite bogie and a triple composite lavatory bogie — are all of the same leading dimensions, as follows: length of body 54-ft.; width of body 8-ft. 6-in.; height inside 8-ft. $7\frac{3}{4}$-in.; height from rail 12-ft. 11-in.; wheelbase 45-ft.; bogie centres 37-ft.; length over buffers 56-ft. 11-in. The 1st class bogie brake has four passenger compartments, each 7-ft. 3-in. long, and seats 24 travellers. The 2nd class bogie has eight compartments, each 6-ft. 2-in. long, seating 78 passengers, and has in addition two lavatory compartments. The 3rd class bogie has nine compartments, 5-ft. $10\frac{1}{2}$-in. long between transverse bulkheads, seating a total of 90 passengers; and the 3rd class brake with five similar compartments seats 50. Of the types not illustrated, the composite bogie has four 1st class compartments, 7-ft. 2-in. long, seating 32 passengers, and four 2nd class, 6-ft. 1-in. long, seating 40 passengers, or a total of 72; the triple composite lavatory bogie has two 1st class compartments, 7-ft. 2-in. long, seating 10 passengers; two 2nd class, 6-ft. long, seating 20 passengers; and four 3rd class, 5-ft. 9-in. long, seating 40 passengers; in addition to two lavatory compartments adjoining the 1st class; the total accommodation being for 70 passengers.

NEW SLEEPING CARRIAGES, MIDLAND RAILWAY.

The first-class sleeping car here illustrated is 65-ft. long and 9-ft. wide, which is the maximum width available on English railways; this allows sleeping berths 6-ft. 2-in. long to be arranged transversely, with ample space for a corridor running the full length of the vehicle, thereby admitting of access to other parts of the train. All the sleeping berths are on the same level; one of them is double, the other 10 having one berth each, but eight of them may be converted into double compartments if desired, by the withdrawal of sliding doors in the partitions. Spring mattresses are provided, and each compartment is supplied with proper lavatory accommodation, in addition to which there is a well appointed water-closet at each end of the car. A smoking compartment with a folding table is provided at one end of the car, and an attendant travels with each car and supplies light refreshments when they are required.

Being built with a clerestory roof, the compartments are lofty and airy, and the interior fittings have been designed with a view to giving the maximum amount of convenience and comfort during long journeys. Efficient roof ventilation is provided, which may be augmented in summer time by lowering the windows and inserting wire-gauze dust screens in the openings, whilst in the winter the car is heated by steam, the temperature being regulated by passengers in the compartments to suit their convenience.

Particular care has been taken to ensure smooth running, and to prevent noise and rattle when travelling at high speeds. With this object in view, the flooring is double and has been specially arranged with a view to deaden sound; its upper surface is covered with an Axminster pile carpet. All the interior doors have been made to slide, so as not to block the corridor and also to obviate the possibility of disturbance through banging.

The vehicles are fitted with the new passenger communication, which applies the brake and can be operated by a passenger in any compartment. There is also a complete installation of electric bells by means of which passengers can call the attendant. The car is lighted throughout by electricity, the fittings being so arranged that a passenger can turn the light on or off from his sleeping berth. A "Rex" fire extinguisher is provided in each car for immediate use in case of emergency.

The new cars have been built at the M. R. Works at Derby, to the designs of Mr. D. Bain.

MINERAL WAGON ON NORTH BRITISH RAILWAY.

THE accompanying illustration shows a peculiar steel bodied hopper wagon of the North British Railway, used chiefly for the conveyance of gas coal from the Lothian coalfields to gas works on the system provided with appliances for the handling of such trucks.

These wagons, a large number of which are in use, can, according to modern ideas, hardly be considered of economical design, as on a tare of 5 to 5¼ tons they carry but 6 tons of paying load, a proportion of 1 to 1.2 (as compared with 1 to 2.35 in the new Caledonian eight-wheeled "hoppers"), but owing to their short wheelbase they are very useful for the sharp curves which abound at the collieries and gas works.

6-TONS MINERAL WAGON, NORTH BRITISH RY.

The underframing is of wood, as are the two hopper doors at the bottom, which open by hinges and are secured by four bolts, two at each side and clearly seen in the illustration. The wheels, &c., are of the usual North British standard for mineral stock.

Trade Catalogues, Pamphlets, etc., received:—

Messrs. Archibald J. Wright, Ltd., of Leyton Green Road, London, N.E.—Sections "M" and "I" of list of electrical specialities.

The Brush Electrical Engineering Co., Ltd., Victoria Works, Belvedere Road, London, S.E.—Steel rolling stock.

Crosby Steam Gage and Valve Co., 147, Queen Victoria Street, London, E.C.—Crosby specialities.

George Polkey, Ltd., Hockley Lamp Works, Pitsford Street, Birmingham, and Finsbury Pavement House, London.—The Polkey headlight, Polkey's lamps.

The Consolidated Pneumatic Tool Co., Ltd., Palace Chambers, 9, Bridge Street, Westminster, S.W.—Special circular No. 13, relating to electric drills, etc.

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THE LOCOMOTIVE MAGAZINE.

Vol. XII. JULY 14th, 1906. No. 167.

RAILWAY NOTES.

GREAT WESTERN RY.—The accompanying photo-reproduction shows the new four-cylinder Atlantic No. 40 hauling the 11.40 a.m. express, Paddington-Ilfracombe, which now runs *via* the new Castle Cary line and starts 5 min. later than before and is accelerated throughout to the extent of 37 min. to Ilfracombe, 36 min. to Exeter and 32 min. to Torquay. No. 40 is stationed at Old Oak Common, and is in general dimensions similar to the other Atlantics on the line, except in regard to having four cylinders 14¼-in. in diameter by 26-in. stroke. The inside pair are placed under the bogie platform in advance of the smokebox saddle and drive the leading pair of coupled wheels.

The latest of the 3701 class of four-coupled bogie engines are Nos. 3708-3718.

Two more 7-ft. 8-in. bogie singles, Nos. 3048 "Majestic" and 3052 "Sir Walter Raleigh," have been rebuilt with domeless Belpaire boilers.

In connection with the Swindon Mechanics' Institution trip, which took place between the 6th and 13th inst., an elaborate 16 pp. working time table had to be issued, dealing with trains conveying 14,620 adults and 10,706 children, comprising the London, Winchester, West of England, Weymouth, South Wales and Northern contingents.

FOUR-CYLINDER ATLANTIC LOCOMOTIVE No. 40, HAULING THE 11.40 EXPRESS TRAIN, GREAT WESTERN RY.

GREAT CENTRAL RY.—The latest Atlantics built at Gorton works are Nos. 360, 362 and 363. Two more compound Atlantics are to be built at Gorton, also a number of six-coupled outside cylinder tank engines.

The new six-coupled bogie engines with 6-ft. 6-in. wheels have been delivered by Messrs. Beyer, Peacock & Co., Ltd., up to No. 1101, making seven out of the ten in order. There are also ten similar engines, but with 5-ft. 3-in. wheels, in course of construction by the same firm, designed for fast goods traffic. No. 1097 of the former class has been named "Imming-

ham," after the new dock to be constructed at Grimsby, the nameplate being above the driving splasher, as on G.W. engines.

Two of the five standard six-coupled goods engines, building by the Yorkshire Engine Co., have been delivered, Nos. 1115 and 1116.

Twelve new bogie passenger tank locomotives will shortly be put in hand "outside."

No. 452, one of the Altrincham tank engines, is being adapted for use as a motor engine with a trailer car, and three cars specially built for the purpose are in hand; two other similar engines will shortly be adapted.

LONDON & NORTH WESTERN RY.—Following are the latest engines of the "Precursor" type: Nos. 804 "Amphion," 990 "Bucephalus," 988 "Bellerophon" and 1787 "Hyperion." The numbers omitted last month are 1433 "Faerie Queene" and 1650 "Richard Trevithick." The number of "Antæus" is 561, not as given previously; for some time this engine bore the name mis-spelt, "Antaeus."

Three of the new 4-4-2 passenger tank locomotives will shortly be in service, bearing Nos. 528, 531 and 784. They are intended for the Buxton line. A new type of number-plate, upon which the date is shown, has been introduced on this class, and will be carried on the coal bunker side, it being intended to paint the company's initials on the tank side.

Among recent withdrawals from service are the following: 7-ft. 6-in. singles: Nos. 97 "Atalanta," 531 "Lady of the Lake," 561 "Prince Oscar," 563 "Combermere," 675 "Ivanhoe," 804 "Soult" and 1433 "Daphne"; "Greater Britain" class: 528 "Richard Moon" and 772 "Richard Trevithick"; "Teutonic" class: 1305 "Doric"; 4-ft. 6-in. double end tank: 282, 988 and 990; special DX goods: 1650, 1787 and 2017; 4-ft. 3-in. tender goods: 784; and No. 1132 "North Western," of the "Newton" class.

The following four-cylinder compound eight-coupled mineral engines have been converted into "Consolidations": Nos. 1044, 1273 and 2570; and the following, three-cylinder type, have been converted to simple type, with large boilers: Nos. 1822 and 2548.

MIDLAND RY.—Of the 20 new three-cylinder compounds in course of construction at Derby, the latest completed are Nos. 1020-1023.

By a misprint, the ten new goods locomotives referred to in our May issue were allocated Nos. 575-584; their numbers are 275-284.

The 7-ft. bogie engines Nos. 157, 2186 and 2194, the 6-ft. 6-in. bogie engines Nos. 162, 185, 187, 194, 2210, 2212 and 230-239, and the double-framed goods engines Nos. 649 and 683, have been supplied with new large boilers.

Several motor trains of the type illustrated on page 54 are now at work on local services from Derby to Wirksworth, Ashby and Ripley, and on the Sutton-in-Ashfield and Hemel-Hempstead branches.

SOUTH EASTERN & CHATHAM RY.—Five new engines of Mr. Wainwright's latest express passenger type, similar to No. 273 illustrated in our February issue, are now out bearing Nos. 275, 503, 504, 506 and 511.

The following new bogie tank locomotives are now running: Nos. 305, 306, 308 and 309, replacing Mr. Stirling's bogie tanks which are now in the "A" list.

A number of Stirling engines have recently been rebuilt with domed boilers and new cabs, amongst them being the four-coupled bogies, Nos. 29, 35, 187, 212 and 249; the bogie tanks, Nos. 304, 324 and 81; and the six-coupled goods engines, Nos. 282, 373, 377 and 316.

LONDON & SOUTH WESTERN RY.—The four-cylinder 4-4-0 and 4-6-0 locomotives which were withdrawn from service during the winter months are again at work on the summer traffic.

The engine concerned in the lamentable disaster at Salisbury on the 1st inst. was No. 421, of the class illustrated in our issue of July, 1904.

In connection with the notes in recent issues relative to new rail motor coaches, the following branch lines of the L. & S.W.R. will this summer be worked by this type of vehicle: Friary and Turnchapel; Plymouth and Tavistock; Bishop's Waltham; Exeter and Honiton; Poole, Bournemouth and Christchurch; Bodmin and Wadebridge; Fratton and Southsea; Hurstbourne and Fullerton; and it is possible that other sections may also shortly be supplied with motor coaches in place of locomotives and trains of the ordinary type.

It is interesting to note that the last of the named goods engines of Mr. Beattie's design, No. 092 "Charon," has been withdrawn from service after 39 years of work, during which it has run a mileage of over 973,000.

G.W.R. locomotives are now working through to Southampton from Winchester (Cheesehill), piloted by South Western drivers.

MIDLAND RY. LOCOMOTIVES FOR ITALY.—Recent developments on the Italian Government Rys. have given rise to a considerable shortage of locomotive power, and extensive orders for new engines have already been given out, the Baldwin Co. in particular having secured a contract for 20 locomotives. Owing to immediate want of adequate engine power, however, Comm. Luigi and other State officials have paid a visit to this country for the purpose of obtaining some second-hand locomotives to tide over the present

season, and after careful inquiry and inspection in various quarters they have, we understand, arranged to acquire at once 50 six-coupled goods engines from the Midland Railway, which that company will replace by newer and more powerful locomotives, better suited to the growing requirements of the line.

FRANCO-SPANISH RYS.—Owing to the difference in gauge of the lines in the two countries, travellers by the Sud Express now have to change cars at the Spanish frontier station at Irun on the southward journey and at the French frontier station at Hendaye going north. Arrangements are being made for the provision of a third rail to suit the Spanish 5-ft. 6-in. gauge from the frontier station to Biarritz, and similarly to suit the standard 4-ft. 8½-in. gauge from the frontier to San Sebastian so that the express trains from Paris may run right through to the latter place. King Alfonso has expressed a wish that the mixed gauge may be extended as far as Madrid.

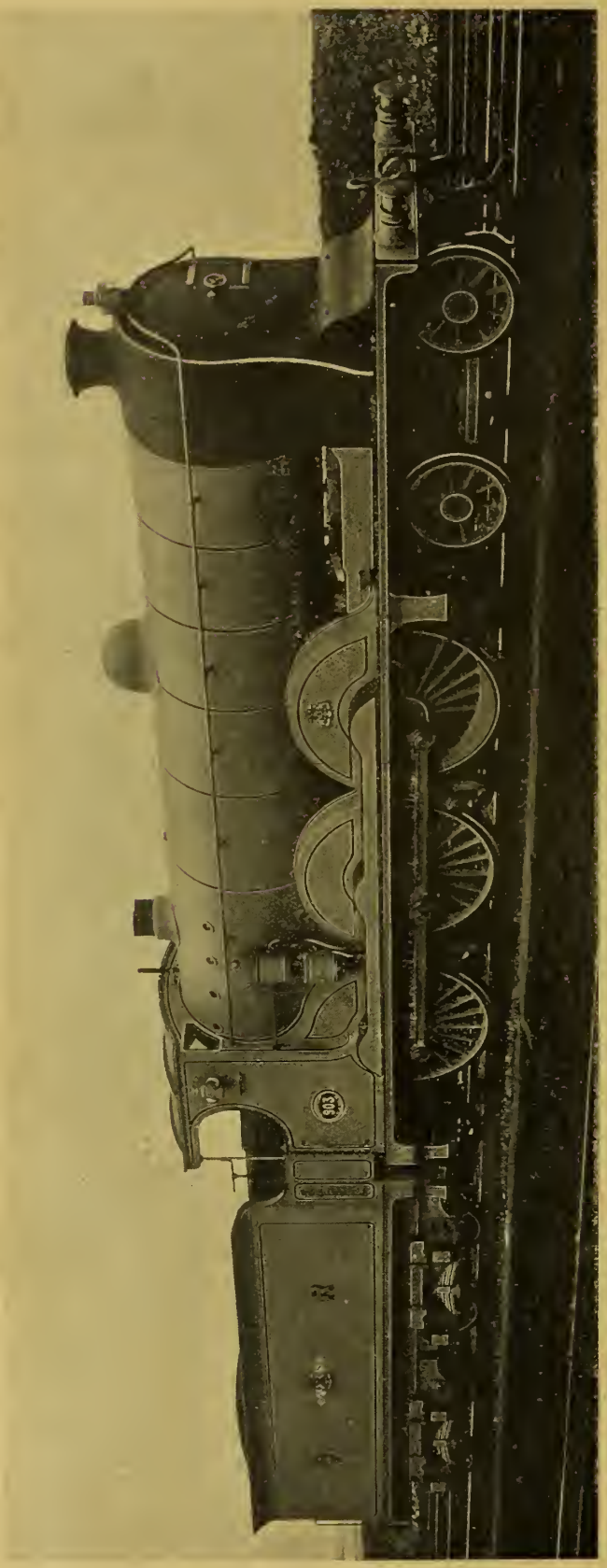
The engine shown is one of the large six-coupled bogie compound express locomotives of the Northern Ry. of Spain, built by A. Borsig, of Berlin.

GREAT CENTRAL & GREAT WESTERN JT. RY.—From the 1st inst. the G.C.R. "Sheffield Special," leaving Marylebone at 3.25 p.m., has been diverted to the new Wycombe-Prince's Risboro' line. The distance from London to Sheffield by this route is 169 miles 4 chains, as compared with 164 miles 56 chains *via* Quainton Road. The running time has also been increased by 3 min., making the booked time 178 min. The G.N.R., therefore, still holds the record to Sheffield with the 6.10 p.m. express from King's Cross, which performs the journey in 170 min.

G. W. R NEW ROUTE TO PLYMOUTH.—The shortened route to Plymouth *via* Castle Cary and Langport was opened for traffic on July 2nd. A saving of 20 miles between London and Taunton and places westward is effected. The "Plymouth Limited," which starts running again on July 21st, will take the new route and reach its destination in 4 hours 10 minutes, instead of 4 hours 25 minutes, the time it occupied last year. Exeter, too, will be 3 hours and 3 minutes from London, instead of 3½ hours. On Friday, June 29th, a special train was run over the new route, leaving Paddington at 9.30 a.m. and running to Plymouth without a stop, arriving there at 1.40 p.m. The following is a copy of the official schedule of the train timing :—

Photo by the PARIS-MADRID EXPRESS, IRUN STATION, NORTHERN RY. OF SPAIN. *Loco. Pub. Co.*

M.	Ch.			
—	—	Paddington	dep	A.M. 9.30
115	28	Castle Cary	pass	11.33
129	73	Langport	,,	11.49
173	54	Exeter	,,	12.33
				P.M.
225	57	Plymouth (North Road)	arr.	1.40
227	0	Plymouth (Millbay Docks)	,,	1.50
—	—	Plymouth (Millbay Docks)	dep.	4.10
1	23	Plymouth (North Road)		4.20
53	26	Exeter	pass	5.30
97	7	Langport	,,	6.14
111	52	Castle Cary	,,	6.30
227	0	Paddington	arr.	8.30



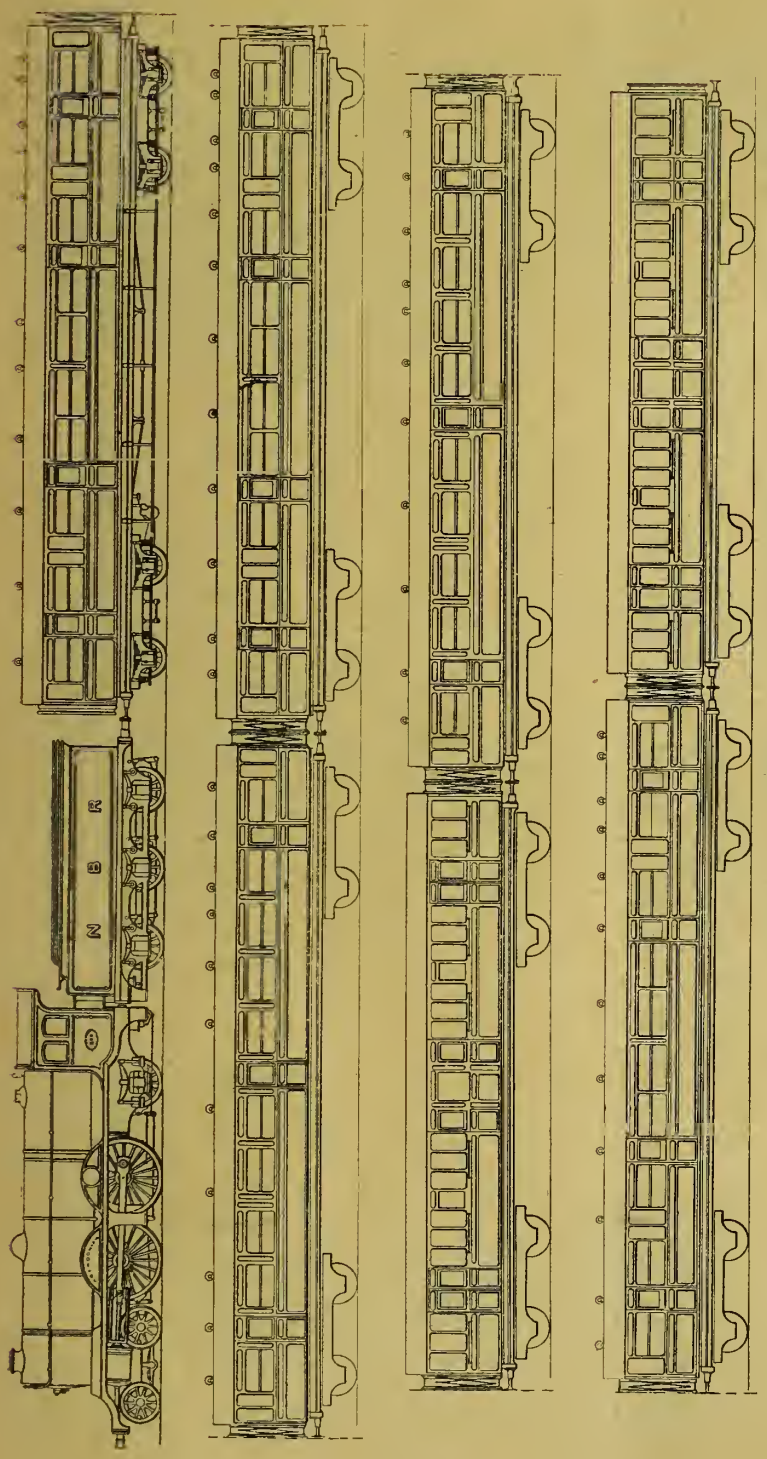
Six-coupled Bogie Express Locomotive No. 903, Caledonian Ry.

SIX-COUPLED BOGIE EXPRESS LOCOMOTIVE, CALEDONIAN RY.

By the courtesy of Mr. J. F. McIntosh, the locomotive superintendent, we are able to reproduce here a photograph of No. 903, one of five new express locomotives now in course of construction at the St. Rollox works of the Caledonian Ry. As can be seen, these engines are of very similar type to Nos. 49-50, but experience with the pioneers of the class has dictated sundry modifications of detail. For example, the diameter of the cylinders has been reduced by 1-in., and the connecting rods are, by a slight alteration of the wheelbase, increased in length from 6-ft. 8-in. to 7-ft. These changes have not, however, necessitated any change in the valve motion, except to the extent of lengthening the rods. While the total wheelbase remains as in Nos. 49-50, the rigid wheelbase of the coupled axles is reduced by 4-in., and this again is still further minimised by providing $\frac{1}{2}$-in. of side play on the trailing axle, which has, of course, necessitated the use of knuckle-joints on the coupling rods. The alteration in the wheelbase and a desire to effect a better distribution of weight at the trailing end has led to the employment of a built-up steel plate drag-box in place of the cast-iron box formerly adopted, and this alteration of weight is also affected by the substitution of direct stays in place of roof-bars in the firebox crown. The boiler is slightly longer in the barrel, and has its diameter increased from 5-ft. to 5-ft. $3\frac{1}{2}$-in., and the tubes are now all 2-in. in diameter, of mild steel, galvanised.

Following are leading particulars of No. 49 and No. 903 for comparison :

	No. 49.			No. 903.	
	Ft.	In.		Ft.	In.
Cylinders : diameter	0	21		0	20
stroke	0	26		0	26
Wheels : bogie, diameter on tread	3	6		3	6
coupled, diameter on tread	6	6		6	6
Wheelbase : bogie	6	6		6	6
bogie pin to driving wheels	10	6		10	10
driving to intermediate wheels	7	6		7	2
intermediate to trailing wheels	7	6		7	6
Total	28	8		28	8
Boiler : length of barrel	17	$4\frac{1}{2}$		17	$7\frac{7}{8}$
diameter, mean	5	0		5	$3\frac{1}{2}$
height of centre from rails	8	6		8	6
Tubes : length between tubeplates	16	3		16	8
number, 257 at $1\frac{3}{4}$-in., 13 at $2\frac{1}{2}$-in.					
	sq. ft.			sq. ft.	
Heating surface : firebox	145			148·25	
tubes	2255			—	
Total	2400			—	
Grate area	26			26	
Weight in working order	73 tons			73 tons	
Weight of tender	55 tons			57 tons	
Capacity of tender, coal	5 tons			6 tons	
Capacity of tender, water	5000 gals.			5000 gals.	



Elevation of New Block Trains, Aberdeen Service, North British Ry.

A noteworthy feature of these new engines is the large size of the bearings, which in the driving axle are 9½-in. by 10½-in., and in the intermediate and trailing axles are 9½-in. in diameter at the ends, 8-in. in the centre, the shape being concave, and 12-in. long. The big-end bearing is also ¼-in. longer than in No. 49, being 9½-in. by 4¾-in. The safety valves are double, having four 4-in. valves with independent springs, and they are set to a working pressure of 200 lbs. per sq. in.

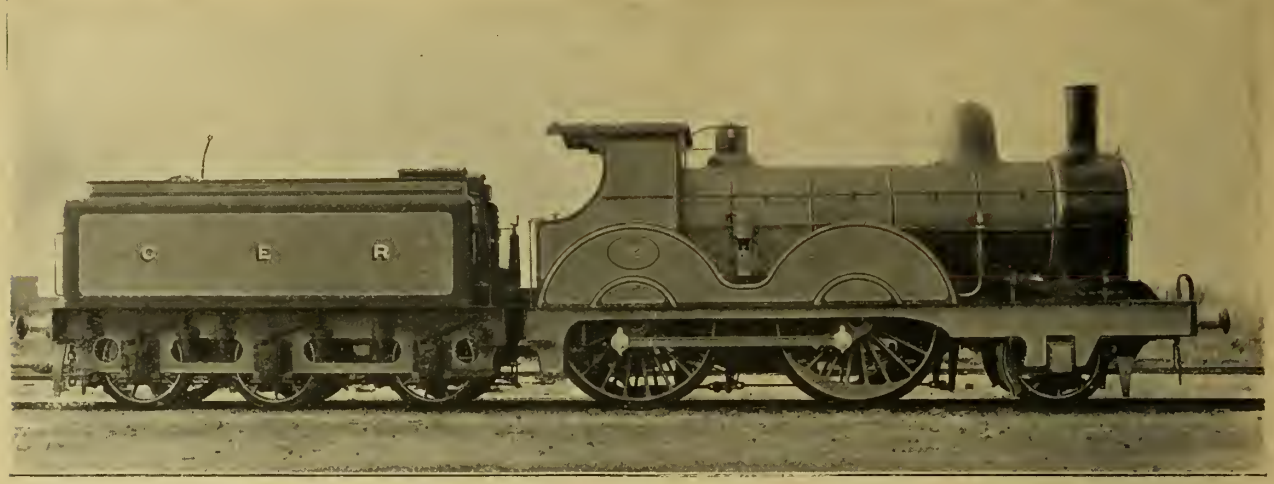
No. 903 is named "Cardean," after the seat of Mr. E. Cox, one of the directors of the railway company.

ABERDEEN SERVICE, NORTH BRITISH RY.

We are indebted to the *Railway Gazette* for the loan of the accompanying illustration showing one of the new Aberdeen block trains recently built at Cowlairs works of the N.B.R. for service between Glasgow and Edinburgh and Aberdeen. The Edinburgh section comprises one composite, two 3rd class and a luggage and brake van, and the Glasgow portion consists of a composite, one 3rd class, and a luggage and brake van, the two portions joining at Dundee. The passenger coaches each measure 58-ft. 4-in. long by 8-ft. 6-in. wide, and the luggage vans are 59-ft. 8½-in. long and 8-ft. 6-in. wide There are two lavatories to each coach, and every fitting of the stock is of the most modern and luxurious character.

The ten Atlantic locomotives for this service, referred to in our last issue, are in course of construction at the Hyde Park works of the North British Locomotive Co., Ltd., and will have the following dimensions: cylinders 20-in. by 28-in.; diameter of bogie, coupled and trailing wheels 3-ft. 6-in., 6-ft. 9-in. and 4-ft. 3-in. respectively; boiler pressure 200 lbs. per sq. in.

Nos. 849-852 are now running, large six-coupled goods locomotives with 18½-in. by 26-in. cylinders. They were built at the Atlas Works of the North British Locomotive Co., Ltd.



Coupled Passenger Locomotive No. 1021, as originally built in 1895, Great Eastern Ry.

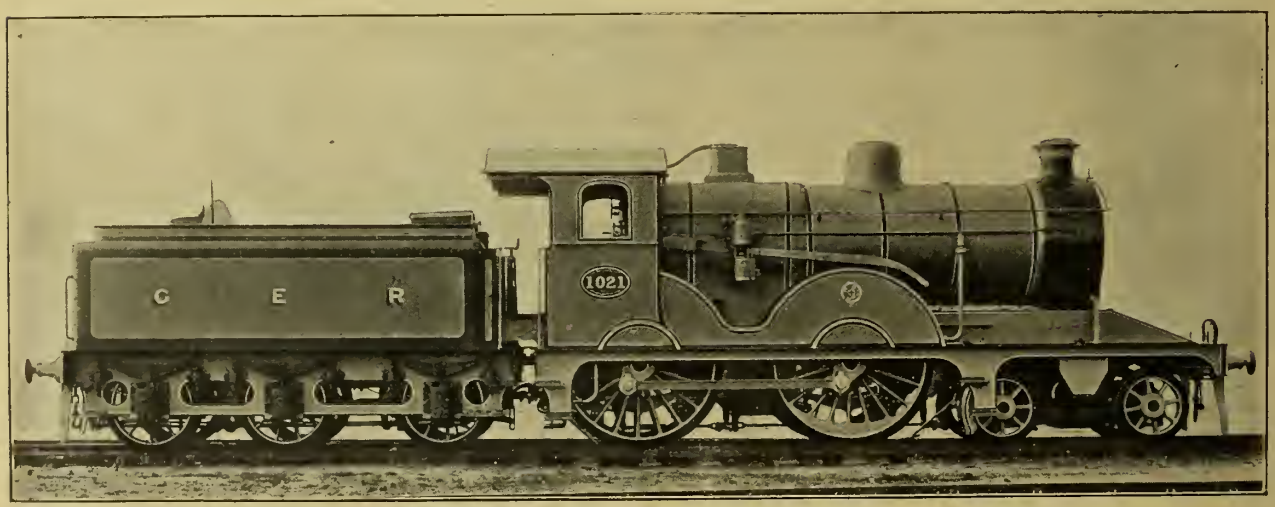
REBUILT G. E. R. LOCOMOTIVE.

By the courtesy of Mr. James Holden, the locomotive superintendent of the Great Eastern Railway, we are able to give here the comparative dimensions of a number of engines as originally built and as rebuilt with leading bogies and larger boilers. A total of 51 engines of this class have been rebuilt, but only 31 have bogies.

	As built in 1895. Six Wheels. (Four coupled.)	As rebuilt 1906. Four-coupled with leadg. bogie
Boiler—	ft. in.	ft. in.
Diameter of barrel (outside)	4 4	4 8
Length between tube plates	10 4	10 4
Type of firebox	Ordinary	Belpaire
Length of firebox (outside)	6 0	7 0
Width of firebox (outside)	4 0½	4 0½
Number of tubes	250	287
Diameter of tubes (outside)	1⅝-in.	1¾-in.
Working pressure, per sq. in.	140 lbs.	180 lbs.
Heating surface—tubes	1098·6 sq. ft.	1358·5 sq. ft.
,, ,, firebox	100·9 ,,	117·7 ,,
,, ,, total	1199·5 ,,	1476·2 ,,
Grate area	18·0 ,,	21·6 ,,

Cylinders—		
Diameter	18-in.	18-in.
Length of piston stroke	24-in.	24-in.
Diameter of wheels—	ft. in	ft. in.
Leading	4 0	——
Bogie	——	3 1
Coupled	7 0	7 0
Tender	4 1	4 1
Wheelbase—		
Leading to driving centres	7 9	——
Bogie centre to driving centre	——	9 6
Driving to trailing centres	8 9	8 9
Total wheelbase of engine	16 6	21 4½
,, ,, engine and tender	36 7	41 5½
Weight in working order—	T. C. Q.	T. C. Q.
On leading wheels	14 8 2	——
On bogie	——	14 18 2
On coupled wheels	27 11 3	32 17 0
Total weight, engine	42 0 1	47 15 2
,, ,, tender	30 12 2	30 12 2
,, ,, engine and tender	72 12 3	78 8 0
Capacity of tender—		
Coal	5 tons	5 tons
Water	2640 galls.	2640 galls.

Metropolitan District Ry.—Mr. Tarver, of the Cleveland Bridge Co., has been appointed engineer of this railway.



Coupled Passenger Locomotive No. 1021, as rebuilt with a Bogie in 1906, Great Eastern Ry.

WEIGHING LOCOMOTIVES.

THE accurate weighing of a locomotive is important, not only to ascertain its exact weight as a whole, but to equalize the amount resting upon each wheel, and so ensure that the weight is properly distributed over the whole wheelbase to provide an easy running, powerful engine, and one that will not unduly try the roadbed.

It is the usual practice to measure each spring for camber, selecting those of equal camber for the same pair of wheels, and also to try the mean level of the engine by measuring from rail to footp'ate at each side and end. These precautions, however, only give an approximate result and determine the general level of the engine, but do not necessarily affect the distribution of weight.

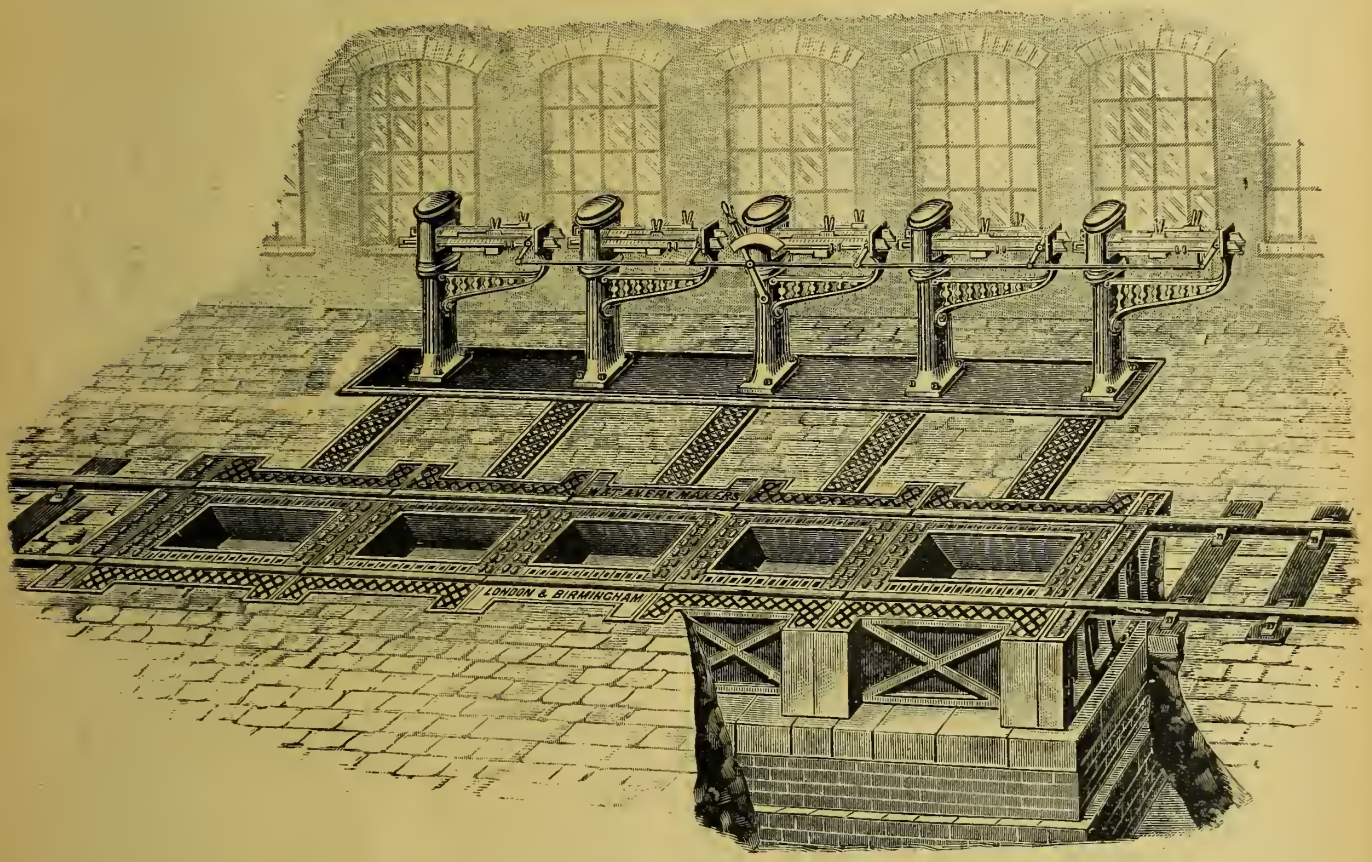
When the engine is drawn out of the erecting shop the jolting that it receives while passing over points, etc., causes it to settle down upon the springs and enables a fair result to be observed when the weight resting upon each wheel is ascertained on the weighbridge.

If these weights vary very much from the intended figures it will be necessary to transfer a portion of the load from one wheel, or pair of wheels, to others. This can be done on many engines by means of screw adjusting gear either at the ends of the springs, where they are attached to the framing, or at the hangers, where they are fixed to the axleboxes, the former being the usual practice. By this means an accurate weight distribution can readily be effected.

This screw adjusting gear is, however, open to the objection that it can be tampered with after the engine has left the weighbridge. On some railways, therefore, no adjusting gear at all is provided, and in these cases, should the weight require to be shifted it is necessary to change the springs, substituting others of less camber if less weight is required on any particular wheel, and of greater camber if more weight is to be put upon it. Engines can, therefore, only be tampered with in the running sheds by changing springs, and as this involves extra work it is more difficult to do it undetected by those in charge.

It may to many seem unnecessary to guard against such a contingency, but readjustments of the loads on wheels have often been made in the past, due to ignorance of the importance of equal distribution.

As mentioned earlier, the success of an engine will largely depend upon the proper distribu-



LOCOMOTIVE WEIGHBRIDGE WITH TEN SEPARATE TABLES.

tion of the weight over the wheelbase. As, for instance, upon a double ended engine, that is, one having carrying wheels at each end and the coupled drivers between, if an excess of load is thrown upon the end, or carrying wheels, weight is necessarily taken from the coupled drivers, and an engine lacking in adhesive power will result. If, however, a too large proportion is taken from the carrying wheels and put upon the drivers the engine may not slip, but it will ride hard and rough and be liable to mount the track when on curves, etc., and so be unsafe.

From these remarks it may be gathered that an accurate distribution of the total weight of a locomotive is of great importance.

The fact of each railway having engines of so many differing wheel bases, etc., makes it necessary to provide a weighbridge with several tables. It is, therefore, usual now to provide 10 tables, one for each wheel of a 10 wheeled engine, that is, one with 5 axles, enabling the weight upon each wheel, as well as that upon each axle, to be ascertained. Such a table, supplied by Messrs. W. & T. Avery for the Barry, N.E., and other railways, may be described as a standard weighbridge for locomotives.

Each table of this machine is completely equipped with its own levers, knife-edges, steelyard, poises, etc., independent of all the others. It consists of a length of steel rail, upon which one wheel will rest, and as it is most important that there should be no liability to "tip" or raise the opposite end when the engine is run on to the weighbridge, a novel and peculiar system of levers was necessary to prevent this, and so protect the knife-edges, etc., as shocks of impact would necessarily have a disastrous effect upon the efficiency and life of these relatively delicate parts.

A massive and substantial cast iron frame, which is firmly embedded in a concrete and masonry foundation, supports and encloses all the mechanism, etc., for the ten tables. The upper surfaces of the steel rails forming the tables are made in line and perfectly horizontal, and the rails spaced to the standard gauge of 4-ft. 8½-in., a short piece of fixed rail forming a dead plate between each table or weighing rail.

Between the rails the top cover plates of the machine are recessed, or dished, so as to allow room and freedom for men to work below the engine in changing or adjusting the springs or gearing, without it being necessary to move the engine from the weighbridge over an engine pit.

Each table connects with a separate steelyard, the two opposite tables for each axle having their yards upon the same pillar or standard. Thus for the ten tables there are five standards. Each steelyard is fitted with poises to weigh by 7 lbs. divisions up to 10 tons, entirely dispensing with loose weights, and the whole machine will indicate accurately up to 100 tons.

An ingenious and simple arrangement of cam gearing is attached to the pillar for the purpose of simultaneously locking by one movement the whole of the 10 steelyards while the locomotive is being taken on and off the machine. Each steelyard is fitted with Avery's patent steel notched protection bar, which renders the unsightly indentations and consequent wear upon the upper edge of the steelyard an impossibility. These machines can be made with any desired number of tables and to suit any wheelbase, capacity or gauge of rails, etc.

(*To be concluded.*)

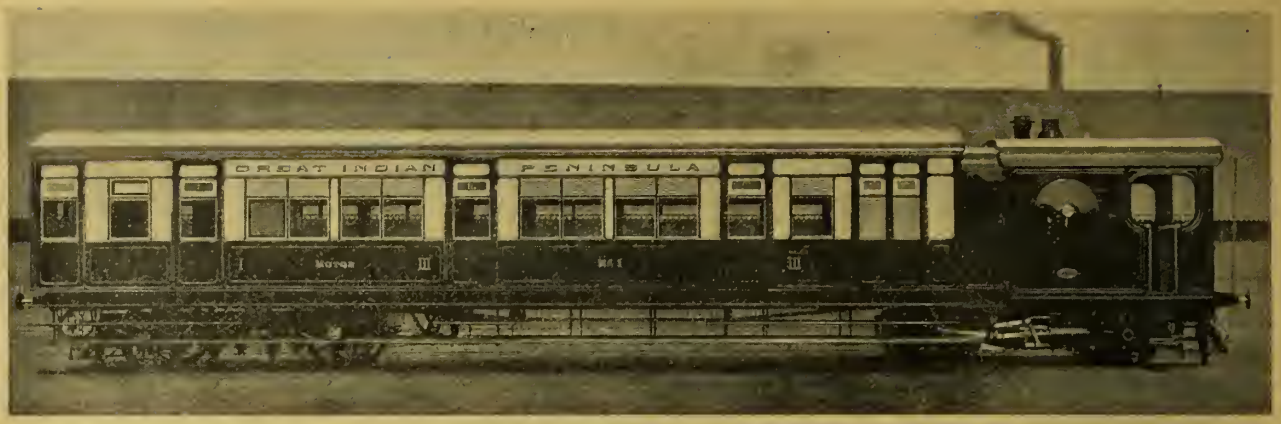
TRAFFIC ON THE G.E.R.

THE photographic reproductions which are shown on the opposite page illustrate in a graphic form the enormous amount of traffic, chiefly of a suburban character, that works in and out of Liverpool Street Station during every period of twenty-four hours. For purposes of observation the camera was, through the courtesy of the G.E.R. officials, placed in the Bethnal Green signal-box, which is situated in that mile or so of line just outside Liverpool Street Station, known as "the neck of the bottle." Here the 18 platform tracks of the terminus converge into six, three up and three down, whilst further out these meet four up and four down tracks, serving the network of suburban and main lines, all finding a terminus at Liverpool Street. Through this bottle-neck, during the busiest periods of the day, 41 trains per hour work inwards and again outwards; the average number of trains arriving or departing during each day of 24 hours being about 990 in summer and 960 in winter. This apparently endless procession of trains conveys an average, inward and outward together, of over 176,000 passengers per day, to and from the terminus, to say nothing of other passengers who may alight at or depart from intermediate stations in the Metropolis. A large proportion of this vast total consists of business and work people, whose comings and goings are concentrated into two or three hours in the morning and the same in the evening, a fact which renders the uniformly smooth and punctual working of the G.E. traffic one of the wonders of the railway world.

Adding to the above figures about 62,000 passengers to and from Fenchurch Street, and 29,000 to and from Bishopsgate, the daily average of the Great Eastern Ry. City stations is 267,000 passengers.

Photo by 1.35 P.M. YARMOUTH EXPRESS AND 1.30 P.M. WOOLWICH LOCAL ON BETHNAL GREEN BANK, GREAT EASTERN RY. *Loco. Pub. Co.*

Photo by FIVE TRAINS IN MOTION ON BETHNAL GREEN BANK, GREAT EASTERN RY. *Loco. Pub. Co.*



Steam Rail Motor Coach, Great Indian Peninsula Ry.

NEW LOCOMOTIVES FOR THE GREAT INDIAN PENINSULA RY

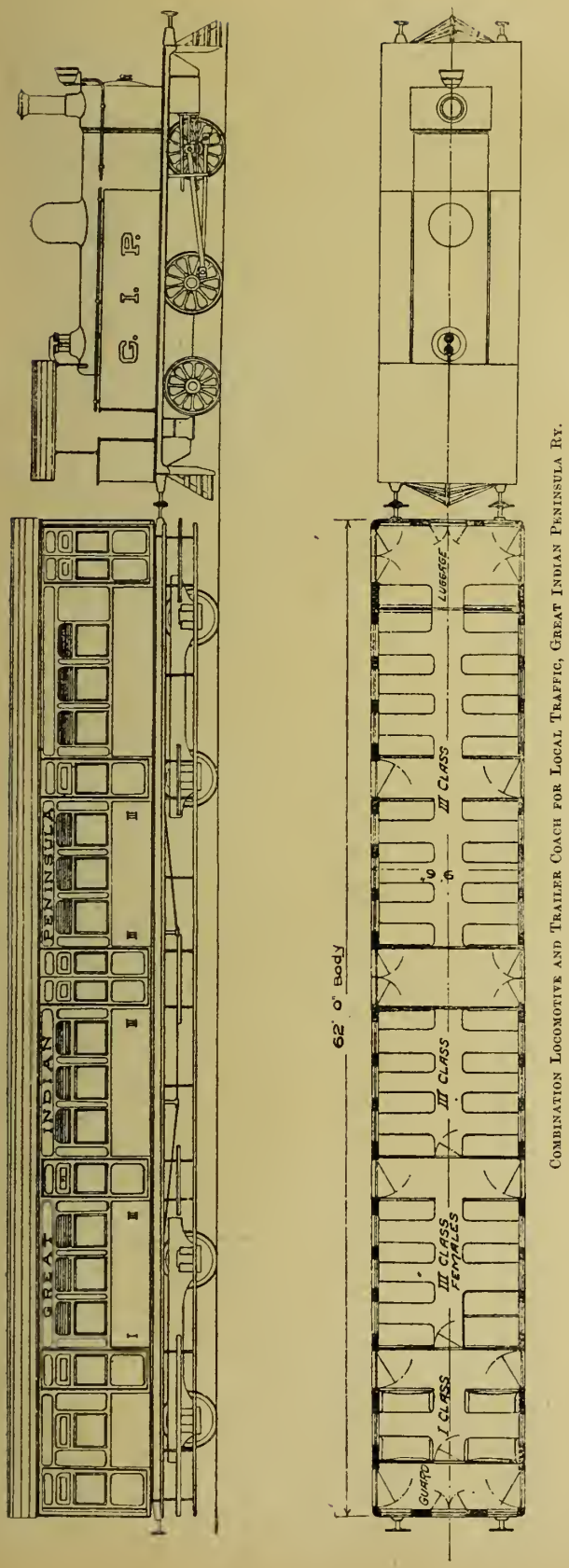
(*Continued from page* 74.)

Another acquisition of the Great Indian Peninsula Railway is the steam rail motor car, shown in the reproduced photograph annexed. The engine, with its boiler, is one of Messrs. Kerr Stuart's construction, whilst the car body was built at the railway shops at Parel, Bombay. The engine has cylinders 9-in. diameter by 15-in. stroke outside the frames, with Walschaerts valve gear, and a single pair of drivers 3-ft. 5-in. in diameter; it is all carried on the front bogie, which is detachable for overhaul or repair. The boiler has 160 1½-in. tubes, with 306 sq. ft. of heating surface, whilst the firebox adds another 47 sq. ft.; the firegrate has an area of 8.75 sq. ft. The working pressure is 170 lbs. per sq. in. A tank with a capacity of 550 gallons is placed at the rear of the engine compartment, while the bunker with space for 15 cwt. of coal is located at the front of the cab.

Electric light is installed in the car, which is also furnished with electric head and tail lamps, the current being generated by a small "turbo-generator" running at 3,000 revolutions per minute, supplied by Messrs. Greenwood and Batley, Ltd., of Leeds. The body represents a "composite" I. and III. class car, with accommodation for six and 56 respectively; suitable luggage room is also provided. The car can be operated from either end, as both steam regulator and vacuum brakes are connected up in the conductor's compartment.

The body of the coach is 48-ft. long, with an overall width of 10-ft. The bogie centres are 40-ft. 6-in. apart, while the total wheelbase is 51-ft. 6-in. Each bogie has a wheelbase of 10-ft.,

Trailer Car for Combined Steam Rail Motor Train, built in 40 hours, Great Indian Peninsula Ry..



Combination Locomotive and Trailer Coach for Local Traffic, Great Indian Peninsula Ry.

but the centre pivot of the engine bogie is set back 1-ft., thus reducing the distance between bogie centres.

To compete with this steam motor, one of the original Ghat engines, a very small tank locomotive, built by Wilson's, of Leeds, in 1863, has been re-modelled, and a "trailer" built for it. The outline sketch shows the arrangement. The building of the car was accomplished, we believe, in the record time of 40 working hours, as a test of the capabilities of the carriage shops in turning out work quickly in Bombay City. The car is 62-ft. long and 9-ft. 6-in. wide, and, like the motor, is a "composite" I. and III. It seats six first class and 60 third class passengers. The whole of the material was prepared accurately by machinery and assembled by men who made each branch in construction a speciality. Work commenced at 8.30 a.m. on Monday, March 26, and the car was finished, furnished, painted, lettered, etc., complete, ready for traffic by the following Friday evening at 5.30 p.m. No overtime was allowed, and the car is constructed almost entirely of Australian timber. A total of 172 men with eight chargemen were engaged in the task, but of this number several worked but a few hours on it, as, for instance, the painters and trimmers. No material of foreign origin was employed in construction, and the Union Jacks displayed on the finished car are emblematical of its British manufacture.

(*To be concluded.*)

LOCOMOTIVE WHEELS AND AXLES.

In modern locomotive practice, wheel centres are almost invariably made of cast steel, the use of wrought iron for this purpose being now of rare occurrence; the exceptions, in the case of wheels for goods and shunting engines, having centres of cast iron. These cast steel centres, in common with all other steel castings, are seldom made in the locomotive builders' works, the custom being to furnish the pattern and leave the casting to outside firms who make a speciality of this class of work.

But though wrought iron wheel centres are now more or less obsolete, a short description of the method of forging them may not be out of place; the process being of considerable interest and forming one of the highest examples of the smith's art.

The spokes, which are stamped out in dies under a steam hammer or hydraulic forging press, are originally in two pieces which are afterwards welded together, the inner portion being made with a wedge shaped piece at one end which forms part of the boss, whilst the outer portion is T shaped, the cross bar of the T being curved and

forming part of the rim. The spokes, when complete, are placed together, as shown in Fig. 1 herewith, the wedge shaped pieces forming the boss. It will be seen that the parts of the rim do not come in contact with each other, a gap being left between each of the spokes. A strap is placed round the whole and the ends of this drawn together by screws so as to hold all the spokes in their places. The central part of the wheel is then heated in a suitable fire, a round washer of the same diameter as the boss being simultaneously heated at another fire. When both are brought to a welding heat the boss of the wheel is placed on the anvil of a special steam hammer having a large gap to enable the wheel to be placed in position, the tup and anvil being cut out to clear the spokes. The washer is laid on top and the whole is united into one solid piece by a few blows from

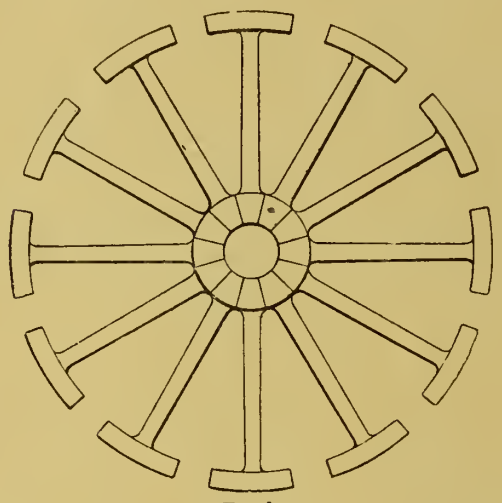


Fig. 1.

the hammer. A punch is then driven through the centre to bring the hole for the axle to size, the outer surface of the boss being finished with hand tools. Pieces are afterwards welded into the gaps in the rim and the forging is complete.

In the machine shop the hole for the axle is first bored, the boss also being faced. For this process the wheel may be chucked in a large facing lathe or the work may be done in a boring machine, the wheel being laid flat. The keyway, if any, is then cut.

The wheel is next put on the axle, the latter having been previously finished. The wheel seat on the axle is turned a shade larger than the corresponding hole in the wheel, which is forced on to the axle in a hydraulic press, a pressure of about 10 tons per inch of diameter of the wheel-seat being usually adopted, and the keys are afterwards driven in. The wheels are then turned up on the rims ready for the tyres to be put on.

The holes for the coupling rod crank pins in coupled wheels are bored out in a quartering machine, both together and parallel. The machine has two headstocks, in each of which is fixed a boring bar. The wheels are held between centres, one boring bar being below on the same vertical centre line and the other lying on the horizontal centre line. Supports are provided between the wheels for the other ends of the boring bars. The pins are turned, on the seat, slightly larger than the hole in the wheel. The latter is heated locally, the pin inserted and its end rivetted over.

Tyres are usually purchased in the rough from an outside firm, the machining only being done at the locomotive works. They are made of steel, the process being as follows. The ingot is first hammered down into a thick slab, the middle is punched out and the tyre is then rolled in a specially constructed mill to the right diameter and section. Before rolling, the blanks are weighed to insure the finished tyre being of the right diameter when of the required section.

A proportion of the tyres are usually tested to destruction under a falling weight, and a tensile test is also made before they are accepted by the locomotive builders. The tensile strength of the material should not be less than about 45 tons per square inch, nor the elongation less than 15 per cent. on a length of two inches.

After being received at the locomotive works the tyre is first chucked and bored in a lathe, the internal diameter being made a little smaller than the external diameter of the wheel centre. The tyre is then heated, usually by gas, and slipped over the rim on to which it is shrunk in cooling. The bolts or other fastening devices are then added.

The heating of tyres by gas is done in a furnace specially constructed for the purpose. These furnaces are simple in design consisting, as a rule, of a brick-lined pit with a row of gas jets around it, placed horizontally so as to cause the flame to impinge upon the tyre. Atmospheric burners are adopted.

A light crane is placed near the furnace by means of which, when the tyre is at the proper temperature, the wheels and axles are lifted (the axle being vertical) and the bottom wheel dropped into the tyre, after which the latter is allowed to cool.

The last process is to put the wheels again in the lathe and turn the tyres to gauge.

Axles, both straight and cranked, are usually purchased from an outside firm. Tensile and bending tests are made on metal cut from both, and straight axles are also tested under a falling weight. The tensile strength of the material should be about 30 tons per square inch and it should have an elongation of not less than 25 per cent. in two inches.

A piece of the material of a suitable length, about $1\frac{1}{4}$ inches square, should stand bending double when cold without any signs of failure.

The manufacture of crank axles is interesting. They are made chiefly from Siemens-Martin steel, the ingot being cast considerably heavier than the forging when finished, so that sufficient metal is used to form a good sound one. Allow-

Fig. 2.

ance should be made for the removal of about one-third of the upper portion.

The first process in the forging of the ingot is to hammer it down into a slab of about 2-ft. wide by 1-ft. thick as shown in Fig. 2. A hammer of 15 tons or over should be used for this operation. The finishing may be done under a smaller one of about 8 or 10 tons.

The shaded portions (Fig. 2) are then cut away and the ends and middle roughly rounded. The two projecting pieces form the cranks. Two heats are necessary for this operation. After the axle has been reheated the crank which is to "follow" is held between the anvil and the tup and a large spanner applied to the "leading" crank, which is drawn up at right angles to the other by means of suitable hydraulic or other apparatus. The middle and end portions are then finished and the cranks hammered up to shape, a portion being removed from the bottom between the webs.

In machining, the axles are first cut to length over all and rough turned on the wheel seats and journals. They are then placed on the marking off table, where the error in the twist, if any, is ascertained, the quadrant centres being afterwards put on accordingly. The space between the crank webs is tooled out by means of a milling machine, the tool consisting of a disc round the periphery of which a number of ordinary cutters are affixed. This milling tool is first fed into the web for some distance, after which the axle is caused to revolve round the centre of the crank pin, which is thus roughed out. The turned parts are finished in another lathe, quadrant centres being fitted to the ends to enable the crank pins to be turned. The principle of these centres is shown in Fig. 3. The end of the axle is inserted in the hole A. The centres B are at right angles to each other and at a distance from the centre of the hole A equal to the throw of the crank. By inserting the lathe centres in each of the centres B in turn the axle may be revolved around the centre of each crank pin.

The edges of the webs are slotted or planed round in special machines, or, if of the Worsdell circular type they may be turned in the lathe.

When straps are placed round the webs they are shrunk on.

The manufacture of built-up cranks is a comparatively simple matter and calls for no special machinery. The wheel seats, journals, crank-pins, etc., can be turned upon ordinary lathes and the webs finished in the ordinary planing and slotting machines. The webs are afterwards forced on to the cylindrical parts and keyed.

Straight axles are, in the best shops, turned in special lathes arranged with the driving gear at the centre of their length, and with a slide rest fitted at each end. The lathe mandrel is of large diameter, hollow and short, and the axle is passed through it and held between two dead centres. The journals and wheel seats are turned at each end simultaneously; the middle portions

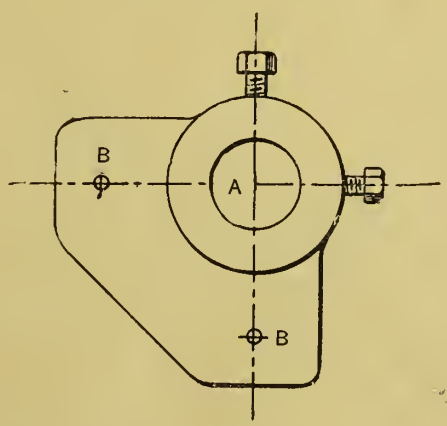


Fig. 3.

being left unturned. In some shops the journals are finished by means of a hard steel roller held in a forked support, the shank of which is held in the slide rest like an ordinary tool; the roller is pressed against the journal and fed along. In other cases the journals are case hardened after turning and are finished by grinding.

OLD LOCOMOTIVES ON THE WESTERN RAILWAY OF FRANCE.

On page 189, volume V., December, 1900, appeared an account of No. 4 engine, Waterford and Tramore Railway, which was built in 1844 (this is the date on the original axle) for the Liverpool and Manchester Railway, and has been working passenger trains ever since, though it is now only used for light work in winter. Some of the French railways have also very old locomotives still in active service. For example, the Orleans Company have in their possession an engine constructed to their order

in 1846, by Stephenson, after plans by Mons. F. Seguin. They also have a locomotive still in service built in 1855.

The Western Railway of France have a few engines built in 1844, which are still employed for light passenger and shunting work. These engines were the first to run on the line, and were built to the designs of Mr. Buddicom, at Chartreux Works, near Rouen. Originally they were single-driver tender engines and worked express trains between Paris and Rouen. They were converted to well-tank engines, and one (No. 131) is still preserved in almost its original condition in the Sotteville Works, near Rouen. This engine formed part of the company's exhibit in the Champ de Mars, at the Paris Exhibition of 1900, and the following particulars obtained then may be of interest :—

Distance run, 1,310,000 kilometres, or 813,986 miles.		
Boiler pressure	.. ..	6 atm. or 88 lbs. per sq. in.
Weight empty	.. ..	18 t. 600
,, full	.. ..	23 t. 900
Cylinders, diameter	..	.317 m. or 12-ft. $\frac{7}{16}$-in.
,, stroke	.. ..	.535 m. or 21-ft. $\frac{1}{16}$-in.
Driving wheels, diameter	..	1 m. 710 5-ft. $7\frac{8}{16}$-in.
Heating surface : firebox	..	4 m² 95=53.22 sq. ft.
tubes	..	48 m. 73=524.48 ,,
Total	..	53. 68.=577.70 sq. ft.
Grate area	.. .. ..	.87 m²=9.3 sq. ft.
Wheelbase	.. .. ..	3 m 959=12-ft. $11\frac{3}{16}$-in.
Length over buffers	..	7 m. 327=24-ft. $0\frac{9}{16}$-in.

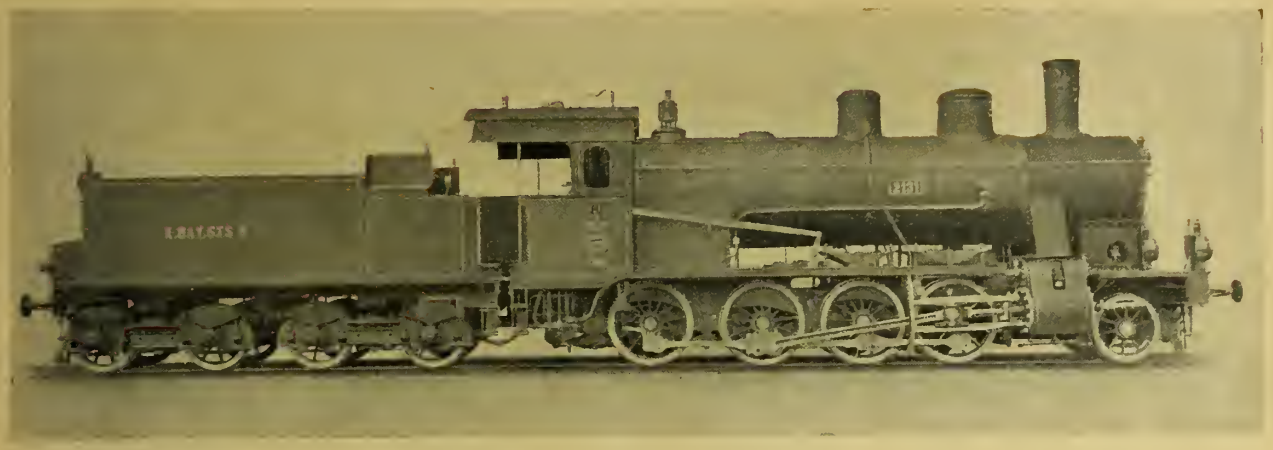
The example we illustrate, No. 0128, has been altered by rebuildings, and the addition of the Westinghouse brake, injectors and other modern improvements. There are at present not more than three of these engines in service ; one of them works passenger trains from Louviers to St. Pierre-du-Vauvray, on the Paris-Havre main line, while the others are used for marshalling passenger trains at Rouen.

Some years ago several of these engines went through a complete metamorphosis and commenced a new period of service as four-coupled side tanks, similar to several others built by Messrs. Cail, Gouin, &c. ; in this case, however, the engines were so materially altered that they were practically new ; this type of engine is very common on the Western Railway, and works local and branch line traffic on all parts of the system.

Single Driver Tank Locomotive No. 0128, Western Ry. of France.

Several of the six-wheeled four-coupled express engines with outside frames on this line, built by Messrs. Neilson & Co., of Glasgow, have now been rebuilt with leading bogies at the Rouen and Rennes shops.

It may also be noted in passing that many of the old four-wheeled first and second class carriages have been curiously transformed into long corridor coaches. The method of doing this is to join together two of the old carriage bodies, with a new lavatory between and a side corridor made right through. The vehicles as thus reconstructed are more than double their former length, but curiously enough these rebuilt coaches run on four wheels.

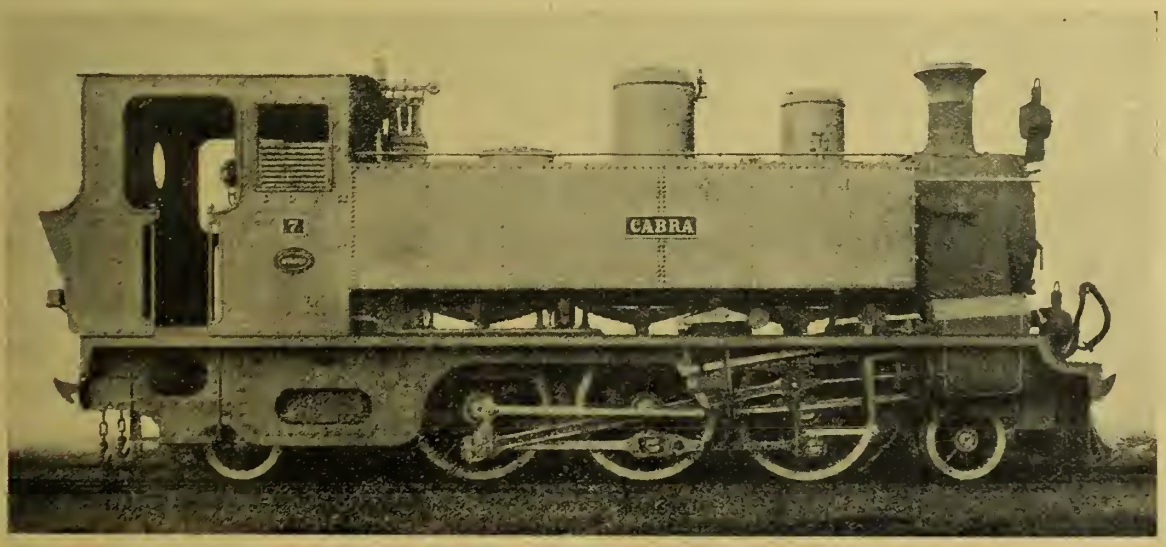


"Consolidation" Locomotive, Bavarian State Rys.

KRAUSS LOCOMOTIVE NO. 5,000.

The well-known locomotive building firm, Messrs. Krauss & Co., of Munich, have recently completed their 5,000th locomotive, and they have celebrated the occasion by issuing a most beautifully printed souvenir and catalogue, of which a copy has reached us. The locomotive in question, which is illustrated in the accompanying photo-reproduction, is a powerful "Consolidation" engine for the Bavarian State Rys., a line of normal gauge, and is of the following leading dimensions: cylinders 21¼-in. in diameter by 24-in. stroke; diameter of coupled wheels 4-ft. 2-in.; total wheelbase 23-ft. 3½-in.; heating surface, firebox 118 sq. ft., tubes 2,057 sq ft., total 2,175 sq. ft.; grate area 30.67 sq. ft.; boiler working pressure 176 lbs. per sq. in.; weight in working order about 64 tons. The engine is provided with a double bogie tender, the wheels being 3-ft. 3⅝-in. in diameter, distributed over a total wheelbase of 17-ft. 8¾-in.; it has a capacity for about 4,000 gallons of water and 6 tons of coal, and weighs, full, about 44¼ tons.

Our other illustration depicts a previously built tank locomotive for the metre-gauge Cantabrian Ry. from Santander to Llanes. This engine is No. 4,991 in the books of the makers, and has the following leading dimensions: gauge of railway 3-ft. 3⅜-in.; cylinders 15¾-in. in diameter by 23⅞-in. stroke; diameter of leading and trailing wheels 2-ft. 2¾-in., and of coupled wheels 3-ft. 11¼-in.; total wheelbase 20-ft. 0¼-in.; boiler, diameter (mean) 3-ft. 10½-in.; height of centre above rails 6-ft. 10⅝-in.; 134 tubes, 14-ft. 1¼-in. long and 2-in. in diameter; heating surface: firebox 62.3 sq. ft., tubes 993.7 sq. ft., total 1,056 sq. ft.; grate area 17.22 sq. ft.; boiler pressure 176 lbs. per sq. in.; capacity of tanks 880 gallons and of bunker 1¼ tons; weight of engine 43¾ tons, of which 32 tons are on the coupled wheels; length over buffers 29-ft. 1⅜-in.



Metre Gauge 2-6-2 Tank Locomotive "Cabra," Cantabrian Ry., Spain.

A RAILWAY ON A ROOF.

A MELANCHOLY interest attaches to the model railway illustrated in the accompanying photo-reproduction, owing to the fact that the builder of it, Mr. H. Fehlmann, of Zurich, has died since he submitted particulars of his unique model for publication in this magazine. When sending photographs to us in November last, he gave particulars of the construction of his railway as follows :—The whole is made of wood. The gauge is 0.043 m. (1.69-in.). The rails are of ⏢-section and rest on square sleepers at distance of 0.1 m. (3.93-in.). Owing to the little space I had at disposal, the railway is a terminus with a total length of only 5 m. (16.4-ft.) and a greatest breadth of 2.5 m. (8.2-ft.). At both ends are traversers for communication between the different lines. The locomotives are types derived from the old Swiss Central Ry., the North Eastern Ry., and the Communicated Swiss Rys. The carriages and wagons are of different patterns, selected from the German, French, Austrian, Italian and Swiss railways. For example, an express train consists of a four-coupled bogie locomotive of the N. E. R., a luggage van and composite I. and II. car of the Halle and Erfurt division of the Prussian State Rys., a dining car of the International Co., and a I. and II. composite of the St. Gothard Ry. The average height of the cars is 0.12 m. to 0.13 m. (4.72-in. to 5.11-in.) from rail level to the roof top, with a breadth of 0.07 m. (2.75-in.). Each car has two buffers at each end and wire couplings. Some railway men who have seen the railway recognised all the types at a glance.

MODEL RAILWAY LAID OUT ON THE ROOF OF A HOUSE.

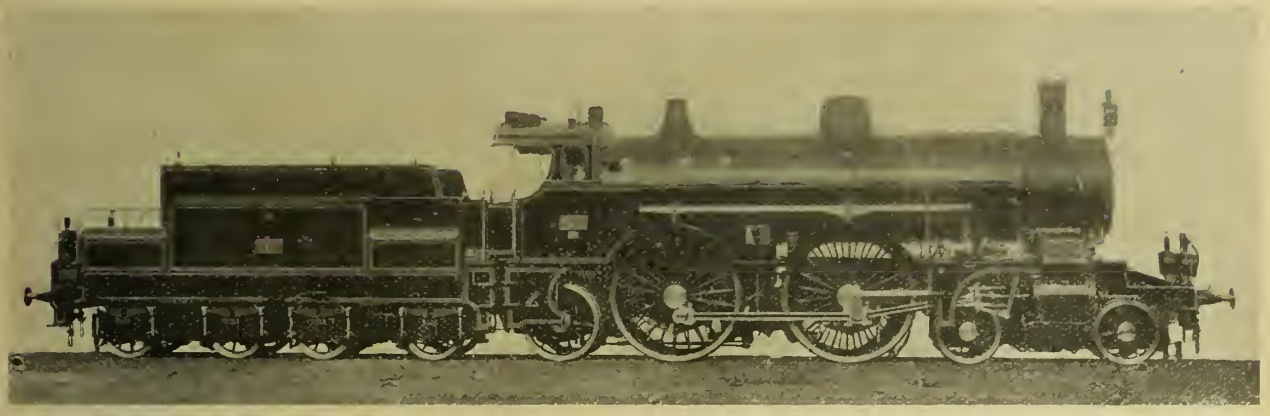
Mr. Fehlmann was only 19 years of age, and built this interesting model as a hobby. He studied the "Locomotive Magazine," and in addition derived much of his knowledge of railways and rolling stock from close observation of examples at the different stations of Zurich.

WE are informed that the North Eastern Ry. Co. have placed an order for two 30-ton chain testing machines with Messrs. W. & T. Avery, Ltd., of Birmingham. This firm have also secured an order from the Mersey Dock & Harbour Board for two of their 30-ton improved railway weighbridges, made sufficiently strong to allow of a 60-ton locomotive passing over.

SOUTH AFRICAN RAILWAYS.

A series of interesting experiments are being conducted on the Cape Government Rys. with three self-propelled rail motors. Two of these vehicles are petrol driven, built by the Maudslay Motor Co., of Coventry, and were illustrated and described in our issue of April, 1905. It is said these cars are capable of ascending gradients as steep as 1 in 40, with a good margin of power. The third car is steam-propelled, built by the North British Locomotive Co., of Glasgow, and provides accommodation for 20 first class and 16 third class passengers. A photo of this car was reproduced in our issue for March of this year.

Mr. L. S. Smart, chief locomotive superintendent of the Central South African Rys., has constructed a rail motor by utilising an old 19-ton locomotive formerly in service on the Netherlands Rys. of the South African Republic, and a side door suburban coach. He has also adopted a new style of coloring for the carriage stock of these lines. Instead of lake and chocolate color they are in future to be teak grained, which is said to stand the sun's rays better, besides being more economical.



Four-cylinder Gölsdorf Compound Locomotive No. 108·22, Austrian State Rys.

FOUR-CYLINDER COMPOUND ATLANTIC LOCOMOTIVE, AUSTRIAN STATE RAILWAYS

We are indebted to our friend Herr Gölsdorf, of the above railway administration, for the accompanying illustrations of a locomotive exhibited at the Milan Exposition, which represents the latest type of express passenger engine on the State railways. Four similar locomotives, Nos. 108·18—108·21, were built last year, and the leading dimensions are shown in metric measurements on the subjoined diagram. For the sake of readers not readily conversant with the metric figures, we give the following details in English equivalents: diameter of high pressure cylinders 13¾-in., and of low pressure cylinders 23⅝-in.; stroke of all four cylinders 26¾-in.; diameter of bogie wheels 3-ft. 3¼-in., of coupled wheels 6-ft. 10⅝-in., and of trailing wheels 4-ft. 1½-in.; the boiler carries a working pressure of 200 lb. per sq. in. and contains 314 tubes of 2-in. diameter; heating surface: fire-box 177.17 sq. ft., tubes 2,166.60 sq. ft., total 2,343.77 sq. ft.; grate area 38 sq. ft.: weight of engine empty, about 59¾ tons, and in working order about 67¼ tons, of which only about 28 tons are on the coupled wheels. The tender is of the new pattern recently introduced on the State Railways, with access to the water tank from the side.

THE CANTERBURY-WHITSTABLE RAILWAY.

The Last Trip of "The Invicta."

We stated in last month's issue that George Stephenson's interesting old locomotive "The Invicta," built in 1830 for the Canterbury and Whitstable Railway, and which has been preserved at the Ashford Works, had been presented to the city of Canterbury by Sir David Salomons. A site was selected by the Corporation just outside the old city walls, near the pleasant public garden known as "The Dane John," and a pedestal of Kentish rag was erected on a concrete foundation, the top face being paved with random setts, in which old stone sleepers were inserted, and on these were fixed cast iron

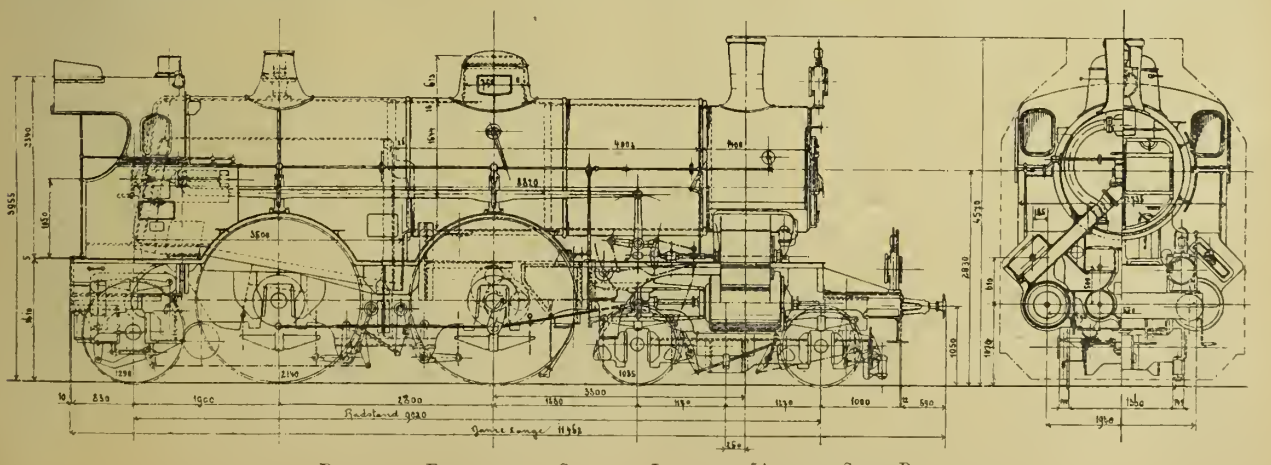


Diagram of Four-cylinder Compound Locomotive, Austrian State Rys.

chairs with old fish-bellied rails, similar to those in use on the old line in 1830.

On Wednesday evening, June 6th, the "Invicta" arrived at Canterbury East goods station, having been brought from Ashford via Dover on a truck attached to a goods train. A gang of workmen from the Ashford works, under Mr. David Reid, locomotive foreman (who took the "Invicta" to the Paris Exhibition in 1900), followed, and early on the morning of June 7th she was unloaded, and travelled on her own wheels along the road to her last resting place, two horses being used to haul her. The wheel-base being rigid and the road curving, some trouble was experienced in getting the engine round the curves, but all went well, and on reaching the site she was lifted up sideways on to the pedestal, the work being watched throughout the day by numbers of citizens, among them being the mayor, Mr. F. Bennett-Goldney, F.S.A. (to whose influence it is largely due that this interesting and historic relic of early railway practice has been secured for Canterbury) and other members of the Corporation.

The Canterbury and Whitstable Railway, which was opened on May 3rd, 1830, was not only the earliest piece of railway in the South of England, but was one of the very first for passengers in the kingdom. The Stockton and Darlington line had been opened in 1825, but although the historic locomotive trials, in which the "Rocket" proved so great a success, had taken place on the Liverpool and Manchester Railway in October, 1829, that line was not actually opened for traffic until September, 1830.

George Stephenson was engaged as engineer for the Canterbury and Whitstable line, but Mr. Smiles in his biography says Stephenson was too busy with the Liverpool and Manchester line to give the Kentish Railway his personal attention, and that he sent his assistants, Mr. John Dixon, to survey it, and Mr. Locke, to superintend its construction.

The "Invicta" was built by Stephenson, at Newcastle, and was brought by sea to Whitstable, Mr. E. Fletcher, subsequently locomotive superintendent of the N.E.R., coming with it and driving it on the opening day. Its dimensions were: coupled wheels 4-ft. diameter, cylinders 10-in. by 18-in., boiler 10-ft. long, steam pressure 40-lb. It was not intended to work over the whole of the line, which is six miles long, but only over the two miles nearest Whitstable, the other portion of the line being worked by fixed engines and ropes, on account of the steep inclines. The gradients of the Church Street Bank, near Whitstable, were, however, found too heavy for the "Invicta," and its work was confined to a level length of about a mile, at the top of the bank, on which it ran for some years, taking a gross load of 20 tons at a speed of ten miles an hour. Subsequently (about 1838) the boiler was altered, but with the result that sufficient steam could not be produced, and the engine had to be laid aside and horses were substituted for it on the level, the rest of the line being worked by three fixed engines and ropes. The "Invicta" was brought to Canterbury and stood in a shed near the terminus of the line in North Lane, Canterbury, until the S.E. line was made in 1845, and the old line connected with it. Since then the engine has been preserved in the Ashford Works, but was sent to the Darlington Exhibition in 1875, the Stephenson Centenary at Newcastle in 1881, and the Paris Exhibition in 1900. It has now found a very appropriate permanent resting place near the scene of its early labours, where it will form an addition to the many existing attractions of the venerable Cathedral City, and it is somewhat curious to notice that what will probably prove to be the last trip of this old veteran should have been on a common road and that the motive power should be horses and not steam.

The Whitstable branch is still a single line, and the low pitched tunnel near Canterbury is a great source of annoyance. The old booking office and the ticket box, and other relics of the old line are still in existence.

Our friend, Mr. H. H. Battey, of Canterbury, has kindly supplied the foregoing particulars, also the photographs reproduced last month.

THE EVOLUTION OF THE LOCOMOTIVE ENGINE.—We have received from the publishers, Messrs. William Dresser & Sons, Darlington, a neatly and tastefully bound reprint in reduced fac-simile of the 14 large charts of locomotive diagrams drawn by the late Mr. Theodore West, formerly chief draughtsman of the North Eastern Ry. locomotive works at Darlington. Originally produced on the scale of ½-in. to the foot, these diagrams are now reproduced at approximately 1/10-in. to the foot, a very considerable reduction, but without rendering the detail and dimensions indistinct. Though even the most modern of the original sheets of drawings has now become almost obsolete, they are still of value for the sake of recording phases of development, while those dealing with ancient British and American locomotives contain most interesting particulars of forgotten types. As there are probably but few complete sets of the original broadside sheets in existence, and those have a value largely in excess of their first cost, this excellent and handy reprint should be eagerly sought for by the railway "collector."

A ROYAL TRAIN.—Messrs. Robert Ingham Clark & Co., Ltd., have forwarded a pamphlet, printed on fine art paper, giving a number of excellent photographic views of the Royal coaches constructed by the L. & N. W. Ry. for the journeys of T.M. the King and Queen. The firm's specialities, "Britannia" varnishes, have been used extensively in the decoration of these palatial railway carriages.

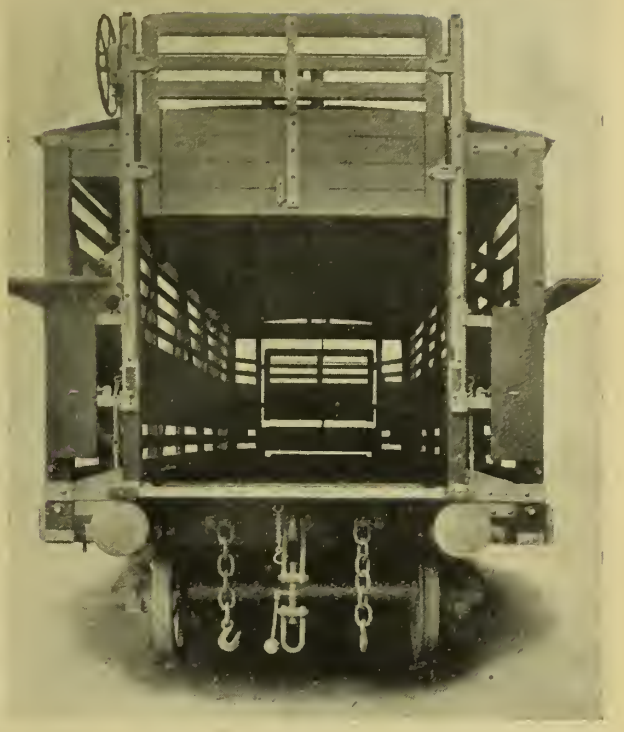
NEW WAGON STOCK, BUENOS AYRES GREAT SOUTHERN RY.

THE photo-reproductions on this and the following page illustrate some new rolling stock for the above railway, built by Messrs. the Metropolitan Amalgamated Railway Carriage and Wagon Co., Ltd. The covered cattle wagon here shown has a total length over headstocks of 35-ft., and a width over the pillars of 10-ft. 2-in., the height inside being 8-ft. at the centre and 7-ft. 5-in. at the sides. The bogies have each a wheelbase of 5-ft. 6-in., their centres being 24-ft. 6-in. apart. The tare of a wagon as shown is 15,300 kilos (15 tons 1 cwt.). It will be noticed that the doors of this wagon are of the guillotine pattern, placed at the ends, giving ready access to the interior.

The covered goods wagon shown on the following page has a total length over headstocks of 32-ft., and a width over the body of 10-ft. 1-in., the height inside being 8-ft. $6\frac{3}{4}$-in. at the centre and 7-ft. at the side; the bogies have each a wheelbase of 5-ft. 6.in., the centre being 22-ft. 9-in. apart. The tare of this wagon is 15,600 kilos (15 tons 7 cwt.) and its capacity is 40,000 kilos. (39 tons $7\frac{1}{2}$ cwt.). There are three filling holes in the roof to facilitate loading grain in bulk, whilst for unloading at the port of shipment sliding doors are provided in the floor, operated by a hand wheel. The underframe of this wagon is of Messrs. Livesey & Gould's patent cantilever type, giving a very light and strong construction.

Trade Catalogue received :—

Veithardt & Hall, Ltd., 41, Eastcheap, London, E.C. —Electric train lighting.

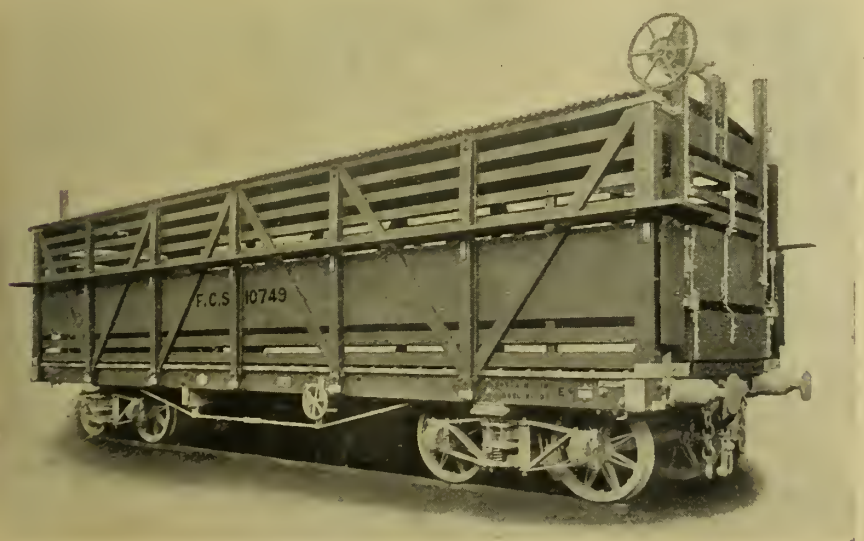


END VIEW, CATTLE WAGON, BUENOS AYRES GREAT SOUTHERN RY.

EITHER-SIDE WAGON BRAKE, GREAT WESTERN RAILWAY.

WE illustrate herewith the standard G.W.R. either-side wagon brake, invented by the late Mr. Wm. Dean and Mr. G. J. Churchward. It has been found in practice to meet all the requirements laid down by the Board of Trade, and a series of severe tests were also made by the representatives of the Amalgamated Society of Railway Servants, on the Dowlais branch of the G.W.R. on Sunday, November 5th, 1905. Their report spoke most highly of the brake for reasons of safety to shunters and brakesmen, and strongly recommended other railway companies to adopt it, as men run considerable risks in crossing the metals when wagons are in motion.

Referring to the drawings, which show an elevation and plan of part of a wagon fitted with the brake, it will be seen that on the outward ends of the transverse shafts



CATTLE WAGON, BUENOS AYRES GREAT SOUTHERN RY.

40-tons Covered Goods Wagon, Buenos Ayres Great Southern Ry. *(Particulars on preceding page.)*

A, short hand-levers B1 and B2 are securely fixed at opposite diagonal corners of the vehicle, so that both levers act simultaneously on the shafts, whichever is operated. One of the hand-levers, B1, has a "tripping" arm C1, projecting upwards, its end being extended

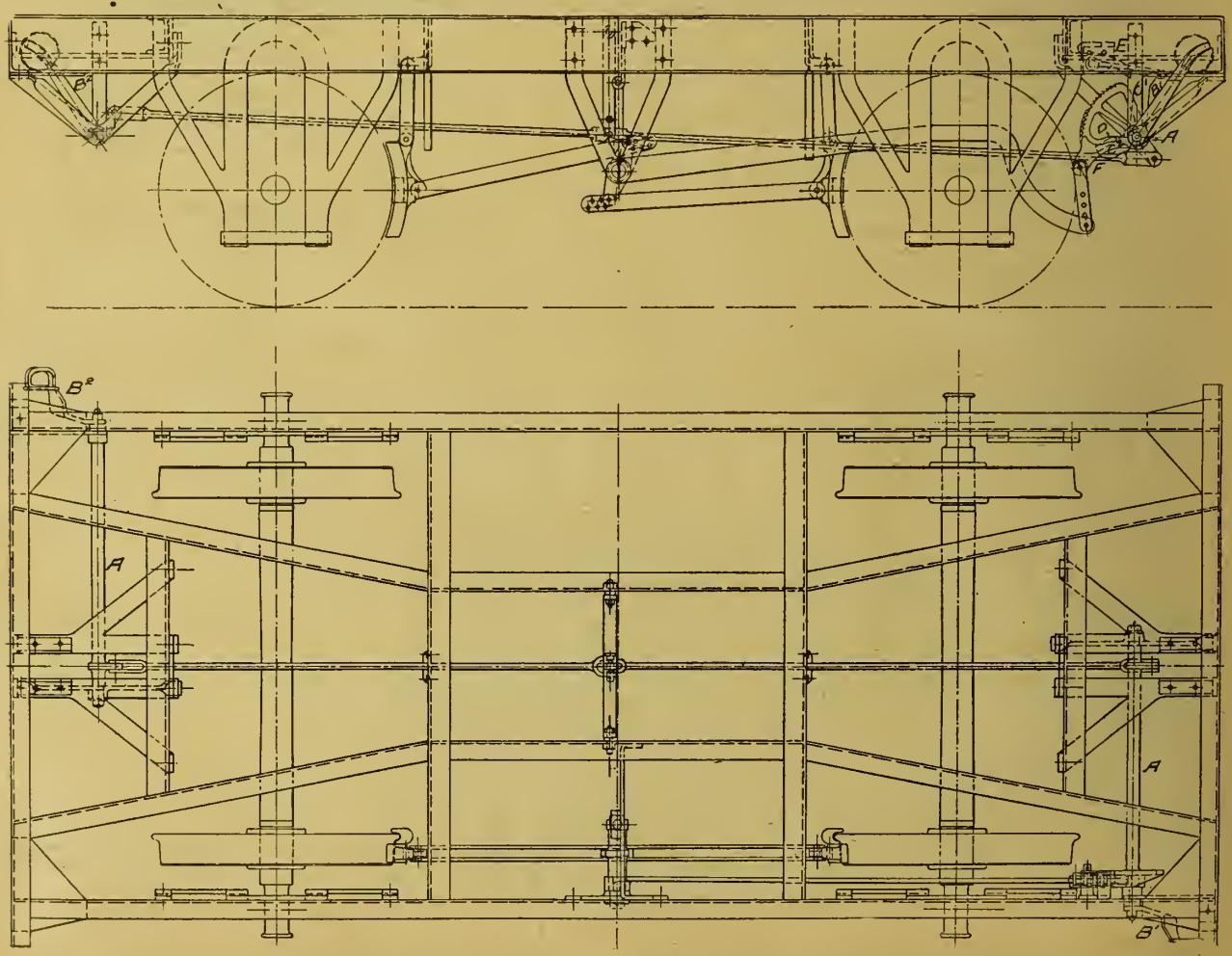


Diagram of Either-side Wagon Brake, Great Western Ry.

New North Country Continental Express Train. Great Eastern Ry.

rearwardly to engage with a projection on the pawl, when the brake is "off"; it has also an arm C2 projecting forward, which engages with a lug D on the segmental-shaped rack, which is placed loosely on the same shaft, but is prevented from moving laterally. This rack is provided with ratchet teeth, into which a pivoted pawl E is arranged to engage. A projection F is formed on the segmental rack to which a rod is connected by a pivot and led to a long lever on the usual brake shaft and gear.

To put on the brake, from either side of the wagon, the hand lever is pressed down by the shunter, when the forward extension will bear on the segmental rack and cause it to turn on its shaft, and its connected rod to pull on the long lever which operates the second or brake shaft; the pivoted pawl then engages and prevents the return movement and thus holds the brake on.

To take off the brake, either of the hand levers is raised and this upward movement brings the "tripping" arm C1 under the pivoted pawl E, lifting it out of the serrated rack; the brakes are then immediately released by the gravitation of the mechanism. The levers are retained in the "off" or normal position by the pointed rearward extension of the "tripping" arm of the hand lever taking its bearing against the projection formed on the end of the pawl, a spring retaining the pawl in the normal position. With this combination it has been found impossible for the brake to be jarred on when the vehicle is violently shunted. Of course in applying the brake the projecting arm is forced past the projecting lug, so allowing the pawl to engage with the teeth of the rack.

The mechanism is simple and not likely to get out of order, and it has the advantage of being light and easily applied to wagons fitted with the ordinary lever brake.

Mr. R. Weatherburn, M.I.M.E., has been appointed sole British agent for A. Borsig, of Berlin, whose works were established in 1837, and are now among the largest on the Continent for the manufacture of locomotives and other steam engines and boilers, "Mammoth" pumps, refrigerating, compressing and such like plant. Mr. Weatherburn has opened offices in London, and all future enquiries and communications should be addressed to Finsbury Pavement House, E.C.

The late Mr. T. Robertson, C.V.O.—The death is announced, at the age of 70, of Mr. T. Robertson, who in 1901, at the request of the Government, made an investigation of the working of the railways in India. Previous to visiting India, Mr. Robertson made a tour of the United States and Canada, and in connection with his mission travelled upwards of 76,000 miles. As a result, he recommended the transfer of railway management from the hands of Government officials to a properly qualified Railway Board.

CORRESPONDENCE.

The Locomotives of the Great Eastern Ry.

To the Editor of "The Locomotive Magazine."

Sir,—I have read with much interest Mr. Rous-Martin's recollections of Eastern Counties' engines in your May number. I am glad to have the point cleared up that, when built, the 250 class had not a safety valve column on the barrel, as I was not sure of this. I should, however, like to point out that these columns were not in all cases added when domes were put on, as I have before me a copy of an old photograph of No. 253, plainly showing the usual Gooch valve casing on the firebox and the column on the barrel, and this was my authority for Fig. 88. The "Butterfly," No. 214, had a like combination of mountings. I have heard that the columns were put on during the latter part of Mr. Gooch's superintendence, those on the firebox being inadequate.—Yours faithfully,

June 6th. H. T. B.

L. & S. W. R. Locomotives.

To the Editor of "The Locomotive Magazine."

Sir,—I notice an omission in your account of the first passenger tank locomotives built by Mr. W. Adams for the S. W. Ry. The reproduced photograph of No. 379 on p. 89 shows a plate fixed to the framing just above the cylinders. This plate states that the engine is fitted with Church's valves. As a matter of fact all the engines bore a plate on each side. Beyer, Peacock & Co. were agents for the supply of these patent valves. I should think that the valves must have been circular ones, which "stuck" when the engine had been running without steam or had been standing a little time at a station, and the valves were thus dry. The hideous screeches they made when the engine again moved off were most abominable, just as if hundreds of slate pencils were being scraped on slates "the wrong way." There was also a very considerable leakage of steam through the use of Church's patent valves.

I fancy, also, that you will find, if you get hold of the right authority, that the diameter of the cylinders of these engines was originally 17½-in., and not 18-in. as stated.—Yours, etc., J. K.

June 18th, 1906.

*** A series of diagrams published some years ago with the authority of Mr. W. Adams, showing a number of L. & S. W. R. locomotives, gave the cylinder dimensions of these engines as 18-in. by 24-in.—Ed. "Locomotive Magazine."

A Broad Gauge Boiler Explosion.

To the Editor of "The Locomotive Magazine."

Dear Sir,—As one of the readers of the "Locomotive Magazine" for a number of years past, I wish to express the interest afforded me by the letters in your recent issues in connection with the boiler explosion of the broad-gauge locomotive "Perseus," and also to know there are some of your contributors who are so well acquainted with the history of the broad gauge at that period. I think a few such letters, at times, would afford much gratification to your readers generally, and would certainly do so to myself.

Living as I did, as a youth, close to the Great Western main line, I took a very keen interest in those locomotives, and have since read with much interest your articles on the B.G. locomotives of the Great Western Ry. I was also in touch, as a passenger, with the London & South Western, and often travelled from Brentford to Isleworth to see relatives, and well remember the little engines "Locke," "Comet," "Briton" and others referred to in your "History of the Locomotives of the London & South Western Railway."

With reference to the "Railway Reminiscences" in your April issue, I have the Diaries of the late Sir Daniel Gooch, and often refer to the book. From these diaries I find it was exactly 62 years ago this 1st of May since the G. W. Ry. system was opened from Bristol to Exeter, 1st May, 1844, when the first train from Paddington, a special with a large party, was driven to Exeter and back in the day, by Mr. (after Sir Daniel) Gooch, leaving Exeter on the return journey at 5.20 p.m., and reaching Paddington at 10 p.m., when Sir Thomas Acland went at once to the House of Commons and by 10.30 got up and told the House he had been in Exeter at 5.20, the distance being 195 miles. The engine used was the "Actæon," and there were six carriages in the train.

For fast running, however, this record was eclipsed the previous year, 1843, at the launch of the "Great Britain" steamship, when Mr. Gooch ran a special, with Prince Albert, from Paddington to Bristol, to the launch. "On the down journey," he says, "we had some long stops for the Prince to receive addresses, but having no delays on the return journey it was done in two hours and four minutes. Few runs over so long a distance have been made as quick as this, even since."

Both these records are on page 52 of the "Diaries."

One other note only, if you will kindly allow me. I find the old "Lightning" referred to by one of your interesting correspondents in your April issue had a greater mileage between 1847 and 1878=816,601, than any other of the old B.G. 8-ft. wheel engines. I do not see in your records that any other of these engines came up to 800,000 miles, some did not do half.—Yours faithfully,

Barry, May 1st, 1906. An Interested Reader.

The Locomotive Magazine.

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RAILWAY NOTES.

LONDON & NORTH WESTERN RY.—In the illustration below is shown one of the new 4-4-2 passenger tank locomotives recently built at Crewe for working heavy branch line traffic. These engines are of the following dimensions: cylinders 19-in. in diameter with a stroke of 26-in., diameter of radial truck and trailing wheels 3-ft. 9-in., and of coupled wheels 6-ft. 3-in.; wheelbase, radial truck 6-ft. 3-in., centre of radial truck to driving wheels 12-ft., coupled wheels 10-ft., centres of trailing driving and trailing radial wheels 7-ft. 6-in., total 32-ft. 7½-in.; boiler heating surface, firebox 161·3 sq. ft., tubes 1848·4 sq. ft., total 2009·7 sq. ft.; grate area 22·4 sq. ft.; working pressure 175 lb. per sq. in.; total weight of engine in working order 74 tons 15 cwt.

NEW TEN-WHEELED PASSENGER TANK LOCOMOTIVE NO. 528, LONDON & NORTH WESTERN RY.

HIGHLAND RY.—The three locomotives of the "Ben" class built by the North British Locomotive Co., Ltd., Polmadie works, have been delivered as follows: Nos. 38 "Ben Udlaman," 41 "Ben Bhach Ard," 47 "Ben A'Bhuird" (makers' Nos. 17438-40, 1906). In appearance they are identical with Nos. 1-17, except for having the new number plate with raised cast figures on a red ground.

LONDON & SOUTH WESTERN RY.—The five six-coupled bogie engines are now in regular work between Salisbury and Exeter. The new mixed traffic bogie engines have been delivered up to No. 411. The total engine stock of this railway at June 30th was 916, of which 180 are on the duplicate list; of this total 532 are tender engines. The railway owns 552 tenders and 17 rail motor coaches (two of these being jointly-owned with the L. B. & S. C. R.). During the half-year 12 new engines and 7 tenders were built at Nine Elms, apart from several new rail motor engines, and 212 engines passed through the shops for repairs. There are now in course of construction ten passenger tank engines and ten steam rail motor engines.

GREAT CENTRAL RY.—The six-coupled bogie passenger engines have now been delivered up to No. 1104, making a series of ten built by Messrs. Beyer, Peacock & Co., Ltd. The ten six-coupled bogie goods engines with 5-ft. 3-in. wheels on order from the same firm will bear Nos. 1105-1114. Messrs. Beyer, Peacock & Co., Ltd., are also about to build 12 ten-wheeled passenger tank locomotives of No. 1055 class. Messrs. Kitson & Co. have received an order for 13 eight-wheels coupled goods locomotives. Six six-coupled shunting locomotives with outside

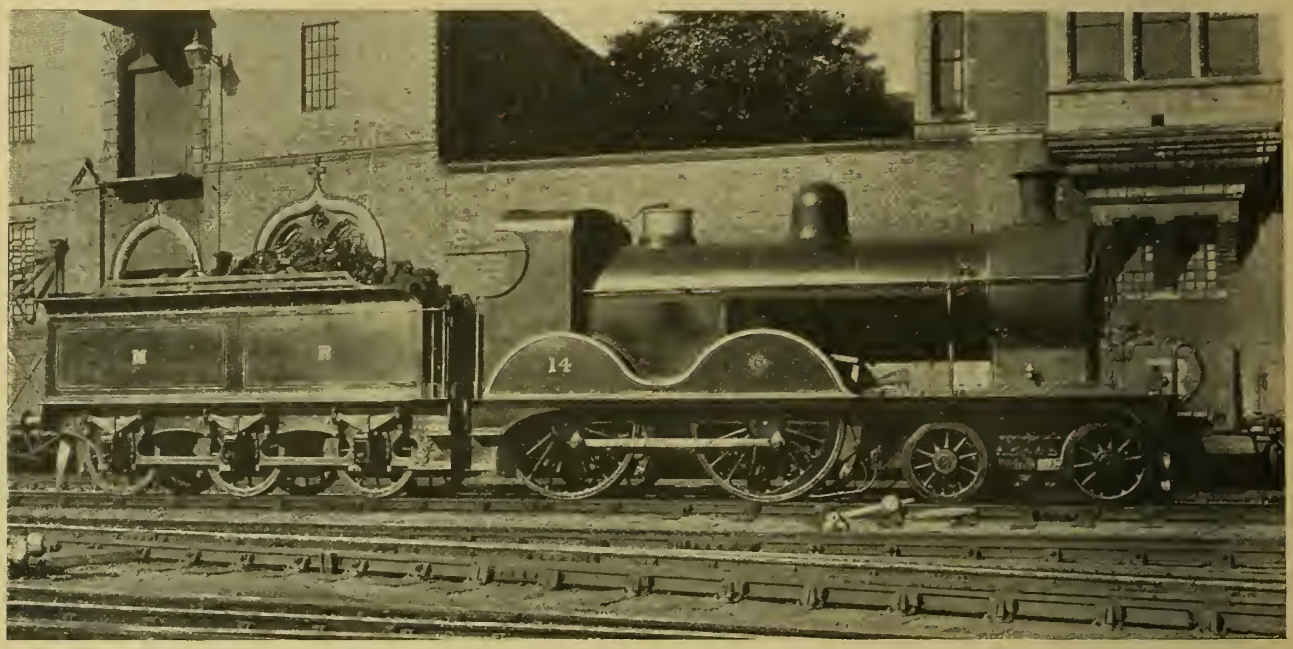
cylinders are in course of construction at the Gorton works of the G. C. R.

MIDLAND RY.—A number of Mr. Johnson's coupled bogie passenger locomotives are being rebuilt with larger boilers, new cabs and modified splashers. The photo-reproduction below shows No. 14 so converted, this being one of a series of 18-in. by 26-in., 6-ft. 6-in. engines built in 1891. With slight differences in detail other bogie engines have also been rebuilt—Nos. 61-4, 19½-in. by 26-in., 7-ft., and Nos. 2187-90, and 2195, 18½-in. by 26-in., 7-ft., being amongst the number; and other engines dealt with include Nos. 197, 805, and 2594 and 2597.

Mr. J. W. Smith, chief draughtsman at Derby, has been appointed works' manager of the G.C.R. locomotive department at Gorton.

HAMMERSMITH & CITY RY.—The first of the new electric trains built by the Metropolitan Amalgamated Carriage & Wagon Co., Ltd., for the Great Western and Metropolitan joint service has been delivered at Neasden. Nine of the trains running between Hammersmith and the City are now worked by electric locomotives between Bishop's Road and Aldgate. On Bank Holiday some of these steam trains with electric locomotives were running on the Uxbridge branch of the Metropolitan.

GREAT WESTERN RY —Nos. 3719-3724 are the latest engines of the four-coupled bogie type at work. No. 3079, bogie single, and 3276 and 3313 of the "Duke of Cornwall" class, have recently been rebuilt with large domeless boilers and Belpaire fireboxes.



FOUR-COUPLED BOGIE PASSENGER LOCOMOTIVE No. 14, REBUILT, MIDLAND RY.

SOUTH EASTERN & CHATHAM RY.—The new express passenger engines mentioned in our last issue should have read—Nos. 273, 275, 504, 506 and 511. No. 503 is a tank engine. Nos. 310 and 312 are the latest bogie tank engines, and five new express locomotives of No. 726 class are in course of construction.

NORTH LONDON RY.—Two locomotives of this railway, Nos. 19 and 86, have been fitted with reservoirs containing oak liquor (oak chips and caustic soda) through which the boiler feed water is passed for purifying and softening purposes. These reservoirs are somewhat conspicuous, as they are placed on the boiler barrel between the steam dome and safety valve.

LONDON, BRIGHTON & SOUTH COAST RY.—Though the naming of engines on this line appears to be doomed, it has been decided that where locomotives are named after living celebrities the names shall be retained, even after re-painting with the new standard colors.

GREAT NORTHERN RY.—Another series of eight-coupled radial side tank locomotives of the N class are in course of construction at Doncaster. Nos. 137 to 141 of this class are at work between Colwick Sidings and Pinxton.

TAFF VALE RY.—Messrs. Manning, Wardle & Co., Ltd., have recently secured a contract for seven six-coupled tank locomotives designed for mixed traffic.

Four-cylinder Atlantic-type Express Locomotive No. 40, Great Western Ry.

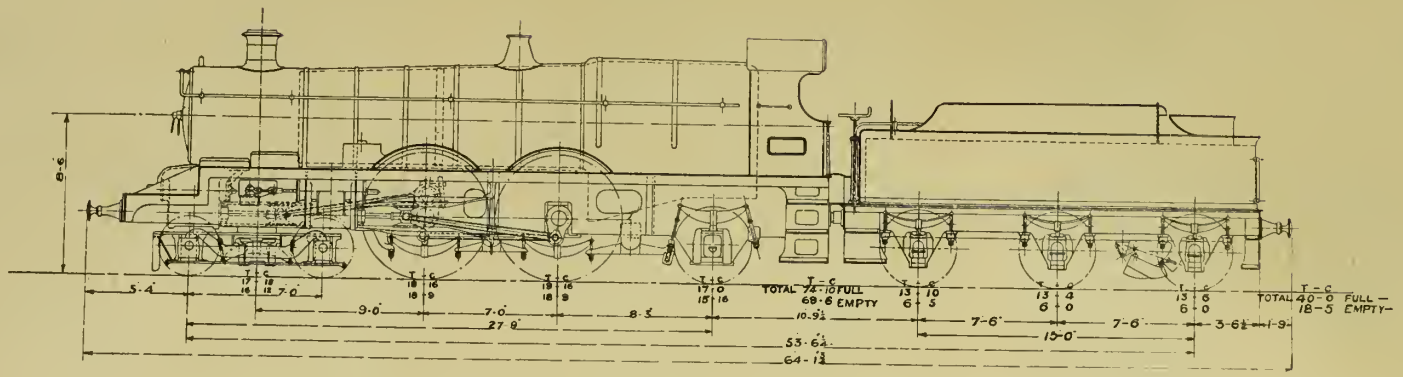


Diagram of Four-cylinder Atlantic-type Locomotive No. 40, Great Western Ry.

FOUR-CYLINDER ATLANTIC LOCOMOTIVE, GREAT WESTERN RY.

By the courtesy of the editor of our contemporary, *The Great Western Magazine*, we are able to illustrate herewith the new four-cylinder simple Atlantic-type locomotive No. 40, recently introduced by Mr. G. J. Churchward, which is now doing excellent service. This engine has cylinders 14¼-in. in diameter by 26-in. stroke, with cranks set on all quarters, the outside cylinders driving the rear pair of coupled wheels, and those inside, which are placed well forward under the bogie platform, driving the leading coupled wheels. The boiler is of the latest pattern, coned from the smokebox plate, and is 14-ft. 10-in. long, with diameters at smokebox and throat plates respectively of 4-ft. 10½-in. and 5-ft. 6-in.; it contains 250 tubes, 15-ft. 2$\frac{5}{16}$-in. long by 2-in. diameter; the heating surface is as follows: firebox 154.26 sq. ft., tubes 1,988.65 sq. ft., total 2,142.91 sq. ft.; grate area 27.07 sq. ft.; boiler pressure 225 lbs. per sq. in.; total weight of engine in working order 74 tons 10 cwt., and of the standard 3,500 gallon tender 40 tons.

Six-coupled Goods Locomotive No. 329, North British Ry.

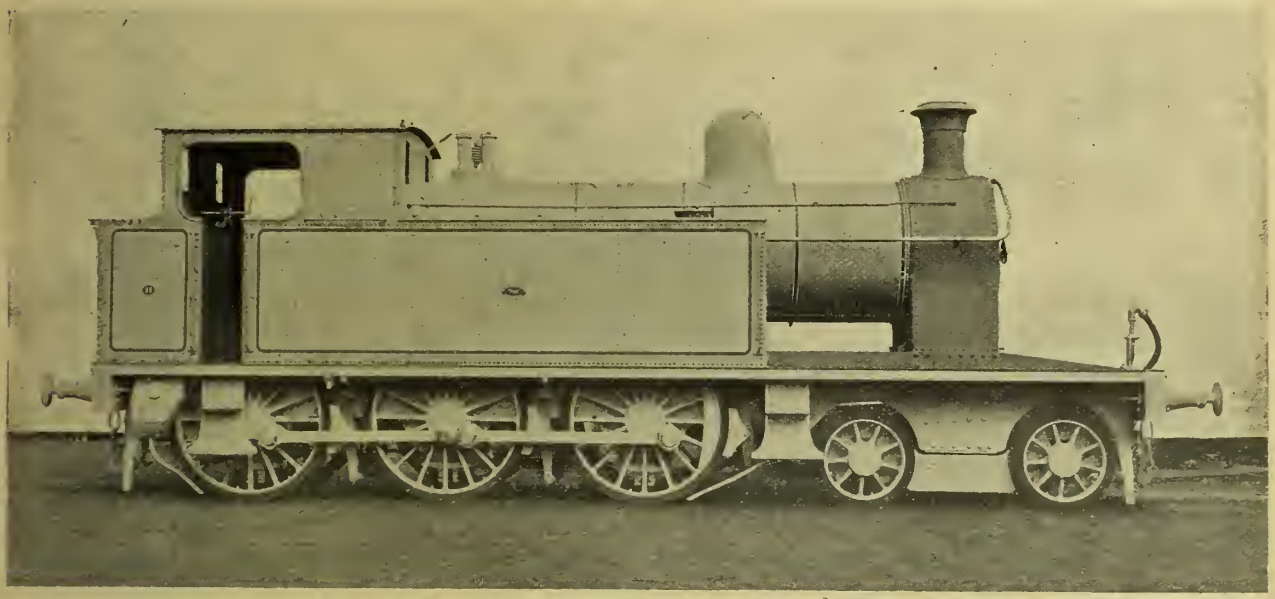
NEW LOCOMOTIVES, NORTH BRITISH RAILWAY.

By the courtesy of Mr. W. P. Reid, locomotive superintendent of the above railway, we are able to illustrate herewith one of the 20 large six-coupled goods locomotives, of which 10 have been built at Cowlairs and 10 by the North British Locomotive Co., Ltd., at their Atlas Works, Glasgow. These engines have cylinders 18½-in. in diameter with a stroke of 26-in., actuated by piston valves, and coupled wheels 5-ft. in diameter, and have relatively large boilers 5-ft. in diameter, with a total heating surface of 1,605 sq. ft., of which the firebox contributes 143 sq. ft. and the tubes 1,462 sq. ft.; a grate area of 19·8 sq. ft., and a working pressure of 180 lb. per sq. in. The total weight of the engine in working order is 50 tons 7 cwt., and it is provided with a standard tender with 4-ft. wheels, carrying 3,500 gallons of water and 4½ tons of coal, and weighing 38 tons 1 cwt. full. The total wheelbase of engine and tender is 39-ft. 2¾-in., and the length over buffers 51-ft. 8¼-in. The ten engines built "outside" have running Nos. 849-858, and are now all at work.

Atlantic Passenger Locomotive No. 868 "Aberdonian," North British Ry.

In addition to the diagram given on page 109 of our last issue, we are enabled to show herewith a photo-reproduction of one of the new Atlantic type locomotives now being built for the East Coast service by the North British Locomotive Co., Ltd., Hyde Park Works, Glasgow. Some of the leading dimensions of these noteworthy engines were detailed in our last issue, to which may be added the following: height of boiler centre from rails 8-ft. 11-in.; heating surface: firebox 184.8 sq. ft., tubes 2,071.4 sq. ft., total 2,256.2 sq. ft.; grate area 28.5 sq. ft.; there are 257 tubes of 2-in. diameter; weight of engine, empty, 67 tons 2 cwt.; total weight of engine in working order, 74 tons 8 cwt., distributed as follows: on bogie 15 tons 18 cwt., on the four-coupled wheels 40 tons, and on the trailing wheels 18 tons 10 cwt.; weight of tender, with 4,240 gallons of water and 7 tons of coal, 45 tons 8 cwt. The boiler, which has a Belpaire firebox, is constructed entirely of steel, with steel tubes, and the internal firebox is of copper. Among the fittings are combination injectors, and asbestos-packed water-gauge cocks provided with protectors to prevent injury from a broken glass. Piston valves of the Smith pattern, with collapsible segmental rings, are employed, and are placed inside the frames; asbestos packing is fitted to the cylinder relief cocks, and automatic air and vacuum-destroying valves are provided, with a lubricator, whereby steam and oil are admitted to the cylinders when the engine is running down hill with the regulator shut. The engine is fitted with the Westinghouse brake, and vacuum ejectors coupled to this apparatus, so that trains provided with the vacuum brake may be worked. Steam reversing gear is provided, an auxiliary reversing handle being easily placed in position should necessity arise. Air sanding apparatus is fitted to both pairs of coupled wheels. A steam cock and reducing valve are provided for steam-heating the train. The tender is of standard N.B. type, supplied with a special water-gauge for indicating the height of water in the tank.

Several of these engines are expected to be at work shortly, when they will be placed upon the East Coast and Waverley route and the Aberdeen main line, with the new trains which were described in our July issue.



Ten-wheel Tank Locomotive, Cork, Bandon & South Coast Ry. (Ireland).

TEN WHEEL TANK LOCOMOTIVE, CORK, BANDON & SOUTH COAST RY.

We are indebted to Mr. J. W. Johnstone, locomotive engineer of the above railway, and to the builders, Messrs. Beyer, Peacock & Co., Ltd., for the particulars and above illustration of a new tank locomotive recently constructed. The engine is of a powerful type, as the subjoined dimensions will show: cylinders 18-in. in diameter by 24-in. stroke, diameter of bogie and coupled wheels 3-ft. and 5-ft. $2\frac{1}{2}$-in. respectively, fixed wheelbase 12-ft. 6-in., total 25-ft. 3-in.; diameter of boiler barrel 4-ft. 4-in., height of centre above rails 8-ft.; 214 tubes 10-ft. $11\frac{5}{8}$-in. long and $1\frac{3}{4}$-in. in diameter; heating surface: firebox 107.5 sq. ft., tubes 1,075 sq. ft., total 1,182.5 sq. ft.; grate area 24 sq. ft.; capacity of tanks 1,000 gallons, and of bunker $2\frac{1}{4}$ tons of coal.

Renard Petrol Motor Road Passenger Train for Service in Hungary.

THE RENARD ROAD TRAIN.

The ingenious motor trains for service on ordinary roads, illustrated in the accompanying photo-reproductions, have recently attracted great attention in connection with the races conducted over the Sarthe Circuit, as constituting a new and practical system of conveying passengers and goods over routes not served by railways. The disadvantages attending the use of tractors of great weight, and trailers which do not track with the motor vehicle, have been successfully avoided. The motor vehicle, despite its capacity for haulage—in the case shown 75 h.p.—is of no great weight, no heavier in fact than is necessary to carry a powerful petrol engine, as there is no need to provide great adhesion weight, each vehicle being propelled by the engine of the motor through the medium of a differential gear and flexible shafting which operates the middle axle of each vehicle. Thus, the aggregate number of vehicles is limited solely by the power of the motor engine, and not by the weight of the tractor, as each vehicle is propelled by its own middle pair of wheels. Another feature of considerable importance consists in the draught mechanism. The two end axles of each vehicle have a radial movement controlled by a series of tillers connecting each car, the result being that each trailer car follows exactly in the track of the motor in front, enabling corners to be turned with a minimum clearance. It is possible, indeed, for a train of these vehicles to turn round completely in a space limited by the amount of "lock" allowed to each, and to track exactly during the whole

Renard Motor Goods Train for use on Ordinary Roads.

movement as though running upon a railway. This accuracy of tracking also permits a train of such construction to be backed with certainty and safety for considerable distances. Another feature consists in the engineer's control of all the vehicles by means of a continuous brake applied simultaneously to all the train. The six wheels of each vehicle have great vertical as well as horizontal flexibility, to allow for traversing uneven ground.

The passenger train shown in the illustration has been built for service in Hungary. It consists of a 75 h.p. petrol motor vehicle and four trailer cars, accommodating respectively twenty-two first class, twenty-two second class, and thirty-two third class passengers; the two third class coaches are open at the sides. The speed contemplated is upwards of 12 miles per hour. The wagons shown in the goods train have the same construction of chassis and mechanism as the passenger coaches, and are intended to carry loads of about 3½ tons each.

Fig. 54.—Four Wheels Coupled Bogie Mixed Traffic Locomotive No. 384, London & South Western Ry.

THE HISTORY OF THE LONDON & SOUTH WESTERN LOCOMOTIVES.

(Continued from page 90.)

FOLLOWING this group of locomotives came 12 mixed traffic engines built and delivered in the same year by Messrs. Beyer, Peacock & Co., and except for the fact that these were of course tender engines, they were of practically the same dimensions as the tanks just described. They had leading bogies with the disc wheels 2-ft. 6-in. diameter, and driving and trailing wheels coupled 5-ft. 7-in. diameter; outside cylinders 18-in. diameter with a 24-in. stroke, and were numbered in the Company's books 380 to 391 inclusive (makers' Nos. 1854 to 1865 inclusive). The height from rail level to centre of boiler was 7-ft., the boiler itself being a counterpart of those supplied with the tank engines, but with a diameter of 4-ft. 6-in. instead of 4-ft. 2-in., and a working pressure of 140 lbs. per sq. in. The heating surface and grate area were slightly more than in the tank engines: tubes 1,035 sq. ft., firebox 101 sq. ft., total 1,136 sq. ft. The grate area was 16·96 sq. ft.; length of firebox 6-ft., by 4-ft. 8½-in. high. The weight in working order was as follows: on bogie wheels 16 tons 6 cwt. 2 qrs., on driving wheels 15 tons 8 cwt., on trailing wheels 14 tons 7 cwt., total 46 tons 1 cwt. 2 qrs. The tenders ran on six wheels, and had a carrying capacity of 2,500 gallons of water. The centres of the tender wheels were placed 5-ft. 1½-in. apart, and the total wheelbase of the engine and tender coupled was 40-ft. 1-in. The length over buffers was 47-ft. 9¼-in. The weight of tender in working order was 26 tons 12 cwt. The tender wheels are 3-ft. 9¾-in. in diameter.

During recent years some of these engines have been rebuilt with new boilers. No. 386 was in the collision at Tresmeer Station on the North Cornwall Ry. in November, 1898.

When these engines first arrived they were engaged on excursion and other heavy traffic, and later were employed in working the transfer goods and coal trains between Brent and Battersea Yard, but they are now all running in the West of England working goods and passenger

trains on the Devon and Cornwall lines of the South Western Ry.

In the following year Messrs. Beyer, Peacock & Co. delivered two more of the light "Ilfracombe" class of goods engine and tenders, similar in all respects to the 282 class already described. These engines were numbered 393 and 394 in the Company's books (makers' numbers 2041 and 2042). They had six wheels coupled 4-ft. 7½-in. in diameter, and inside cylinders 16-in. diameter with a stroke of 20-in. The details already given of the other engines of this class will be sufficient without further reference to them in this part of our history, except that these two were supplied with light wrought iron buffers and much larger sandboxes. Both of these engines are still at work, and they are the only two of the type that have not been rebuilt, except that they have been provided with larger tenders running on six wheels, in place of the small four wheeled tenders with which they were originally fitted, and containing 1,850 gallons of water. They are now engaged principally upon ballast train and shunting duties, or upon the "light" lines connected with the South Western system.

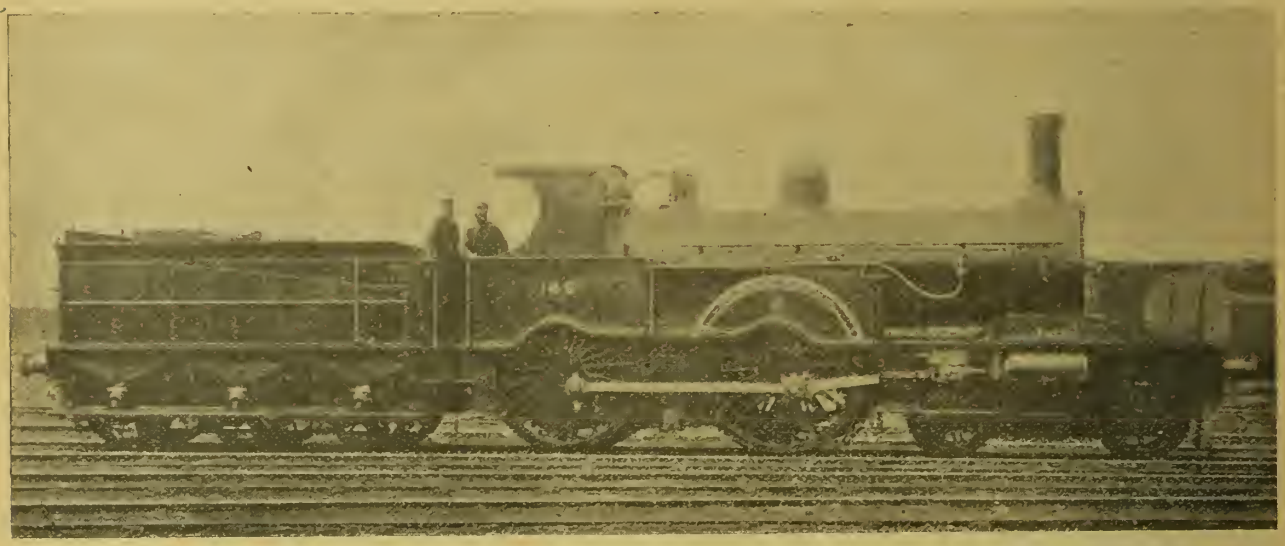


Fig. 55.—Four Wheels Coupled Bogie Express Passenger Locomotive No. 146, London & South Western Ry.

Mr. Adams' first express engines for the London & South Western Ry. were introduced during the year 1880, twelve being constructed and delivered by Messrs. Beyer, Peacock & Co., who seem at this period to have obtained nearly all the orders for locomotives for that Company. These engines were numbered from 135 to 146 in the books of the railway (the makers' numbers being 1948 to 1959 inclusive). They had leading bogies with wheels 3-ft.4 -in. in diameter, and driving and trailing wheels coupled 6-ft. 7 in. in diameter. The cylinders were placed outside the frames with centres 6-ft. 1½-in. apart, and had a diameter of 18-in. with a stroke of 24-in. The boilers were 10-ft. 0¾-in. long with a diameter of 4-ft. 6-in., and contained 234 tubes of 1¾-in. outside diameter. The firebox was 6-ft. from back to front, and 5-ft. 0½-in. in height. The heating surface was as follows: tubes 1,112 sq. ft., firebox 111 sq. ft., total 1,223 sq. ft.; grate area 17.77 sq. ft., and working pressure 140 lbs. per sq. in. The centres of bogie wheels were 7-ft. apart; from centre of bogie to centre of driving wheel was 9-ft. 11-in., the coupled centres being 8-ft. 6-in. apart. The tenders ran on six wheels 3-ft. 9¾ in. diameter, placed 5-ft. 1½-in. apart, and contained 2,500 gallons of water. The height from rail level to top of chimney was 13-ft. 2¾-in., the boiler centre being 7-ft. 4-in. from level of rails. The total wheelbase of engine and tender was 40-ft. 4-in., and the length over buffers 48-ft. 10¼-in. The weight of these engines and tenders in working order was as follows: engine—on bogie wheels 17 tons 13 cwt., on driving wheels 14 tons 9 cwt., on trailing wheels 14 tons 6 cwt., total 46 tons 8 cwt.; tender—on leading wheels 8 tons 14 cwt., on middle wheels 8 tons 11 cwt., on trailing wheels 9 tons 7 cwt., total 26 tons 12 cwt. Total weight of engine and tender 73 tons.

These engines for many years worked the fast express services on the main lines, and gave every satisfaction, but the ever increasing weight of modern trains has necessitated their being relegated to less important and lighter duties, and they are now generally employed upon short passenger train work in the central district, but still frequently run the fast special boat trains from Southampton Docks to London, and daily run certain trains on the Portsmouth direct line services. No. 136 engine was in 1896 fitted with a conical shaped smokebox front, and was also rebuilt with a new boiler.

(To be continued.)

HEATING OF "BIG ENDS."

THE connecting rod "big ends" are important details of a locomotive, and require careful attention from the driver during the time an engine is under his charge if he does not wish for the exasperating experience of having to give up a train through a heated "big end." Passing aside the vagaries of bad fitting, which it is needless to say will result in trouble, some of the causes that lead to overheating are briefly enumerated below.

All bearings must "heat" to some extent through friction, and in this direction much depends upon the lubrication. The oil should be of such a quality and consistency that it will remain as a film between the surfaces of the metals and prevent actual contact. If it can be "squeezed out" of the bearing the resulting

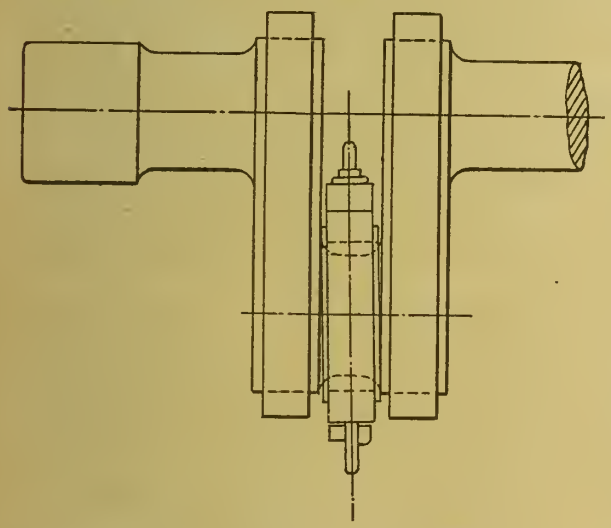


DIAGRAM TO SHOW CROSS-WIND IN BIG END.

friction of the metallic surfaces will not only cause them to "heat" and expand so as to "bind" or "seize," but in the case of "big ends" and similar bearings will melt out the white metal linings.

An important consideration is the size and kind of trimming used in the lubricators. This must consist of the correct number of strands to easily fill the oil pipe and adjust the oil supply consistent with the length of journey the engine is called upon to perform. If this detail is not attended to, the oil will be "syphoned" out too rapidly and the supply exhausted before the end of the trip is reached. Apart from this there is the question of waste.

Periodical examinations of the oil cups and pipes are advisable; neglect of this and a cracked or loose pipe have often caused a hot "big end." The cup should at such times be thoroughly cleaned out, all dirt and deposits removed so that all the capacity of the lubricator is available for oil. When cane or cork is employed to close the oil hole of the cup, care should be exercised in the selection of a suitable piece to see that it is sufficiently but not too porous, and that it is not too tightly screwed into the hole, otherwise there will be no admission of air into the lubricator to replace the oil used.

A frequent cause of heated "big ends" may be found in the want of "truth" in the fitting of the "small end" brasses or the slide bars; such may produce a "cross wind" when the big end is coupled up to the crank web journal, and produce a state of affairs such as is shown in the illustration.

Insufficient side play will sometimes cause "big end" brasses to bind hard on the radii of the journal, and hot running results.

If the crank pins of an engine which has been in service some time are carefully callipered, it will be found that the journals are worn to an irregular shaped oval, which unless modified will produce constant trouble. This unequal wear is due to the fact that these particular bearings undergo the influence of varying pressures during their rotation. For example, a main line engine usually runs in "forward" gear, and the areas of the crank web journal that wear most rapidly are those whereon the maximum "pull" and "thrust" of the connecting rod take effect—*i.e.*, whilst passing the top and bottom centres respectively. This uneven wear cannot be taken up by the cotters, and the only remedy short of re-turning the journal is to file it up to approximately a true circle, a difficult operation for the best mechanic.

An important detail towards securing cool running is the quality of the white metal used in the brasses, its purity and freedom from dirt and grit when put into the recesses by the tinsmith. It is good practice to fit the "big end" brasses up "metal to metal" at the faces without allowance of "draw" between; this tends to economy in oil and also prevents the cotter being tightened up injudiciously. In fitting it is advisable that the surface of this brass should be finished with a smooth file rather than a scraper, as the minute grooves left by the former tool hold the oil, thus giving the brass a good start when newly fitted, and by the time these are worn out the brass will have got into good working trim.

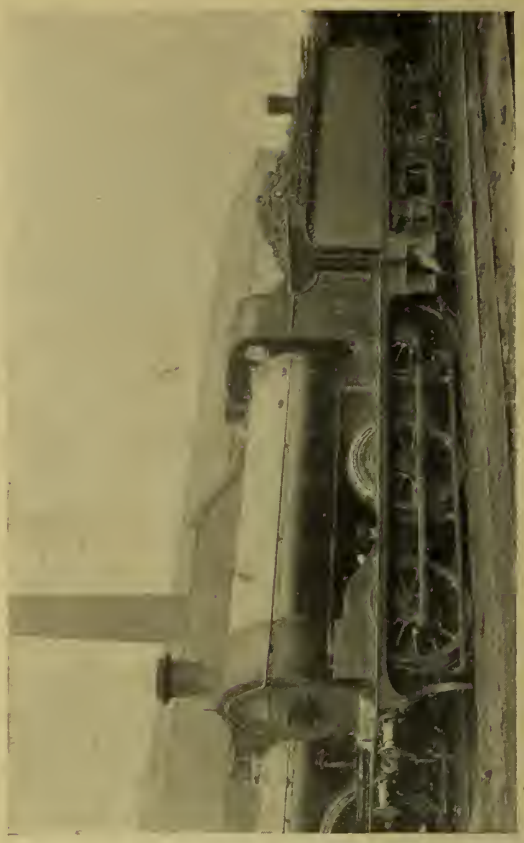
There is another cause of trouble, that is if the "glut" plate and cotter pin are not exactly to the same taper, as tightening up these, badly fitted, will produce a twist on the front brass, which will prevent it taking its proper proportion of pressure on its working surface.

As stated at the commencement of this article, careful attention to these small details, and many

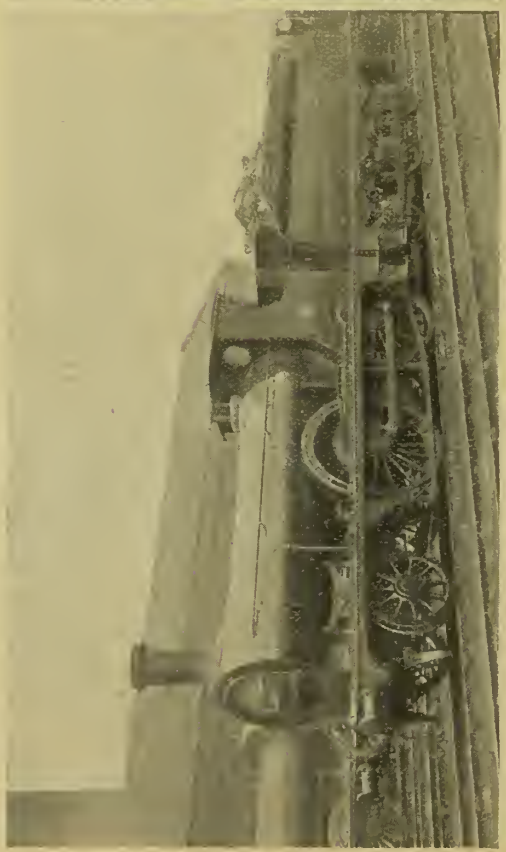
REBUILT LOCOMOTIVES, HULL AND BARNSLEY RY

(Photographs by H. Fayle.)

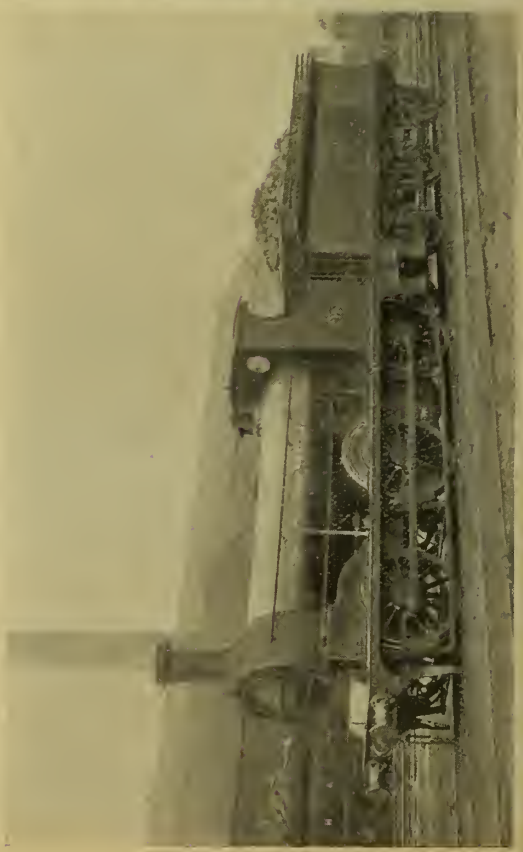
FOUR-WHEELS COUPLED PASSENGER LOCOMOTIVE, No. 38, AS RECENTLY REBUILT.



SIX-WHEELS COUPLED GOODS LOCOMOTIVE, No. 13, AS RECENTLY REBUILT.



FOUR-WHEELS COUPLED PASSENGER LOCOMOTIVE, No. 33, AS FIRST REBUILT.



SIX-WHEELS COUPLED GOODS LOCOMOTIVE, No. 17, AS FIRST REBUILT.

others daily before a driver takes his engine out of the shed, will often prevent trouble on the road and ensure the clean record every engineman proud of his profession is anxious to maintain.

REBUILT LOCOMOTIVES, HULL & BARNSLEY RAILWAY.

THE illustrations on the opposite page show two stages of development of passenger and goods locomotives on the above railway, bringing them successively into line with traffic requirements.

The four-wheels coupled passenger locomotive is one of ten built by Messrs. Beyer, Peacock & Co., Ltd., in 1885, bearing Nos. 33-42 (builders' Nos. 2479-2488) to the designs of Mr. Wm. Kirtley, consulting locomotive superintendent. As originally built, they had steam domes and the Kirtley pattern of chimney, and were of the following dimensions : cylinders 17-in. diameter by 24-in. stroke; diameter of leading and coupled wheels 3-ft. 9-in. and 6-ft. respectively; wheelbase : leading to driving 7-ft. 9-in., driving to trailing 8-ft. 3-in., total 16-ft. ; boiler : length of barrel 10-ft. 5-in., diameter 4-ft. $2\frac{1}{8}$-in., height of centre from rails 7-ft ; heating surface : firebox 93.6 sq. ft., tubes 981.85 sq. ft., total 1075.45 sq. ft.; grate area 10.31 sq. ft. : boiler pressure 140 lb. per sq. in. ; weight in working order : leading wheels 10 tons 15 cwt. 3 qrs., driving wheels 13 tons 14 cwt. 2 qrs., trailing wheels 12 tons 3 cwt., total 36 tons 13 cwt. 1 qr. The tender carried 2,000 gallons of water and 3 tons of coal.

Mr. Matthew Stirling, the present locomotive superintendent, subsequently rebuilt all the class with domeless boilers, and in this condition they are shown in our first illustration. The cylinders were enlarged to $17\frac{1}{2}$-in. diameter and the new boilers had the following dimensions : diameter of barrel 4-ft. 3-in. ; heating surface : firebox 100 sq. ft., tubes 964 sq. ft., total 1064 sq. ft.; grate area 16.25 sq. ft., working pressure 150 lb. per sq. in.

Quite recently the majority of these engines, which are the only passenger locomotives on the H. & B. Ry., have been again rebuilt with much larger boilers of Mr. Stirling's design, having the following dimensions : diameter of barrel 5-ft.; heating surface : firebox 100 sq. ft. tubes 1,018 sq. ft., total 1,118 sq. ft. ; grate area 16.25 sq. ft., working pressure 170 lb. per sq. in. The weight of these engines is increased to 39 tons 17 cwt. Our second illustration shows No. 38 thus rebuilt, and provided with a standard H. & B. cab.

The six-coupled goods engine illustrated in the other photo-reproductions is one of 20, also built in 1885, by Messrs. Beyer, Peacock & Co., Ltd., bearing Nos. 13-32 (builders' Nos. 2489-2508). As originally built, these had steam domes and the Kirtley chimney, the boilers being in fact very similar to those of the passenger engines already referred to. Their leading dimensions were : cylinders 17-in. diameter by 24-in. stroke, diameter of wheels 5-ft. ; wheelbase : leading to driving 7-ft. 6-in., driving to trailing 8-ft., total 15-ft. 6-in. ; boiler : length of barrel 10-ft., diameter 4-ft. $2\frac{1}{8}$-in., height of centre above rails 6-ft. 11-in. ; heating surface : firebox 93.6 sq. ft., tubes 943.85 sq. ft., total 1037.45 sq. ft. ; grate area 16.31 sq. ft. ; working pressure 140 lb. per sq. in. ; weight in working order : leading wheels 12 tons 5 cwt., driving wheels 13 tons, trailing wheels 10 tons 14 cwt., total weight 35 tons 19 cwt. The tender was the same as in the passenger engines.

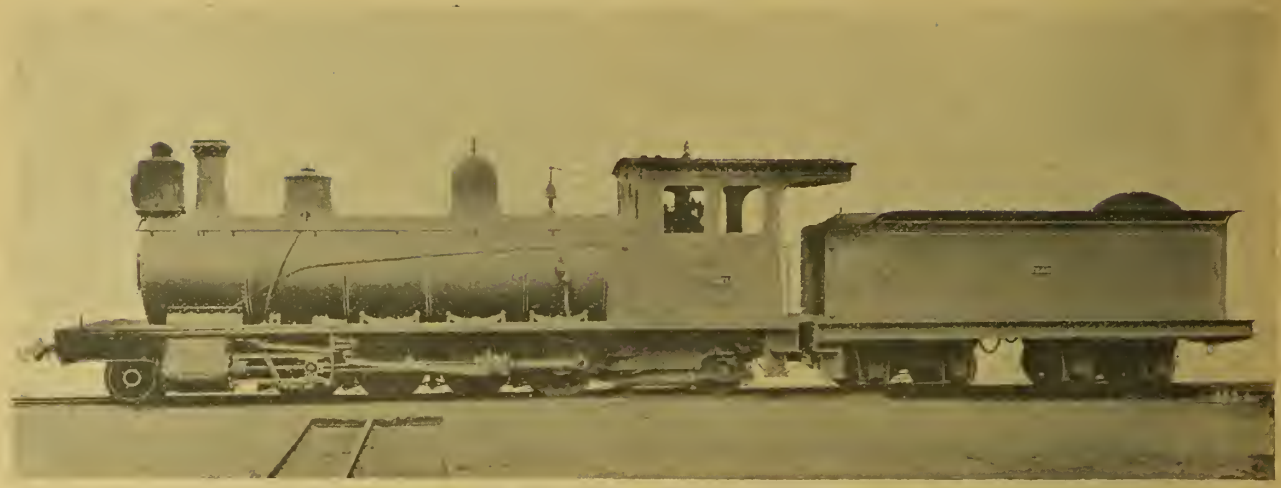
Mr. Matthew Stirling rebuilt these engines as shown in our third illustration, boring out the cylinders to $17\frac{1}{2}$-in. diameter, and supplying a boiler similar to that furnished to the rebuilt passenger engines, except that the shorter length of the tubes gave them a heating surface of only 927 sq. ft., the total thus being 1,027 sq. ft.

Since 1902 ten of these engines have been supplied with new boilers of 5-ft. diameter; heating surface : firebox 100 sq. ft., tubes 980 sq. ft., total 1,080 sq. ft. ; grate area 16.25 sq. ft. ; working pressure 170 lb. per sq. in. ; and in this condition No. 13 is shown in our fourth reproduction.

Our best thanks are due to Mr. Matthew Stirling for permission to photograph these locomotives, and for the particulars of the new large boilers, which bring these two types of engine into accordance with modern needs.

NEW NARROW GAUGE LOCOMOTIVES, ANTOFAGASTA RY.

THE accompanying illustrations, kindly supplied by the Railway Co., show two new types of locomotives built by the Hunslet Engine Company, Ltd., to the order of the Antofagasta (Chili) and Bolivia Railway, a railway of 2-ft. 6-in. gauge running from Antofagasta, a port in the north of Chili, to Oruro in Bolivia, a distance of 574 miles, a considerable portion of the line being laid at an altitude of 12,000-ft. above sea level. The traffic is fortunately of a favourable character, the products of the country, nitrate of soda and minerals of various descriptions, being brought down to the coast for shipment, and provisions and stores going in the opposite direction, the chief weight of traffic therefore being in the direction of falling gradients. At the same time the nature of the road, with banks

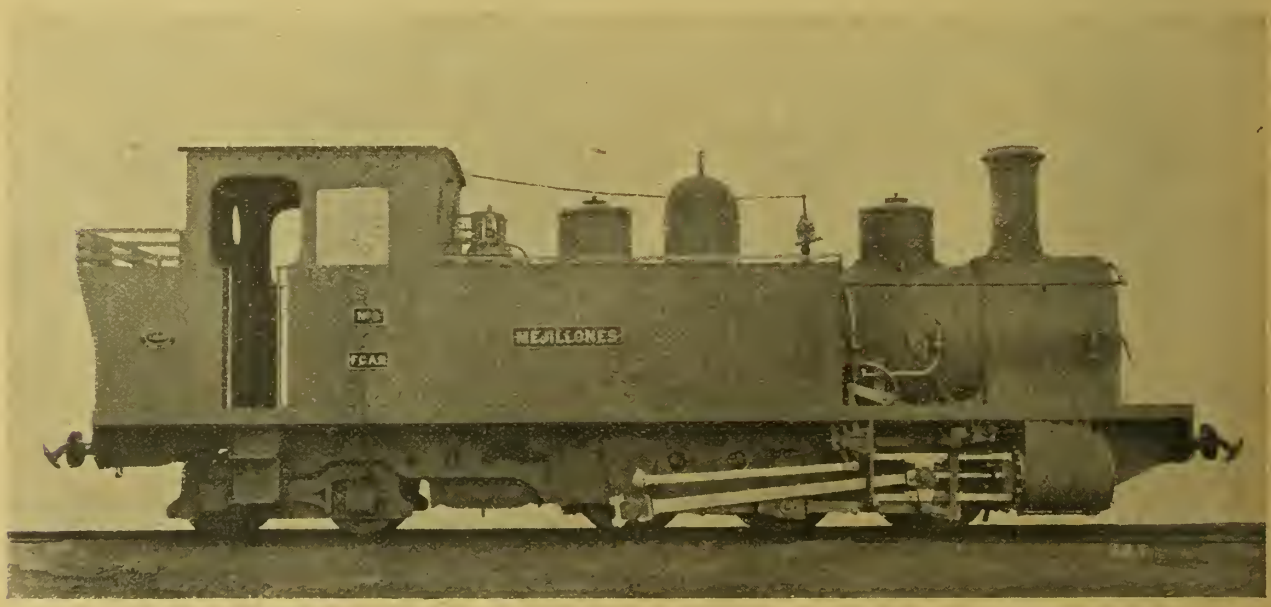


Eight Wheels Coupled Locomotive No. 78 "Uyuni," Antofagasta (Chili) & Bolivia Ry.

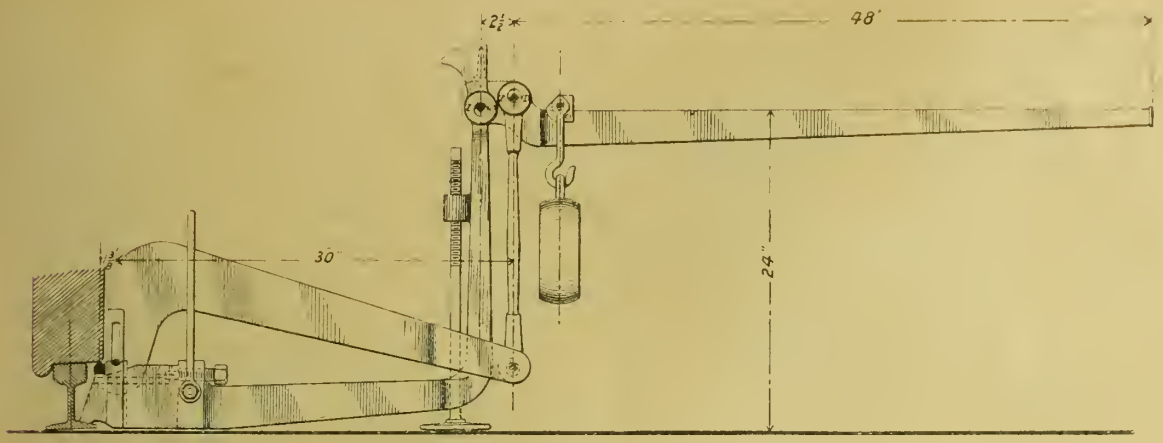
as steep as 1 in 33 and curves of 200-ft. radius, calls for relatively powerful locomotive stock, and the engines here illustrated represent unusual haulage capacity for a railway of such narrow gauge.

There are at present four locomotives of the tender type in course of delivery by the above-mentioned builders, Nos. 75-78, of which the last-named is illustrated here. They have the following leading dimensions: cylinders 15-in. diameter by 20-in stroke; diameter of pony truck and coupled driving wheels 2-ft. $2\frac{7}{8}$-in. and 3-ft. $1\frac{1}{2}$-in. respectively; coupled wheelbase 10-ft. 7-in., total wheelbase of engine 18-ft., and of engine and tender together 42-ft. 1-in.; the boiler, which carries a working pressure of 170 lb. per sq. in., is of large dimensions, having a heating surface of: firebox 82 sq. ft., tubes 1,078 sq. ft., total 1,160 sq. ft.; the grate area is 14 sq. ft.; the engine weighs a total, in working order, of 40 tons, of which 35 tons rest on the eight-coupled wheels, and the tender, which has a capacity for 2,000 gallons of water and 7 tons of fuel, weighs 24 tons. The ingenious outside balanced driving crank calls for attention, also the fact that the two central pairs of driving wheels have "blind" tyres.

There are three tank engines for shunting purposes, Nos. 1-3, of which No. 3 is illustrated, and others of a similar type are in contemplation. These have the following dimensions: cylinders 15-in. diameter by 18-in. stroke: diameter of coupled wheels 3-ft. 1-in.; rigid wheelbase 9-ft. 3-in., total 17-ft. 3-in.; capacity of tanks 840 gallons; bunker capacity, 50 cwt. of coal.



Six Wheels Coupled Trailing Bogie Tank Locomotive No. 3 "Mejillones," Antofagasta (Chili) & Bolivia Ry.



PORTABLE 9-TONS WEIGHING MACHINE FOR USE ON THE TRACK.

WEIGHING LOCOMOTIVES AND STOCK.

(*Concluded from page* 112.)

FOR weighing and testing locomotives out on the road, as is sometimes necessary, or at stations unprovided with proper weighing tables, Messrs. W. & T. Avery, Ltd, have introduced a strong yet portable weighing machine capable of dealing with one wheel at a time and having a range of registration varying from 2 up to a maximum of 9 tons. It will, therefore, despite its convenient size and portability, be of service even in the case of a large modern engine carrying from 17 to 18 tons on the driving wheels. As shown in the accompanying illustration, the appliance consists primarily of a wrought iron frame, with a heel extension at one end which rests upon the bottom flange of the rail whilst in position for weighing, and a flat round foot at the other end below the vertical arm of the frame, the foot being at the end of a perpendicular screwed rod which gives adjustment to the whole appliance and allows it to be placed in a vertical position. Above the heel are hardened steel bearings for the main lever, which can be raised or lowered to suit various neights of rail, etc., by means of a sliding wedge controlled by a screw. The main lever, which is of curved design, and has hardened steel knife edges, terminates at the other end in a forked bearing for a rod connecting it with the steel yard above, which is graduated in 28-lb. divisions from 2 to 9 tons. A sliding poise on the steelyard, carrying a suitable poise weight, completes the apparatus. All bearings and knife edges are of hardened steel, and each machine is carefully tested and viewed so as to ensure correct registration.

Whilst weighbridges form a valuable and necessary adjunct to all locomotive depots, similar appliances are also required at all goods depots for ascertaining the weights of wagons, merchandise, etc. For these purposes, however, they need not be so elaborate as those provided for locomotives, as it is only necessary to record the total weight of the vehicle or load. The distribution of the weight in the vehicle can be easily judged by seeing if the whole is loaded evenly.

In this class of machine usually the whole table with its rails, etc., move as one piece, and only one steelyard and pillar are necessary. The table and gear are locked, as in the case of the first mentioned machines, while the trucks are being moved on or off or over the machine.

In the case of the newer style of wagons on two bogies and of higher capacity, the makers already mentioned provide a double weighbridge, having two tables pitched such a distance apart as to accommodate the bogie vehicles. The two tables work together and register on one steelyard, when a bogie wagon is being weighed, and are arranged so that one of the tables can be instantly put out of action when but one is required, as when the ordinary type of four-wheeled wagon is weighed. By this means trains of mixed vehicles can be expeditiously dealt with as they chance to arrive at the table.

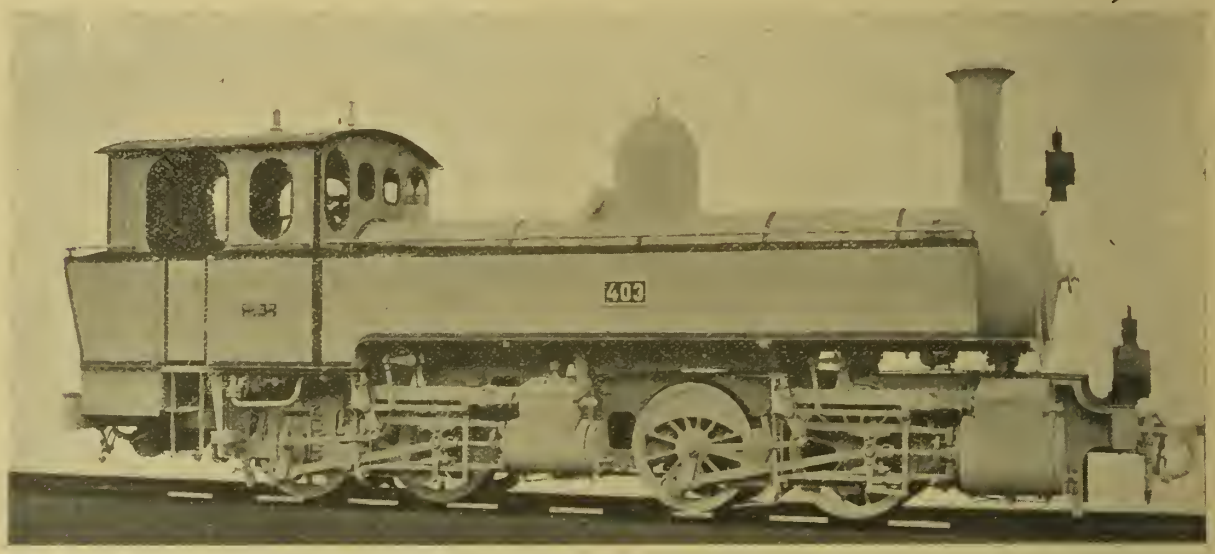
In such a machine each table is made to take say 30 tons weight, and the two together will take a 60 ton bogie wagon. They can thus deal with practically any contingency in ordinary work and traffic.

At district locomotive depots, whilst a weigh-bridge would be but seldom in demand, and its provision therefore doubtful of justification, a portable arrangement, whereby the distribution of weight on a locomotive can be readily obtained, is of considerable value, and an apparatus has been introduced by Messrs. Carl Schenck & Co. specially adapted to running shed requirements and also very suitable for use in shops where locomotives of different gauges are turned out.

In this system a pit is constructed to take two lines of shafting, connecting as many small

weighing machines as there are wheels to be weighed. These machines run upon and are supported by independent rails in the pit. To weigh a locomotive or other vehicle it is run upon the pit on rails of its own gauge, and one of these machines is moved along the shafting and placed below the flange of each wheel and adjusted closely to it. When the whole of the wheels are so provided they are simultaneously lifted by suitable gearing, each lifting equally until all the wheels are raised about one eighth of an inch from the rails; a man in the pit can then go along and adjust the weights upon each steelyard, and the distributed and total weights are recorded.

This apparatus has the incidental advantage of not requiring the rails to be cut away at all, the weighing gear being entirely independent of the ordinary road.



Meyer Four-cylinder Compound Locomotive No. 403, Portuguese State Rys.

MEYER COMPOUND LOCOMOTIVES, PORTUGUESE STATE RYS.

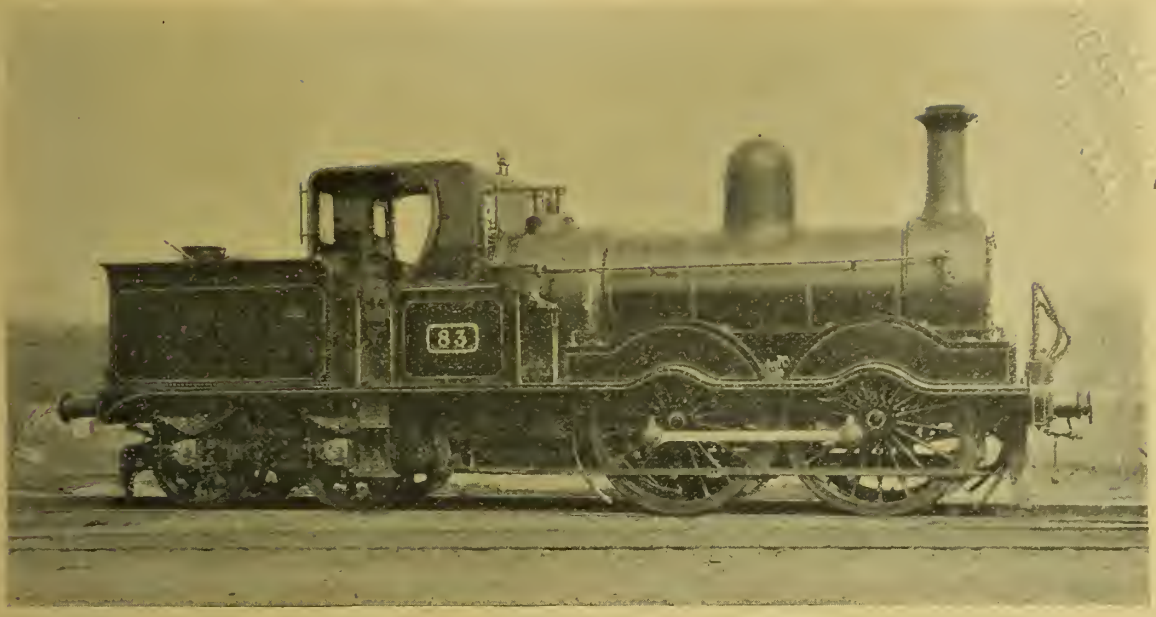
The accompanying illustration, for which and the subjoined particulars we are obliged to our friend Mr. Hugh Vivian, of Oporto, relates to a series of four locomotives of the Meyer-Rimrott type, recently constructed by Messrs. Henschel and Sohn, of Cassel, for a metre gauge section of the Portuguese State Rys. These engines are four-cylinder compound, the high pressure cylinders driving the four wheels at the trailing end, while the low pressure cylinders drive the leading group of wheels, which are provided with swivelling and lateral adjustment for taking curves. The cylinders are fitted with piston valves operated by Walschaerts gear, and are lubricated by means of a Friedmann oil pump and Kessler lubricator. The gear of both pairs of cylinders is worked simultaneously by a reversing screw on the right hand side of the cab. The boiler is of the ordinary loco. type with a copper firebox, and has a steam dome provided with a water separator, and a smokebox fitted with a spark arrester; two "pop" safety valves are provided, in addition to which there is a special safety valve on the steam starting valve. Among other features are the Hardy vacuum brake and a spindle hand brake, and Holt-Gresham sanding apparatus.

The following are the leading dimensions of these locomotives, which are Nos. 7019-7022 in the books of the makers: diameter of cylinders: high pressure $12\frac{5}{8}$-in., low pressure $18\frac{3}{4}$-in.; stroke $21\frac{5}{8}$-in.; diameter of driving wheels 3-ft. $7\frac{1}{4}$-in.; wheelbase of each group 4-ft. $7\frac{1}{8}$-in., total wheelbase 17-ft. $0\frac{3}{4}$-in.; working boiler pressure 176 lbs. per sq. in.; total heating surface 839·6 sq. ft., grate area $14\frac{3}{4}$ sq. ft., capacity of water tanks 770 galls., and of bunker 1 ton.

The railway has curves with a minimum radius of 196 ft. and the highest speed permitted on any portion is 25 miles per hour.

BOGIE TANK LOCOMOTIVE, GREAT SOUTHERN & WESTERN RY

In the photo-reproduction on page 141 is shown one of a relatively numerous class of tank locomotives built for branch line traffic on the G.S. & W. Ry., of which twenty are still at work, Nos. 47-51 and 70-84, whilst several have been removed from service after careers extending over periods up to 23 years, the first engine of this class having been completed in 1883.



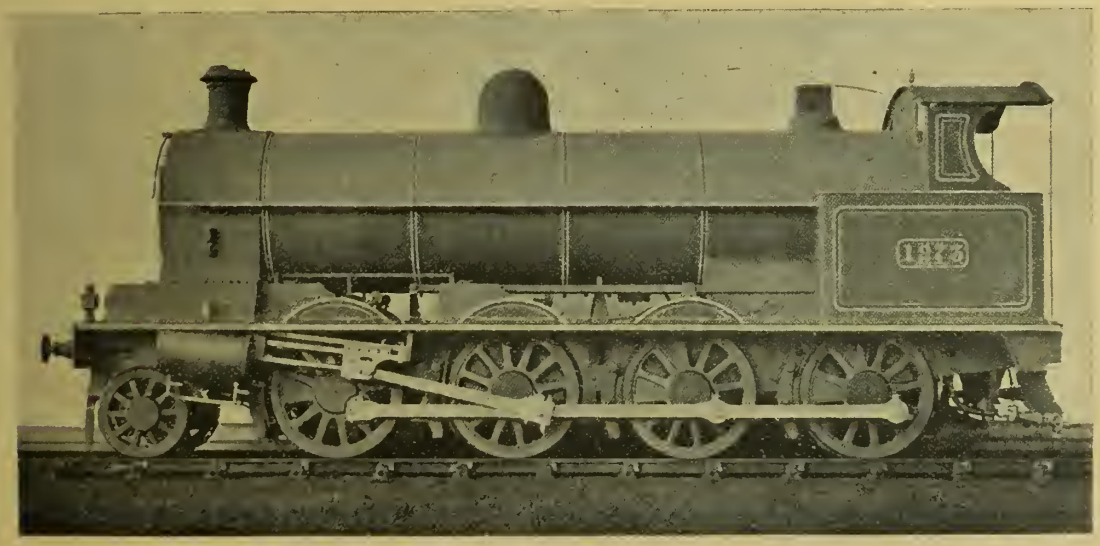
Four Wheels Coupled Trailing Bogie Tank Locomotive No. 83, Great Southern & Western Ry.

Of those still performing a very efficient service, a number are stationed on the Cork-Queenstown-Youghal line, and nearly all the local traffic on that section is worked by this class of engine. The day-mail from Queenstown to Cork, a heavy dining car train timed to cover the 12 miles in 22 minutes, is regularly hauled by one of the type illustrated.

The leading dimensions are as follows: cylinders 16-in. in diameter by 20-in. stroke, diameter of coupled and of bogie wheels 5-ft. 8½-in. and 3-ft. 9-in. respectively, heating surface 755 sq. ft., grate area 15¼ sq. ft., capacity of tanks 1,044 gallons, weight in working order 41 tons 16 cwt.

REBUILT MINERAL LOCOMOTIVE L. & N.W.R

In our issue for March 15th last year, p. 39, we illustrated one of the late Mr. F. W. Webb's four-cylinder compound eight-coupled mineral engines as rebuilt by Mr. Geo. Whale, the present locomotive superintendent, with a pair of radial truck wheels in front, thus converting the engine into a "Consolidation." The engine then referred to retained the original boiler, but later rebuilds, of which No. 1273, here illustrated, is an example, have been supplied with a new type of boiler similar to that furnished to recently rebuilt three-cylinder compounds, as for instance



Four-cylinder Compound Mineral Locomotive No. 1273, Rebuilt, London & North Western Ry.

No. 1866 illustrated in our May issue, and having the following dimensions: length of barrel 14-ft. 6-in., mean diameter 5-ft. $0\frac{3}{4}$-in., working pressure 175 lb. per sq. in.; heating surface: firebox 146.6 sq. ft., tubes 2,034 sq. ft., total 2,180.6 sq. ft.; grate area 23.6 sq. ft. The original valve gear —two sets of Joy's gear actuating the four valves —is retained, but amongst other alterations are the provision of sand boxes fitted to the driving wheel splashers, and the extension of the cab roof to cover the footplate.

REVIEWS.

"A History of the Whitby & Pickering Ry. By G. W. J. Potter. *London:* The Locomotive Publishing Co., Ltd.

There is a much larger amount of interesting information contained in this little volume than the mere enumeration of chronological facts that might be suggested by its title, it being in fact a descriptive pictorial account of the railway, and containing, in addition to notes on all the more important events bearing on the inception, construction and development of the line, full details of the gradients, stations, locomotives, train services, etc., together with many interesting particulars of men and matters connected with it. The illustrations are excellent, and the blocks of the old four-wheeled locomotive N.E.R. No. 272 and those showing Fletcher's "Whitby bogies" in various stages, are especially interesting, whilst many more of the various engines which at one time or another have done duty on this section of the N.E.R. are faithfully reproduced.

"Dictionary of Engineering Terms in English and Spanish." By A. J. R. V. Garcia. *London:* Hirschfeld Bros., Ltd. 3s. 6d. net.

The ever-increasing development of commerce between this country and Spain and the South American Republics, all of which are Spanish excepting Brazil, with the enormous strides in railway extensions, dock works, bridge-building, etc., have no doubt created a demand for an up-to-date technical dictionary of terms used by engineers, and in his effort to supply this the author has been successful. The dictionary contains indices in both the English and Spanish languages, arranged so that the finding of any particular term or word is quite easy, and as no less than 3,000 technical terms in general use by engineers are included, it will be a most useful help to firms preparing catalogues, etc., of their specialities.

"History of the East Indian Railway." By Geo. Huddleston, C.I.E., chief superintendent E. I. Ry. *London:* W. Thacker & Co., 2, Creed Lane; *Calcutta* Thacker, Spink & Co. 7/6 nett.

Mr. Huddleston's book is a careful record of the annals of the East Indian Ry. from its inception in 1845 to the present time. It is not merely an account of the construction of the line, but goes into other matters which have affected the development of the railway and its affairs, and should therefore be of interest to the general reader as well as those more intimately connected with the line.

In 1850 the construction of the first section of the line from Calcutta (Howrah) to Pundooah (about 130 miles) was sanctioned, and shortly afterwards undertaken as a single track. This was completed and opened for traffic early in 1854. Although the history of the E.I.R. has been one continual record of progress, it had a close connection with the political history of Eastern India, and thus we find reference in the affairs of the company to the Great Mutiny of 1857 and the praiseworthy efforts of the staff in those troublous times. The author also touches on the part played by the E.I.R. when famines have visited the country, and also the enormous development of the Bengal coal traffic, which has been and still is of the greatest importance to the railway.

A long chapter is devoted to tracing the competition the East Indian Ry. has to meet, particularly by the development of the lines of Western India, which divert the export traffic to Bombay, as against the E.I.R. and Calcutta. The book can be recommended to every one interested in railway enterprise and progress.

We have received from Messrs. George Newnes, Ltd., Part XIII of the *Technological and Scientific Dictionary*, which ranges from "Tie" to "Warehouse." This very useful work bids fair to be completed in the fourteen parts originally projected, and will form a wellnigh invaluable book of reference to all interested in scientific pursuits.

New Six-wheel Bogie Train used on Edinburgh-Glasgow Service, Caledonian Ry.

25-tons Covered Goods Wagon, North Eastern Ry.

25 TONS COVERED GOODS WAGON, NORTH EASTERN RY.

THE accompanying illustrations show a new type of covered goods wagons of large capacity recently introduced on the N. E. Ry. by Mr. Wilson Worsdell, chief mechanical engineer, and designed for high speed service between important centres. They have a total length over body of 37-ft., an outside width of 8-ft., and a height of 12-ft. 1-in. from rail level, the internal dimensions being, length 36-ft. 3-in , width 7-ft. 3¼-in., and height at centre 7-ft. 9½-in. ; the bogies, which are of diamond frame pattern on the Sheffield-Twinberrow system, supplied by the Brush Electrical Engineering Co., Ltd., have wheels 3-ft. 1-in. diameter on a wheelbase of 5-ft. 6-in., the centres of the bogies being 27-ft. apart. The wagon has four body doors and two sliding roof doors to permit of the lading of grain, etc. ; the lower part of the side doors falls outwards to form a gangway. These wagons are equipped with the rapid-acting vacuum brake and a through pipe for Westinghouse connections, together with a hand brake. Inside the wagons are a number of lashing hooks, to enable heavy goods to be securely fastened. The tare of wagons of this type is 15 tons 18 cwt., and the gross load 25 tons, which is so far the largest capacity available in covered wagons in this country.

NEW EAST COAST JOINT STOCK.—The North British Ry. have built six of the large bogie luggage brakes of the same pattern as illustrated in our July number. The Great Northern Ry. have completed no less than 12 of these fine vehicles. Six third class side corridor coaches have also been put into use from Doncaster; these cars have luggage lockers so that they can take private parties to and from any part of Scotland. The passenger cars are all electrically lighted.

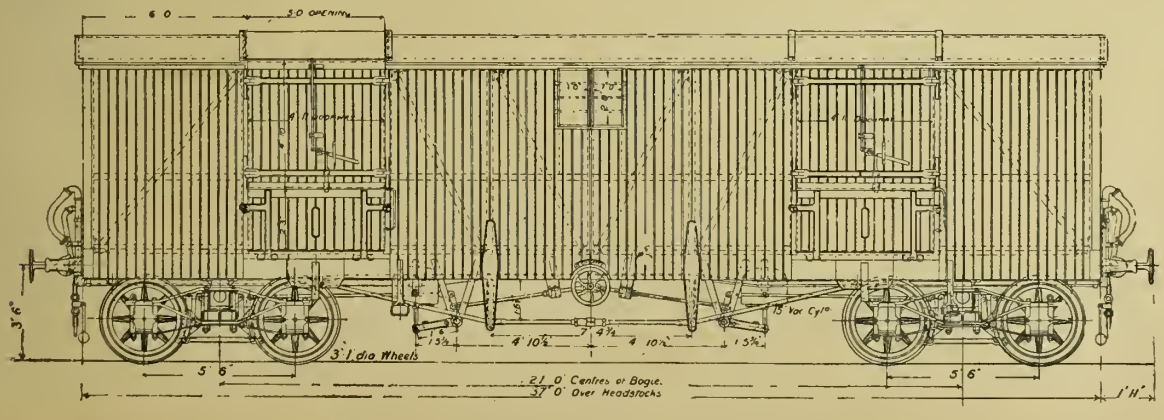


Diagram of 25-tons Covered Goods Wagon, North Eastern Ry.

Van for Motor Car Traffic, Caledonian Ry.

MOTOR CAR VAN, CALEDONIAN RY.

To accommodate the general traffic in motor cars, and particularly the productions of the many car factories throughout their system, the Caledonian Ry. have built a number of roomy six-wheeled vans for the exclusive transit of these vehicles. The outside dimensions are: length 30-ft. 0-in. over body, breadth 8-ft. 0¼-in., height at centre 8-ft. 10-in. and at side cornice 7-ft. 0-in. Height from rail at centre 12-ft. 9⅞-in. and at side cornice 11-ft. 0-in. The underframe is 30-ft. 0-in. long, giving 33-ft. 8-in. over the buffers. The sole-bars and cross-members of the underframe are of steel channels, the longitudinals and diagonals being of oak, secured by angle bar and plate knees. The wheels are 3-ft. 9-in. diameter on tread and 9-ft. 0-in. between centres, giving a total wheelbase of 18-ft. 0-in.

The body framing is of teak, panelled in mahogany. There are two double folding doors on either side, each giving a clear opening of 4-ft. 2½-in., with large sliding windows, which give the interior a good light. The waist panels on doors are of slate for writing purposes. Each side door is fitted with a slip bolt and carriage standard lock. The centre panel at either end on both sides is louvred, and lined inside with perforated zinc. The roof is of galvanised steel plate ⅛-in. thick, supported by light steel roof bars of channel and T sections.

The two folding end doors are V-boarded and hung from the corner pillars by wrought iron hinge straps, three to each door, the centre hinge straps having a stud and cotter fastening. There is also a slip bolt fastening inside. The doors give openings the full width and height of the van. There are four wheel bars stretching across the vehicle, sliding on angle bar brackets, having holes 2-in. pitch for adjusting purposes, giving accommodation for two ordinary sized motor cars. There are also notched bars along the sides having a shackle and strap attachment for more securely fixing the load. Two steel plates 10-in. by ¼-in. thick run the full length of floor inside on which the wheels of vehicles rest.

The vans are fitted with dual brake equipment, as well as "either-side" hand brakes, and have pipe connections for steam-heating. The tare is 12 tons 19 cwt., and load 6 tons. They have been built at the Company's St. Rollox workshops to the designs and under the supervision of Mr. J. F. McIntosh, the locomotive superintendent.

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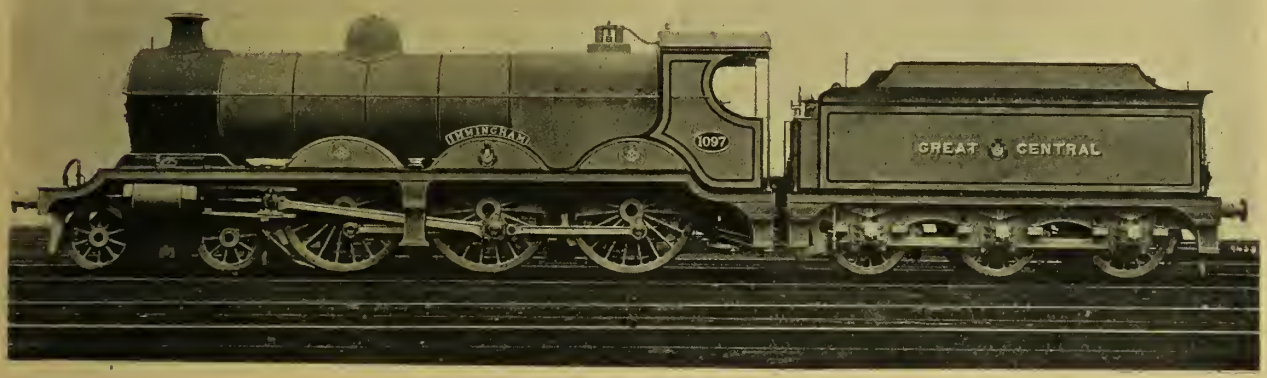
THE LOCOMOTIVE MAGAZINE.

Vol. XII. **SEPTEMBER 15th, 1906.** **No. 169.**

RAILWAY NOTES.

GREAT CENTRAL RY.—In the accompanying illustration is shown No. 1097, one of the new series of six-coupled bogie passenger locomotives recently built by Messrs. Beyer, Peacock & Co., Ltd., to the same general dimensions as the first examples of the class, but with the slightly larger heating surface adopted in the later Atlantics. This engine is noteworthy on account of bearing a nameplate, the name "Immingham" being also given to the new docks in course of construction for the Great Central Ry. on the Humber.

THE NEW ROUTE TO IRELAND.—The Fishguard-Rosslare route to Ireland *via* the Great Western and Great Southern & Western Ry.'s new lines, was formally opened on the 30th ult. To bring the scheme to completion a vast amount of work has been accomplished, including the construction of harbours at Fishguard and Rosslare, the laying out of a new line from Clarbeston Road to Letterston Junction in South Wales, a distance of 10 miles 50 chains, and a new single line 38 miles long between Rosslare and Waterford. For the sea passage the G. W. R. provide three turbine-propelled steamers of 22½ knot speed, which will accomplish the crossing of 54



SIX-COUPLED BOGIE PASSENGER EXPRESS LOCOMOTIVE NO. 1097 "IMMINGHAM," GREAT CENTRAL RY.

GREAT WESTERN RY.—Nos. 3725-30 of the new four-coupled bogie type of express passenger locomotives are now out, thus completing a series of 30 in all.

In consequence of the success of No. 40, some four-cylinder six-coupled bogie locomotives are shortly to be built.

A new series of the "County" or outside cylinder type of express engine are also to be built, and progress is being made with the nine tank engines of the 4-4-2 type similar to No. 2221 illustrated in our April issue, while a series of 2-6-2 tank engines of the 3121 type are in contemplation.

Nos. 3004, 3296, 3303, 3406 and 3407 have recently received new taper boilers with Belpaire fireboxes.

nautical miles in less than three hours. The whole distance from Paddington to Cork is reduced by this new route to 457¼ miles, and the actual time occupied on the journey will be 13 hours, including the sea passage. Apart from giving this more direct and speedy communication with the South of Ireland, the G. W. R. have undoubtedly had in mind, in establishing a magnificent new harbour in South Wales, the idea of wresting some part of the Transatlantic mail and passenger traffic from Liverpool and Southampton. The distances of Fishguard, Liverpool and Southampton from New York are respectively 2,902, 3,017 and 3,077 nautical miles, the disparity being further marked by the compulsory stop of all Liverpool liners at Queenstown to land mails.

LONDON & SOUTH WESTERN RY.—The six-coupled bogie engines of No. 330 class have been doing good service during the busy holiday season, hauling heavy loads.

The ten small four-wheels coupled tank locomotives for motor service with vestibule coaches, now in course of construction at Nine Elms, will bear Nos. 736-745 inclusive.

FURNESS RY.—An order for six tank and four six-coupled tender goods locomotives has been placed with the North British Locomotive Co., Ltd.

HULL & BARNSLEY RY.—A contract for the supply of ten eight-coupled mineral locomotives has been placed with the Yorkshire Engine Co., Ltd. These engines will have the following leading dimensions: cylinders 19-in. in diameter by 26-in. stroke; diameter of coupled wheels 4-ft. 6-in., wheelbase 16-ft. 6-in., length of boiler barrel 14-ft., height of centre above rails 8-ft. 2-in.; number of tubes 234, of 2-in. diameter; heating surface: firebox 131 sq. ft., tubes 1,728 sq. ft., total 1,859 sq. ft.; grate area 22 sq. ft.; the capacity of the tenders will be 3,300 gallons.

GREAT EASTERN RY.—Referring to our illustrations on p. 110 of the July issue, the engines rebuilt with new boilers and a leading bogie during the year are Nos. 704, 708, 712, 719, 728, 745, 772, 777, 779, 1012, 1013, 1015, 1016, 1021, 1023, 1025, 1026, 1027, 1030 and 1032.

Ten new six-coupled goods engines of the 640 class are out bearing Nos. 552-561. They are painted blue, and are equipped for working the Westinghouse and automatic vacuum brakes.

New double-end tank engines Nos. 231-240 are out.

The large bogie engines Nos. 1890, 1894, 1895 and 1897 have been equipped with the vacuum brake and located at Doncaster for the purpose of working the new Doncaster-London express goods trains which from August 1st have been timed to accomplish the journey in 6 hours, with a maximum load of 25 wagons and a brake van.

The new Sheringham line, branching off from the Norwich to Cromer section at Cromer Junction, and converging with the Norfolk and Suffolk Joint Ry. at Roughton Road Junction, and thence *via* Newstead Lane Junction to Runton West Junction on the Sheringham and Cromer Beach line of the Midland & Great Northern Joint, was opened on July 23rd with G. E. R. engine No. 678.

NORFOLK & SUFFOLK JOINT RY.—The new coast line from Mundesley *via* Trimingham and Overstrand to Roughton Road Junction, there forming part of the G. E. R. new Sheringham route, was opened on August 3rd. Two spur lines from Newstead Lane Junction, the next junction after Roughton Road Junction, give access respectively to Runton West Junction, West Runton and Sheringham, and to Runton East Junction and Cromer Beach, on the Midland and Great Northern Joint Ry. The first G.E.R. train, Overstrand to North Walsham (G.E.R.), was worked by tank locomotive No. 591, and the first Joint Co.'s train, Mundesley to Cromer Beach, was worked by the Midland Ry. tank locomotive No. 143.

GREAT NORTHERN RY.—Following is a complete list of the new loading classification for locomotives on this railway, referred to briefly in our May issue: Class B, Mr. Ivatt's six-coupled goods engines of 1101 class, Stirling's goods rebuilt with domes, and the American Moguls; C, all Stirling's goods engines with domeless boilers, 474, 372 and 1021 classes, also Mr. Ivatt's Nos. 1091-1100 with domes; D, eight-coupled mineral engines, Nos. 401-440; F, Stirling's six-coupled saddle tanks, 601 class; H, six-coupled tank engines, 1201 class; K, miscellaneous small tank engines; L, Stirling's passenger bogie tank engines, 116A and 504 classes; M, ten-wheeled passenger tanks, 1501 class; N, ten-wheeled eight-coupled tank engines, 116-146; P, single-driver express engines of all classes; R, four-coupled in front mixed traffic tender engines; S, Stirling's four-coupled 6-ft. 6-in. passenger engines with domeless boilers; T, Stirling's four-coupled passenger engines rebuilt with domes, and Mr. Ivatt's 1061 class and the small bogie engines of 1071 class; W, Mr. Ivatt's large eight-wheeled bogie engines Nos. 1321-1340, and 1361-95; Y, the Atlantics of 990 class; and Z, the large Atlantics of 251 class. The letters omitted are as yet unrepresented.

NORTH BRITISH RY.—The following is the list of names allotted to the new Atlantic type locomotives illustrated and described in our last issue:—"Aberdonian," "Abbotsford," "Bon Accord," "Borderer," "Cumberland," "Dunedin," "Dundonian," "Hazeldean," "Midlothian," "St. Mungo," "Teviotdale," "Thane of Fife," "Tweeddale," and "Waverley."

CALEDONIAN RY.—The six-coupled bogie express locomotive No. 903 has been named "Cardean."

MR. JAMES HALCROW, London agent for the Hanover Locomotive Works, Bochumer Verein, and Augsburg & Nürnberg Engineering Works, gives notice that he has removed from 5, Moorgate St. Buildings, to 18, Coleman Street, E.C.

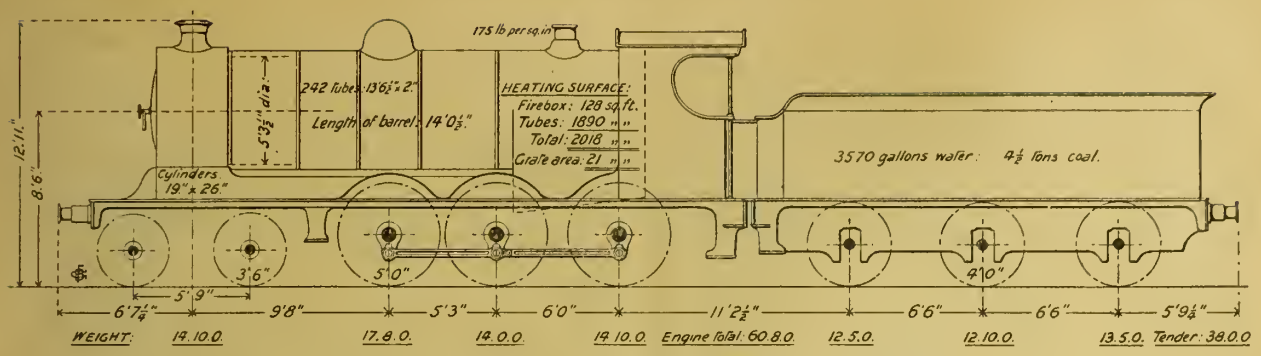
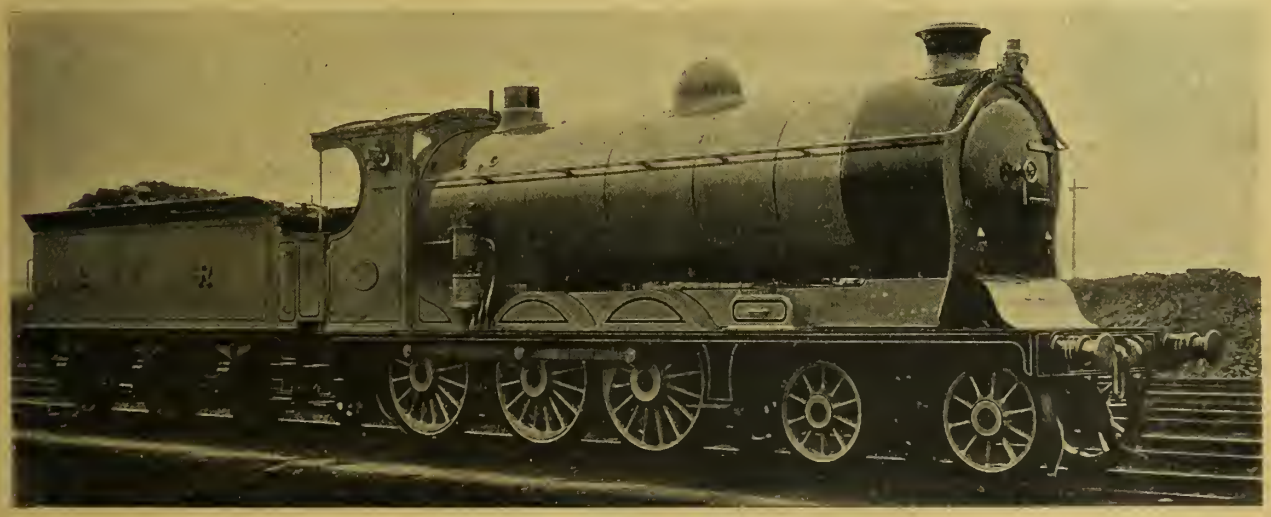


DIAGRAM OF SIX-COUPLED BOGIE GOODS LOCOMOTIVE No. 918, CALEDONIAN RY.

SIX-COUPLED BOGIE GOODS LOCOMOTIVE, CALEDONIAN RY.

MR. J. F. MCINTOSH, the locomotive superintendent of the above railway, has recently designed a new type of engine for heavy fast goods traffic, of which we give illustrations from photographs courteously supplied by the designer. The diagram shows the leading dimensions of this powerful locomotive, which presents many features of interest. It may be remarked that the cylinders are practically as large as it was possible to make them, while still retaining the direct Stephenson link motion, with a valve chest between the cylinders. As in the 55, or "Oban" class, the engine is driven from the leading coupled axle, this arrangement giving the advantage of reducing the inclination of the cylinders to a minimum. At the same time the bearings have all been increased in size to take the additional weight of a large boiler, and with a view to easing the engine round curves, a play of ½-in. is allowed to the trailing axle, the rear portions of the coupling rods being provided with knuckle joints. Sandboxes are fitted to the driving and trailing wheels. The boiler is of a similar type to that provided for the 903 class, described in our July issue, but is shorter in the barrel and firebox. The tubes are of mild steel galvanised, and the internal firebox is stayed directly to the outer shell with screwed stays. The safety valves are four in number, 4-in. in diameter, with independent springs. Steam reversing gear, with a reversing lever and notched quadrant plate, is fitted; the stuffing boxes of piston rods and valve spindles have metallic packing. The engine is equipped with the usual Westinghouse brake fittings, and also has an ejector and "through" pipes to enable it to work vacuum-fitted trains. Although designated a goods engine, it should be well adapted for working heavy passenger traffic also.

THE RAILWAY CLUB.—The next meeting will be held on Tuesday, 9th October, at 92, Victoria Street, London, S.W., at 7.30 p.m. Mr. C. Rous-Marten hopes to be present to deliver an address.



SIX-COUPLED BOGIE GOODS LOCOMOTIVE No. 918, CALEDONIAN RY.

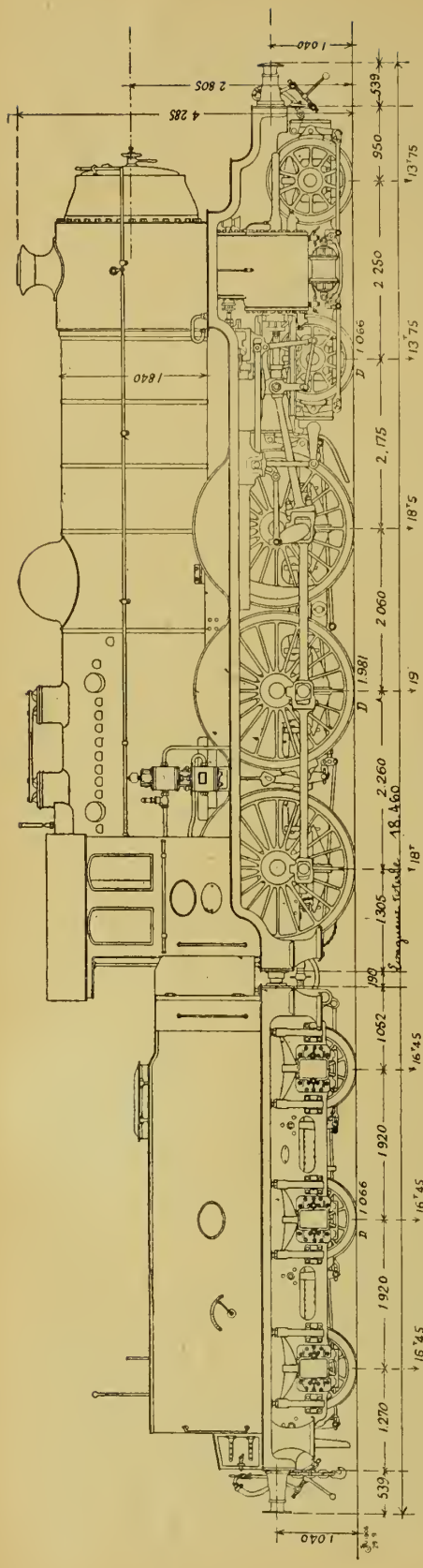


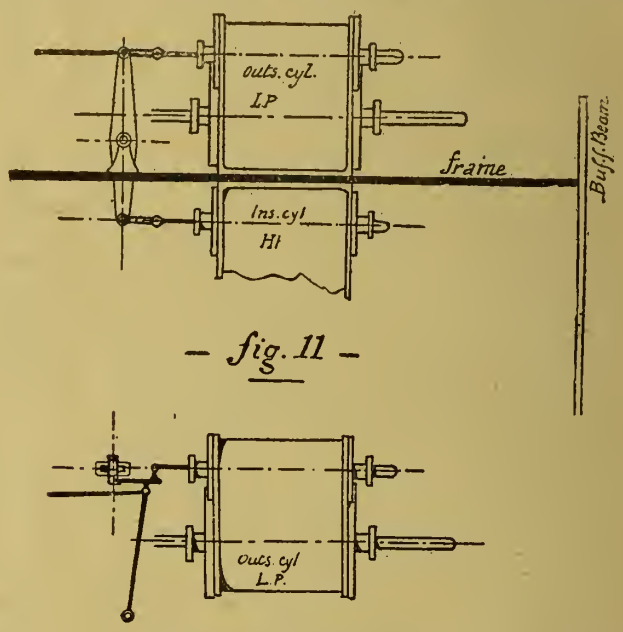
Fig. 10.—Six-coupled Bogie Four-cylinder Compound Locomotive, Type 19, Belgian State Rys.

RECENT LOCOMOTIVES OF THE BELGIAN STATE RAILWAYS.

(*Continued from page* 95.)

THE four-cylinder compound locomotives mentioned in our June issue are of two slightly different types, known as Type 19 and Type 19 Bis. Their boilers are of the same dimensions as that of No. 3303, illustrated on page 94, but some are equipped with a special form of superheater introduced by the Société Cockerill.

There are at present only two locomotives of Type 19 in actual service, Nos. 3301 and 3304, both built by the Société Cockerill. They are alike in every respect except that No. 3301 has no superheater, and consequently has a heating surface equal to that of the four-cylinder simple No. 3302 already described. These engines, as can be seen from the accompanying illustration, Fig. 10, have the four cylinders



— *fig. 11* —

Diagram of Valve Motion of Four-cylinder Locomotives, Nos. 3301 and 3304, Belgian State Rys.

placed in line transversely, all actuating the leading coupled axle, this being an arrangement also adopted on recent German and Austrian compound locomotives, the high pressure cylinders being between the frames and the low pressure outside. As in the four-cylinder simples last described, the two cylinders on each side of the centre line of the engine are controlled by one set only of Walschaerts valve gear, but the method of application is somewhat different, as will be gathered from a comparison of the accompanying diagram, Fig. 11, with the corresponding Fig. 8 on page 95 preceding. In this case the horizontal rocking shaft to transmit the motion of the radial gear in the first place to the inside cylinder, is dispensed with, the Walschaerts gear being connected to the piston valve of the outside cylinder direct, and the balance cranks reversing the motion for the inside cylinders are therefore arranged in a more simple manner without having recourse to extended valve spindles as in the previous instance. The principal dimensions of the engine

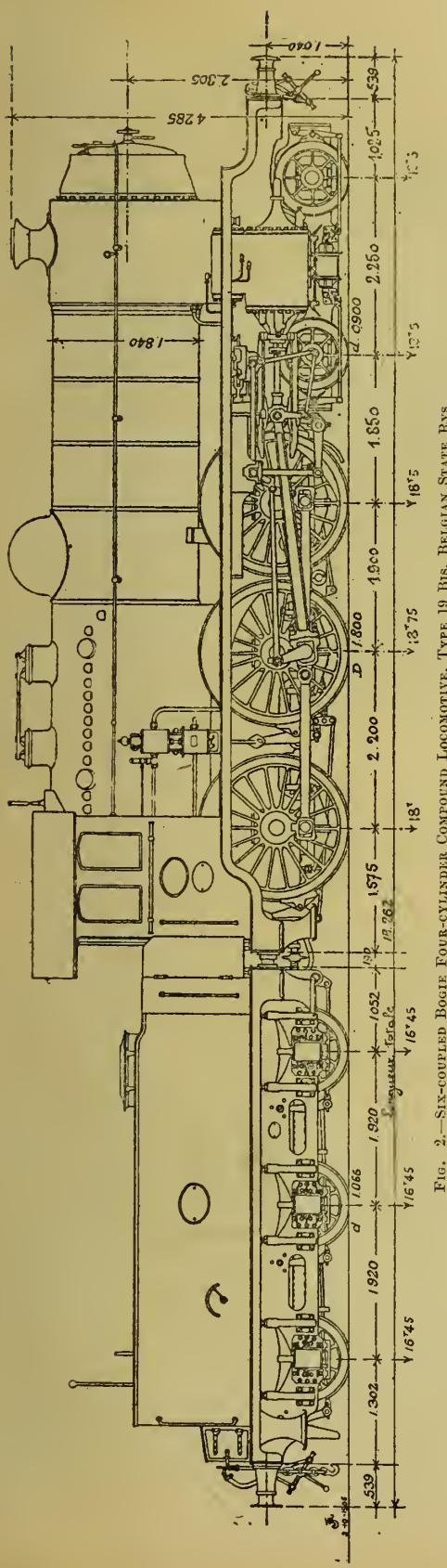


Fig. 2.—Six-coupled Bogie Four-cylinder Compound Locomotive, Type 19 Bis, Belgian State Rys.

illustrated, No. 3304, are as follows: high pressure cylinders 14⅛-in. by 26 13/16-in., and low pressure cylinders 24½-in. by 26 13/16-in.; diameter of bogie and coupled wheels 3-ft. 6-ft. and 6-ft. 6-in. respectively. It will be noticed that these engines have bogies of different dimensions from those of other engines described in this series of articles, the wheels being larger and the springs placed outside the frames; the boiler barrel has a maximum diameter of 5-ft. 6½-in., and contains 219 tubes 13-ft. 1½-in. long and 2-in. in diameter in addition to 30 superheater tubes of 4 3/16-in. in diameter; heating surface: firebox 182 sq. ft., tubes 1,696 sq. ft., total 1,878 sq. ft.; the superheater surface is 440 sq. ft., and the grate area 32·4 sq. ft. The Cockerill superheater attacks the steam after leaving the high pressure cylinders, and before it enters the low pressure cylinders, and not as usual directly after leaving the boiler. The working boiler pressure is 225 lbs. per sq. in. In respect to wheelbase, total length and height of boiler centre from rails, this engine is identical with those last described; the weight is practically the same also, and the various fittings and accessories are of the Belgian State standard pattern.

There are in service eight locomotives of Type 19 Bis, illustrated in Fig. 12, bearing Nos. 3293-3300, all built by the Société Cockerill. These differ from the preceding type principally in the disposition of the cylinders; the high pressure cylinders, inside the frames, actuating the leading coupled axle as in previous classes, whilst the low pressure are connected to the second pair of drivers by means of somewhat long connecting rods. The cylinders are of the same dimensions as Type 19, but the driving wheels are only 5-ft. 11-in. in diameter, and the bogie is of the same type as in the four-cylinder simple engines. The boiler has a rather deeper firebox than that of Type 19, owing to the smaller diameter of the wheels, and has the following altered heating surface: firebox 197·5 sq. ft., tubes 1,696·6, total 1,894·1 sq. ft.; grate area 32·4 sq. ft. All the engines of this class are provided with the Cockerill superheater, but No. 3293 has it in a somewhat complicated form, the superheated steam being supplied at will either to the high or the low pressure cylinders; this arrangement is being tried experimentally, but apparently gives inferior results as compared with the simpler method already described. The weight of engines of this type is 82 tons, of which about 55 tons are on the coupled wheels.

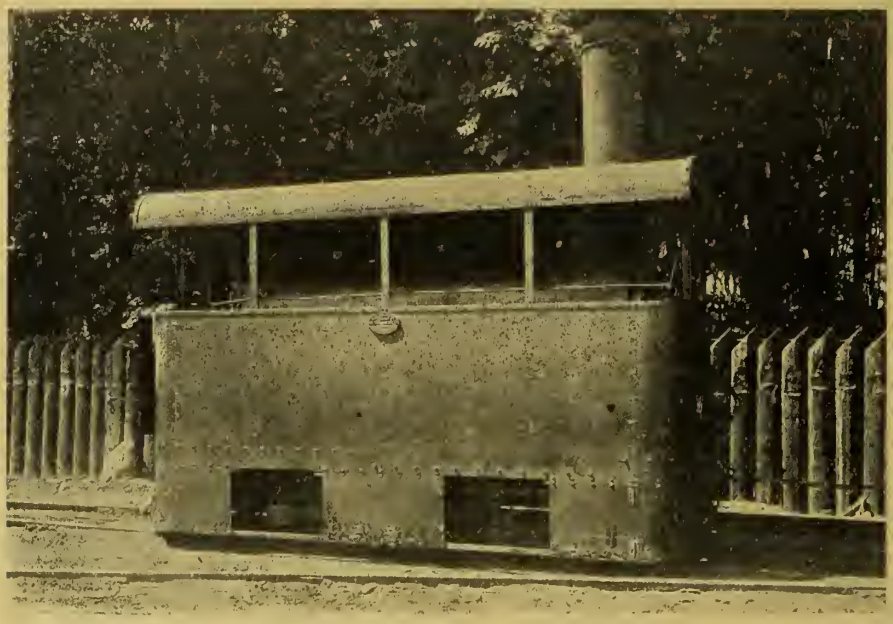
All the engines recently described are supplied with the standard tender adopted on the Belgian State Rys., referred to on page 44 preceding.

(*To be concluded.*)

"La Locomotive Actuelle."—Our friend, M. Maurice Demoulin, the author of "Traite Practique de la Machine Locomotive," one of the most exhaustive works on locomotive practice ever published, with the further advantage of being modern, has sent us a copy of a supplementary treatise bearing the title above quoted, which deals with still more recent practice on the Continent, in Great Britain and the U.S.A., and which forms a fourth volume worthy of being placed side by side with the previous three. It is sufficiently up-to-date to include the latest G.N. and L.B. & S.C.R. Atlantics and the latest six-coupled bogie engines of the L. & N.W.R. and L. & S.W.R., and consists of 324 pages of letterpress, illustrated by 132 engravings and 40 plates. The book is published by M. Ch. Beranger, of Paris and Liège, but copies may be ordered from the Locomotive Publishing Co., Ltd., price 25s.

SCHULL AND SKIBBEREEN LIGHT RAILWAY.

THIS line, remotely located in the west of Ireland, is one of the numerous light railways constructed with Government assistance, the interest on the capital (5 per cent.) being guaranteed by the baronies through which it runs.



FOUR-COUPLED TANK LOCOMOTIVE No. 3, AS ORIGINALLY BUILT, SCHULL & SKIBBEREEN LIGHT RY.

The line, which is of the 3-ft. gauge, is 15¼ miles in length, and extends from the market town of Skibbereen (53¼ miles from Cork on the C. B. & S. C. Ry.), to the small fishing village of Schull, skirting the coast for a portion of the way; for about half the distance the railway runs alongside the public road, the permanent way consisting of flat-bottomed rails, 45 lbs. to the yard, spiked to the sleepers. The opening for traffic took place in 1886, and the company was originally known as the West Carbery Light Railway and Tramway.

The station at Skibbereen adjoins that of the C.B. & S.C. Ry., a run of about 2¼ hours from Cork; here are situated the locomotive and carriage sheds, and a small shop for repairs. In order to start out of the station the train has first to back down into a siding, and the same process has to be repeated on arriving. There are no signals, but there is one intermediate crossing place at Ballydehob, 10 miles from Skibbereen, these two sections being worked by small wooden train tablets; there are in addition five other stations, where the accommodation consists of a shelter, with in some cases a siding; the gradients and curves are very severe, the steepest being 1 in 24, while the sharpest curve is 2 chains radius; as a matter of fact there is hardly a level stretch on the whole line, gradients of 1 in 30 being quite common. There are only two bridges, one of these being a stone viaduct of 12 arches, crossing an arm of the sea at Ballydehob.

The traffic is extremely small, and, needless to say, does not even pay working expenses, two mixed trains in either direction on weekdays and one on Sundays amply sufficing for the needs of the district; these are timed to perform the 15¼ miles in 1 hr. 20 mins., including six stops.

The rolling stock consists of four locomotives, six carriages, four brake vans, and 45 goods vehicles; the first three locomotives, Nos. 1

FOUR-COUPLED TANK LOCOMOTIVE No. 2, REBUILT, SCHULL & SKIBBEREEN LIGHT RY.

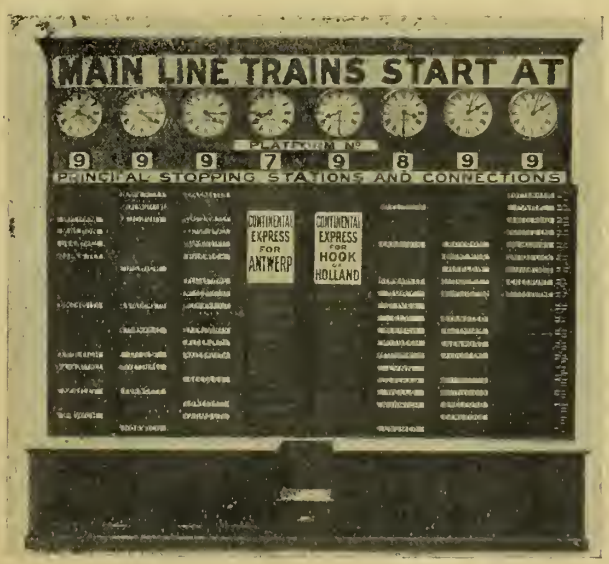
"Marion," 2 "Ida," and 3 "Ilen," were built by Messrs. Dick, Kerr & Co., Britannia Works, Kilmarnock, in 1886; they are four-wheels coupled tank engines (0-4-0) with outside cylinders, and cased in—to suit Board of Trade requirements. In their original form they were domeless, but No. 1 was afterwards re-boilered with a dome; this engine is, however, now replaced and lies in a dismantled condition at Skibbereen; No. 2 "Ida" has been rebuilt recently with a much larger boiler, with Belpaire firebox, and presents rather a novel appearance, the casings round the boiler and dome having now been removed. The photo. of No. 3 shows one of the engines in their original condition. The original dimensions are as follows: cylinders 9½-in. by 16-in., coupled wheels 2-ft. 6-in. diameter, wheelbase 6-ft., tanks (under boiler) 350 gals., weight in working order 18 tons. The next engine, No. 4 "Erin," was built by Messrs. Nasmyth, Wilson & Co., in 1888; it is a four-wheels coupled side tank with leading bogie (4-4-0), Belpaire firebox, and has the following dimensions: cylinders 12-in. by 18-in., coupled wheels 3-ft. 4-in. diameter, bogie wheels 1-ft. 10-in. diameter, coupled wheelbase 5-ft. 6-in., total whelbase 15-ft. 3-in., tank capacity 500 gals., heating surface (total) 508 sq. ft. This engine was probably the first in Ireland to have a Belpaire firebox.

The latest engine, No. 1 "Gabriel," has only just been supplied by Messrs. Peckett & Co., Bristol, and has the same arrangement of wheels as No. 4, with the exception that the coupled wheels are inside the frames and the firebox is not Belpaire. The dimensions are as follows: cylinders 12-in. by 18-in., coupled wheels 3-ft. 0½-in., bogie wheels 2-ft., wheelbase (rigid) 5-ft. 6-in., wheelbase (total) 15-ft., heating surface (total) 575 sq. ft., tank capacity 600 galls., bunker 25 cwt., weight (loaded) 24½ tons. This engine presents a very smart appearance and reflects great credit on the builders.

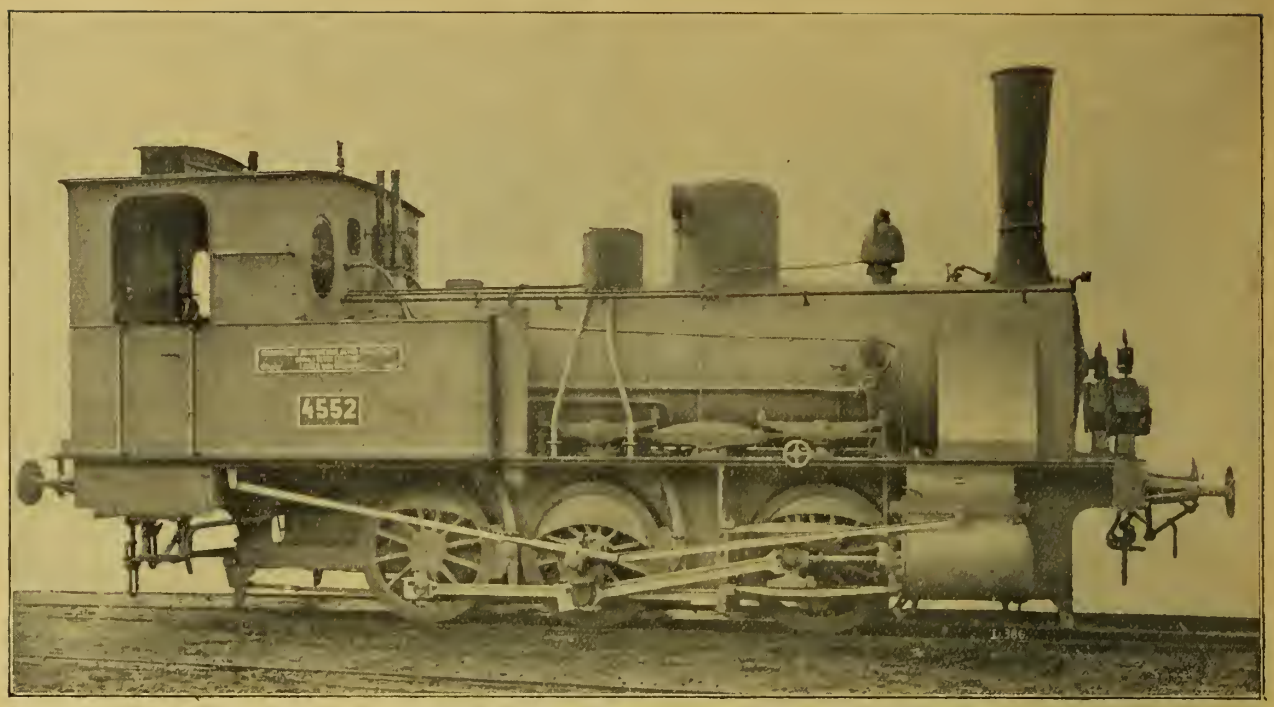
Four-coupled Bogie Tank Locomotive No. 1, Schull & Skibbereen Light Ry.

The carriages are mostly composite (first and third class) vehicles, running on four-wheeled bogies, the latest specimen, a third class bogie coach, has both let down windows and dust screens; the seats are arranged along each side, and the entrances are at each end; the running is, however, by no means smooth, and with the small four-wheeled engines is almost equal to a sea trip.

The traffic along the line is purely local, the district being quite out of the beat of the tourist; during the summer, however, it is possible to do the journey from Cork to Schull and back (136 miles) for the small sum of 4s. third class, and to anyone interested in railways the trip is strongly to be recommended.



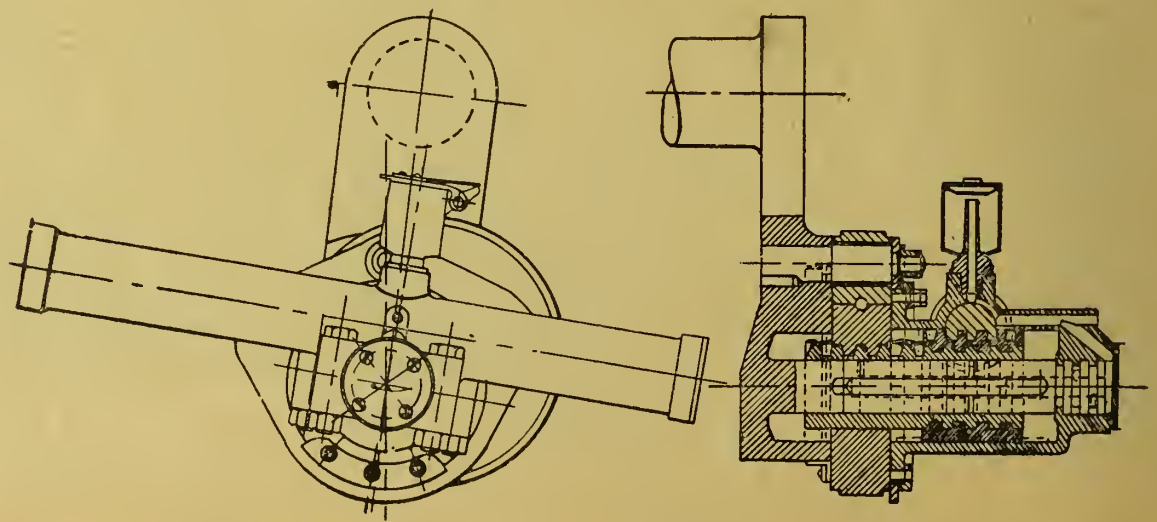
Train Indicator at Liverpool Street Station recently provided for the guidance of passengers to main line stations on the G.E.R. system. It was constructed in the Stratford carriage shops.



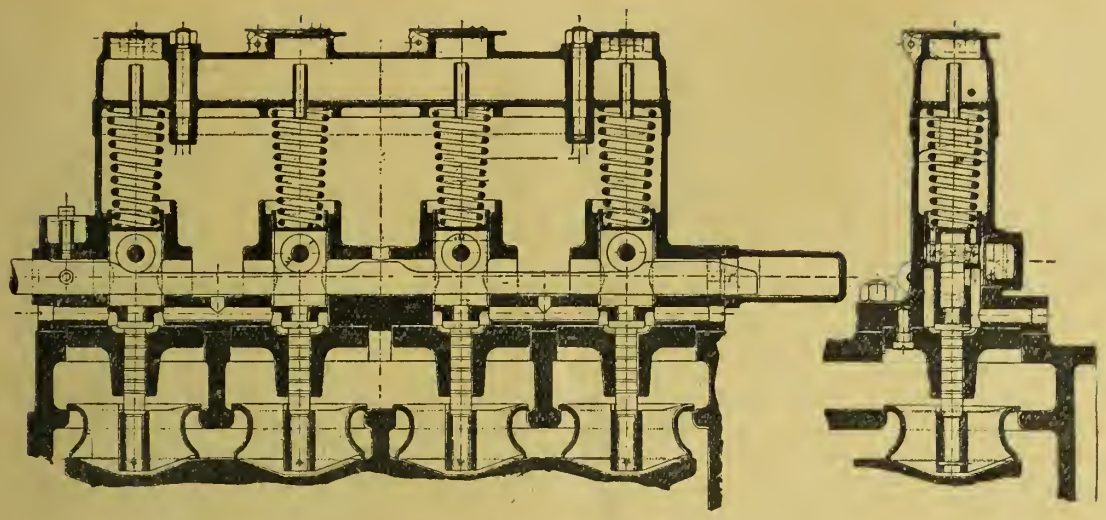
Six-coupled Tank Locomotive fitted with the Lentz Valve Gear and Poppet Valves.

THE LENTZ LINKLESS VALVE GEAR.

In the accompanying illustrations are shown details of the Lentz valve gear as fitted to a locomotive built by the Hannoversche Machine Co. (formerly George Egestorff) and exhibited at the Milan Exposition this year. Herr Gustav Lentz originally introduced this form of linkless gear some few years ago, and it appears to have given complete satisfaction on a number of locomotives and stationary engines. The gear, as here shown, comprises two distinct features, one being the employment of a shifting eccentric on the crank axle—in the example illustrated on a return crank outside the "big-end"—and the other feature being the use of poppet valves to control the steam distribution. On the engine illustrated two rods are seen which converge at the driving axle. That which leads forward to the cylinder is the valve rod, and its action will be described in due course; it receives motion from an eccentric on the pin of the return crank, and the direction and extent of its travel relatively to the cylinder pistons is controlled by the rod that inclines backward towards the footplate, where it is connected to the usual lever



Side elevation and Cross section of Valve Rod and Eccentric of the Lentz Gear.



Longitudinal and Transverse Sections of Poppet Valves as adapted to the Lentz Valve Gear.

working in a quadrant plate. Our second illustration is a cross-section of the eccentric and reversing gear on the crank pin. Briefly explained, the eccentric has a spiral bearing engaging with a similar spiral on a sleeve which revolves with the axle, but which is arranged so as to slide transversely; it is obvious, therefore, that a movement of the sleeve across the axle will cause the eccentric to change its position relatively to the crank, the range of travel being from extreme forward to extreme backward gear, with any intermediate position. The traversing sleeve is controlled by another sleeve which does not rotate; this also has a spiral thread engaging with inclined surfaces on the end of the rod coming from the cab, and the backward or forward movement of the lever, therefore, acting through these various series of oblique teeth, causes the eccentric to occupy any desired position with regard to the crank pin. The motion of the eccentric is transmitted to a valve-rod provided with inclined projections, which act as cams in conjunction with rollers turning on pins attached to the four lifting or poppet valves, shown in our third illustration. Of these the two nearest the centre are inlet valves, and the others are for the exhaust, and the cam surfaces of the valve rod lift them in due sequence both in forward and backward gear. As regards the employment of poppet valves, it may be remarked that ordinary valve gears can also be used, and indeed, examples shown at Milan so fitted include a large Atlantic type locomotive with Walschaerts gear, and another engine with Allan straight-link motion. The tank engine here illustrated, in addition to having Herr Lentz's gear and valves, is provided with the Pielock superheater, and is of the following leading dimensions: cylinders 15¾-in. by 21⅝-in.; diameter of driving wheels 3-ft. 7¼-in.; wheel-base 9-ft. 10⅛-in.; heating surface: 996 sq. ft.; superheater surface 264 sq. ft.; grate area 15½ sq. ft.; weight in working order 35 tons 7 cwt.

ERECTING A LOCOMOTIVE.

In order to erect locomotives in an economical manner, a leading hand should have, whenever possible, three pits under his charge. By this arrangement any time of waiting for delivery of work belonging to one engine from the machine, fitting shops, etc., can be utilized by the men in forwarding the others.

The details of erection naturally differ in various classes of locomotives. In the present article, as a typical case, the erection of an ordinary inside cylinder single-framed 0-6-0 goods engine is briefly described.

The first step is the setting up of the frames. These are sent to the erecting shop in as complete a state as is practicable, having been slotted round the edges, straightened, and having all holes drilled where possible and sharp corners taken off. They are first laid on trestles and the various centre lines marked out. They are then placed upright in forked supports, stayed together by means of standard temporary stays cut to dead length, and set square and level with each other.

In order to ascertain when they are square, centre pops are made at various points on the top edges of the frame plates, the pops being put on to each frame at exactly similar points. The frames can then be set square by trammelling diagonally from a point near the front of each plate to one near the back of the other. They are levelled, both longitudinally and transversely,

by means of a straight edge and spirit level. A cord is also placed along each side at a given distance back and front, and the space between the cord and frame plate is then callipered at various places in order to make sure that the plates are straight.

All footplate brackets, cross stays, etc., are next fixed. These are first bolted up with a few bolts, then set to their exact position and rivetted up, the holes being opened out where necessary. The motion plate and other important cross stays are usually fastened with cold rivets, which are turned a driving fit to the holes. The horn blocks are secured with turned bolts.

The cylinders are next lowered into position between the frames, the weight being taken on a pair of jacks placed one under each end of the cylinder casting.

Strips of template iron, having a small central hole, are bolted across the front of each cylinder and set so that the small hole is exactly on the centre line. A line is then passed through each hole and secured at the other end to a straight edge, which is laid across the driving horns with the top edge on the centre line of the driving axle according to the drawing. These lines are set parallel to the frames and to each other, and the position of the cylinders adjusted by means of the jacks until their centre lines exactly correspond with the actual lines, after which the bolt holes, which in the cylinders are drilled in the first instance below the required size, are rose-bitted out, and the bolts, which are turned to a driving fit, driven in and the nuts firmly screwed up.

After securing the cylinders the slide bars are put up and set. The bottom bars are set to the lines used in setting the cylinders. A gauge is used, which is shaped to fit the bars on its bottom edge, and has a pointer on its top which is exactly central at the required distance from the bottom, each bar being so set that the gauge, when resting at any point along its length, will just touch the centre line with the pointer. When all the bottom bars are set, a straight edge, thinly smeared with red paint, is rubbed over them to see that they are all fairly in the same plane.

The top bars are now set from the bottom ones by means of a dummy slide block, which must work freely, but without "slogger," between the two.

At this stage all the measurements are usually checked over by the foreman, in order that he may satisfy himself that all the essential parts of the engine are square and true.

The boiler may next be lowered on to the frames and secured. Before being received in the erecting shop it has been mounted and tested under both hydraulic and steam pressure. The expansion brackets should have been so set when mounting the boiler that no adjustment is necessary, and having been once placed in the frames it remains there. The front tube plate is bolted to the cylinder casting, the joint being usually made with red lead putty, and the expansion bracket guides attached to the frame at the firebox end.

When in position the boiler is lagged and cleaded, and the smokebox, cab, splashers, etc., put up, this latter work being done by a gang of boiler makers usually attached to the erecting shop.

In the meantime the axleboxes may be fitted up in the horn blocks. The boxes are left a little large in the planing machine and are scraped down to fit the blocks, the latter being coated with "red marking," so that a true bearing may be obtained. They are fitted fairly tight, but should be capable of being comfortably moved up and down by means of a bar three or four feet long. They are next bedded down to their respective journals, the surfaces cleaned out and oiled and the keeps put on.

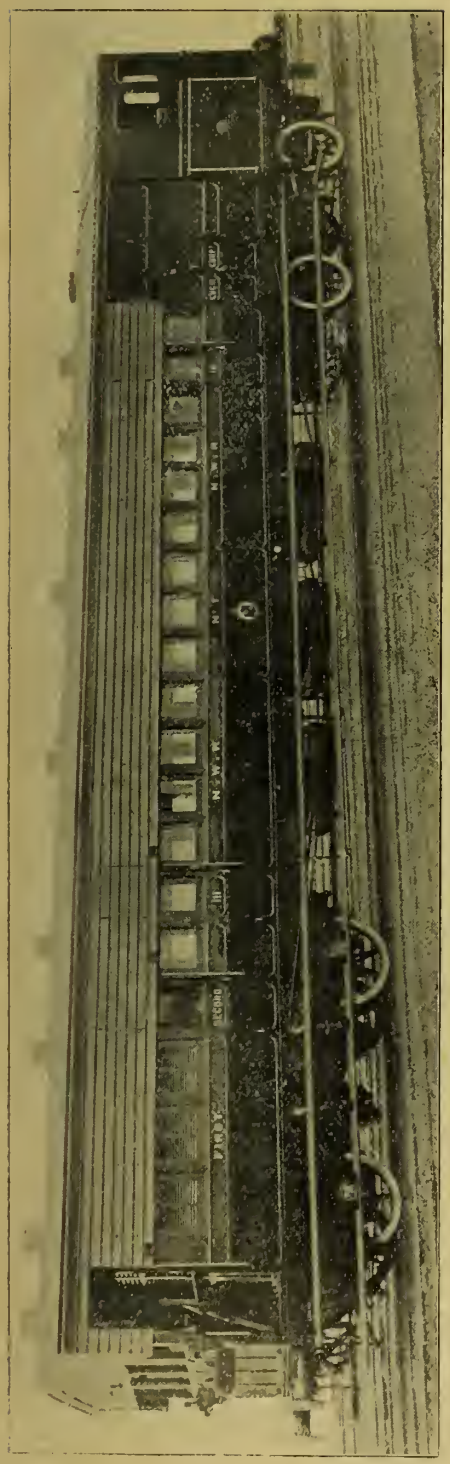
The engine is now ready for wheeling. To do this it is lifted clear by means of an overhead crane, the wheels rolled underneath, and then the engine is lowered on to them; a man being stationed at each axlebox to guide it into the horn blocks. Small pieces of packing are placed on the tops of the axleboxes, on which the tops of the horns rest until the springs are put up and secured.

The engine is now ready for the motion, which is put up, and the valves set. The setting of the valves is the most important piece of work in connection with the erection of a locomotive, and is only performed by specially skilled men. It properly forms a subject of itself, and an article on it is in preparation.

On completion of the motion the springs are put up and fastened, the buffer beam attached, and the engine lifted on to a "running road," if such is available. The coupling rods are put on, and when all the minor details, such as brake gear, feed pipes, cylinder cock gear, etc., have been completed the engine is ready for trial.

When the boiler has been filled with water, the fire lighted, and the engine coupled to the tender (which is coaled and watered) before starting on the trial trip the whole is weighed. The weighing machine is so arranged that each wheel rests on a separate table and may be weighed by itself. The springs are adjusted until a correct proportion of the weight is obtained on each wheel.

The tender is put together in a similar manner to the engine, the frames being set, marked off, rivetted up and wheeled, and the tank (which is made in a separate shop) lowered into them and secured and the various fittings attached.



Steam Rail Motor Coach, North Western Ry. of India.

STEAM RAIL MOTOR COACH, NORTH WESTERN RY. OF INDIA.

The accompanying illustration shows a new steam rail motor coach built for local traffic on the above-mentioned State railway, to the designs of Sir Alexander Rendel. The steam and carriage bogies, underframe, all the iron work, fittings, carriage seats, glass, etc., for finishing were supplied by the Vulcan Foundry, Ltd., of Newton-le-Willows, Lancs., whilst the woodwork was added after assembling the various parts of the vehicle, by the carriage department of the railway company itself. The engine bogie is carried on four wheels of 3-ft. 3-in. diameter, of which only one pair are drivers, and has cylinders 9-in. by 14-in., supplied from a boiler carrying 160 lb. of steam and having a heating surface of: firebox 48 sq. ft., tubes 252 sq. ft., total 300 sq. ft. This bogie is detachable by slightly lifting that end of the coach. It carries 300 gallons of water and half a ton of fuel. The body of the carriage has accommodation for three first-class, three second-class and 72 third-class passengers, it is suitably upholstered, and has brass fittings; there is also a luggage compartment. Lighting is provided on Pintsch's patent gas system. This car is typical of the numerous vehicles of a similar character which are now coming so extensively into use for local service both in this country and in the various parts of the British Empire.

AN INDIAN LOCOMOTIVE'S CREW.

Three men occupy the footplate of an Indian engine, driver, fireman and assistant fireman or "augwalla." Originally, the first-named was invariably an European, but now so many natives are qualified to take charge of a locomotive, that an English driver is becoming the exception, not the rule. Foremost among the natives competing for employment on the railways are the Parsees, a caste or sect of the Indian people anxious to adopt the everyday methods of the West. The curious "topee" or conical hat usually worn has had to give way to the wants of the locomotive service, and the Parsee driver now adopts a small skull cap instead. The Parsee headgear is about as suitable to the footplate as a Scotchman's kilt would be. The locomotive is a great "leveller," it reduces all to standards of utility. Clean and painstaking in his duties, the Parsee driver is a favorite amongst the shed foremen of India. The fireman is often a young European or Parsee, sometimes a Eurasian or Hindoo. There is great variety in this grade of the service, but smart young men are in demand. The "augwalla," or "Jack," as he is familiarly called, is generally a Hindoo. He does all the hard work of the run; trims the coal in the tender and delights in officiating with a flag as he passes all stations. If allowed to manipulate the whistle his satisfaction is boundless. If of a lazy temperament, not exceptional, he goes to the front and crouches down on the front buffer beam out of the driver's way. "Jack" rarely gets excited, but at times, when running a bit behind with a mail train and the speed goes up, he grins contentedly and flourishes his flags with redoubled ardour.

NEW LOCOMOTIVE AND TRAIN, GOTHARD RAILWAY.

WE are indebted to the management of the above railway for the accompanying illustration and particulars of a locomotive and rolling stock exhibited at the Milan Exposition, which represents the most recent practice of this progressive line. The locomotive shown is one of 29 six-coupled four-cylinder compounds of the de Glehn-du Bousquet type, the first of which was put in service in June, 1894, but successive engines have embodied various improvements in detail as dictated by experience. No. 228, which was built in 1905 at the Swiss Locomotive Works, Winterthur, has the following leading dimensions: diameter of h.p. cylinders (which are inside the frames) 10⅝-in., and of the l.p. cylinders (placed outside) 23⅝-in.; stroke 23⅝-in.; diameter of bogie and driving wheels, 2-ft. 10¼-in. and 5-ft. 3⅜-in. respectively; wheelbase: bogie 5-ft. 11-in., trailing bogie to leading coupled 7-ft. 7-in., leading coupled to centre coupled 6-ft., centre coupled to trailing coupled 6-ft. 6¾-in., total 26-ft. 0¾-in.; diameter of boiler barrel 4-ft. 11-in., height of centre above rails 7-ft. 8¾-in.; number of tubes 227, length between tube-plates 13-ft. 1-in., diameter 2-in.; heating surface: firebox 137 sq. ft., tubes 1,539 sq. ft., total 1,676 sq. ft.; grate area 25.8 sq. ft., boiler pressure 220 lb. per sq. in., weight of engine in working order 64 tons; tender: capacity 3,740 gallons of water and 5 tons of coal, weight 36½ tons.

In addition to this fine locomotive four examples of bogie carriage stock are shown. One is a composite mail and luggage van, and the other are respectively a first class, a first and second class composite, and a third class coach. As regards wheels, bogies and frames, they are all of similar design, with the following dimensions: bogie wheelbase 8-ft. 2½-in., distance between bogie centres 44-ft. 3½-in., diameter of wheels 3-ft. 5-in., length over headstocks 60-ft. 2-in., extreme width of body 9-ft. 8¼-in., height above rails 12-ft. 0½-in. The first class coach seats 36 passengers; the composite seats ten first class and 28 second class, and the third class coach seats 84. The weights of these carriages vary slightly, ranging from 31¾ tons for the mail van to 33½ tons for the composite.

Engine and train are provided with the Westinghouse-Henry brake, a Westinghouse alarm signal, and steam heating, while the first

SIX-COUPLED BOGIE LOCOMOTIVE NO. 228, AND TRAIN OF NEW CARRIAGE STOCK, GOTHARD RY.

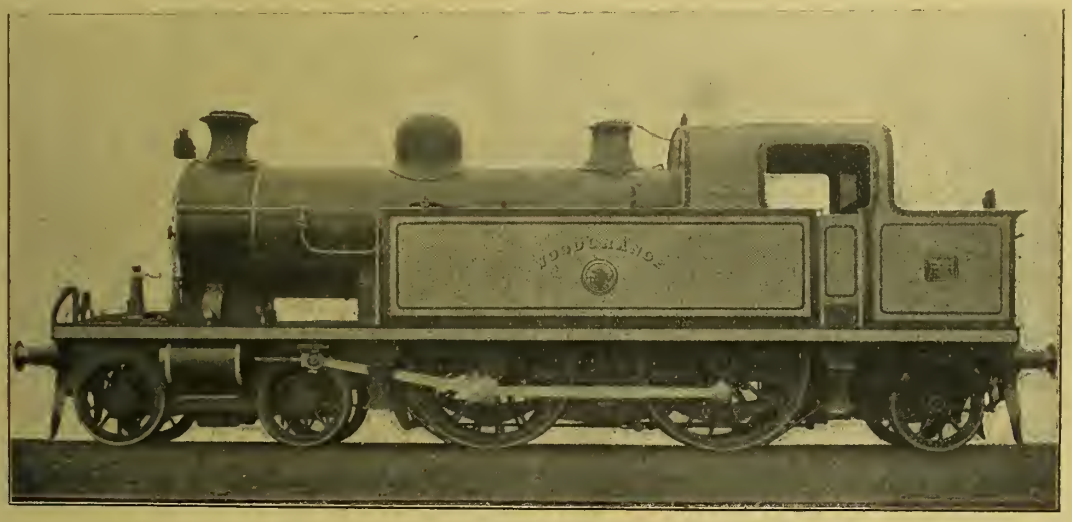
class and mail carriages are lighted electrically on the Aichele system, supplied by Messrs. Brown, Boveri & Co., of Baden, and the composite and third class coaches by Pintsch's patent gas system. All the appointments are up-to-date.

REBUILT LOCOMOTIVE, LONDON, TILBURY & SOUTHEND RY.

To cope with increasing traffic and heavier trains it has been decided to re-construct the No. 37 class of engines on the above railway, and our illustration shows the first one of the class so altered. This engine as originally built was one of twelve, six being constructed by Messrs. Sharp, Stewart & Co., Atlas Works, Glasgow, in 1897, and six by Messrs. Dübs & Co., Glasgow Locomotive Works, Glasgow, in 1898.

The principal alteration consisted in providing a larger boiler, of 4-ft. 7⅞-in. internal diameter, having a total heating surface of 1,099 sq. ft., with a grate area of 19.7 sq. ft., and working at 170 lbs. pressure per sq. in. The height of centre of boiler from rail level is 8-ft. 3-in., compared with 7-ft. 6-in. when first built. To accommodate the enlarged diameter of boiler, it was necessary to bring the side tanks out flush with the edge of the footplate. The water capacity has been increased from 1,500 to 1,614 gallons. To ensure the smokebox door being kept thoroughly tight, a dove-tailed ring, into which is fitted asbestos tape, is fixed on the outside of the smokebox front, and the edge of the door makes a joint up against it. New cylinders have been provided, 19-in. diameter by 26-in. stroke, the crank pins having been enlarged and new connecting rods of a solid-ended pattern adopted. The whole of the original valve motion has, however, been utilised. Steam reversing gear has been substituted in place of the ordinary hand lever with which these engines were first fitted. An enlarged air pump, 8-in. by 8½-in., in place of the original 6-in. by 6½-in., has been attached to the right hand side of the smokebox, it being found that these large pumps provide the necessary air pressure in a much more satisfactory manner than the smaller type. This engine is fitted with both Westinghouse and Vacuum brakes; although the latter does not in itself operate on the engine, the driver's valve is fitted with a combination by which, when the vacuum brake is being actuated on the train, the air brake is applied on the engine. A new form of cab has also been provided.

This engine has been working the Southend expresses now for the past eight months, and has given every satisfaction and shown a marked increase in power and speed.

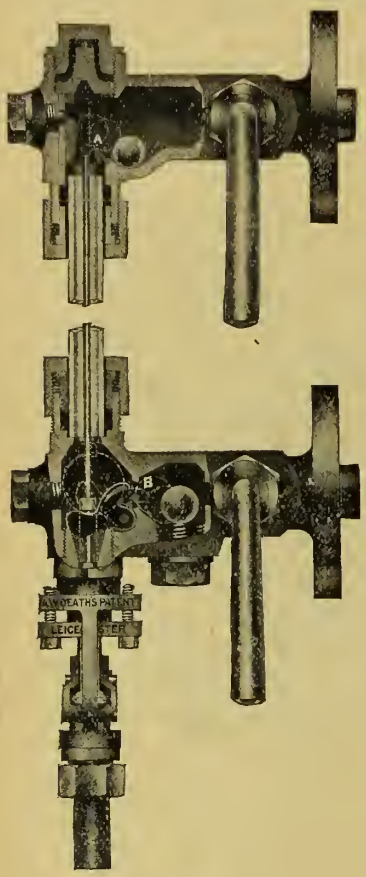


Rebuilt Four-coupled Bogie Passenger Tank Locomotive No. 37 "Woodgrange," London, Tilbury & Southend Ry.

A Railway Lamp Works.—By the courtesy of Messrs. George Polkey, Ltd., we recently had the pleasure of visiting their extensive works at Birmingham. The firm makes a speciality of railway lamps, including under that category locomotive head-lights, carriage roof lamps, and various classes of signal and hand lamps. At the time of our visit several Colonial orders were in hand, one in particular being for a South African railway, which requires locomotive head-lights giving sufficient candle-power to illuminate the track for a distance of 100 yards ahead. Great care is bestowed on all details of manufacture, and to ensure the highest standard of excellence every part of the lamp, with the exception of the glasses, is made at the works of the firm. Messrs. Polkey supply lamps to railway companies in all parts of the world, and in addition to this speciality they make several patterns of head and tail lamps for road vehicles.

A NEW WATER GAUGE.

THE glass water gauge has long been undergoing improvement at the hands of engineers, and, if we except the safety valve, probably no fitting on a steam boiler has received more attention. Despite the numerous attempts, however, the ordinary gauge may be a treacherous indicator if not constantly cleaned; its chief failing being through its tendency to become choked with deposit and sediment thrown down from the water in the passage ways of the connecting arms. The novel arrangement shown in the annexed blocks has been designed to overcome the trouble hitherto existing, and it undoubtedly possesses considerable merit. The construction will be readily understood from the section. The "rod valve tap" which replaces the "blow through" cock of the ordinary class is formed of a small tube closed at its upper end but provided with apertures which open to the internal passage when the tube is lifted. The valve also carries a prolongation in the shape of a small rod passing up through the glass tube to operate the automatic balls of the gauge. When the "rod valve" is opened for blowing through, its position with its attachments is shown by the dotted lines in the drawing, the balls being pushed away from the passages A and B. Either arm can be "blown through" separately in the ordinary way and the great danger arising from the valves being held upon their seats is avoided. All the automatic parts can be withdrawn for cleaning whilst the boiler is under steam, thus enabling a driver to undertake the little job at any convenient "wait." The glasses are inserted by removing the top cap and the ball seating from the upper arm. This improved gauge is being introduced by the United Asbestos Co. Ltd., to whom enquiries should be addressed.

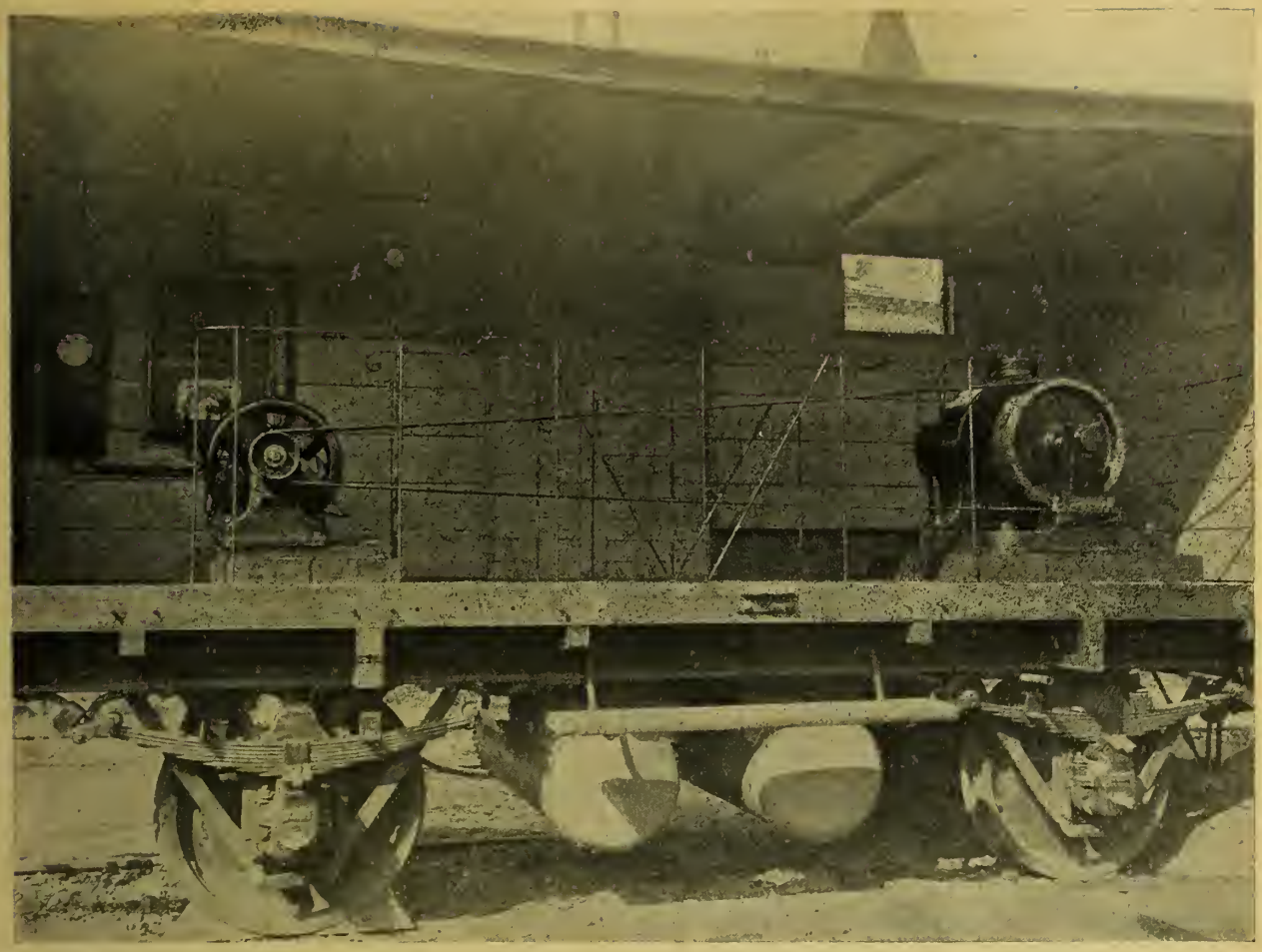


A NEW WATER GAUGE.

THE BORSIG CARRIAGE-CLEANING PLANT.

THE well-known firm of A. Borsig, of Berlin-Tegel, has recently introduced a novel form of cleaning plant, one modification of which, adapted for use in railway carriages, is shown in the accompanying illustrations. The apparatus differs from atmospheric cleansers hitherto introduced in respect to method, the system consisting of a double action of compressed air and a vacuum-suction as well, and it is claimed that the efficiency of the operation is largely enhanced by the introduction of the duplex influences of pressure and exhaust. It is of course obvious that a much greater disturbance of ingrained dust can be effected by air at high pressure than by a suction limited to something below 15 lb. per sq. in., and the conjunction of the two actions, first displacing the dust and then sucking it up, should be well-nigh irre-

THE BORSIG CARRIAGE-CLEANER AT WORK.



The Borsig Carriage-cleaning Plant fitted up inside a Covered Wagon.

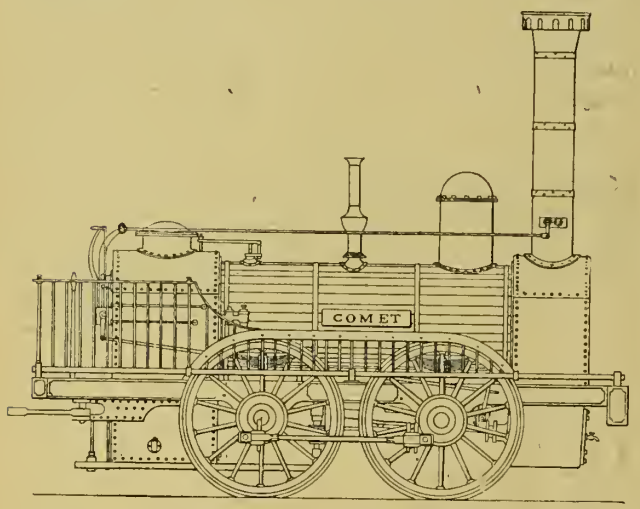
sistible. The installation can be mounted in a van set apart for the purpose, as shown, or it can be supplied in a portable form, and it is equally applicable to carpets, furniture and rooms, to hotels, public halls and private houses, and to ships and steamers, as to railway carriages, the plant being supplied in forms and capacities suited to the various requirements above indicated.

MORE RAILWAY REMINISCENCES.

The illustrations of new large locomotives for the North Eastern Railway, which appear from time to time in the "Locomotive Magazine," make me recall the days of my boyhood when I lived at Haydon Bridge on the Newcastle & Carlisle Ry., now a section of the North Eastern system, and compare the engines of those days with the handsome machines of the present.

The N. & C. R. is 60 miles long and was opened through from Gateshead to Carlisle on the 18th of June, 1838; the first engine, "No. 1," built by Stephenson, of Newcastle, had four-coupled wheels and weighed 12 tons: the boiler pressure was 50 lbs. per sq. in. The two eccentrics were loose on the axles and some six or seven movements with different handles were necessary to reverse. Some drivers were puzzled at first to know how to start this engine until they had been instructed, but I soon discovered the correct procedure (the irony of it), when, as a little boy about 6 years of age, I climbed on to the footplate of "No. 1" one dinner time when it was standing in steam in the engine shed at Haydon Bridge, which was built at right angles to the main line. I began to play with the regulator handle, and there was no difficulty in starting the engine this time. The wheels began to revolve and did not stop until "No. 1" had cleared the shed, passed over the turntable and embedded itself in the ground beyond; there were no lifting jacks in those days, but by means of a few pieces of wood for a fulcrum and a long pole for a lever the engine was soon put on the rails again. I at once became a noted engine driver, but the only reward I received for my

brilliant performance was a good birching from my father (the driver). The second engine "Comet," by Hawthorn, also had four-coupled wheels, weighed 12 tons and had four eccentrics. In this gear the rods not in use were lifted up clear of the weigh-bar shaft. To see and hear this engine running on a dark night was a fire-work display in miniature. There were no ash-pans in those days, so that the red hot cinders falling through the firebars on to the ground and rebounding to be caught by the wheels and thrown aside, in conjunction with the "rockets" from the chimney, formed an imposing sight. This locomotive was afterwards used as a stationary pumping engine at the building of a bridge over the River Tyne, near Riding Mill station, and when that work was complete it was put on the rails again for another period of duty as a locomotive. Finally it was re-purchased by the builders, Messrs. Hawthorn, and used by them in their factory at Newcastle as a stationary engine.



Four-coupled Locomotive No. 2 "Comet," Newcastle & Carlisle Ry.

Locomotive No. 3, "Meteor," was built by Bury of Liverpool, and had four-coupled wheels. It was of the usual "Bury" type, with bar framing and high firebox top, weighed 12 tons, and had a boiler pressure of 55 lbs. per sq. in. The two eccentrics were placed on the leading axle and the rods went through a space provided at the bottom of the smokebox and were connected to a weigh-bar shaft between the buffer beam and the cylinders. If by any accident it became necessary to take off the side rods, the slide valves had to be worked by hand by means of the two gear handles at the side. From this it can be gathered No. 3 was a "convenient" and "handy" locomotive, the manipulation of which would have puzzled a Philadelphia lawyer. After this time locomotive designs began to improve, though engines were still being constructed with only four wheels. Some were provided with an additional pair of wheels under the footplate, notably, No. 4 "Hercules," No. 5 "Samson,"* and No. 8 "Tyne"; No. 9 "Eden" differed in having a pair of small wheels placed at the leading end; No. 6 "Goliath," and No. 7 "Atlas" were six-coupled engines with piston rods underneath the leading axles.

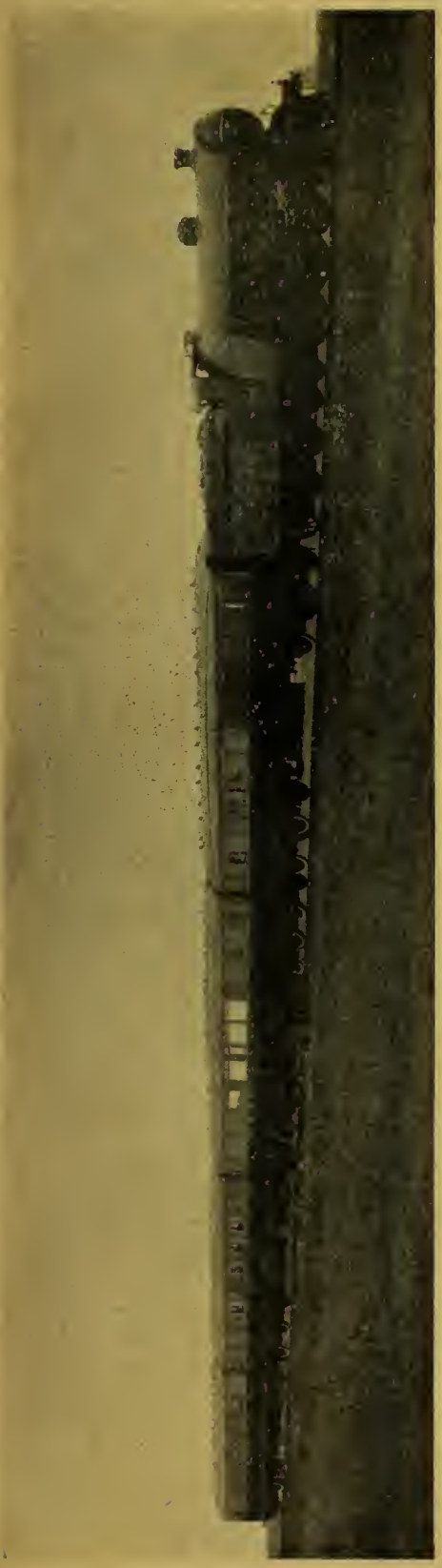
I think that it was in the year 1850 that the Stephenson link motion was introduced on this railway and I well remember the gratification expressed by the drivers as the different engines were fitted with it in turn; there was such simplicity and economy in working in comparison to the old gab-ended eccentric rods with motion always running in "full gear."

When the line was opened through to Carlisle my father was sent to the halfway station, Haydon Bridge, with the "Rapid" engine, and as there was no telegraph his business was to always have steam up ready to take the engine out to look after any train that happened to be very late; frequently men would come in after miles on horseback to seek the "pilot." My eldest brother William became father's fireman when about 14 years old; he soon became an adept in working the handles of the engine and when there was any shunting to be done father very wisely stood to one side and allowed William to handle the regulator. They had to clean, light up, and keep the engine in good order, and father being handy with his tools used to take the "Rapid" to pieces himself at Haydon Bridge when repairs were needed; the wheels went to Newcastle when required to be re-turned. When this work was in hand, engine No. 12 "Carlisle," Robert Dent driver, did the service of the "Rapid."

There were no guards at this time for goods or coal trains, and it was the fireman's duty to fix a long pole or wisp of straw on the last vehicle of a train in the day time, and at night a large lamp or firebucket. The driver or fireman carried the invoices. At 10 p.m. trains were supposed to cease running and the gatemen at the level crossings closed the gates at that hour across the track and retired to their dwellings; the drivers of any belated trains desiring to pass after this time had to stop, get down and open the gates for themselves; this procedure, needless to say, often meant a very bad time for the gates.

The passenger guards were resplendent in scarlet uniform coats, drab trousers and cream coloured hats; their duties were to travel on the steps of the carriages when in motion and collect tickets; when not so employed they rode on the top of the last carriage to keep a good lookout and apply a hand brake when required. The

* A photograph of the "Tyne" in an altered state was reproduced in the "Locomotive Magazine," page 132, Volume VII.



New Vestibuled Corridor Train for London-Sheffield-Manchester Service, Great Northern Ry.

carriages had seats on the top to accommodate two persons, but many passengers had to ride in open wagons with temporary seats placed in them. The first class carriages were painted yellow, picked out with black, and the second class were white picked out with green. The luggage vans and horse boxes were painted green.

(To be continued.)

NEW ROLLING STOCK, G.N.R.

TWO vestibuled corridor trains of an entirely new design were turned out from the Doncaster carriage shops last month. Each train, composed of four coaches, is arranged as follows: Third class, luggage and brake, with five private compartments, third class open saloon seating 42 persons, composite dining car seating 18 third class and 12 first class passengers, with kitchen in centre, first class luggage and brake having four private compartments. The dining car has six-wheeled bogies, the other cars four-wheeled only. The cars have the high elliptical roof, which has superseded the "clerestory," such a feature of G. N. stock for the past ten years. All the cars are of full width, so much so, that the guard's observation windows in the brakes are unusually narrow, the electric side lamps on the same being only about 2-in. in diameter. The interiors of the cars are different in many respects from the standard G. N. design, particularly the first class dining car, the windows of which have green side curtains as well as blinds. The trains are lighted throughout with electricity, and the first class dining saloons have a unique arrangement of horizontal lamps concealed along the cornice, the cars being lighted by reflected light from the ceiling, table lamps being also used. A striking novelty in the outside finish of these trains is the large letters and figures along the sides, giving the name of the railway in full, "Great Northern." The doors have the class designated thus, "1st" and "3rd." The latter is quite an innovation on G. N. main line stock.

The trains run on the London-Sheffield and Manchester service.

MIDLAND RY.—New coaches just turned out have the class designation painted in large figures on the doors, and the word "Midland" in "decorated" block letters on a small black facia board over the centre windows.

HULL & BARNSLEY RY.—Messrs. R. Y. Pickering & Co., Ltd., have in hand twelve bogie brake carriages, to be fitted with steam heat apparatus, vacuum automatic brake gear, Pintsch's gas lighting and torpedo ventilators. These carriages will measure 50-ft. long by 8-ft. 9-in. wide, by 12-ft. 6-in. high from rail level. The wheels will be 3-ft. 6⅞-in. diameter, the bogie wheelbase being 8-ft., and the distance between bogie centres 35-ft. Messrs. C. Roberts & Co., Ltd., have received an order for ten 20-tons goods brake vans for the same railway.

MR. GEORGE J. KOBUSCH, President of the St. Louis Car Co. and other American concerns, is at present in this country on a pleasure trip, with his wife. This is his first visit to Europe.

Correspondence.

Letters containing practical queries for this column are invited, and will be dealt with in rotation. The name and address of the sender should be enclosed, not necessarily for publication, but as a guarantee of good faith.

Old Locomotives on the Western Railway of France.

To the Editor of "The Locomotive Magazine."

Dear Sir,—On page 117 of July issue. with reference to Waterford & Tramore engine No. 4, you state "for the Liverpool and Manchester Railway." I am not aware of this engine running on the L. & M. Perhaps you intended to say built by Bury, of Liverpool.

On page 118 you illustrate an old French engine. The French directors at the time, by invitation through Mr. Locke, paid a visit to Crewe. They inspected Mr. Alexander Allan's designs of 6-ft. single and 5-ft. coupled engines, and they decided to have the same type for their line. They applied to the Grand Junction Company to allow Mr. Allan to supply drawings and dimensions. This was granted. Mr. Allan supplied the drawings, etc., and the Grand Junction Company allowed him to be paid by the French Company. When new, the engines had tenders, each running on four wheels.

For the information of the Chicago Exhibition authorities, in 1892, I had to inspect the drawings and correspondence. The drawings were marked "Alexander Allan's design," and signed by him. The payment to Mr. Allan was "for use of his designs."

These few facts will show that the engines were not designed by Mr. Buddicom.—Yours faithfully,

Clement E. Stretton.

Leicester, July 18th, 1906.

*** The engine No. 4 was *said* to have been originally built for the Liverpool and Manchester Ry., but there is no evidence to show that it ever ran on that line, as almost immediately after completion it appears to have been converted to the 5-ft. 3-in. gauge for use by the contractor engaged on the construction of the Waterford & Tramore Ry. This is stated in the article in Vol. V. referred to in our July issue.—Ed. L.M.

Trailing Bogie Tank Engines, G.S. & W.R.

To the Editor of "The Locomotive Magazine."

Sir,—Is not your contributor under a misapprehension as to the first of the above engines having been completed in 1883? I do not know the exact date when the class came out, but a drawing of a trailing bogie tank engine, to all intents and purposes identical with the one illustrated in your August issue, was published in the *Proceedings* of the Institution of Civil Engineers, session 1876-77. Further, an engraving of No. 35, an engine of apparently the same class, appeared in the *Engineer* some time in September, 1879. The engine which you show has a new chimney, but there can be no doubt I think that it is one of those designed over 30 years ago by Mr. Alex. McDonnell.—Yours faithfully, F. W. Brewer.

August 18th, 1906.

ANSWERS TO CORRESPONDENTS.

"Great Central."—The following ten-wheel tank engines have been stationed at Neasden: for working the Marylebone to Chesham and Aylesbury trains, Nos. 10, 29, 114 and 115; and for the High Wycombe-Calvert service *via* the new line, Nos. 47, 178, 191, 310, 359 and 453. Two of these engines and a tender engine (No. 105) work through to Woodford by this route. No. 28, ten-wheel tank, and No 1 rail motor work on the Aylesbury and Verney Junction service, and are stationed at Aylesbury. To relieve No. 3 rail motor on the Marylebone, Wembley and South Harrow suburban service, No. 162, a very small four-wheels coupled double-framed tank engine, is kept at Neasden.

Subscriber.—The leading dimensions of Mr. Wainwright's new bogie express engines, illustrated in our February issue, are as follows: cylinders 19¼-in. by 26-in.; diameter of bogie wheels 3-ft. 6-in., and of coupled wheels 6-ft. 6-in.; wheelbase: bogie 6-ft. 3-in., bogie centre to driving wheel centre 10-ft. 10-in., coupled wheel centres 9-ft. 6-in., total 23-ft. 5½-in.; boiler 11-ft. 1-in. long by 4-ft. 9-in. diameter, height of centre above rails 8-ft.; 266 tubes 1¾-in. diameter: length of firebox casing 7-ft.; heating surface: firebox 136 sq. ft., tubes 1,396 sq. ft., total 1,532 sq. ft.; grate area 21.15 sq. ft.; boiler pressure 180 lbs. per sq. in.

Trade Catalogues received:—

Wallach Bros., 57, Gracechurch Street, London, E.C.—Blue list of safety appliances.

J. T. Reade & Son, 4, Donegall Square North, Belfast.—Reade's patent cigar ash tray for use in railway carriages and other vehicles.

THE LOCOMOTIVE MAGAZINE.
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THE LOCOMOTIVE MAGAZINE.

Vol. XII. OCTOBER 15th, 1906. No. 170.

RAILWAY NOTES.

LONDON & SOUTH WESTERN RY.—Herewith is shown the latest type of front-coupled bogie passenger tank locomotive built to Mr. Dugald Drummond's design, which has the following leading dimensions: cylinders 18½-in. by 26-in., diameter of coupled wheels 5-ft 7-in., and of bogie wheels 3-ft. 7-in.; total wheelbase 23-ft. 7-in.; boiler pressure 150 lbs. per sq. in.; boiler tubes 216 of 1¾-in. diameter; heating surface: firebox 123·9 sq. ft., tubes 1,067·8 sq. ft., total 1,191·7 sq. ft.; grate area 20·36 sq. ft.; the tanks have a capacity for 1,300 gallons, and are provided with a feed water heater consisting of 40 tubes 11-ft. 3½-in. long and 2-in. in diameter, giving a heating area of 234 sq. ft.; the fuel space is 90 cubic ft., and the engine weighs 54 tons 13 cwt. in working order.

FRONT-COUPLED BOGIE SUBURBAN TANK LOCOMOTIVE No. 59, LONDON & SOUTH WESTERN RY.

SOUTH EASTERN & CHATHAM RY.—The following are new four wheels coupled bogie express engines: Nos. 470, 509, 545, 549 and 577, similar to standard, but with round-topped fireboxes, four windows to the cabs, and new tenders holding 3,450 gallons of water.

Nos. 305-6, 308-9 are new front-coupled bogie tank engines.

GREAT WESTERN RY.—Nos. 2222-5, ten-wheeled tanks of the type illustrated in our issue of April last, are now out. They differ from No. 2221 in having the number plates on the bunker side, and "Great Western" in yellow on the tanks. They are painted black below the running plate, and have hand-operated water scoops.

No. 2120, a Wolverhampton-built tank engine, has recently been enclosed above the running plate with a coach body, and is provided with fittings to allow it to work between two trailer cars. The tank has been replaced by another of different pattern, and the boiler pressure is increased to 165 lbs. per sq. in.

GREAT CENTRAL RY.—Following are new engines recently put in service: No. 363, Atlantic type, which is the eighth of this class built at Gorton; two new three-cylinder compounds, similar to No. 258 are also in hand; Nos. 1105-6 are two new six-coupled bogie fish engines with 5-ft. 6-in. wheels, recently delivered by Messrs. Beyer, Peacock & Co., Ltd. They are fitted with wet sanding to the leading coupled wheels and dry sanding to the drivers, and are provided with the quick-acting vacuum brake; they are painted black. No. 1119, the last of the five six-coupled goods engines built by the Yorkshire Engine

Co., Ltd., has been delivered. No. 60 is the first of a new type of six-coupled outside cylinder side tank shunting engine, fitted with condensing apparatus and combined vacuum and steam brake, built at Gorton.

LONDON, BRIGHTON & SOUTH COAST RY.—A tribute to this railway's former locomotive superintendents has been paid by re-naming two locomotives, No. 184, formerly "Carew D. Gilbert," now bearing the name "Stroudley," and No. 66, until recently "Balmoral," now being named "Billinton." The illustration below shows No. 184 as now running. Full particulars of both these types of engines, and of all others built by Messrs. W. Stroudley and R. J. Billinton will be found in "The Locomotives of the London, Brighton & South Coast Ry.," copies of which may still be obtained at the office of this Magazine.

FRONT-COUPLED EXPRESS PASSENGER LOCOMOTIVE NO. 184, NOW RE-NAMED "STROUDLEY," LONDON, BRIGHTON & SOUTH COAST RY.

A new condensing tank locomotive of the 4-4-2 type, to be known as I class, similar in appearance to the G. N. R. suburban tanks of that type, has recently been built at Brighton to the designs of Mr. D. E. Marsh, the locomotive superintendent. It bears No. 595, and has the following leading dimensions; cylinders 17½-in. by 26-in., diameter of bogie wheels 3 ft. 6-in., of coupled wheels 5-ft. 6-in., and of trailing radial wheels 4-ft.; diameter of boiler barrel 4-ft. 3-in. It is provided with Ramsbottom safety valves and pumps for the boiler feed.

LONDON & NORTH WESTERN RY.—The following new passenger tank engines 4-4-2 type are now at work: Nos. 97, 111, 181, 528, 531, 616, 784, 803, 1295, 1305, 1981-1985. These engines are all stationed in the Manchester district—Nos. 181, 1981, 1985 at Longsight, and the remainder at Buxton.

A further ten new express engines of the "Experiment" type are in course of construction at Crewe.

A new type of mixed traffic engine is contemplated, having six-coupled wheels and a leading bogie. In general appearance it will be similar to the "1400" type.

LANCASHIRE & YORKSHIRE RY.—Five new four-coupled radial tank locomotives have been turned out from Horwich Works, Nos. 260, 813, 814, 821 and 823. The first four of a new series of six-coupled goods engines have also been turned out, Nos. 41, 55, 115 and 123.

No. 1452, an eight wheels coupled mineral engine, has been converted to a compound with four cylinders. At present it is employed on fast goods trains between Aintree and Goole, and is reported to be working very satisfactorily.

Some new four wheels coupled outside cylinder saddle tank locomotives adapted for use as rail motor engines, have been put in hand, and will shortly be ready for service. They are numbered 3, 4, 5 and 6.

NORTH EASTERN RY.—The new high level bridge over the river between Newcastle-on-Tyne and Gateshead, which was formally opened and christened King Edward's Bridge by the King during his visit in July last, was actually opened for traffic on the 1st inst. after completion of the necessary alterations and approaches at the west side of the Newcastle Central station, the first train running over the new route being the 9.30 a.m. express from Newcastle to York, and thence over the G. C. and G. W. lines. There was no special ceremony. At present only express traffic will use the new bridge, the diversion of existing local service not taking place until the new year. The approaches to the bridge and to the Central station are protected by an installation of the Westinghouse electro-pneumatic signalling system.

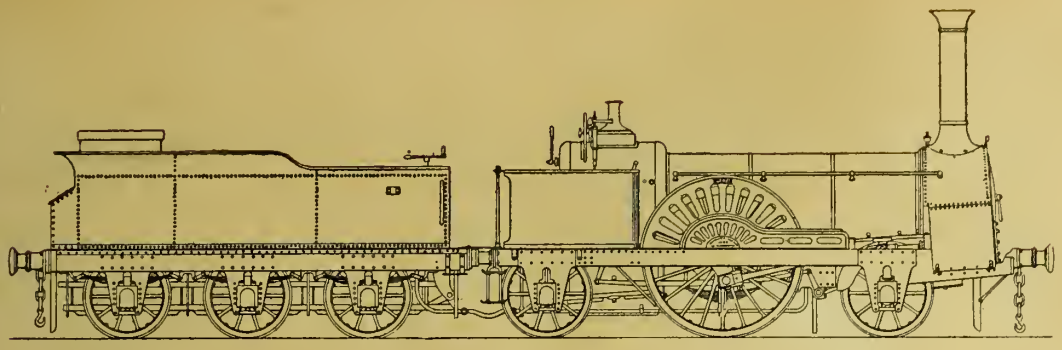


Fig. 95.

THE LOCOMOTIVES OF THE GREAT EASTERN RAILWAY.

(*Continued from page* 76.)

The last class of locomotive designed by Mr. Gooch for the E.C.R. was a single wheel express type having outside cylinders and a single pair of leading and trailing wheels with outside bearings. As originally built they had domeless boilers with raised fireboxes and are thus illustrated in Fig. 95. The cylinders were 15-in. diameter with a stroke of 22-in. and were placed at an inclination of 1 in 18 with their centres 5-ft. 11-in apart. The diameter of the driving wheels was 6-ft. 6-in., and of the leading and trailing 3-ft. 8-in. The wheelbase was 14-ft., from leading to driving centres being 6-ft. 9-in., and from driving to trailing 7-ft. 3-in. The overhang at the leading end was 5-ft. 1-in., and at the trailing end 2-ft. 1-in. The boiler was lap-jointed and carried a pressure of 120 lbs. per sq. in.; it was 10-ft. 6-in. long and had an external diameter of 3-ft. 7$\frac{1}{8}$-in., the height of its centre line from the rails being 5-ft. 7$\frac{3}{8}$-in. There were 164 tubes of 1$\frac{7}{8}$-in. outside diameter. The firebox shell was 4-ft. 2-in. long and 3-ft. 11-in. wide outside, whilst the inside firebox was 3-ft. 7-in. long and 3-ft. 5$\frac{1}{8}$-in. wide. The frames were of wrought iron placed 4-ft. 0$\frac{1}{2}$-in. apart, the inside frames being of $\frac{7}{8}$-in. plates and the outside $\frac{3}{4}$-in. The diameter of the blast pipe was 5-in. These engines were known as Class "C" and were constructed at the Canada Works, Birkenhead, the following being a list of their numbers, dates, etc. :—

Engine No.	Makers' No.	Date New.	Date Scrapped.
274	42	Dec., 1855	Jan., 1875
275	43	July, 1856	,,
276	44	,,	Oct., 1875
277	45	Aug., 1856	July, 1878
278	46	Sept., 1856	July, 1875
279	47	,,	Sept., 1874

Six engines of this class were also put in hand at Stratford Works, but as these were not completed until after Mr. Sinclair had assumed control and differed slightly in detail and dimensions from their predecessors, it will be more convenient to defer a description of them until dealing with the engines of Mr. Gooch's successor.

In August, 1856, Mr. Gooch resigned, 48 engines having been built for the E.C.R. during his tenure of office in addition to those which had been taken over from other companies. Of these engines 27 were built at the Company's works at Stratford.

(*To be continued.*)

THE GRANTHAM DISASTER.

The terrible mishap which befell the 8.45 p.m. *ex* King's Cross on Wednesday, the 19th ulto., at Grantham has been copiously dealt with by our daily and weekly contemporaries, and we can add nothing to the details of this more than regrettable accident. Although many incidents doubtless conduced to the actual destruction of the train, the primary cause was the failure to stop, as scheduled, at the Grantham platform, and it is possible the exact reason for this omission will never be definitely ascertained, seeing that the chief actors in the tragedy are dead. Theories innumerable have been adduced, some ridiculous and many of them unpractical, the lack of technical knowledge on railway working exhibited in some leading journals being remarkable. To one used to the footplate it is difficult to imagine that the brakes were applied throughout the train, even as it passed through the station; if they had been, the speed would have been reduced sufficiently for the points to have been safely negotiated, seeing that there are 250 yards between the end of the platform and the spot where the engine was derailed. With the regulator open and rails slippery or the wheels skidded, the retardation even then must have been sufficient to reduce the speed.

If the brakes were not applied, then it seems they were not in working order. The suggestion that the brake pipe may not have been coupled

up at Peterborough when the engine was attached is dismissed with little consideration on the ground that the train could not have been moved unless some evil disposed person had with criminal intent "leaked off" the brakes whilst the train stood in the station. We would point out that leaking off is not necessarily performed with criminal intent. It is a fairly common procedure, often necessary if time is to be kept, for the following reason. The vacuum ejectors of the different engines vary very considerably in creative power, and should a train arrive at an engine-changing station with a locomotive having a good ejector making 22-24-in. of vacuum, that train cannot be moved by an engine provided with an ejector only capable of maintaining 18-20; consequently the brakes have to be "leaked off," and we can quite understand that this proceeding might be undertaken, to save time, before the fresh engine was attached. Then if no connection of the pipes was made, nothing would denote to the driver that he had not been coupled up. With four minutes' stop to change engines, all the rules and regulations for testing the brakes from the rear van are rarely carried out to the letter.

The condition of the valves in the vans spoken of by the guards, "no vacuum," and the speed of the train through the station both point to the brakes on the train not being in operation, whilst the sparks from the wheels noticed by one observer, and the skidding spoken of by another, may refer to the engine and tender only, as the brakes would be serviceable and operating there.

All, however, at present is surmise, and the report of the Board of Trade inspector will be awaited with interest.

The engine which hauled this ill-fated train was No. 276, one of the large-boilered "Atlantic" type, built in 1904.

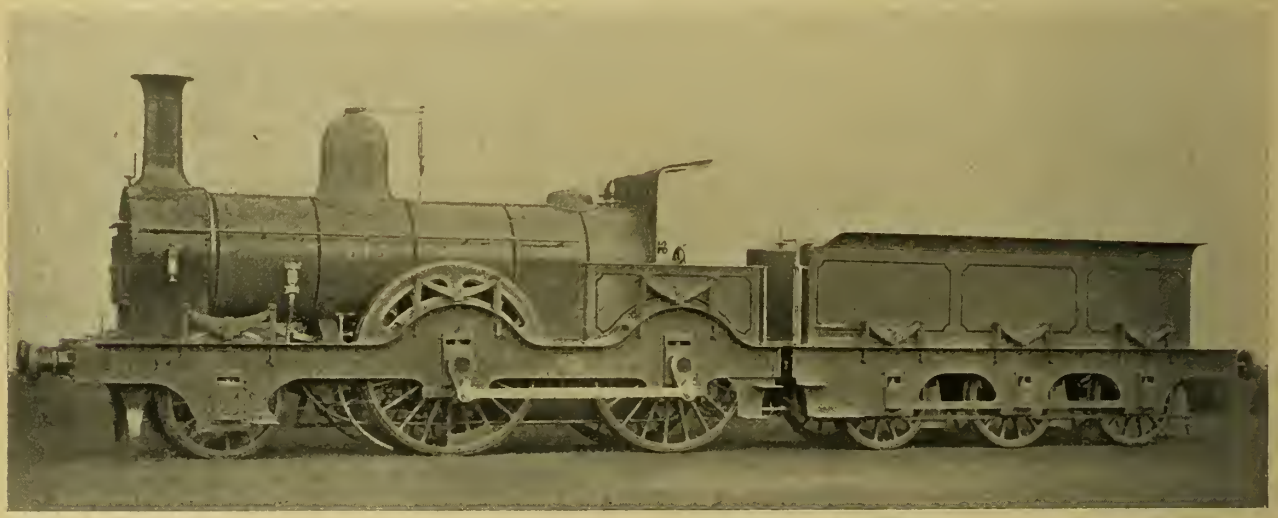
THE "800" CLASS, MIDLAND RY.

WE illustrate this month one of the Midland "800" class of express engines, a class which has become justly celebrated for the excellent work which they have always performed, the hardest and fastest main line work on the Midland having been for many years allotted to them.

They were originally designed by the late Mr. Matthew Kirtley, and the whole of the 48 engines of the class were built in 1870-1871. Of these 30 engines, Nos. 800 to 829 were built in 1870 by Messrs. Neilson & Co., of Glasgow. Twelve engines—Nos. 60 to 66, 165 to 169—were built in the same year at the Midland works at Derby, and the remaining six engines, Nos. 3, 22, 23, 93, 138 and 139, also at Derby in 1871.

The dimensions as originally built were as follows: cylinders 17-in. diameter by 24-in. stroke, diameter of coupled wheels 6-ft. 8½-in., diameter of leading wheels 4-ft. 2-in.; wheelbase: leading to driving 8-ft., driving to trailing 8-ft. 6-in.; the boiler barrel was 11-ft. long by 4-ft. 2-in. diameter, and contained 167 2-in. tubes, giving a heating surface of 993 sq. ft., to which must be added 104 sq. ft. of firebox heating surface: total heating surface 1,097 sq. ft.; the grate area was 17 sq. ft. The weight in working order varied from 35½ to 36 tons.

There were a few differences in the engines which are of interest. The 30 Neilson engines, and also the six built at Derby in 1871, had bush ends to the coupling rods, whereas the 12 Derby engines of 1870 had the old form of brasses with cotters. There were three distinct forms of reversing gear: the Derby-built engines all had reversing levers with notched quadrants; the first ten of the Neilson engines had screw reversing gear with a vertical shaft very similar in



FOUR WHEELS COUPLED PASSENGER LOCOMOTIVE No. 813, AS ORIGINALLY BUILT, MIDLAND RY.

appearance to a brake handle. The other 20, Nos. 810 to 829, had horizontal screw gear. In external appearance the Neilson engines were handsomer in having brass beading for the driving splashers, whilst the 18 Derby built engines had black beading. The vertical shaft and horizontal wheel used for reversing Nos. 800 to 809 was not a good arrangement, and a very serious accident was directly due to it. This occurred near Kibworth in the early 'eighties. An express from Leicester to London drawn by No. 809 was stopped, and in error the driver reversed his engine. Being foggy, it was difficult to see clearly whether the engine was going ahead or back, and the driver, who had not previously worked one of this particular lot of engines, started his train so that it moved backwards. In the darkness this was unobserved until too late to prevent a collision with another train standing on the same line of rails. During the early period of their existence Nos. 800 to 811 worked between Leicester and London, 812 to 819 were at Leeds, 820 to 829 at Bristol, 60 to 66, 165 to 169 at Leicester, and the six engines of 1871 in the north at Carnforth and Skipton.

When the Settle and Carlisle section was opened and the increased weight of the Scotch expresses necessitated greater engine power, Mr. S. W. Johnson began to rebuild these engines with larger cylinders and boilers. Nos. 801, 806, 809 and 810 were rebuilt in 1875, and Nos. 802, 808, 817, 22, 60, 138, 139 and 165 in 1876. The new cylinders were 18-in. in diameter, the stroke remaining 24-in. as before. The new boilers had 223 $1\frac{3}{4}$-in. tubes, and the total heating surface was 1,225 sq. ft., of which the tubes furnished 1,115 sq. ft. The grate area was increased to $17\frac{1}{2}$ sq. ft., but the pressure remained 140 lb. as before. The above engines and also Nos. 803 and 815, rebuilt in 1880, retained the old open splashers for many years, but all subsequent rebuilds were turned out with closed splashers.

A further increase of power was made in the case of No. 169 (rebuilt 1876) and the following ten engines in 1877: Nos. 800, 804, 805, 807, 811, 813, 814, 816, 818 and 819, in that the cylinders were increased to 18-in. by 26-in.; but the practice of lengthening the stroke was then discontinued on the grounds of expense. Of the remainder of the engines, Nos. 820 to 829 were rebuilt in 1880, except 824 and 826 which came out in 1881, and all the others were rebuilt in 1882.

In 1889 a further increase in power was made in the case of Nos. 811 and 817, which received new boilers having 160 lb. pressure, and much more recently in 1904, a few more of the class have been reboilered with a similar pressure.

Four-wheels Coupled Passenger Locomotive No. 808, as Rebuilt, Midland Ry.

During the last few months Nos. 3, 801A and 807A have been broken up, but all the others are still at work. The work which these engines have done is phenomenal, and up to the appearance of the "Belpaire" bogie engines they were often to be found on the best and heaviest of the Midland express trains. In 1899 the writer timed No. 828 at 81·8 miles an hour maximum speed, and in the following year No. 821 ran from Leicester to St. Pancras in 110 minutes with a Scotch express weighing 210 tons. With loads up to 230 tons there are few engines now running that can beat them, especially at uphill work. Another performance worthy of mention by one of the class was the running of one of the Scotch trains from Carlisle to passing Ais Gill box, $48\frac{1}{4}$ miles, in 59 minutes, nearly all of which is uphill, including a fine stretch of 11 miles of 1 in 100. The train weighed 180 to 190 tons.

Four-wheels Coupled Passenger Locomotive No. 15 (No. 2 Class), Ottoman (Aidin) Ry.

LOCOMOTIVES OF THE OTTOMAN (AIDIN) RY.

By the courtesy of a correspondent we are able to show in the accompanying illustrations three types of locomotives built for the Ottoman, Smyrna-Aidin-Diner Ry., a line of standard (4-ft. 8½-in.) gauge having a total mileage of 321, and possessing 52 locomotives, 131 carriages and 1,155 goods wagons. The small passenger engine No. 15 was built by Messrs. Sharp, Stewart & Co., Ltd., and has cylinders 16-in. in diameter

Six-wheels Coupled Goods Locomotive No. 41 (No. 4 Class), Ottoman (Aidin) Ry.

Four-wheels Coupled Bogie Passenger Locomotive No. 5 (No. 5 Class), Ottoman (Aidin) Ry.

by 22-in. stroke, and coupled wheels 4-ft. 6-in. in diameter. It has a total heating surface of 764 sq. ft. The six-coupled goods locomotive No. 41 was also built by Messrs. Sharp, Stewart & Co., Ltd., and has cylinders 18-in. by 24-in., and six-coupled wheels 4-ft. 6½-in. in diameter; the total heating surface is 1,119 sq. ft. The third type, illustrated by No. 51, has cylinders 17½-in. in diameter by 24-in. stroke, and coupled wheels 6-ft. 1½-in. in diameter, with a total heating surface of 1,067 sq. ft.; it was built by Messrs. Neilson, Reid & Co., Ltd. It will be noticed that these engines are provided with light cow-catchers, and that the tender of the small passenger locomotive is four-wheeled.

Advancement of Apprentices.—Messrs. Andrew Barclay, Sons and Co., Ltd., have forwarded a copy of a little book containing details of the scheme introduced at the Caledonian Works, Kilmarnock, N.B., with a view to encouraging their apprentices towards self-improvement. For this purpose, prizes are offered under two distinct heads: Section I.:—A, for general care and attention to class work, and B, for merit throughout the session and result at examinations; Section II:—For good time-keeping, conduct and ability in daily work. The first of these sections was established in March, 1903, and the second in December, 1905. There can be no doubt that the introduction of such incentives to study and to a painstaking performance of ordinary routine work should have an excellent effect in bringing out the best qualities of apprentices, and we should be glad to see some such scheme in operation in all the leading engineering works of the United Kingdom.

SLIDE VALVE SETTING.

One of the most important operations that an erector is called upon to carry out on a locomotive is the "setting" of the motion and valve gear. It is the accuracy with which this work has been done on which so much of the efficiency of an engine depends. If the valves are not set "squarely" the engine will beat out of truth, and owing to it receiving and exhausting unequal quantities of steam for each beat, it will, by working against itself, set up internal friction or resistance, and as a consequence consume more fuel for its equivalent of useful work.

An engine which has the valve gear well designed and truly set will give clear beats, following each other at regular intervals, whilst one with badly set or worn valves will beat "lamely" and have one or more heavy beats followed by others of less intensity. This lameness has an irritating effect on one who understands the reason, and, as mentioned above, seriously detracts from the efficiency of the engine.

The necessary operations in setting valves, as well as a method of carrying them out, will be described, and as a word or two about the cylinders and valves will make some of the points clear to those who do not actually have to do the work, as well as, possibly, add to the knowledge of those who do, or who may have to do it in the future, a short description of the type of engine that will be specially dealt with will be given.

Most of the operations, however, with minor modifications for the particular type of engine dealt with apply to almost all steam engines of the reciprocating type.

The type selected for special consideration is the ordinary two-cylindered high pressure locomotive with "Stephenson" link reversing gear, this being practically a standard throughout the world. The gear has two eccentrics for each cylinder, one being set in such a position on the axle that it will cause the engine to move forward and the other for moving backwards. These two eccentrics are coupled to the top and bottom respectively of a slot link, and either eccentric at will can be made to control the travel of the slide valve, and so cause the engine to receive steam for moving forward or backward. The link has a block fitting in the slot, and as this block is in direct connection with the valve spindle, the valve itself is moved to exactly the same extent as the block, if the latter is in "full gear" or at its extreme travel.

Any intermediate position between the extreme limits will give a correspondingly less definite effect on the valve and cause the points of "cut off," etc., to take place earlier in the stroke. When the slot link is in the middle position, so that both eccentrics have an equal effect on the movements of the valve, the engine is said to be "out of gear" or in "mid gear."

There is, as a rule, a position in which most of the work of an engine is done, and this is called the "running position." It will vary according to the class of engine and the work upon which it is engaged, but as an average may be said to be at 30 per cent. of the stroke of the piston. In goods engines it will probably be more than this, and in express engines less, but for valve setting purposes this will be the position in which the eccentric rods are to be set.

The cylinders are provided with pistons, which travel from end to end and are coupled by the piston rods, crossheads and connecting rods to the cranks, which convert the reciprocating movement of the pistons to rotary at the crank axle for transmission to the wheels.

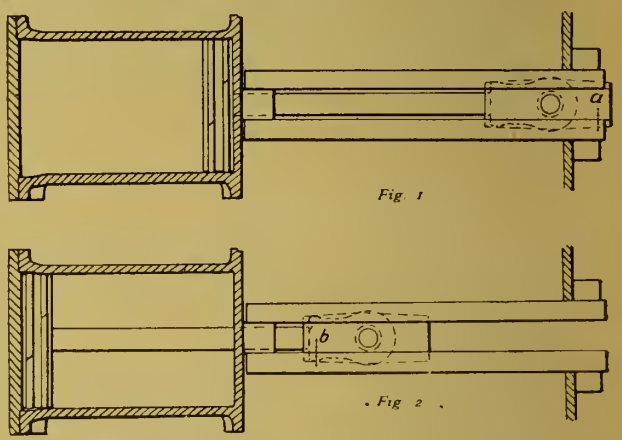
It is required to find four positions of the pistons in each of the cylinders exactly. These are the extreme limits of travel in the cylinders when not coupled up, and the extreme stroke when coupled up to the crank. These two positions must be located and marked for each end of each cylinder; the distance between each of the two marks respectively is the piston clearance for that end of the cylinder.

The steam is admitted to the cylinders through ports from the steam chest. The "port face" is a flat surface in the steam chest where the communicating passages commence. There are three ports for each cylinder, two leading to the ends of the cylinder—viz., one to each end, and the third, midway between them, leads to the blast pipe. The former ports are called "front" and "back" steam ports and the latter the "exhaust" port.

The slide valve moving over the "port face" alternately admits steam by one port into the cylinders at one end and, by means of the other, exhausts from the opposite end, this being done by putting the steam port into communication with the exhaust by way of the cavity of the valve.

The setting of the valves consists in adjusting the valve gear so that the operation of opening the ports to steam and exhaust respectively shall take place when the piston is in certain definite positions in the cylinders.

The "lap" of a valve is the amount that the valve projects beyond the outside edges of the steam ports when the valve is in its mid position.



Marks to show Extreme Limits of Travel of the Piston in the Cylinder.

"Lead" is the amount that the port is open to admit steam to the cylinder when the piston is at the end of its stroke. "Lap" depends upon the size of the valve, and can only be varied by altering the size of the valve, whilst "lead" depends upon the position that the eccentric occupies on the axle, and can only be varied by moving the eccentric round on the axle. Increasing the angle between the centre line of the eccentric and the centre line of the crank will give a larger lead, and decreasing it will lessen the lead. This angle is called the angular advance, or sometimes the angle of advance of the eccentric.

For the work of setting the valves it is assumed that the fitting up of the various parts has been done, so that they can be assembled and put together and taken apart again as required. Some marks will have to be made on various parts to work from, and the piston and crosshead may be taken first and the travel points obtained as mentioned above. The piston is put

in and the crosshead coupled to the rod-end and cottered up firmly in its proper place. The front cylinder cover is put on and held by six or eight nuts only, and the crosshead drawn out until the piston strikes the back of the cylinder as at Fig. 1. Now take a set square, and by it scribe a line partly on the crosshead and partly on the slidebar as at *a*, putting some centre pop marks upon it so that it may not be lost.

Next push the crosshead forward until the piston strikes the front cylinder cover as in Fig. 2 and make a similar mark at the front end of the slide block of the crosshead to that at the other end. These marks show the extreme limit of travel of the piston.

The connecting rods can now be coupled up and the wheels revolved, in order that the travel of the crosshead and piston may be ascertained.

For the purpose of revolving the wheels it is usual to have a pair of rollers actuated by a hand ratchet arrangement, upon which the flanges of the driving wheels rest; the wheels can be moved by this means without advancing the engine along the rails. An alternative method for valve setting is to have a long piece of straight road and move the engine up and down upon it. The first method, however, is as a rule the handiest.

Two trammels are next brought into use, in order to enable the exact dead centres to be ascertained. As the crosshead approaches the end of its stroke, Fig. 3, the wheels are stopped, and a pop mark made on the slide bar, from which an arc is scribed on the crosshead at *d*. At the same time, from a pop mark (*e*) on the frame, or other convenient fixed point on the engine, an arc (*f*) is marked on the tyre of the wheel. With a pair of male calipers a line (*g*) is drawn parallel with the rim of the wheel, and at the intersection of *f* and *g* a pop is made.

The wheels being revolved in the same direction, the crosshead continues to move, stop and return. When it has moved until the crosshead trammel exactly touches the line (*d*) it is stopped and another mark made as on Fig. 4 at *h*, cutting (*g*) where another pop-mark is made. The distance between *f* and *h* is divided, and a pop made at *j* and a ring of chalk put round it to render it easily visible, as this is the point that is required for finding the lead.

(*To be continued.*)

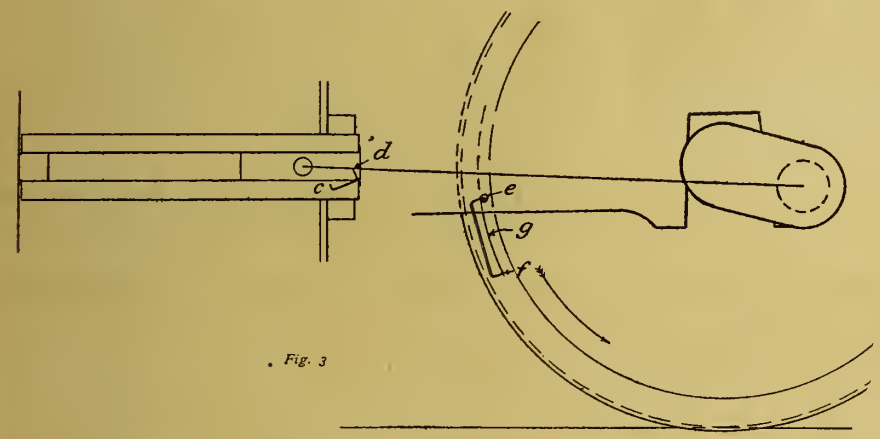


Fig. 3

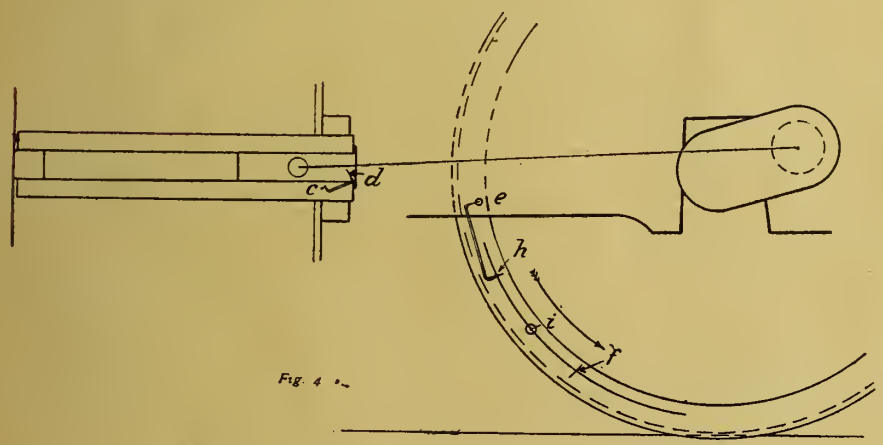


Fig. 4

METHOD OF ASCERTAINING THE EXACT DEAD-CENTRE OF THE CRANK.

MIDLAND RY. NORTHERN COUNTIES COMMITTEE.—Mr. B. Malcolm will combine the offices of chief engineer and locomotive superintendent of the M.R.N.C.C., Mr. Wise having vacated the position of chief engineer owing to ill-health.

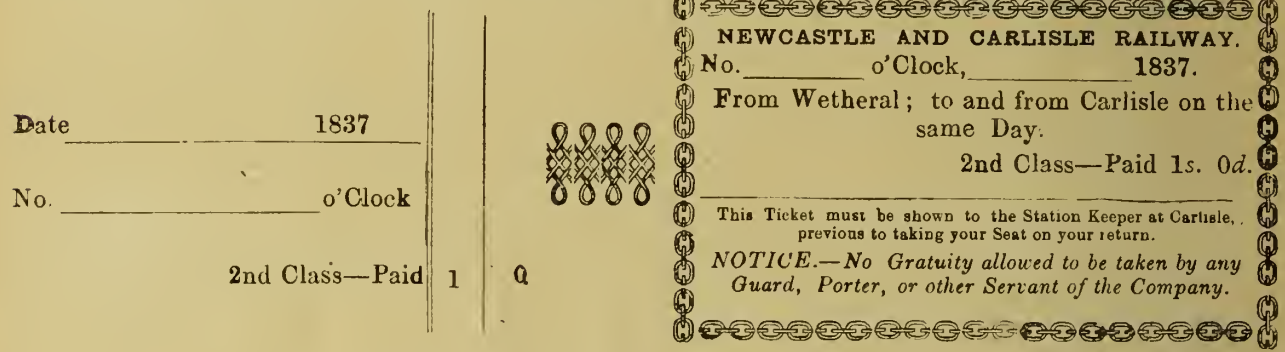
A TECHNOLOGICAL AND SCIENTIFIC DICTIONARY.—We have received Part XIV. (and last) of this work, which, in addition to dealing with terms ranging from "Warehouse" to "Zymase," contain an appendix, corrigenda, etc. The complete volume contains 875 pages, treating a thoroughly representative collection of subjects in a clear and fairly comprehensive manner. We think that the editors, Mr. G. F. Goodchild and Mr. C. F. Tweney, and the publishers, Messrs. George Newnes, Ltd., are to be congratulated on the production, within a comparatively limited compass, of so useful a reference book for all engaged in technical and scientific pursuits.

MORE RAILWAY REMINISCENCES.

(*Concluded from page* 161.)

In connection with the old Newcastle and Carlisle Ry. ticket here reproduced in facsimile, it may be interesting to mention that the ticket system introduced by Mr. Edmondson, and now in use on every railway in the United Kingdom, was first introduced on this line. Mr. Edmondson was at one time a book-keeper at one of the intermediate stations on the N. & C. Ry.

The space between the "up" and "down" line was the same as the gauge of the rails, so that it was possible to run a wagon or carriage with the wheels on one side on an "up" and on the other on a "down" rail; this spacing made it very dangerous for passengers to put their heads out of the windows when passing another train or an overhead bridge. Another feature of the N. & C.R. was that the "up" and "down" lines were on different sides to the connecting railway. This peculiarity necessitated the conversion of the "up" to "down" line and *vice versa* when the railway was finally merged into the N.E.R.; it also meant the alteration of all the crossings, water columns, etc., on the 60 miles.



Fac-simile of First Ticket issued on Newcastle & Carlisle Ry.

The rails were laid on stone blocks and there were no spring buffers on engines or carriages. Travelling was therefore rough, although no complaints were made, everything being taken as a matter of course; it certainly was a great improvement when wooden sleepers were laid for the permanent way and spring buffers were introduced on the rolling stock.

When the telegraph had been put into operation, and larger and more powerful engines had been introduced, the "pilot" at Haydon Bridge was abandoned and my father was transferred to Newcastle. In 1859-60 he secured employment with Lord Willoughby de Eresby on his private railway at Edenham, Lincolnshire. His lordship's country seat, Grimthorpe Castle, is situated there. We had two four-wheels coupled engines from Hawthorn's, "Havilah" and "Columbia," each running for an alternate week, and there were two carriages, a 3rd class brake and a 1st and 2nd composite. We ran five trips per day to meet the G.N.R. trains at Little Bytham station, four miles each way; my father was there about 13 years. On the death of his lordship and the opening of a competing line from Essendine, G.N.R., to Bourne, this short railway was abandoned, the engines sold and my father's railway career ended. After 13 months on the G.N.R., I entered the service of the L.C. & D.R. in 1862 as a fireman, and the first engine I did duty on was the old "Tiger," illustrated in the "Locomotive Magazine," page 41 of Vol. VII, and shown rebuilt on page 263, Vol. VIII. Young drivers would find it difficult to believe the rough experience I had on that "beast," which was by courtesy called a locomotive engine.

THE TROCHOMETER.

This instrument, which has frequently been mentioned in our notices of foreign locomotives under its other title of Hausshalter's speed indicator, is the subject of a pamphlet issued by the Engineers' Agency, the British and Colonial agents of the manufacturers, Messrs. Seidel and Naumann, of Dresden. To enlighten readers who are not acquainted with this ingenious appliance, it may be stated that the Trochometer is actuated primarily from one of the wheels of a locomotive, usually from an extension of a coupling rod, and that the motion thus obtained, in conjunction with a train of clockwork, not only indicates to the engine men, by means of a dial, the speed at which the engine is travelling, but also records on a continuous roll of paper the speed at any distance from the starting point and the duration of any stoppages *en route*. This latter application enables the incidents of a whole journey to be placed on record for reference at any future time if necessary. Another accessory is a bell which can be arranged to ring whenever the maximum speed permissible on the particular railway is attained.

Locomotive "Argyll" and Train, Campbeltown & Macrihanish Light Ry.

THE CAMPBELTOWN & MACRIHANISH LIGHT RY.

The fact that the Campbeltown & Macrihanish Light Ry. is the first narrow gauge passenger line in Scotland makes it unusually interesting, and whilst such railways have not found very much favour in Great Britain, they are at all events of value in thinly-populated countries, and therefore its progress will doubtless be closely watched. Although on the mainland, the locality served is quite remote from any of the trunk lines.

The peninsula of Kintyre, which is in most parts of a mountainous character, is divided transversely by a low-lying plain known as the Laggan, extending from sea to sea. It terminates on the east side at Campbeltown Loch and on the west at Macrihanish Bay. The general elevation of this low tract does not exceed 50 or 60 feet above sea level. On the north and on the south side the ground rises abruptly into hills of more than 1,000 feet in height.

Until the opening of the C. & M. Lt. Ry. on August 20th, visitors desirous of reaching the famous Macrihanish golf links were conveyed by "char-a-banc" from Campbeltown, but the popularity of the passenger service from Glasgow via Wemyss Bay or Fairlie piers by the 22-knot turbine steamer "Queen Alexandra" so greatly increased the traffic, and showed the need for better means of communication, that it is now possible to make the journey of six miles in a comfortable railway carriage.

Macrihanish shore and the bracing winds from the broad Atlantic are too far from the great centres of population to ensure any excursion traffic that would make the railway profitable, in spite of the fact that 10,000 passengers availed themselves of its advantages during the first three weeks it was open. It is from the development of the mineral deposits that the greatest benefits to trade and employment are anticipated.

It has not been ascertained with certainty at what date mining operations first began in the Campbeltown coal field, but there must have been a considerable output toward the end of the eighteenth century, for about 1773 those responsible for the conduct of the colliery, which is several miles from Campbeltown, decided to construct a canal, although wooden railways with horse traction were not unknown at that time. It is an interesting circumstance that the engineer who selected the route and made the survey for the canal was no other than the great James Watt. The date of his survey, according to Muirhead's "Life of Watt," was 1773, and the canal was probably constructed soon after.

It continued in use for about 80 or 90 years, but on the colliery changing hands, the canal having become considerably obstructed with weeds and difficult to clear, the management decided to abandon it and to substitute a light railway of 2-ft. 3-in. gauge. This railway was laid down in 1876 to connect the Kilkevin pits with a depot at the west side of Campbeltown, a distance of about $4\frac{1}{4}$ miles. In 1881 these pits became exhausted, and the railway was altered and extended to the new Drumlemble pits half a mile further west.

The new Light Railway Co. has now bought over the rolling stock of the Colliery Co., re-laid the line with heavier rails (50 lbs. per yard), made deviations at the sharpest curves to suit Board of Trade requirements and extended the line westwards to Macrihanish and down to the quay at Campbeltown, making a total length of 6 miles. By doing away with the inconvenience and expense of conveying the coal across the town in carts, and by the introduction of higher capacity wagons on the railway, it is hoped to be able to ship 500 tons of coal a day. Kintyre coal is admittedly of poor quality, but is useful for steam raising.

The rolling stock taken over from the colliery included three small tank locomotives. The first locomotive, the "Pioneer," had four wheels coupled with a rigid wheelbase of 4-ft., and had the frames inside the wheels, with a very narrow

grate. This engine is no longer in service, and is stored away at Drumlemble.

The "Princess," the second engine, with side tanks, has now been fitted with the vacuum brake to act as spare engine for the passenger traffic. She has four-coupled driving wheels 26-in. in diameter and a pair of trailing wheels 16-in. in diameter, rigid wheelbase 3 ft., total 7-ft. The third, a saddle tank locomotive named "Chevalier," was built by Messrs. Barclays, of Kilmarnock, in 1885. It has cylinders 7-in. in diameter by 15-in. stroke, 24-in. driving wheels and a pair of trailing wheels, afterwards added, 15-in. in diameter; the boiler being 2-ft. $4\frac{3}{4}$-in. in diameter. Both these engines have outside frames, bearings and cranks. The attachment of the trailing pair of wheels is by a long radius bar centred under the engine, the other end of which is fixed to a small frame which carries the wheels, axles and axleboxes. A spring is interposed, and the frame has a lateral travel of several inches. The wagons taken over are all of the platform type, having short rails laid transversely on which the small colliery trams containing coal are carried. Each carries four mine wagons containing $9\frac{1}{2}$ cwt. of coal, or 38 cwt. in all. As the tare of the railway wagon is 18 cwt., and that of the four trams 10 cwt., the ratio of paying load to dead weight is somewhat disproportionate, but reference has already been made to a new type of wagon now in course of consideration.

Locomotive "Argyll" and Train at Macrihanish Terminus, Campbeltown & Macrihanish Light Ry.

To work the heavy summer passenger service a larger locomotive, appropriately named "Argyll" has recently been built by Messrs. A. Barclay, Sons & Co., of Kilmarnock. This engine is of the 0-6-2 type and was illustrated and described in our July issue. The engine is painted in exactly the same style as the North British Railway locomotives and carries a large headlight. It has cylinders $11\frac{1}{4}$-in. diameter by 18-in. stroke. Steam pressure is 160 lb. per sq. in. and the total heating surface 354 sq. ft. The side tanks hold 600 gallons. The total weight of the engine is 22 tons loaded, or about $2\frac{1}{2}$ times that of the smaller engines, but it is so distributed that each pair of wheels only carries $5\frac{1}{2}$ tons, the springs of the three pairs of driving wheels

Passenger Car, Campbeltown & Macrihanish Light Ry.

being connected by equalising levers. The rigid wheelbase is 6-ft. 4-in., but the total is 12-ft. 9-in. Centre buffers and screw couplings as well as side buffers to suit the coal wagons are provided. At the time of our visit the passenger train comprised 4 bogie cars, each 48-ft. long of very smart appearance. The upper panels are painted cream color and the lower part olive green. A fifth car is now in service, so that large numbers of passengers can be dealt with. Messrs. R. Y. Pickering & Co., of Wishaw, are the builders of the carriages. A centre corridor enables tickets to be issued and collected on the journey. Transverse double seats with reversible backs furnish maximum seating accommodation. Bracket lamps to take candles provide illumination. The vacuum brake is fitted. The maximum speed is fixed at 20 miles an hour, the journey being accomplished in about 20 minutes, while the smoothness of the running is most marked.

Interior of Car, Campbeltown & Macrihanish Light Ry.

The line is single with a passing place halfway at Kilcreggan. There are short branches about a mile from Macrihanish to the Drumlemble pit, also to the old terminus at the back of Campbeltown.

For the greater part of its length the railway coincides with the track of the old canal, and consequently is approximately level. Within about a mile of Campbeltown, however, it deviates from the line of the canal and crosses a ridge which gives rise to gradients of 1 in 35 on both sides. By this the length of the line is somewhat shortened, but the more serious evil of curtailing the power of the locomotives is introduced.

A sharp curve where the railway crosses the road leading to Southend and Macrihanish has been eased off considerably by deviating the line. At this crossing there are gates and a signal, which are attended to by a woman. There are a number of other crossings provided with cross trenches to prevent sheep or cattle from wandering on the line. At present there are no station buildings—the train starts from the street at Campbeltown, while the western terminus is in a field close to the Macrihanish wireless telegraph station.

The provisional service of trains on week days (Sept.) comprises five trips each way, with one extra on Wednesdays and Fridays, and two on Saturdays. Stoppages will be made at any cross roads by all trains except the express running in connection with the steamer. This latter is a rather curious example of excursion train working. Tickets for the rail trip are issued on the steamer at 1s. a head, and the train leaves Campbeltown at 12.50, arriving at its destination at 1.10. It starts back again at 1.50, giving excursionists only forty minutes sojourn.

Mr. T. Lindsay Galloway, A.M.I.C.E., is the chief engineer, and Mr. Alex. Black, formerly of the Caledonian Railway, has been appointed superintendent of the line. We must acknowledge our indebtedness to Mr. Galloway for much of the information contained in this article.

BOARDITE WHEEL CENTRE TESTS.

We have received a copy of a report made by Mr. T. L. Canfield, of the American Car and Foundry Co., Manchester, relating to a test made in his presence of a railway carriage wheel with Boardite centres.

The test was in accordance with the requirements of the Master Car Builders' Association, of which Mr. Canfield is a member.

The wheel was placed in a vertical position on three bearing points, and a tup weighing 203 lb. was dropped from a height of 12-ft. 1-in. After twelve such blows a larger tup weighing 225 lb. was used, and then two final blows from a 560 lb. tup. Early in the tests the retaining ring slightly loosened, but afterwards apparently found its bearing. After these fifteen blows the wheel showed no damage. All retaining ring bolts took about a quarter turn to tighten at the end of the test, but Mr. Canfield was of opinion that the retaining ring had not been properly tightened down before starting the test.

Another test of Boardite blocks as against teak blocks, made by Messrs. David Kirkcaldy & Sons, Ltd., gave the following results: Boardite blocks crushed at pressures of 7,591 lb. and 7,000 lb. per sq. in. respectively; one teak block crushed at pressures of 2,840 lb. per sq. in, another teak block sheared at pressure of 1,824 lb. per sq. in., the shear following the curve of growth.

RAPID-ACTING VACUUM BRAKE.

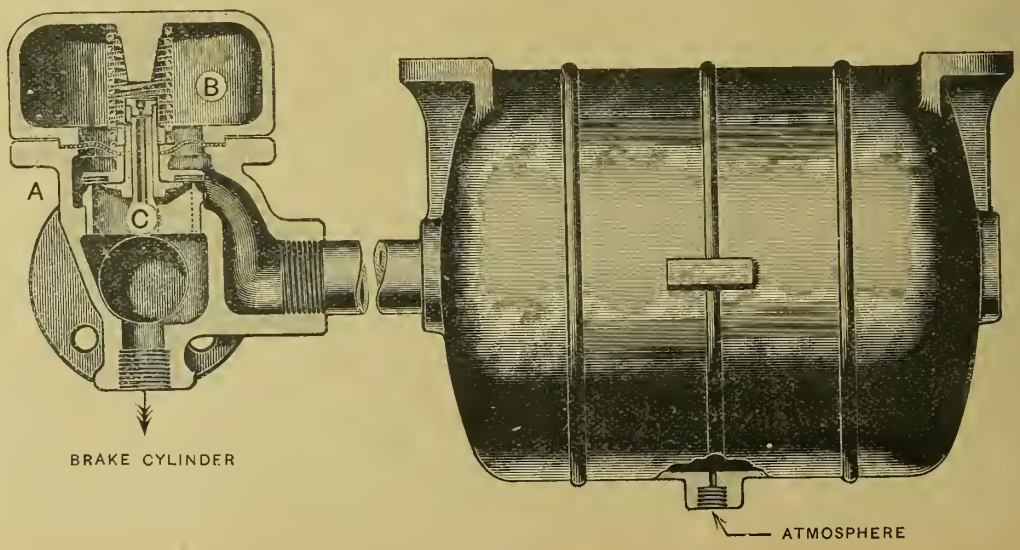
AMONG the many recent improvements in brake apparatus the device just introduced by the Westinghouse Brake Co. deserves careful consideration by railway officials. It consists of a small reservoir and an accelerating valve. The small reservoir is always open to the atmosphere through a restricted passage, and the accelerating valve is placed between the reservoir and the train pipe. The accelerating valve A is normally closed by its own weight, and there is also a light spring upon it which prevents any tendency of the valve to lift through accidental shocks or jars. Above the valve there is a small chamber B closed at the bottom by a diaphragm. The chamber B is exhausted through the small passage C down the stem. When air is suddenly admitted to the train pipe, and the pressure in it is increased in order to apply the brakes, the pressure in the small chamber B being unable to equalize with sufficient rapidity through the small passage C, permits the valve A to rise and open communication between the small reservoir and the train pipe, thus increasing the pressure in the train pipe and brake cylinder by the quantity of air contained in the small reservoir. This reservoir is made of such a size as to provide sufficient air to actuate each next succeeding accelerating valve throughout the train, but only to partly set the brakes on each vehicle. By means of this device a nearly simultaneous initial action of the brakes is obtained throughout the longest train, both in partial and full applications, and jerks and shocks caused by vehicles running together are prevented, even on trains loosely coupled.

If a still quicker full application of the brakes is desired for fast express trains, a second accelerating valve may be provided similar to that already described, opening direct to the atmosphere. This valve is more heavily weighted and does not move in all partial applications of the brake, but opens fully to the atmosphere until the brakes are applied with full force whenever full quick-action is wanted, and the driver's valve is manipulated in such a way as to secure it.

UNITED STATES METALLIC PACKING CO., LTD.—We are notified that this firm has recently opened a new branch office at Angel Chambers, York Street, Swansea, for the convenience of clients in South Wales and the adjoining districts. The Jurors of the Tourcoing Exhibition have awarded a gold medal to the exhibit of the U.S. Metallic Packing Co., Ltd.

MESSRS. GEORGE POLKEY, LTD.—In our notice of this firm's lamp works on page 157 of our September issue, we omitted to mention that they are lamp manufacturers to the British War Office, Admiralty, the India Office, Colonial Governments, and many of the leading home and foreign railways, and that they have in the course of their 45 years' experience made more than 1,500 different types of railway lamps.

A NEW STEAM JOINT.—The Engineers' Agency, of 63, Chancery Lane, W.C., have forwarded us a sample of the "Lion" jointing material, which is a new form of packing for making joints in high pressure steam fittings. It is claimed that this material does not adhere to the metal or soften, that it will not blow or burn out, and that it will resist the action of acids and alkalies, oil, gas, water and steam; it is said to last longer than asbestos, and to be capable of being used more than once, and should be well suited for employment when superheated steam is used.



NEW AUTOMATIC VACUUM BRAKE VALVE.

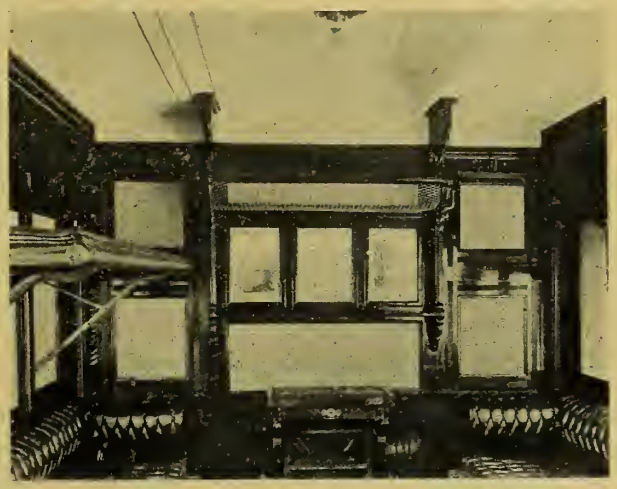
New 1st and 2nd Class Carriage for Service on Mail Trains, Great Indian Peninsula Ry.

NEW CARRIAGES FOR MAIL SERVICE, GREAT INDIAN PENINSULA RY.

Some handsome new 1st and 2nd class composite carriages which have just been completed at the Parel shops for the mail services of this railway incorporate the latest in railway carriage construction. The body of each car is 62-ft. long by 9-ft. 6-in. wide, built on a steel underframe resting on four-wheeled bogies of the "swinging bolt" type. It is divided into one 1st class coupé with two berths, two 1st class compartments of four berths each with a servant's room intervening, and two 2nd class compartments with five berths in each. Each compartment has a communicating lavatory provided.

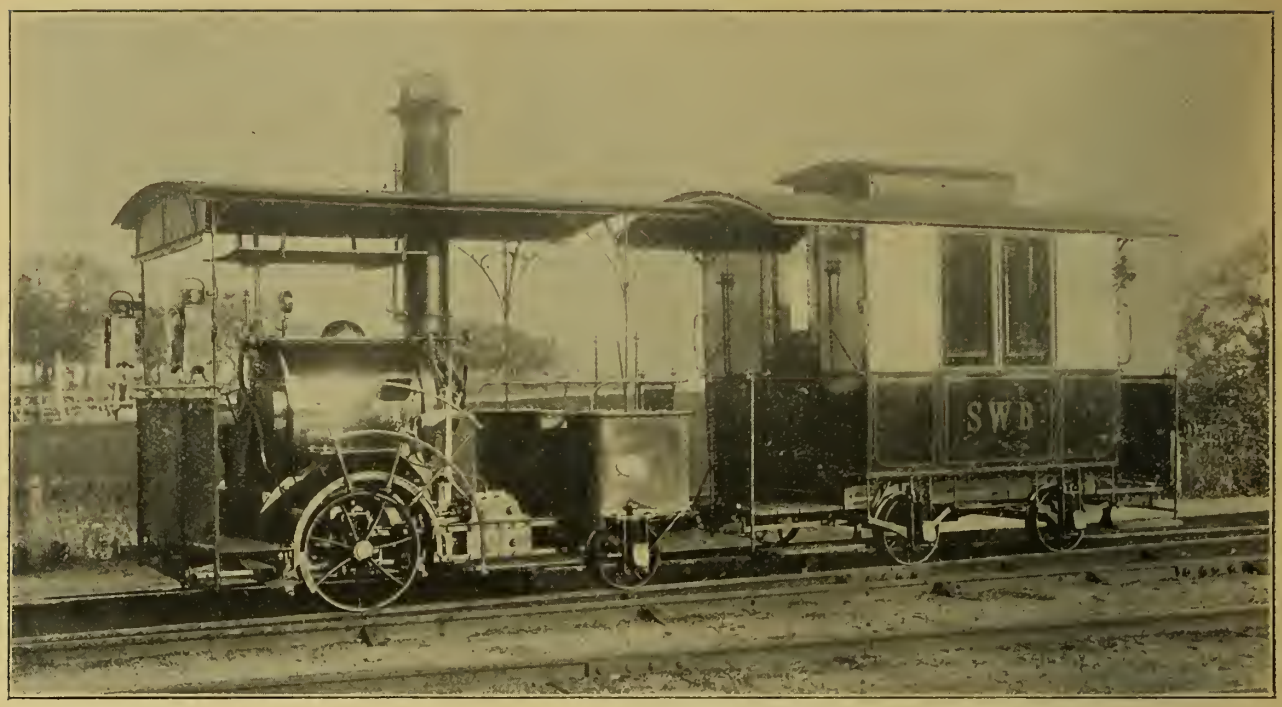
Protected sides and roof on the most approved principle have been adopted in place of "sun-shades." The heat-resisting coating consists of a non-conducting roof cover, teak boarding, first an air space, "Uacolite" non-conductor, a second air space, treated deal wood lining and Salamander asbestos decoration. The body frame is of teak, but to economise in the use of this now expensive wood, steel has been freely introduced among the members relied on for strength. The doors are composite of steel and wood, opening inwards in doorways 2-ft. 4-in. wide. The employment of steel in the doors has enabled the thickness to be reduced to $2\frac{1}{2}$-in.

The interior of the first class compartments are beautifully finished, the side panels being of different fancy woods framed in teak, whilst the ends are decorated in "Salamander" tinted in art shades. Photographs of Indian scenery adorn the partitions. Novel arrangements have been introduced in the berths; the lower ones are formed of "braided wire" mattresses, upholstered in buffalo hide, which pull out to 33-in. wide, whilst the upper ones are folded and packed away beneath revolving shutters above the upper lights of the carriage. Folding steps are provided below a small table to give ready access to the upper berths, a valuable concession to ladies when occupying them. A prominent feature in each compartment is the introduction of a reversible reclining chair in the centre with an adjustable leg rest; in this a passenger can lounge at ease under the overhead electric fans. Electric light is installed and provision made for switching off at night, leaving a solitary blue



Interior of Car, Great Indian Peninsula Ry.

lamp for the all-night travel. The fans are of improved construction with large blades and protecting screens. The new alarm signal passes through all compartments the same as on the British railways, with a small chain exposed above each door for facility of use. Another detail new to Indian carriages consists of electrically illuminated destination boards at each side to denote the line of route of the car. These cars will be used on the Bombay-Punjab Mail service.



Steam Motor and Inspection Car, Stockholm-Vesteras-Bergslagens Ry.

ROLLING STOCK OF THE STOCKHOLM-VESTERAS-BERGSLAGENS RY.

By the courtesy of Mr. Th. Geo. Betts, locomotive superintendent, we are able to show herewith illustrations of typical rolling stock on the above-mentioned Swedish railway, which has a total mileage of 242, built to standard gauge, and owns 44 locomotives, 102 carriages and 939 wagons. The inspection engine shown is something of a novelty; it has the following dimensions: one cylinder $3\frac{7}{8}$-in. diameter by $6\frac{7}{8}$-in. stroke; diameter of driving wheels 2-ft., and of trailing wheels 1-ft. $3\frac{1}{2}$-in., wheelbase 5-ft.; boiler: length outside 2-ft. $8\frac{1}{2}$-in., diameter outside 2-ft. $8\frac{1}{4}$-in.; number of tubes 26, length 2-ft. $2\frac{1}{2}$-in., diameter $1\frac{3}{8}$-in.; boiler pressure 160 lbs. per sq. in.; grate area $1\frac{5}{8}$ sq. ft.; capacity of bunker 790 lbs., and of tank 160 gallons. The driver stands in the usual position, where all

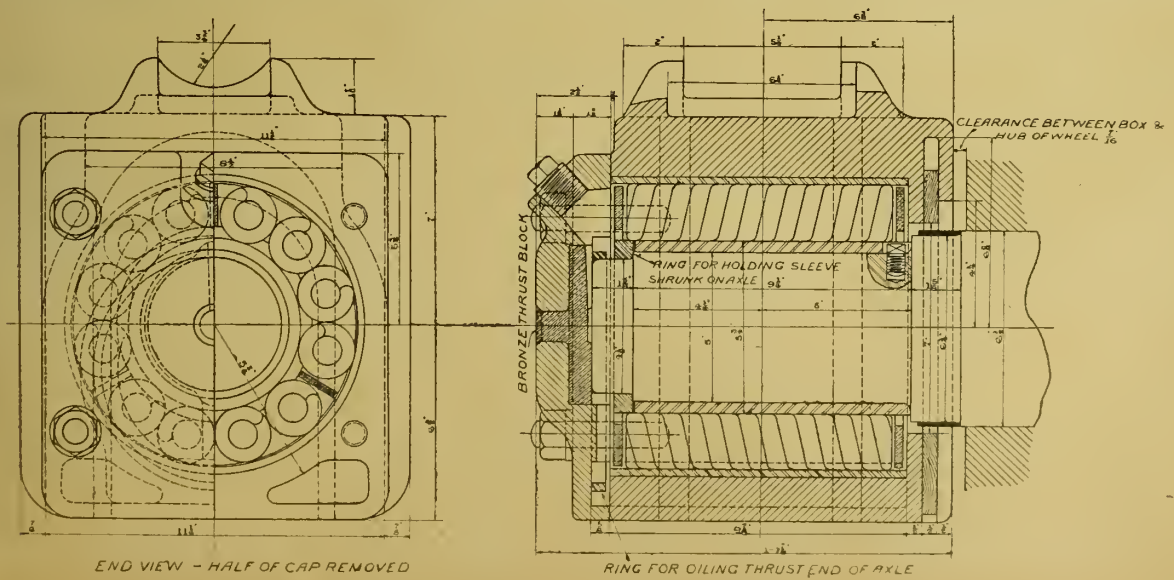
Bogie Coupled Passenger Locomotive and Train, Stockholm-Vesteras-Bergslagens Ry.

necessary handles, etc., for operating the mechanism are at hand, but two seats are provided over the driving wheels, and the engine can be controlled by any one of the three persons thus carried. The car attached has a total length of 11-ft., a width of 6-ft., and a height above rails of 7-ft. 8-in; it is carried on four wheels of 1-ft. 3-in. diameter, the total wheelbase of engine and car being 15-ft. 6-in. The car contains a sofa arranged lengthwise, a chair, table and washstand, and can accommodate five people if necessary. The inspection train frequently travels at a speed of 17-18 miles per hour.

Our other illustration shows one of three bogie coupled passenger locomotives supplied by Messrs. Neilson, Reid & Co., Ltd., in 1899, and a passenger train composed of a brake-van, a composite 2nd and 3rd class bogie car, a saloon car, and another composite 2nd and 3rd class bogie car. These composite cars are of quite modern type, built last autumn from designs furnished by the railway company's locomotive and carriage department. They have a total length over buffers of 72-ft. 2-in., an outside width of 10-ft. $2\frac{3}{4}$-in., and a height inside of 8-ft. $2\frac{3}{8}$-in.; the distance between bogie centres is 49-ft. $2\frac{5}{8}$-in. The seating accommodation is for 18 2nd class and 50 3rd class passengers; they are lighted throughout by acetone-acetylene gas, and the tare weight is about 30 tons. The saloon coach has two compartments, for smokers and non-smokers, a lavatory and vestibule at one end, and a post office sorting compartment at the other, with a corridor leading to the end platform. It weighs about 27 tons and has seating accommodation for 22 2nd class passengers. The leading dimensions are: length over buffers 62-ft. 4-in., width outside 9-ft. 10-in., height inside 8-ft. 8-in., distance apart of bogie centres 38-ft. 7-in. This car is lighted by Pintsch's patent gas system. This year a fine restaurant car has been added to the stock for service between Stockholm and Gothenburg. It is of the same general dimensions as the composite coach, and has accommodation for 24 diners and 16 in a separate café compartment. The kitchen and service compartments are exceptionally roomy. It weighs about $29\frac{1}{2}$ tons.

THE HYATT ROLLER BEARING.

In the accompanying illustrations are shown sectional views of the Hyatt Roller Bearing as adapted for use on journals of railway rolling stock. As is well-known, the employment of ball-bearings for such purposes is practically impossible owing to the limited amount of surface in contact, which tends to crushing of the balls and rapid wear of the coned cups under such weights as must be dealt with in railway practice, and the same trouble operates to some extent in ordinary solid-roller bearings unless very special provision is made to counteract the tendency by the use of rollers and sleeve linings of carefully ground and hardened steel. These requisite precautions in manufacture necessarily enhance the first cost very considerably, and it is undoubtedly the commercial rather than the mechanical aspect of the question that has prevented solid roller bearings from coming into universal use. By the introduction of the system here illustrated, it is claimed that all the advantages of the solid roller bearing, with many others added, and at a minimum of cost, have been successfully applied. The Hyatt rollers are in reality steel springs, which can be made of strength proportioned to the load to be carried so as to ensure firm support, and at the



Sectional Views of the Hyatt Roller Bearing.

same time sufficient flexibility to give uniform distribution of weight and consequently equality of contact and wear, along the entire length of the journal. This flexibility at once dispenses with the need for specially hardened rollers and bearings, since the tendency to distortion of the bearing surfaces is virtually eliminated. The construction of the rollers, as helical springs, also greatly facilitates efficient lubrication, each roller acting as an oil container and distributor during its revolution between the journal and the axle box, the course of the spiral interval between successive folds of the roller ensuring that the lubricant is compelled to travel over every part of the surface in contact. Bearings of this type have already been supplied to cars carrying as much as 22 tons per axle, and have been found to reduce materially the exertion of power required for haulage, more especially in the act of starting from a state of rest.

WEIGHBRIDGES.—Messrs. W. & T. Avery, Ltd., have recently supplied a new 30 tons weighbridge to Thetford Station, G. E. R., which can be used up to an extreme limit of 45 tons if necessary. The same firm is supplying a 36-tons weighbridge to the Indian State Ry., and a number of platform weighing machines for that system and the East Indian Ry., with graduations both in English and Indian standards of weight.

NORTH EASTERN RY.—Mr. R. Pick, of the Shildon wagon shops, has been appointed manager of the carriage works at York, in succession to the late Mr. William Carr. Mr. G. T. Glover, of the Heaton wagon works and electric stock depot, will succeed Mr. Pick at Shildon, his place at Heaton being taken by Mr. J. W. Dow, of York.

GREAT NORTHERN RY.—One of the suburban trains has been fitted with an arrangement for indicating the destination. The panels above the quarter lights of two adjacent compartments are removed and a frame carrying a roller-blind indicator of blue cloth with transparent letters is fitted. At night, the lights inside the compartment shine through the lettering, whilst in the daytime the white letters show up on a dark blue ground.

CORRESPONDENCE.

OLD EAST INDIAN RY. LOCOMOTIVES

To the Editor of "The Locomotive Magazine."

DEAR SIR,—In your article on page 93 of the "Locomotive Magazine," June 15th, 1906. I would point out an error with reference to the early locomotives which ran the mails and passenger service on the E. I. Ry.

These were originally single engines with cylinders 12-in. by 22-in. and 6-ft. drivers, built by Messrs Kitson, Thompson & Hewitson (of Leeds), and 14-in. by 22-in. and 6-ft. 6-in. drivers, by Slaughter, Grunning & Co. They were tank engines with tanks between the frames, and had always been so, from the time they commenced running to date of condemnation, and were *never* converted to tender engines as stated. The one on the pedestal is known as the "Express," 12-in. by 22-in., and 6-ft. wheels. Engines of this type had names "Fairy Queen," "Multum-in-Parvo," "Fawn," "Snake," "Hornet," "Bee," etc. These engines have done excellent work for the past 30 years that I have known them. I would also draw your attention to a similar error, pointed out by Mr. L. Stephenson in your Volume VIII.—Yours faithfully,

L. N. NOLLINS,
Chief draughtsman, E. I. Ry., Jamalpur, Bengal, India.

ANSWERS TO CORRESPONDENTS.

T. B. BRENNAN.—O. and R. Ry., Saharanpur. (1.) It is difficult to assert the cause of hot boxes. In practice there are a variety of reasons for a journal failing—grit, lack of lubrication, badly fitted brasses, etc., and it is essential to keep a good look out for defective dust shields, packing, lubrication, etc., if hot journal troubles are to be kept at a minimum. (2.) We do not understand your term "journals cording," please explain. (3.) In packing an axle box with waste, the latter should be well saturated with the oil and then a coil should be made rope fashion and put in first to form a good roll of material at the wheel seat end of the journal. Waste can then be introduced until a good soft cushion is formed extending to about one third the height of the journal. A common error is to cram too much waste in, until there is no room for oil. With the elastic packing mixture (Laycock's) now so much used, an elastic pad is provided which is always in contact with the journal.

ROBERT RANKIN.—The following dimensions relating to Caledonian No. 140 class, illustrated in our issue of July 15th, 1904, are those you require: bogie wheelbase 6-ft. 6-in., coupled wheelbase 9-ft. 9-in., total of engine 23-ft. 10-in.; tender wheelbase 13-ft.; height of chimney top from rails 13-ft., length of engine frames 29-ft. 11½-in., width over footplate 8-ft.

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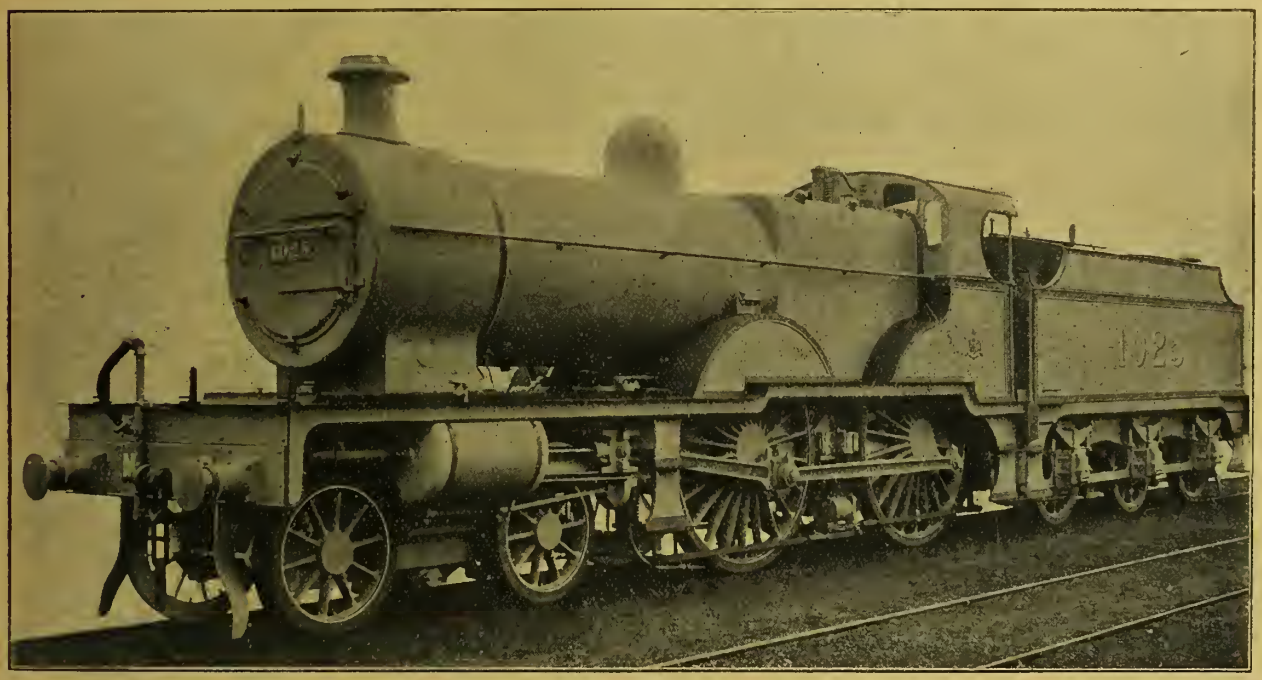
Vol. XII. NOVEMBER 15th, 1906. No. 171.

RAILWAY NOTES.

MIDLAND RY.—By the courtesy of Mr. R. M. Deeley, the locomotive superintendent of the above line, we are able to give the following particulars of the new series of three-cylinder compound express locomotives, Nos. 1010-1029. Cylinders: high pressure 19-in. by 26-in., low pressure 21-in. by 26-in.; diameter of wheels: bogie 3-ft. 6½-in., coupled 7-ft.; wheelbase of engine: 24-ft. 4½-in.; boiler: length of barrel 11-ft. 11-in., diameter inside, mean 4-ft. 7⅞-in.; working pressure 220 lb. per sq. in.; length of firebox shell 9-ft.; heating surface: firebox 152.8 sq. ft., tubes 1305.5 sq. ft., total 1458.5 sq. ft.; grate area 28.4 sq. ft.; weight of engine in working order: on bogie wheels 20 tons 14 cwt., on driving wheels 19 tons 15 cwt., and on trailing wheels 19 tons 7 cwt., total 59 tons 16 cwt. The tender carries 3,500 gallons of water and 7 tons of coal, and weighs 42 tons 16 cwt. 2 qrs. with 4 tons of coal; it occupies a wheelbase of 13-ft. 9-in., the total wheelbase of engine and tender being 48-ft. 3¼-in., and the total length over buffers 57-ft. 3½-in.

Referring to a note on pp. 106-7 of our July issue, we illustrate overleaf two photographic reproductions of Midland Ry. goods locomotives being landed on the quay at Boulogne, *en route* for Italy. A number of these are already in service at Milan, amongst them being Nos. 455, 843, 879, 931, 953, 947 and 981. They still bear the letters "M.R." on the tenders.

LONDON & NORTH WESTERN RY.—The following new express locomotives of the "Experiment" type have recently been built at Crewe: Nos. 1986 "Clanricarde," 1987 "Glendower," 1988 "Hurricane," and 1989 "Lady of the Lake" (works' Nos. 4620-3).



THREE-CYLINDER COMPOUND EXPRESS LOCOMOTIVE No. 1025, MIDLAND RY.

Some of the "Precursor" tanks are stationed at Stockport, and there are eight at Watford: Nos. 196, 139, 562, 616, 803, 1356, 1508 and 2210. There are 30 of them now out, Nos. 97, 111, 139, 181, 196, 528, 531, 562, 616, 653, 784, 803, 834, 874, 1295, 1395, 1356, 1506, 1508, 1572, 1589, 1671 1714, 1981, 1982, 1983, 1984, 1985, 2165 and 2210.

Nos. 1833, 1845, 1863 and 1873, three-cylinder compound mineral engines, have been converted to simple engines with "Precursor" boilers.

The following 4-ft. 3-in. tender mineral engines have recently re-appeared from the shops in the form of saddle tank engines: Nos. 12, 28, 103, 201, 1092, 1096, 1103, 1159, 1317, 2090, 2102, 2103, 2400 and 2413.

GREAT WESTERN RY.—No. 40 is now given the nameplate "North Star," which has been removed from No. 3072, 7-ft. 8-in. single. No. 2901, six-coupled bogie express, now bears the name "Lady Superior."

Photo by MIDLAND RY. LOCOMOTIVES AT BOULOGNE. *A. L. Pfungst.*

The two "Atlantic" engines Nos. 183 and 186 are now named "Red Gauntlet" and "Talisman" respectively.

Five new express locomotives of the "County" class, 4-4-0, with outside cylinders, are now out. They are similar to the first series, but with the new style of painting, and are supplied with the large 4,000 gallon tenders. Their numbers and names are as follows: Nos. 3801 "County Carlow," 3802 "County Clare," 3803 "County Cork," 3804 "County Dublin," and 3805 "County Kerry" (Swindon Nos. 2209-13).

The loading gauge will shortly be increased on the G.W.R. 4-in. in height and 4-in. in width on each side between 5-ft. and 9-ft. 10-in. above rail level on all the main line. The work of making the necessary clearances is nearly finished.

All engines have their numbers painted in yellow on the front buffer planks as they go through the shops. Nos. 3039, 3311, 3411 and 3356 have received new large Belpaire boilers.

Water troughs are being laid down at Carmarthen Junction. This will enable non-stop runs to be possible with the Irish mail trains between Paddington and Fishguard.

The contract for the new line from Ashendon (beyond Princes Risboro' on the G.W. & G.C. Joint line) to Aynho, near Banbury, a distance of about 18 miles, which will complete the new and shorter route from London to Birmingham, was placed with Messrs. W. Scott & Middleton about the end of October.

GREAT EASTERN RY.—A new locomotive shed is being built by this Company at Lincoln, near Pyewipe Junct., to stable the engines working coal trains over the L. D. & E. C. line, and also the goods traffic to and from the Great Central system. Hitherto this service has been performed principally by engines stationed at March (Whitemoor shed). The new shed will be under the supervision of the District Superintendent at Doncaster.

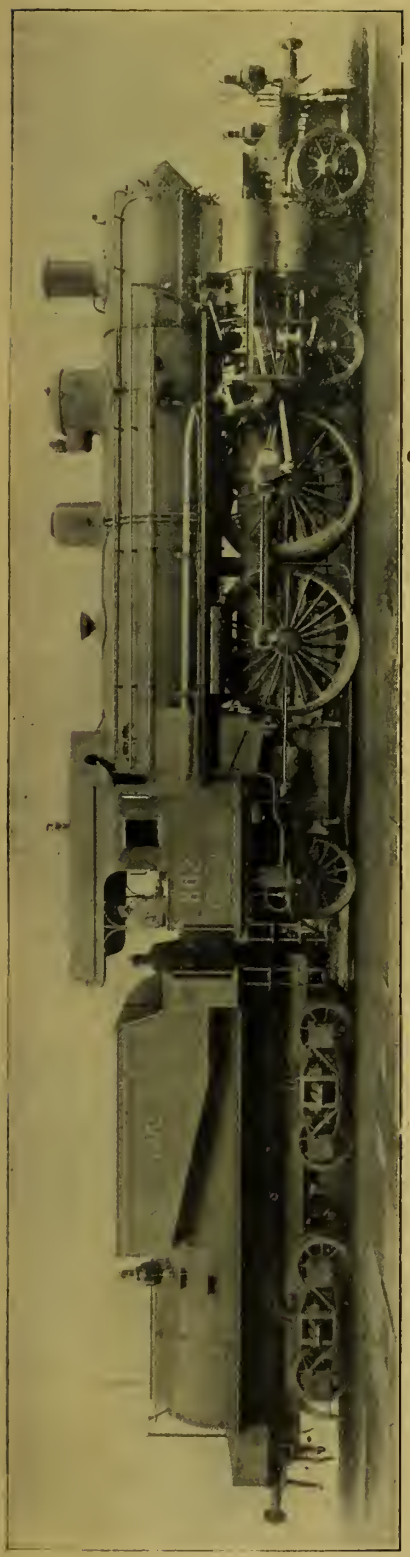
GREAT CENTRAL RY.—Nos. 1107 to 1114 are new six-coupled bogie "Fish" engines, with 5-ft. 6-in. wheels, recently delivered by Messrs. Beyer, Peacock & Co., Ltd.

A new Atlantic compound is in course of construction, which will bear No. 364. No. 259 has been named "King Edward VII."

Nos. 61 and 89 are new six-coupled condensing side-tank locomotives, built at Gorton. Nos. 23 and 24, four-coupled double-framed tank engines, have recently been adapted for service as rail motors. No. 852 has been equipped with Stone's patent ash ejector.

Photo by MIDLAND RY. LOCOMOTIVES AT BOULOGNE. *A. L. Pfungst.*

LONDON, BRIGHTON & SOUTH COAST RY.—A number of the older locomotives of Mr. Stroudley's design are being re-boilered to bring them up to date. Among those under treatment are



Four-cylinder Compound 4-4-2 Express Locomotive No. 802, Hungarian State Rys.

Nos. 191, 193, 200, 214 and 218 of the "Gladstone" or B class; Nos. 1, 6, 18, 34, 226, 241, 289, 293, 294 and 355, of the D class, and Nos. 90, 112, 129, 140 and 145 of the E class.

Nos. 54 and 315 have been repainted in new standard colors, and re-named "Princess Royal" and "J. Gay" respectively, the latter after the President of the Western Ry. of France.

The new ten-wheel tank, No. 595, is working local trains in the Brighton district.

New Appointment.—Mr. R. W. Worsdell has been appointed manager of the N. E. Ry. shops for repairing the electric rolling stock at Heaton, near Newcastle. He will also supervise the wagon shops at that place.

Campbeltown & Machrihanish Light Ry.—The name of the half-way passing place on this line is "Lintmill." "Kilkerran Crossing" is the name of the road over which the railway passes just after leaving Campeltown. The "Argyll" locomotive was described and illustrated in our June issue, not July as stated in our last number.

TEN-WHEEL COMPOUND LOCOMOTIVE, HUNGARIAN STATE RYS.

The accompanying photo-reproduction shows a four-cylinder compound 4-4-2 locomotive recently built at the State railway works, Buda-Pesth, for express service on the above-mentioned railways. It has high pressure cylinders between the frames below the smoke box, and low pressure cylinders outside, all connected with the leading coupled wheels, with the cranks of the adjacent high and low pressure cylinders on either side set at 180 degs, the cranks being on all four quarters; piston valves are used throughout, actuated by a modification of the Walschaerts gear. This locomotive, which is the first of a series and is exhibited at Milan, has the following leading dimensions: diameter of h.p. cylinders 14½-in., and of low pressure 25-in., stroke 26½-in.; diameter of wheels: bogie 3-ft. 6-in., coupled 7-ft., trailing 4-ft. 1-in.; wheelbase 32-ft. 7-in.; boiler: diameter of barrel 5-ft. 2½-in., height of centre above rails 9-ft. 6-in., working pressure 227 lb. per sq. in.; tubes, number 291, length 17-ft. 6-in., diameter 2⅛-in.; heating surface: firebox 137 sq. ft., tubes 2,680 sq. ft., total 2,817 sq. ft.; grate area 42 sq. ft.; weight of engine in working order 72 tons, of which 30 tons are available for adhesion. The tender is of what is known as the Vanderbilt type, and is carried on eight wheels of 2-ft. 10-in. diameter, occupying a total wheelbase of 16-ft. 3-in.; it carries 7½ tons of coal, and weighs 43 tons loaded.

For starting, or where great power is required, valves are provided which supply live steam at reduced pressure to the low pressure cylinders, an intercepting arrangement at the same time turning the exhaust from the high pressure cylinders direct into the chimney, and so closing communication between the high and low pressure cylinders. These engines are intended principally for express service between Vienna and Buda-Pesth, and they are specially interesting as being the first compounds with four cylinders arranged in line so far introduced on the Hungarian State system.

Steam Rail Motor Coach No. 1, Dublin, Wicklow & Wexford Ry.

STEAM RAIL MOTOR COACHES.

There are now comparatively few important railways in the British Isles which do not possess one or more examples of rail motors, and the number of those which still abstain from adopting this economical method of dealing with local traffic grows less from month to month. Among the latest converts are two Irish railways and the Isle of Wight Central.

The Dublin, Wicklow & Wexford Ry. has recently put into service two motor coaches built to the designs of Mr. R. Cronin, the locomotive engineer, by Messrs. Manning, Wardle & Co., Ltd., one of which is here illustrated. The engine has 12-in. by 16-in. cylinders and a locomotive-type boiler carrying steam at a pressure of 175 lb. per sq. in. The total length over buffers is 63-ft., the coach body being 45-ft. long by 9-ft. 6-in. wide, and with 500 gallons of water in the tanks at the sides of the boiler, and 1 ton of coal, the total weight of the car is about 42 tons. There is seating accommodation for 16 first and 39 second class passengers, besides space for luggage, and the internal fittings are designed to give comfort. Steam heating and lighting by means of incandescent oil gas lamps are among the features. The car can of course be operated from either end, and it has sufficient reserve of power to be able to haul two bogie carriages as trailers if necessary.

To supplement the ordinary train service between Belfast and Holywood, the Belfast & County Down Ry. early this year started a service of steam motor cars. There are three cars, two at a time being in steam, running at 20 to 30 minute intervals throughout the day. New halts have been erected at Ballymacarrett, Victoria Park and Kinnegar. The cars have one class only, the tickets being issued and collected by the conductors. The fares are low, 3d. being charged for the $4\frac{1}{2}$ mile journey to Holywood, with lower fares between intermediate points. Fourteen minutes are allowed for the run, with five stops. The first two cars (Nos. 1 and 2) are 63-ft. over buffers, while No. 3, which we illustrate, is 70-ft. over buffers, the actual lengths of the bodies of

Photo by Steam Rail Motor Coach No. 3, Belfast & County Down Ry. *Locy. Pub. Co. Ltd.*

Steam Rail Motor Coach No. 1, Isle of Wight Central Ry.

the cars being 45-ft. and 52-ft. The clerestory roof is furnished with ventilators worked by a lever on each side. Oil gas is used for lighting. The engine is carried on a four-wheeled bogie which can readily be detached from the car when necessary. It has outside horizontal cylinders 10-in. diameter with a 16-in. stroke, the valves being on top and operated by Walschaerts gear. The locomotive-type boiler with Belpaire firebox has a heating surface of 505 sq. ft. and a working pressure of 160 lb. The grate area is $9\frac{3}{4}$ sq. ft. The coal bunker has a capacity of 15 cwt., while the water tank located under the carriage body carries 400 gallons. The regulator, reversing and whistle handles and brake are arranged so that they can be operated by the driver from the end of the car or from the engine. The carriage body is carried on a standard Leeds Forge pressed steel bogie. Messrs. Kitson & Co., of Leeds, built the locomotive to the designs of Mr. R. G. Miller, the locomotive supt. of the B. & C. D. Ry. It is painted red with a gilt band round the tank edged with vermilion stripe, and has a copper-topped chimney. On its trial trip Car No. 1. took two new 6-wheel carriages through to Bangor, up a gradient $2\frac{1}{2}$ miles long mostly at 1 in 98 and in one part 1 in 73

The car ordered by the Isle of Wight Central Ry., the engine being built by Messrs. Hawthorn, Leslie & Co., Ltd., and the coach portion by Messrs. Hurst, Nelson & Co., Ltd., is at present at work on the Ventnor line, and it will perform the full service during the winter months and supplement the service of ordinary trains on other sections during the summer. The engine bogie has the following leading dimensions: cylinders 9-in. by 14-in., diameter of wheels 3-ft. 6-in., wheelbase 8-ft., heating surface of boiler 329 sq. ft., grate area 7·5 sq. ft., capacity of water tank 400 galls., and of bunker 12 cwt., weight in working order $15\frac{1}{2}$ tons. The car portion runs on a bogie having wheels 3-ft. $7\frac{3}{4}$-in. in diameter on a wheelbase of 8-ft., the body is 44-ft. 6-in. long by 8-ft. 4-in. wide, the height of the roof from rail-level being 11-ft. 6-in. It contains a 1st class compartment 6-ft. 6-in. long, an entrance gangway 2-ft. 9-in. wide, and a 2nd class compartment 26-ft. 1-in. long. The normal seating capacity is for six 1st and 44 2nd class passengers, but more can be carried if necessary, and there is a luggage compartment calculated to hold 20 cwt. The total weight of the combined car is 32 tons, and the length over buffers is 61-ft. It is a part of the design that the engine bogie can be detached readily from the car for repairs.

Steam Rail Motor Coach No. 16, Taff Vale Ry.

A new motor coach has recently been supplied to the Taff Vale Ry. by Messrs. Manning, Wardle & Co., Ltd., which is shown overleaf. It has the following leading dimensions: cylinders 10½-in. by 14-in.; engine bogie: driving wheels 3-ft. 6-in. diameter, carrying wheels 2-ft. 10-in.; boiler heating surface: firebox 63 sq. ft., tubes 413 sq. ft., total 476 sq. ft.; capacity of tank 560 gallons. The car is carried at the other end on an ordinary carriage bogie, and has a steel underframe and body frame of teak. It is sub-divided for 1st and 2nd class passengers, and is equipped with Pintsch's system of gas lighting, steam heating apparatus and the automatic vacuum brake.

Steam Motor Locomotive No. 736, London & South Western Ry.

Mr. Dugald Drummond, who was one of the earliest British locomotive engineers to adopt this class of motor, has recently constructed a new type of steam coach, the locomotive being a separate unit. We illustrate herewith one of the engines built at the Company's works at Nine Elms, and also the engine attached to an intermediate car and a trailer. The locomotive is practically a miniature tank engine running on four wheels of 3-ft. diameter, spaced with their centres 8-ft. apart. The cylinders are 10-in. in diameter by 14-in. stroke, and they are supplied with steam from a loco-type boiler having a total heating surface of 571 sq. ft., of which 99 water tubes of 1¾-in. diameter in the firebox contribute 119 sq. ft., 216 smoke tubes of 1½-in. diameter in the barrel give 379 sq. ft., and the firebox supplies 73 sq. ft.; the working pressure is 150 lb. per sq. in. The engine measures 19-ft. 7-in. over buffers, and with 500 gallons of water and 1 ton of coal weighs 24 tons. The two coaches, which were built at the carriage works at Eastleigh, are both of one class, and seat respectively 65 and 48 passengers. The end car has of course a driver's compartment and all the appliances necessary for controlling the engine when running backwards. There are ten of these engines in course of construction for use in connection with six vestibuled cars of the type illustrated, this proportion allowing a good margin of reserve engines for maintaining a constant service of trains.

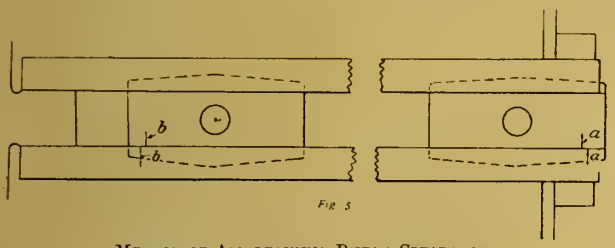
It will be noticed that there is a growing tendency to make the locomotive portion of these rail motor coaches a separate unit, with a view to facilitating repairs.

Steam Rail Motor, Intermediate Coach and Trailer, London & South Western Ry.

SLIDE VALVE SETTING.

(*Continued from page* 171.)

THE four dead centres are found in a similar way, and are taken in order, the wheels being revolved till one of the marks (*j*) can be just entered by the point of the trammel; the distance that the marks *a a* or *b b* on crosshead and slide



METHOD OF ASCERTAINING PISTON CLEARANCE.

bar are apart is observed, as in Fig. 5, and this amount is the piston clearance; that is the distance between the piston head and cylinder cover when the engine is running. When each dead centre has been dealt with, any necessary adjustments may be made to equalise the clearance at each end of a cylinder.

For instance, if a connecting rod is too long, there will be a greater clearance at the back end and a less clearance at the front end of the cylinder than is desirable. If the difference were considerable it might be dangerous, as there would be a likelihood of the piston striking the cylinder cover, especially if the engine worked upon its springs in running.

Slight alterations in the length of a rod can usually be made by disconnecting the big end and putting liners of thin metal between the brass and strap if the rod is too long, or by taking a little off the brass and so letting the small and big end brasses get farther apart if it is required to lengthen it. In the latter case it would be necessary to put a liner at the back of the outer brass or the cotter might go through the hole too far.

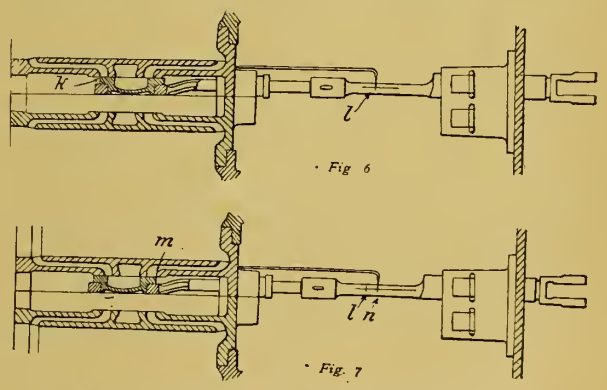
There should be no necessity for such adjustments in a running shed, but all the same occasions may arise when it becomes necessary to carry out a few makeshifts.

When an engine has inclined cylinders it is usual not to equalise the clearance at front and back ends of the cylinders, the front clearance being generally made greater than at the back end; this allows for the sinking of the engine on its springs, which will have the effect of carrying the pistons further forward, when the clearances will become equal. With horizontal cylinders, also, some allowance is usually made for the lengthening of the piston rods as they become warmed by their contact with the steam inside the cylinders.

Should it happen in the operation above described, of catching the centre pop marks to find the dead centre, that a mark is passed before the revolution of the wheel is stopped, it is advisable to turn the wheels back some little distance and again catch the mark on the return, so that all marks, etc., are found while the wheels and motion are moving in one direction. The reason for this is to prevent the risk of error due to the existence of slackness or "back lash," such as must always be present to some extent in the moving parts of machinery.

The connecting rods and pistons having been properly adjusted, the valves will require similar attention, and for this purpose it will be necessary to make indicating marks on the valve spindles, the valves themselves being of course hidden from view in the steam chest. The four positions which the valve spindle occupies when the valves cut off at each port must be known, and to find them the slide valve with its buckle will be put into place in the steam chest, and the intermediate valve spindle firmly connected to it. Two men generally do this work, one going below the engine prepared to mark the valve spindle with a trammel, while the other takes a piece of thin tin and inserts it in the front steam port, drawing the valve up so as to hold it there, thus locating the exact point at which the valve just closes this port. One end of the trammel is inserted into a pop mark on the back end of the cylinder, or any other fixed part of the engine that may be handiest, and the valve spindle is marked with its other end.

In Fig. 6 this position is shown, the piece of



METHOD OF ASCERTAINING POSITIONS OF SLIDE VALVES.

tin being in the steam port at *k*, whilst the trammel has marked the spindle at *l*, a line being scribed along the spindle on which all measurements will be taken. After making these records the tin is withdrawn from the front port and the valve moved forward until the tin can be put into the back port in a similar manner, as at *m* in Fig. 7, when the valve spindle is again marked at *n*. The same series of marks is made with the

other valve, and all subsequent operations of valve setting can be effected without the valves being in place, as the marks already made are all that are necessary.

The next operation is that of equalising the lengths of the eccentric rods so as to give equal port openings at either end of the cylinders. The eccentric rods should be coupled up to the slot link, etc., and all tightened up to running positions, except that the taper pins should not be too tightly driven home, as they will probably have to come out several times before the work is finally completed.

The engine is put into fore gear with the lever in the running position, and the driving wheels are turned in a forward direction. Each port mark is dealt with in turn by the valve setter, who applies the flame of a torch lamp to the spindle, so as to give a thin coating of soot on which his marks can be made, and which can also be easily erased ready for his next trial, if that should be necessary.

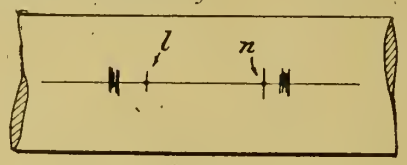


Fig 8

MAKING PORT MARKS ON VALVE SPINDLE.

As the engine wheels revolve, the valve spindle will also slowly move backwards and forwards. The valve setter can catch one port with his trammel and pass the point of the trammel across and across the spindle, which will take off the soot at this point. When the valve spindle has reached its extreme limit of travel, which will be shown by the cross marks, and when the spindle commences to return, the trammel will be withdrawn from the pop on the cylinder and put in that on the other side of the engine ready to catch the next port, which will be on that side. The four ports are thus dealt with in succession, and the markings on the valve spindles will be somewhat as shown in Fig. 8. The revolutions of the driving wheels are stopped, and the setter is able to examine his marks, which will show him how far the eccentric rods are out of truth. To carry out this examination a small pair of dividers is used, one leg being placed in one of the pop marks *l* or *n* on the valve spindle, and the other leg opened out until the point exactly touches the extreme mark where the soot has been removed by the trammel point, as shown in Fig. 8.

The distance separating the points of the divider will show the port opening, and can be measured on a rule and this dimension put down for each port; or a plate, Fig. 9, suitably divided up and marked for each port and gear, can be marked with an arc. This latter method is the one usually adopted. The plate being of sheet metal, generally of brass, can have the marks cleaned off after the engine is done, and so can be used again and again.

The plate is stamped to indicate each port and gear, so that care must be taken to scribe the port marks in their right places, or confusion will ensue. Each side of the engine is dealt with in this manner in both forward and backward gear, and the plate will then present the appearance shown in Fig. 10. From the completed plate each port opening can be measured off with a rule and corrections made in accordance with the results arrived at. To take a typical instance, the port openings will measure—in fore-gear, R.H.F. port $\frac{1}{2} + \frac{1}{32}$ in., R.H.B. port $\frac{3}{8} + \frac{1}{32}$ in. L.H.F. port $\frac{3}{8} + \frac{1}{32}$ in., L.H.B. port $\frac{1}{2}$ in. bare; in back-gear, R.H.F. port $\frac{10}{32}$ in., R.H.B. $\frac{7}{16}$ in., L.H.F. port $\frac{7}{16} + \frac{1}{32}$ in., L.H.B. port $\frac{7}{16}$ in. full.

In making corrections, it must always be borne in mind that the rods be left $\frac{1}{32}$ in. short, so that the front ports in all cases will show $\frac{1}{16}$ in. more opening than the back ports, to allow for the lengthening of the valve spindles, etc., when heated.

It will be seen at once in the instance quoted that the left hand fore-gear eccentric rod is too long, as the opening of the back port is greater than that of the front port. The right fore-gear rod is too short, as there is too great a difference between the openings. The left back-gear rod

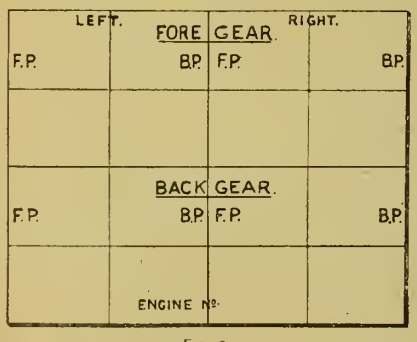


Fig 9

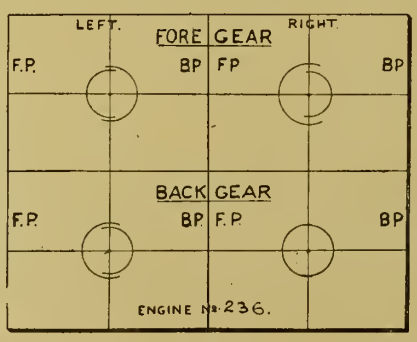


Fig 10

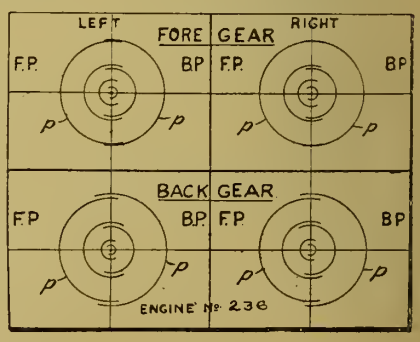


Fig 11

PREPARATION OF PLATE SHOWING PORT OPENINGS AND LEAD IN A LOCOMOTIVE MOTION.

is correct, and the right back-gear just a trifle short. These inaccuracies can be read off without any measuring, but it is of course necessary to get the exact figures in order to make the required adjustments, and even then the amount that the rods will have to be altered varies considerably on different types of engine, due to such causes as, for instance, the point at which the eccentric rods are coupled to the link, top or back, the length of link and other varying characteristics. Sufficient accuracy will be obtained, for the purposes of this description, however, if the difference between the port openings be taken and $\frac{1}{32}$-in. deducted from or added to the result, according to whether the alteration is required in forward or in backward gear. For example, the left fore-gear rod must be shortened ($\frac{16}{32} - \frac{13}{32} = \frac{3}{32} + \frac{1}{32} = \frac{1}{8}$-in.) $\frac{1}{8}$ of an inch. The right fore-gear rod must be lengthened ($\frac{16}{32} - \frac{13}{32} - \frac{1}{32} = \frac{3}{32}$) $\frac{3}{32}$ of an inch. The left back-gear rod is correct, and the right back-gear rod must be lengthened $\frac{1}{32}$-in. full

When these rods have all been taken down and adjusted by the smith they must be put up again and tried over in the same way as before, when the readings will probably be as in Fig. 11, which is taken from an actual plate, and one which has all the port marks so far described, as well as others now to be dealt with.

It will be seen that the back ports receive a little greater opening than the front ports in full gear, whilst they have less in positions nearer mid-gear. These irregularities of port openings are inseparable from the ordinary link motion, and are due to the alterations in the angularity of the rods in different positions of the gear, and to the influence that the back-gear rods have on the fore-gear ones, and *vice versa*.

The next operation is finding the lead. To do this we shall require the dead centre again, therefore place the engine on any one of them, by setting the driving wheels by the trammel from frame to mark *j* on the tyre (Fig. 4), and with the other trammel mark the valve spindle for the port corresponding, viz., if the right crank is on the front dead centre mark the lead at the right front port mark, and then move the driving wheels round to the next mark, and mark the lead on the valve spindle for that port in a similar way, and so do the four ports alike.

Take the compasses and measure off the distances between each port mark and lead mark, and mark the plate as in Fig. 11, when the two smallest semi-circles for each pair of ports show the lead. It is seen to be largest at the front port, as when the rods are hot, as mentioned before, they will be longer and thus tend to equalise matters.

If it should happen that the lead is not as it should be, it will be necessary to alter the position of the sheaves on the axle to correct it, as the lead depends upon their position. The angular advance would have to be increased to give a larger lead, and decreased to give a smaller lead.

If the engine is fitted with screw reversing gear it is usual to scribe the indicator plate with marks corresponding with the percentage of the full stroke at which the engine is cutting off. The marks are obtained from the engine itself after the valves are set. To arrive at these results the engine is prepared by securing a plate in such a position that an indicator attached to one of the crossheads can move along the plate. The engine wheels are revolved until the total travel of the crosshead, indicating the length of stroke, has been registered by marks made on the plate. This distance is then divided up into 100 equal parts, which will give the percentages of cut off. The engine is moved into such a position that the crosshead indicator will be on one of the marks, say 25 per cent., and the port mark trammel is placed in its pop mark on the cylinders, and the proper port mark on the spindle observed while the engine is reversed very slowly. This will move the valve spindle along, and when the mark on the spindle is exactly reached the act of reversing is stopped, and the indicator plate attached to the reversing screw scribed with a mark corresponding with the position of a pointer fixed to the nut on the reversing rod.

The reversing gear is again moved until the point of cut off is in a similar way shown for the back gear and the indicator is again scribed. Each percentage of cut off required is then obtained in an exactly similar way, and the reversing gear indicator marked as before.

When all the marks required are obtained a permanent indicator is made by deeply cutting marks and stamping them with the percentage figures, so that the driver may know exactly the point in the cylinders his pistons have reached before the steam is cut off.

All the pins will now be driven home in the motion and split by opening their lower ends, all nuts checked and split pins put in, and the operation of setting the valves is completed.

The plate, Fig. 11, should be handed over to the foreman by the valve setter for entry in a book in which all the port marks are copied off for future reference if required, and the plate can be cleaned by rubbing the scratch marks off, ready for another engine's record.

TENDERS FOR ELECTRIC STREET RAILWAYS AT ROME.—The Municipal Council at Rome are prepared to receive tenders for the construction and operation of the new Street Railways at Rome. For information, apply to the "Sindaco di Roma." Tenders to be delivered not later than December 31st, 1906.

Six-wheels Coupled Goods Locomotive, No. 365, Glasgow & South Western Ry.

GOODS LOCOMOTIVE G. & S. W. RY.

The accompanying illustration shows one of a series of 20 goods locomotives, Nos. 361-380, built by Messrs. Neilson, Reid & Co., to Mr. James Manson's designs for the above railway in 1900. They have the following leading dimensions: cylinders 18-in. in diameter, with a stroke of 26-in.; diameter of coupled wheels 5-ft. 1½-in.; wheelbase, leading to driving, 8-ft., driving to trailing, 8-ft. 10-in., total 16-ft. 10-in.; boiler, length of barrel 10-ft. 10⅝-in., maximum internal diameter 4-ft. 3-in.; height of boiler above rails 7-ft. 3-in.; tubes, number 231, length 11-ft. 2⅜-in., diameter 1⅝-in.; heating surface, firebox 111 sq. ft., tubes 1097 sq. ft., total 1208 sq. ft.; grate area 18 sq. ft.; boiler pressure 165 lb. per sq. in.; weight of engine, on leading wheels 14 tons 4 cwt., driving wheels 15 tons 13 cwt., trailing wheels 13 tons, total 42 tons 17 cwt.; tender, capacity of tank 2500 gallons, coal 5 tons, weight full 32 tons 3 cwt. These engines are fitted with steam reversing gear, steam sanding apparatus and the vacuum automatic brake. They were practically identical with Mr. J. Manson's standard goods engines of the period, but with slightly larger boilers and fireboxes.

A Railway Weighbridge for Mashonaland.—The Mashonaland Railway, which is a continuation of the line from Beira, now has a combined weighbridge, designed to weigh a single load of 30-tons upon either weighbridge, or a combined load of 60-tons upon the two. The whole has been manufactured by Messrs. W. & T. Avery, Ltd., of the Soho Foundry, Birmingham.

THE INDIAN MECHANICAL AND SKILLED LABOUR MARKET.

In the Indian mechanical and skilled labour market at the present day the demand is admitted to greatly exceed supply. The Committee of Locomotive and Carriage Superintendents of India, Burmah and Ceylon, who, as a body, represent a considerable portion, if not the majority, of employers of skilled labour in the Indian Empire, went into the question of this deficiency very thoroughly at their eighth meeting last year, and it will be again discussed at the next meeting of the members, to be held towards the end of the present or beginning of the new year.

In every one of the large railway locomotive and carriage and wagon workshops of India there is, at the time of writing, a dearth of competent skilled mechanics of practically every class, not only at the benches but also in the subordinate supervising grades of chargemen, leading hands, assistant foremen and foremen. As a field for the mechanic in search of employment, or the energetic workman desirous of raising himself beyond the usual thirty shillings or two pounds a week, India offers opportunities such as exist probably in no other country in the English-speaking world. That the British railway man appreciates the country once he has tried it, is rendered evident by the number who yearly arrive under covenant to one or other of the great lines, a very small percentage of whom, at the expiration of their agreements, vacate their billets and return to England. By far the greater majority avail themselves of the leave which is due to them, visit their native

country and then return to their Indian appointments.

Indian railways generally, though the conditions naturally vary somewhat on the different lines, offer far better pay, prospects and treatment to the European craftsman than do the railways of his own country. A review of these conditions should prove of interest not only to the engineman or mechanic, but also to all interested in railway matters and the general economic aspect of steam locomotion, while a comparision with the position of the Home employee might not be out of place.

To take first the case of enginemen, in India the European is seldom or ever started to work as a cleaner on any line. Cleaning work is performed by natives, the European being put to firing from the start, even if totally without experience. His pay as a fireman varies, but runs from Rs. 40 to Rs. 70 (the rupee may be taken as equal to 1s. 4d. English money) per month, and overtime which, provided the full month is worked, averages Rs. 25 for a 40 rupee man and Rs. 40 for a 60 or 70 rupee man. On some of the smaller lines he will probably not be more than two years firing before being promoted to the grade of shunter, when his pay will be from Rs. 70 to Rs. 100 a month, plus Rs. 30 to Rs. 45 overtime allowance. If on the big lines, he will be firing from 3 to 5 years before reaching the shunter's grade and will probably have to put in at least one year of this as a mail fireman. On no line is he likely to be longer than one year shunting and he will then become a driver. The pay of drivers runs from Rs. 80 to Rs. 240, according to the line and to the class of train worked—goods, mixed, passenger or mail—with Rs. 40 to Rs. 200 a month overtime or mileage allowance. Throughout, it should be borne in mind that the railways of India offer permanent employment and monthly pay to running men. They seldom pay a daily wage, and it is exceptional for men to be booked "spare" on account of slackness of work.

Quarters, generally consisting of one room for a bachelor and two or three for a married man, are always provided at a rent which never exceeds one-tenth of a man's pay (without overtime). Thus, a man on Rs. 100 would, even if married and occupying a two or three-roomed house, never be called upon to pay more than Rs. 10 for it. A generous allowance of leave is given, both privilege and sick, but, as the leave rules apply equally to workshop hands and running men, they will be detailed further on.

The following table gives the wages paid to European firemen, shunters and drivers on the largest broad-gauge line in India, and it may be taken as very typical, though, as has been shown, the rates vary somewhat:—

Fireman (2nd class)	Rs. 50 to Rs. 60
,, (1st class) after about 12 months ..	Rs. 70
Shunter, after about 4 years	Rs. 100
Goods driver (2nd class) after about 1 year shunting	Rs. 120
,, ,, second year driving	Rs. 140
,, ,, third year	Rs. 160
,, ,, fourth year	Rs. 170
Goods driver (1st class) first year	Rs. 180
,, ,, second year	Rs. 190
,, ,, third year	Rs. 200
Passenger driver	Rs. 210
,, ,, (by promotion)	Rs. 220
Mail driver (by promotion)	Rs. 240

Compare these conditions with those under which the engineman in England works, daily pay—no pay for days he is booked spare—and the maximum usually drawn by a driver weekly, say, £3 or Rs. 45 against the Rs. 100 or more drawn by the Indian mail man when his overtime is taken into account. In addition to this, the Indian employee has all the advantages of comfortable quarters at a nominal rent, steady work, plenty of leave and assured prospects of steady yearly increment as long as he gives satisfaction. There is one disadvantage, the climate, but many parts of India are quite as healthy in every way as England, and in those which are not, and where malarial fever is prevalent, the European can, as a rule, by abstemiousness and strict attention to hygiene, keep fairly good health which he can recoup at frequent intervals by taking his leave and spending it in some of the mountain sanitoriums or on a sea trip.

Mechanics are, as a rule, engaged in the various railway workshops on probation, and during that period are paid at a daily rate according to their qualifications and past experience. After a satisfactory trial extending over two to six months, they are confirmed as permanent employees on a monthly wage. The scale of pay for men locally engaged varies similarly to that of enginemen. The following table gives the rates paid by the railway already referred to, and may be again taken as typical of wages paid in all broad-gauge and the principal metre-gauge shops:—

Period.	Pay.	In charge of Single Pit.	In charge of Double Pit.
First year ..	Rs. 80	Rs. 100	Rs. —
Second year ..	90	110	—
Third year ..	100	120	—
Fourth year ..	120	140	160
Fifth year ..	140	160	180
Sixth year ..	150	170	190
Seventh year ..	160	170	190
Eighth year ..	170	170	190
Ninth year ..	180	180	200
Tenth year ..	190	190	210
Eleventh year ..	200	200	220
Twelfth year ..	210	210	230

Fitters and boiler makers are eligible for a

charge allowance, in addition to their salary, of Rs. 20 when placed in charge of single pits, and when in charge of double pits they receive a further allowance of Rs. 20. Overtime is reckoned at the rate of time-and-a-half for any time worked in excess of the ordinary working hours, except on holidays, when 1/8th day per hour of the ordinary shop working hours is paid, and time-and-a-half for any period in excess of the working hours. When travelling on duty, mechanics are allowed ordinary time for eight hours a day and double time in excess of these hours, plus a small night allowance for every night absent from home.

Casual leave is allowed to all Europeans, whether engine or shop men, to the extent of 14 days a year on full pay. Privilege on full pay is allowed to the extent of one calendar month for every 11 months on duty without interruption (casual leave does not count as an interruption) and may be accumulated to the extent of three months. Privilege leave, up to this maximum of three months, may be combined with furlough or sick leave, provided the total of combined leave is not less than six months nor more than 21 months.

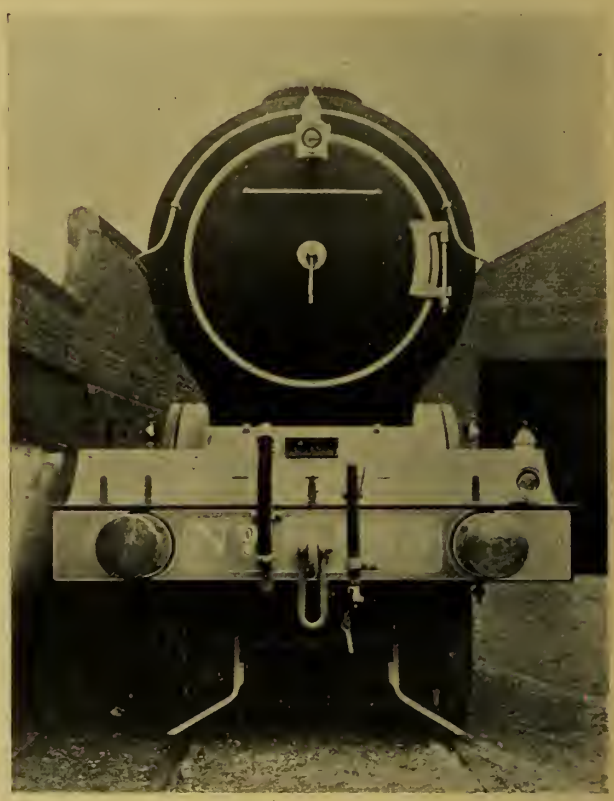
All Europeans are eligible for a first furlough of six months after seven years service, and a second or subsequent furlough after three years further actual service dating from expiration of previous furlough; thus, after seven years' service six months' furlough and for each subsequent complete year's service one month; but a complete three years must intervene between the return of a man from one furlough and his departure on the next. Sick leave is allowed to the extent of 60 days on full pay during a year, any period over being on half pay.

These, briefly, are the inducements offered to Europeans by one of the largest Indian railways; while no other line offers quite such enticing terms, many are but little less generous. Generally speaking, therefore, there can be no doubt that the European engineman or mechanic working in India, provided he sticks to his work and is steady and energetic, is in far better circumstances than those of his class employed in England.

As already mentioned, there is, at present, a dearth of competent enginemen and mechanics in the country, despite the number which is covenanted from year to year. To men of the class indicated, India offers steady and permanent work under easy and remunerative conditions, and for some time to come all who venture out will find ready employment. In view of the great expansion in railway development that is taking place, there is no fear of the supply exceeding the demand, at least during the present generation.

ATLANTIC LOCOMOTIVES, NORTH BRITISH RAILWAY

THE accompanying photographic reproduction of the front end of one of Mr. W. P. Reid's large Atlantic engines on the above-mentioned railway, which were illustrated and described in our July and August issues, shows in a remarkable degree the tendency of modern practice to reduce the chimney of a locomotive to a mere stump. The boiler centre is 8-ft. 11-in. above the rail level, and with the large diameter of boiler, the top of the smoke box can be only an inch or so short of 12-ft. above the rails, so that the remaining height available for the chimney is little, if anything, more than a foot.



END VIEW OF ATLANTIC EXPRESS LOCOMOTIVE NO. 868 "ABERDONIAN," NORTH BRITISH RY.

As a supplement to our note on page 146 of the September issue, we give below the names allotted to the engines of this class: Nos. 868 "Aberdonian," 869 "Dundonian," 870 "Bon-Accord," 871 "Thane of Fife," 872 "Auld Reekie," 873 "St. Mungo," 874 "Dunedin," 875 "Midlothian," 876 "Waverley," 877 "Lidderdale," 878 "Hazeldean," 879 "Abbotsford," 880 "Tweeddale" and 881 "Borderer." Several of the above names were previously carried by engines of the 476 class.

THE LANCASHIRE, DERBYSHIRE & EAST COAST RY. AND ITS LOCOS.

THE intention of the promoters of the Lancashire, Derbyshire & East Coast Ry. was to connect by a "Great Central Railway," as the original prospectus of the line stated, the Warrington Docks on the Manchester Ship Canal and a port to be formed on the North Sea coast at Sutton-on-Sea. Although only the central portion of the proposed railway has been completed, the acquisition of the line by the Great Central Railway Co., which takes it over on January 1st, 1907, will be more or less a fulfilment of the original idea—*i.e.*, the fine new Immingham Dock and Grimsby, with its first class shipping facilities, at one end of the line, and the whole of the traffic-producing area served by the Great Central system at the other. To the G.C.R. it will serve as an alternative main line to the East Coast from the London extension, reducing the distance from all stations south of the new junction at Duckmanton to Grimsby by 15 miles, and to Lincoln by 7 or 8 miles, and by its assistance also avoiding the delays on the congested Worksop route.

Photo by] THE 4.05 P.M. TRAIN, CHESTERFIELD TO LINCOLN, CROSSING BOLSOVER VIADUCT, LANCASHIRE, DERBYSHIRE & EAST COAST RY. [*J. W. Chapman*

As is well known, the completed section of the L. D. & E. C. Ry. main line runs in an easterly direction across England, starting at Chesterfield and ending at Pyewipe Junction, Lincoln. The first portion from Edwinstowe to Lincoln was opened on December 15th, 1896, and that from Chesterfield to Edwinstowe, together with the Clown branch, on March 8th, 1897, while the further extension towards Sheffield of the Clown line to the junctions with the G. C. and Midland Rys. at Beighton was completed and inaugurated on October 1st, 1898. The Shirebrook curve, giving the L.D. & E C. connection with the Midland Ry. system, was opened March 20th, 1899, from which date the M. R. put on a through service of passenger trains between Mansfield and Edwinstowe. The Sheffield District Ry. (an offshoot of the L. D. & E. C. under the the same management) allows the L. D. & E. C. access to Sheffield by running over the Midland Chesterfield, Masboro' and Rotherham line from Beighton to Treeton Junctions, and thence *via* the Sheffield District to Brightside Junction, whence the passenger traffic is worked over the Leeds-Sheffield main line into the Midland station at Sheffield, but the goods traffic of the L.D. & E.C. is dealt with at the large Attercliffe depot belonging to the Sheffield District Ry., a branch half a mile in length connecting it with the Midland at Grimesthorpe Junction. The Sheffield District Ry. has a length of 4 miles, and was formally opened May 21st, 1900.

The Chesterfield terminus of the L.D. & E.C. in the market place is a commodious depot containing four platforms and four roads, and is built almost entirely on a lofty embankment. Immediately after leaving the station the line passes over the Midland Ry. main line, the Great Central loop line from Sheffield to Annesley, and the Derby to Chesterfield road, by a viaduct consisting of steel girders of 115-ft. span over the Midland Ry., and three steel spans over the G. C. R. The remainder of the viaduct consists of seven brick arches, some on the skew and varying in span from 30 to 58-ft. It is 68-ft. high from foundations to rail level. A heavy cutting, 65-ft. deep at the deepest part, is met with soon after crossing the viaduct. The next big work is Duckmanton tunnel, about 500 yards in length. Near Duckmanton, connection is being made with the Great Central main line from Manchester to London, which is at a lower level, by means of a "flying" junction, in order to obtain a better exchange of traffic between the two systems.

Five miles from Chesterfield the line crosses the Bolsover valley by an eight arch viaduct; each arch has a 35-ft. span, and is 80-ft. high

Photo by LANGWITH JUNCTION, LANCASHIRE, DERBYSHIRE & EAST COAST RY. *Loco. Pub. Co. Ltd.*
CHESTERFIELD LINE ON LEFT. SHEFFIELD LINE ON RIGHT.

from foundation to rail level. Shortly after this the line pierces the hill upon which Bolsover Castle stands, by the Bolsover Tunnel, which ranks among the longest in the country, being 1 mile 864 yards in length, and on a continuous rising gradient of 1 in 120. East of the tunnel the line descends through a deep rock cutting on a gradient of 1 in 80 to Langwith Junction Station, 10 miles from Chesterfield. At Langwith the Sheffield line goes off to the north, while the line from the Midland at Mansfield joins from the south. There is also a junction with the Great Northern Leen Valley line. Extensive sidings for marshalling the coal traffic from the Dukeries coalfield make this the busiest centre on the line. The largest signal box on the line controls the junctions here; it contains 81 levers. Langwith is also the principal locomotive depot, 22 or 23 engines being generally stationed there. After leaving Langwith there is a long stretch of embankment to Warsop, which is the commencement of the "Dukeries" district. The line then skirts the southern part of Sherwood Forest to Tuxford, where exchange and storage sidings of considerable magnitude have been laid down to deal with the coal traffic destined for London *via* the Great Northern Ry. The junction with that line is by a curve towards the north, while the station for the exchange of passenger traffic (Dukeries Junction) is on the high level, communicating with the G. N. station below at the point of crossing. The workshops for repairing the rolling stock of the line are located at Tuxford and employ about 130 men. On referring to the accompanying illustration, which is taken looking in the direction of Lincoln, the building with the sheer legs in front, on the extreme right, is the fitting and erecting shop, with a capacity of dealing with four locomotives. To the left of this are the smithy, brass foundry and fitting shop, while at the north west corner of the block is the engine house, containing a vertical engine

Photo by REPAIRING SHOPS, TUXFORD, LANCASHIRE, DERBYSHIRE & EAST COAST RY. *Loco. Pub. Co. Ltd.*

by Messrs. Clench & Co., Ltd., of Chesterfield, and a complete electric lighting installation. A saw-mill stands in front of the engine house. The carriage and wagon repairing shops are at the rear of the main block of buildings—the former to the north with two roads and accommodation for four carriages, heated throughout by steam pipes, while the wagon shop with two bays and four roads will take 20 wagons at a time. The locomotive offices are close to the works, at present under the charge of Mr. C. E. Bressey. In the works a steam fire engine is kept, and a good supply of water is obtained from an artesian well 630-ft. deep. The stores department occupies a separate building to the south of the main block. There is also a locomotive shed at Tuxford, ten engines standing there.

We noticed one rather unusual piece of repair work in progress, at any rate as far as English railways are concerned, and that is the practice of piecing together the short lengths of boiler tubes by means of a combined welding and rolling machine. The results in practice, we learn, are entirely satisfactory.

Beyond Tuxford the only work of any magnitude is the viaduct over the River Trent between Clifton and Fledborough stations. It consists of four river spans of 110-ft. each, consisting of steel girders resting on cast-iron columns filled with concrete. Each side of the river are 30-ft. span brick arches, there being 39 on the west side and 20 on the east side.

The line terminates in an easterly direction at Pyewipe Junction, 38 miles from Chesterfield and a mile and a half from Lincoln, where it joins the Great Northern and Great Eastern Joint Ry., over which it has running powers to the Great Northern station at Lincoln for passenger trains, while most of the mineral trains go through over the G. C. R. line to Grimsby *via* Market Rasen.

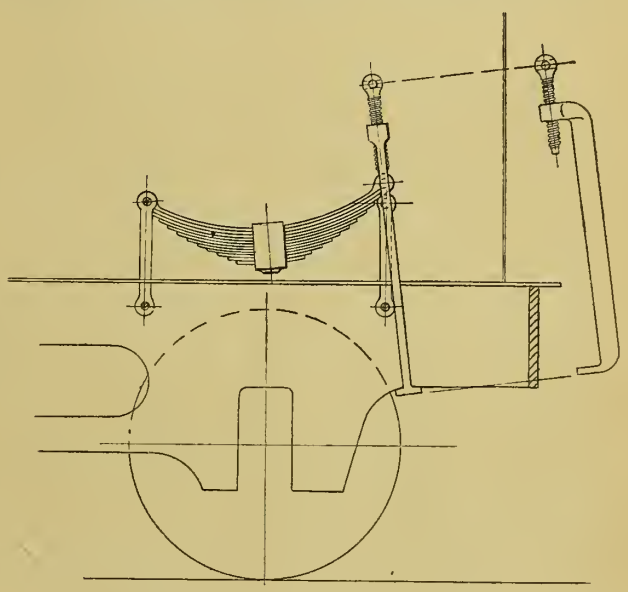
Returning to Langwith Junction, the Sheffield line takes a northerly direction and is about 12 miles in length to the junction with the G.C.R. at Beighton. For the first few miles there is a heavy cutting through rock. Shortly before reaching Clown the line is carried over the picturesque valley near Welbeck by the Markland Grips Viaduct, which consists of six stone arches. There is another heavy cutting beyond Clown, and at Beighton the Spink Hill tunnel. Here there are junctions with the Midland as well as the G. C. Ry. In addition to the main and branch lines we have described there are several colliery branches.

The station buildings are well up to modern standard, while the permanent way consists of 85 lb. per yard rails. The signals are similar to the Great Northern standard, with the improvement that the semaphore arm is in a line with the lamp, and not several feet above it, as is often the custom on the G. N. R.

(*To be continued.*)

SPRING CRAMP.

In locomotive sheds, where sheer legs are not provided, the changing of a spring is a very thankless job, especially on a tender, when the latter happens to be filled with water and coal. To obviate the process of "jacking," that is, lifting the tender off the wheels, until the holes in the spring and link coincide, a cramp as shown in the sketch herewith may be used. The spring is inserted in one link and pinned up. The other end stands a certain distance above its link, due to the camber of the spring being more when light than when the weight is on. The cramp, which is of steel, say $3\frac{1}{2}$-in. by 1-in. section, is provided at one end with a foot, so as to have ample bearing surface on the framing. The adjusting screw at the top is brought to bear on the loose end of the spring, and the head is revolved by means of a "tommy" bar inserted in the holes, thus pressing the spring down gradually on to the link.



Cramp used for Replacing Springs in Position.

An interesting series of 13 colored post cards has been issued to illustrate the scenic attractions of the Lynton and Barnstaple Ry. This narrow gauge line passes through some of the most beautiful scenery of North Devon, and a careful selection of some of the best views *en route* has been made. Nearly every card shows a little of the railway, but of special interest to railway collectors will be the "L. & B. Ry. train," and also the stations. The coloring has been admirably reproduced.

Train of Vestibuled Carriages, Interstate Express, Victorian Rys.

NEW INTER-STATE EXPRESS CARRIAGES, VICTORIAN RYS.

By the courtesy of the Victorian Rys. Commissioners and the chief mechanical engineer, Mr. T. H. Woodroffe, we are enabled to illustrate herewith the new train recently built at the Department's workshops at Newport, near Melbourne, for service on the Victorian portion of the Inter-State Express between Melbourne and Sydney. This is the premier train of the Australasian Colonies, and the new cars are likely to sustain its reputation.

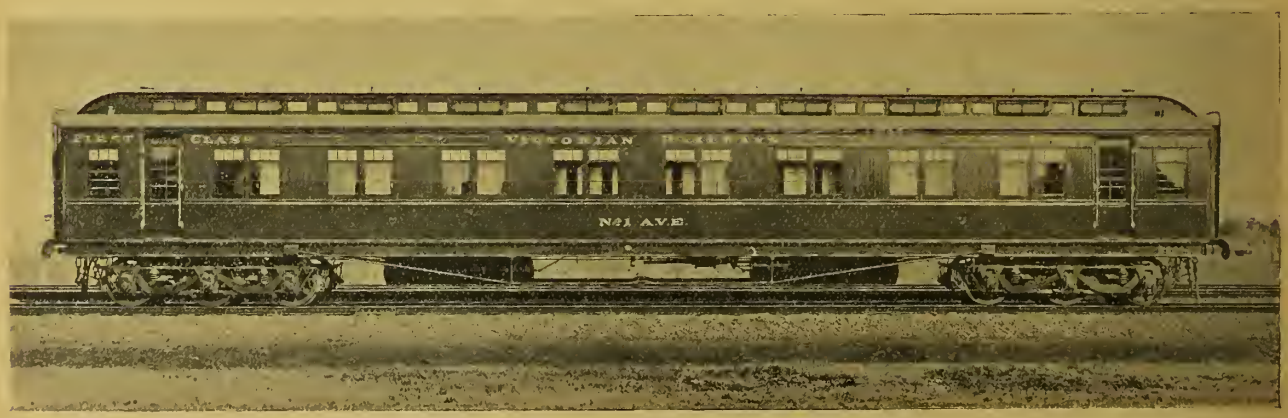
The train is vestibuled throughout, the compartment system being retained with wide side corridors and four external doors as shown. The previous vestibuled stock had doors to and opposite each compartment, but for a service of long non-stopping runs this has been deemed unnecessary, and a stronger design of body framing and better lighting of the compartments has been rendered possible.

The new stock comprises 1st class (48 passengers), 2nd class (72 passengers), composite 1st and 2nd class (56 passengers), and observation cars (33 passengers) and luggage vans. The cars all run on six wheel bogies, and are 74-ft. long over vestibule face plates, with the exception of the vans, which are 63-ft., and 9-ft. 6-in. wide. The average weight is 34 tons.

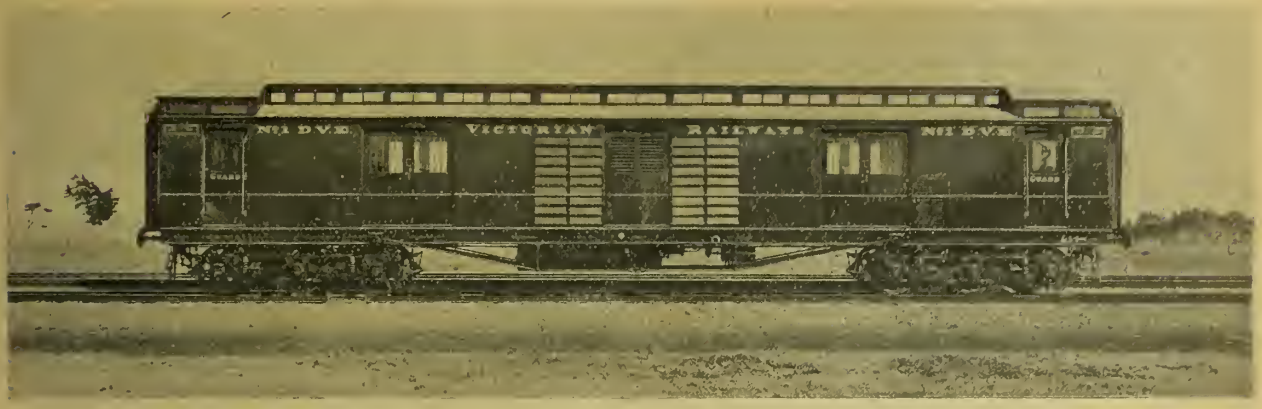
The underframes are of steel throughout, teak being used for the outer body framing, and Tasmanian blackwood for the internal framing, while most successful results have been achieved by the use for the 1st and 2nd class interior panelling of Queensland cedar and New Zealand kauri respectively. Colonial leather is used in both 1st and 2nd upholstering.

Pintsch's gas lighting is provided throughout, with incandescent mantles, and as in all Victorian rolling stock, passenger and goods, the Westinghouse brake is completely installed. The floors are covered with rugs, with tiles in the lavatories. The compartments are decorated with mirrors and scenic photographs. Special precaution has been taken to minimise dust, draughts, noise and vibration, and in short no effort has been spared to secure the comfort and safety of the passengers.

The most novel introduction, perhaps, is the observation car, which contains an observation



1st Class Vestibuled Corridor Carriage for Interstate Express, Victorian Rys.



Vestibuled Brake and Luggage Van, for Inter-State Express, Victorian Rys.

room with large windows and an enclosed rear platform. This car will of course be always be placed at the rear of the train.

The engine shown at the head of the train, though not of the standard express class, is also of the Department's own design, built at Newport. It is of the "D^D" (4-6-0) class, with 18-in. by 26-in. cylinders, 5-ft. drivers, and 175 lbs. boiler pressure. The standard express engines are of the "A^A" class (4-8-0), with 6-ft. drivers, and were illustrated on page 27, Vol. IX, of the "Locomotive Magazine. The "D^D" class are of a very useful "general purposes" type, finding employment principally on light line passenger trains, fast newspaper, goods, live stock and excursion specials.

The working of the Inter-State express, after due allowance is made for stops, slacks owing to single line working, etc., entails a running speed throughout of about 44 miles an hour over a hilly and difficult road.

REVIEWS.

"The Mechanical World Pocket Diary and Year Book for 1907." 6d. net. *Manchester:* Emmott & Co., Ltd.

A number of new features will add considerably to the popularity and utility of this practical little book. Some concise notes on current locomotive practice, data on the construction of reverberatory furnaces, and chapters on gas and oil engines and suction gas producers have been introduced, as well as new tables on worm gear, wire ropes, crane hooks, chords of angles, etc. The whole of the book has been reset with new type, and it is well bound in cloth. It is a remarkably cheap book.

"Modern Gas and Oil Engines." By F. Grover, A.M.I.C.E., M.I.M.E. 5/- net. *Manchester:* The Technical Publishing Co., Ltd., 287, Deansgate.

This is the fourth edition of a practical treatise dealing with the design of gas and oil engines. For the practical man the book should be of value, as it embodies the whole of the principles underlying the design, construction and working of gas engine plants, the various types of modern small and high power gas engines, and explanations as to how the leading dimensions may be calculated.

In view of the growing interest in the subject, considerable space is devoted to consideration of the uses of producer gas and acetylene in combustion motors. The second part of the book deals with petroleum engines. A brief description is given of the physical properties of oils and oil engine vaporisers, and practical hints on testing oil engines.

"Historic Locomotives, and 'Moving Accidents' by Steam and Rail." By A. R. Bennett, M.I.E.E. Paper covers 2/6, bound in cloth 3/6. *London:* Cassell & Co., Ltd.

The beginning of this book is taken up with a series of historical notes, which the author has collected, concerning some of the leading types of express locomotives of the mid-Victorian era, many of them from his personal recollection, and also the narration of the "moving accidents" in which some figured, like the Abergele, Clayton Tunnel and Tay Bridge disasters. The types of engines selected are illustrated in their original colors by an excellent series of ten plates reproduced from water color paintings by Mr. E. W. Twining. Among these it is difficult to single out the most deserving of special recognition, but in our opinion the best are plates No. 3, L. B. & S. C. R. engine No. 122 (one of Mr. Craven's "Jenny Lind" type), and No. 9, of South Eastern outside cylinder Crampton engines Nos. 85 and 92. The pictures furnish a realistic idea of the smart little engines, with their bright colors and handsome finish, that worked the crack trains of 50 years ago. Many of these relics of the past had long careers, and it is interesting to read that one of the L. B. & S. C. R. "Jenny Linds" (built in 1853) is still working in its original condition on the West Flanders Ry. The other engines illustrated in color are the broad gauge engine "Great Western," L. & S. W. Beattie "Milo," Caledonian Ry. 8-ft. single No. 83, Bristol and Exeter tank No. 42, N. B. R. No. 224 (in Tay Bridge disaster), L. & N. W. single "Prince of Wales" (in Abergele smash), and S. E. R. inside cylinder Crampton No. 137. The author has for many years been a strong advocate of the formation of a national collection of railway relics, and one object of this book is to further the project.

Interior of Invalid's Carriage, Hungarian State Rys.—This is a most completely fitted vehicle, specially designed for the transport of invalids and their attendants. This view shows the invalid's room, but there are in addition a completely equipped dispensary, and a compartment for the traveller's attendants.

We have received a copy of the official guide and timetables of the Bideford, Appledore and Westward Ho Ry. The booklet attracts attention to that part of North Devon known as "Kingsley's Country," of which the town of Bideford may be taken as the centre. The outlying villages mentioned in the guide include Westward Ho, Northam, Appledore, Instow, Clovelly, Hartland, &c.

The L. & N. W. Ry. have issued a new booklet for the guidance of American visitors to this country. Much interesting information is condensed in this book. Historical places along the line have their salient features pointed out, while the beauty spots of the districts served by the L. & N. W. R. are illustrated. The general information appendix includes a list of American terms and English equivalents, English currency tables, abridged time and distance table, nautical information, Transatlantic steamers, lighthouses sighted on approaching Queenstown and Liverpool, and British Customs tariff.

THE LOCOMOTIVE MAGAZINE.

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THE LOCOMOTIVE MAGAZINE.

Vol. XII. DECEMBER 15th, 1906. No. 172.

RAILWAY NOTES.

GREAT NORTHERN RY. — Ten new eight-coupled radial tank locomotives have recently been completed at Doncaster, numbered 147-156.

MIDLAND RY.—The following 7-ft. coupled engines have been rebuilt with large boilers: Nos. 159 and 160 (18½-in. by 26-in.), 150, 205, 1674 and 2438 (19-in. by 26-in.), 60, 66, 68, 139, 152 and 2640 (60 class) and 1739 (1740 class). Some goods engines, as Nos. 2049 and 2056, have been rebuilt with 6-ft. coupled wheels, necessitating a a new arrangement of splashers and sand-boxes. Some of the goods engines are now running painted black.

STEAM RAIL MOTOR TRAIN, GREAT CENTRAL RY.

GREAT CENTRAL RY.—The accompanying illustration shows the method by which Mr. J. G. Robinson proposes to utilise the old "Altrincham" tank locomotives which have for some time been outclassed for the rapidly-increasing weights and speeds of suburban traffic on this line, and at the same time still have several years' additional life left in them. The trailer car on standard main line bogies is arranged to permit of the driver occupying the end compartment when running carriage-first, and suitable rods and gearing place him in complete control of the engine when thus working. A number of old engines are undergoing alteration for this new service.

GREAT WESTERN RY.—The following are the latest additions to the "County" class: Nos. 3806 "County Kildare," 3807 "County Kilkenny," 3808 "County Limerick," 3809 "County Wexford," 3810 "County Wicklow," 3811 "County of Bucks," 3812 "County of Cardigan," 3813 "County of Carmarthen," and 3814 "County of Cheshire."

The following names have been allotted: No. 3072 "Bulkeley" (late "North Star"), No. 3079 "Eupatoria" (late "Shooting Star"), No. 182 "Lalla Rookh," No. 186 "Robin Hood" (given in error last month), and No. 189 "Talisman."

Nos. 3292 and 3297 have been rebuilt with new taper boilers.

LONDON & NORTH WESTERN RY.—The following express locomotives of the "Experiment" type have recently been built at Crewe: Nos. 1990 "North Western," 1991 "Palmerston," 1992 "President," 1993 "Richard Moon," 1994 "Scottish Chief," and 1996 "Tornado" (Crewe Nos. 4624-9). Further engines of this class are in hand, two of which have been allotted Nos. 61 and 222, and work is commenced on a new 4-6-0 goods engine with 5-ft. wheels.

Two errors crept into our notes last month. No. 1395 is not a 4-4-2 tank, but a "Precursor" tender locomotive, "Harbinger"; and No. 28 was not a coal engine, but a 7-ft. 6-in. single, "Prometheus." No. 1305 is the 4-4-2 tank referred to.

Forty-two of the 7-ft. 6-in. singles have now been scrapped, leaving only 18 of these famous engines. "Cornwall" is still being kept. Nos. 1671 "Shamrock" and 1673 "Lucknow" have been scrapped. Other withdrawals from service are the following: Nos. 97 "Atalanta," 111 "Russell," 139 "Cygnet," 196 "Leander," 562 "Palmerston," 803 "Tornado," and 834 "Elgin" (7-ft 6-in. singles); 1305 "Doric" (7-ft. compound), 181, 616, 653, 1295, 2165 and 2210 (4-ft. 3-in. tender mineral engines), and 1356, 1508, 1589, 1693, 1714 (special DX goods).

All the six-wheeled "Special" tank engines, hitherto on the duplicate list, are now being brought back into the regular list and allotted numbers below 3000. For instance, No. 3371 has been renumbered 2054, thus replacing "Queen Empress," which is scrapped. Altogether, about 20 engines have so far undergone the change of numbering.

LANCASHIRE & YORKSHIRE RY.—Some slight confusion crept into our October notes. The new four-coupled tank engines referred to have four wheels only, and saddle tanks, and are for shunting purposes at docks, etc. Those completed are Nos. 260, 813, 814, 821, 823, 825, 832, 840, 865 and 879 (works' Nos. 921-30).

The engines built for use as rail motors are side tanks, and those now completed are Nos. 3-8, which have been running in service during the latter part of the summer.

The goods engines referred to in October issue are practically of standard design, except that they have no air pump and are fitted with taper chimneys. Those completed are Nos. 41, 55, 115, 123, 246, 247, 255, 824, 881, 890, 60, 99, 261, 604, 829, 834 and 838, which are all in service.

The following Wright's 6-ft. bogie passenger engines have recently been withdrawn from service: Nos. 813, 814, 821, 823, 824, 825, 832, 840, 865, 879 and 881.

DUBLIN, WICKLOW & WEXFORD RY.—After January 1st, 1907, the name of this railway will be changed to the "Dublin & South Eastern Ry."

SOUTH EASTERN & CHATHAM RY.—Three new standard passenger tank locomotives have recently been put into service, Nos. 307, 321 and 326, the engines previously bearing these numbers having been put in the duplicate list.

The Metropolitan Ry. have ceased to work their trains into New Cross (S. E. & C. station), and in future the service from Whitechapel to that terminus will be worked by S. E. & C. tank engines of No. 710 class, which are already fitted with condensing apparatus.

The latest rebuilds are Nos. 103, 143, 215 and 232, bogie express, and 138, bogie tank, with brass domes, and Nos. 303-4. No. 156 of the first-named class has been hauling the various Royal trains to and from Port Victoria this summer.

MR. W. M. SMITH.—We regret to have to place on record the death of Mr. Walter Mackenzie Smith, the originator of the Smith system of compounding locomotives, and of various other improvements in locomotive design. Mr. Smith was born at Ferryport-on-Craig in 1842, and his early engineering training was obtained with Glasgow firms. For some time prior to 1874 he was employed on the Great Eastern Ry., and at that date he was appointed locomotive, carriage and wagon superintendent of the Imperial Government Rys. of Japan, being the first British locomotive engineer in that country. In 1883 he returned to England to take charge of the arrangement of the workshops and machinery of the North Eastern Ry. at Gateshead.

NORTH BRITISH RY.—Twelve engines of a new class, four-coupled with leading bogie, are to be built for express meat and fish traffic and for service on the West Highland section. They will have boilers similar to the No. 322 class of passenger engines, but with safety valves on the firebox and square cabs, and the driving wheels will be 6-ft. in diameter.

LONDON, BRIGHTON & SOUTH COAST RY.—Another ten-wheeled tank engine has recently been completed similar to No. 595, and is now engaged in running trial trips. It differs slightly from its predecessor, having a clerestory roof to the cab and an iron door between the eye-glasses at the back, and the condensing exhaust pipes are brought down below the running plate and enter the tanks from below. Another feature is the use of the Westinghouse pattern brake handle in place of Mr. Stroudley's modified form. The number of the engine is painted in large figures on the bunker, which will be the practice in future.

Nos. 11 and 22 (D class) and Nos. 309-313 (D2 class) have been withdrawn from service, and No. 53 ~~"Ashtead"~~ "Sirdar" has been re-named "Richmond."

OUR JANUARY ISSUE, 1907.—As is usual, with our January issue will be supplied the index to Vol. XII., and in addition it will consist of a largely-increased number of pages containing colored illustrations of the latest English, Scottish and Irish express trains, an article on the famous "Sharpie" class of narrow-gauge express locomotives on the G.W.R., and other interesting special matter. The price of the issue will be 4d., including the index; art paper edition 6d.

Photo by *Harold E. Jefferiss.*

The Innsbruck Express leaving Feldkirch, Austrian State Rys. Locomotive as illustrated in Vol. IV., page 77.

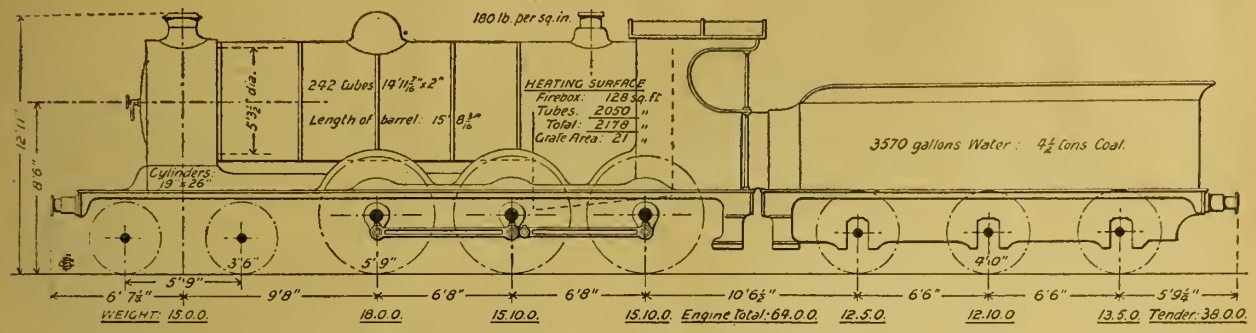


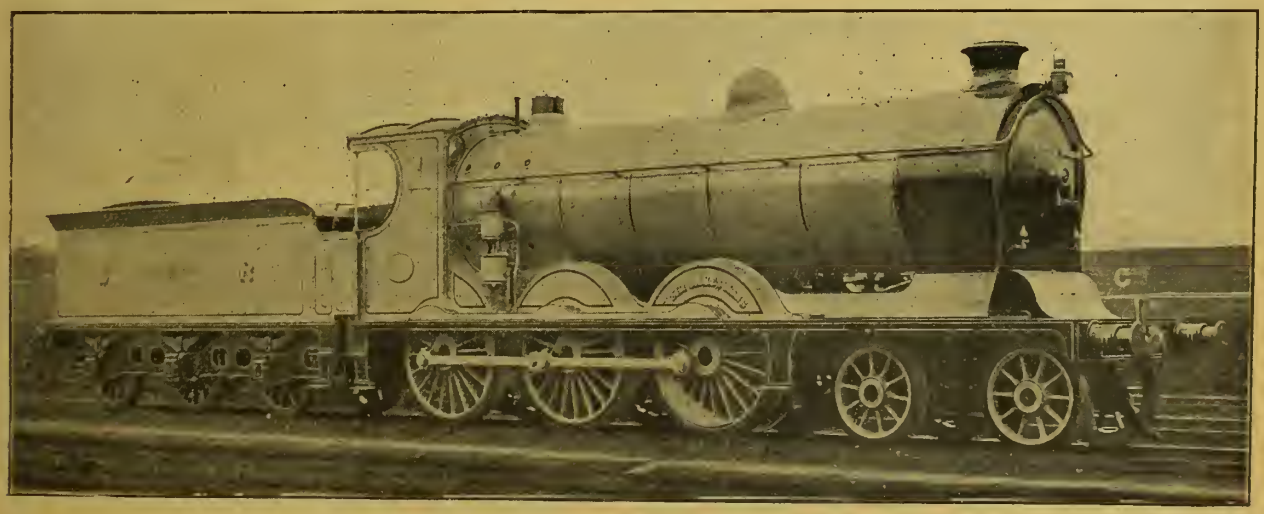
Diagram of Six-coupled Bogie Mixed Traffic Locomotive No. 908, Caledonian Ry.

SIX-COUPLED BOGIE MIXED TRAFFIC LOCO, CALEDONIAN RY.

Mr. J. F. McIntosh, the capable locomotive superintendent of the above-mentioned railway, is evidently so well satisfied with the suitability of the 4-6-0 type of engine for working the heavy traffic of the line that, in continuation of the policy which started with the introduction of the six-coupled "Oban bogies" and the still larger Nos. 49-50, he has this year introduced no fewer than three different classes of six-coupled engines. The two already illustrated were slight modifications of the 55 and 50 classes, but the third type, of which a reproduction is here shown, strikes an exact balance between the goods and express types, and to that extent we are justified in anticipating the designer in describing them as for mixed traffic. There are to be ten of the class, the first, No. 908, being named "Sir James King," out of compliment to the Chairman of Directors.

These engines have the following leading dimensions: cylinders 19-in. in diameter by 26-in. stroke; wheels: bogie 3-ft. 6-in. diameter, coupled 5-ft. 9-in. diameter; wheelbase: bogie 5-ft. 9-in., coupled wheels 13-ft. 4-in., total 25-ft. 10½-in.; boiler: length of barrel 15-ft. $8\frac{3}{16}$-in., diameter 5-ft. 3½-in., height of centre above rails 8-ft. 6-in.; 242 tubes, 14-ft. $11\frac{7}{16}$-in. long by 2-in diameter; heating surface: firebox 128 sq. ft., tubes 2,050 sq. ft., total 2,178 sq. ft.; grate area 21 sq. ft.; working pressure 180 lb. per sq. in.; total weight of engine in working order 64 tons, and of tender 38 tons, the latter having a capacity for 3,570 gallons of water and 4½ tons of coal. The construction and general design of these fine engines is approximately similar to that of the larger No. 903 class described in our issue of July last.

Southern Pacific Ry.—This line is now equipped with a hospital car 67-ft. long and 9-ft. 8-in. wide. The operating and dressing rooms occupy 26-ft. of the length, and there is a ward with berths for 12 patients. The rear of the car is an observation room, with state rooms for doctors and nurses. At the front is the kitchen, a refrigerator room and the attendants' quarters. When out of use the fittings of the berths are packed below the floor. There is, of course, a complete dispensary and surgical outfit.



Six-coupled Bogie Mixed Traffic Locomotive No. 908 "Sir James King," Caledonian Ry.

RECENT LOCOMOTIVES OF THE BELGIAN STATE RYS.

(*Concluded from page* 149.)

BEFORE concluding this account of the new locomotives of the Belgian State, mention must be made of the two types of tank locomotives known as types 15 and 23.

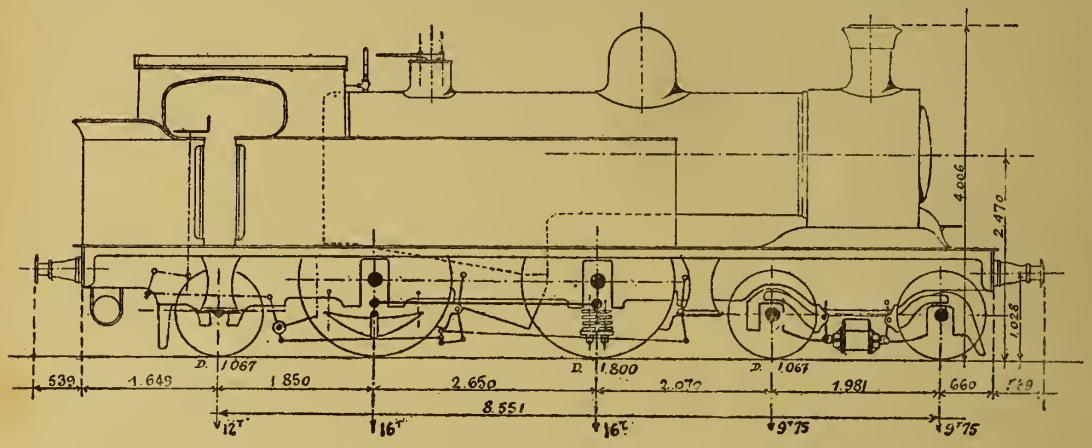


FIG. 13.—TEN-WHEEL SIDE TANK PASSENGER LOCOMOTIVE, TYPE 15, BELGIAN STATE RYS.

Engines of the former type have been in service for some time. The first of the class was exhibited at the Paris Exposition of 1900, and illustrated in our issue of January, 1901, p. 12. There are now about 115 of these at work, the first 50 being as then illustrated, with comparatively deep fireboxes between the two coupled axles. The later engines, 65 in number, are of the modified class shown here in Fig. 13, with longer and shallower sloping fireboxes extending rearwards over the trailing coupled axle. Other differences in detail may be noticed in a comparison of the two outlines, as for instance the increased height of the boiler centre and a greater length over all, though the wheelbase of both classes is the same. All these engines were built between the dates 1900-1903, except two, Nos. 1060-1, which were built in 1905 at the Ateliers du Thiriau at la Croyère and the Ateliers Zimmermann Haurez at Monceau sur Sambre, respectively, and exhibited at Liège in that year. No. 1,061 was provided with the Schmidt superheater, and had the following leading dimensions: cylinders (fitted with piston valves) 18½-in. in diameter by 24-in. stroke; diameter of wheels; bogie and trailing radial 3-ft. 6-in., coupled 5-ft. 11-in.; total wheelbase 28-ft. 0½-in.; total length over buffers 39-ft. 2-in.; heating surface: firebox 126·16 sq. ft., tubes 744·50 sq. ft., total 870·66 sq. ft.; grate area 27·12 sq. ft.; heating surface of superheater 183 sq. ft.; the boiler had a diameter of 4-ft. 4-in., and contained 132 flue tubes 10-ft. 3-in. long and 2-in. in diameter, and 15 superheater tubes of the same length and 5-in. in diameter; working pressure 175 lb. per sq. in. With 1,432 gallons of water in the tanks, and 3½ tons of coal, the total weight of the engine is 64 tons, of which 32 tons are available for adhesion. No. 1061 has its boiler centre 8-ft. 1¼-in. above the rails, as compared with 7-ft. 8¼-in. in the earlier engines with deeper fireboxes. All these engines are employed on suburban traffic.

The locomotives of Type 23 are illustrated in Fig. 14, and as can be seen, they are eight-coupled side tank locomotives with outside cylinders. Their leading dimensions are as follows: cylinders 19-in. in diameter by 23¾-in. stroke, actuated by ordinary D valves and Walschaerts gear; diameter of wheels 4-ft. 1¾-in.; total wheelbase

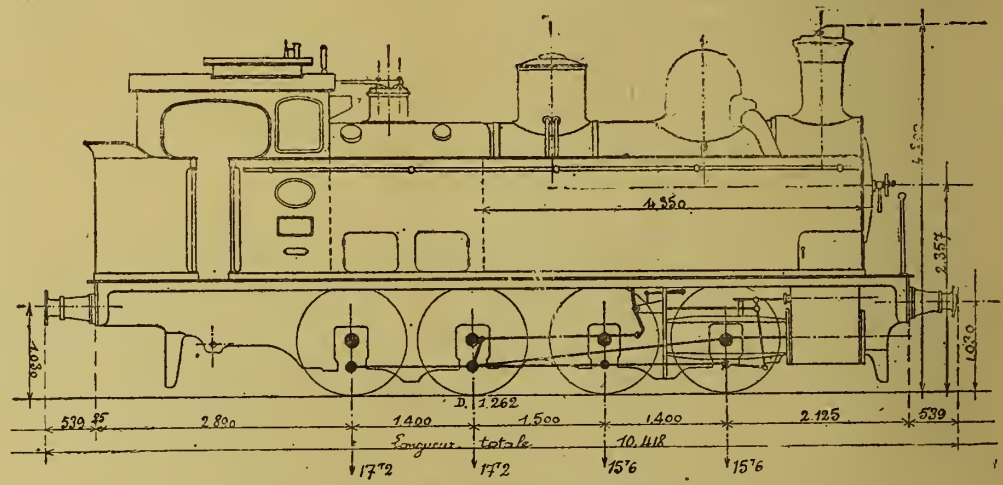


FIG. 14.—EIGHT-COUPLED SIDE TANK LOCOMOTIVE, TYPE 23, BELGIAN STATE RYS.

14-ft. 1¼-in.; total length over buffers 34-ft. 2¼-in.; internal diameter of boiler barrel 4-ft. 6-in., height of centre above rails 7-ft. 8¾-in.; 264 tubes 11-ft. 6-in. long and 2-in. in diameter; working pressure 175 lb. per sq. in.; heating surface; firebox 97·1 sq. ft., tubes 1,252·74 sq. ft., total 1.349·84 sq. ft.; grate area 24·1 sq. ft.; with 1,542 gallons of water and 3 tons of coal the total weight of engines of this class is 65½ tons. There are 65 engines of this type in service, which replace the older eight-coupled engines built in 1870-4, which are now in process of withdrawal. Despite their ample dimensions, they are none too powerful for the special work of hauling express trains up the inclined plane at Liège, where it is found necessary to employ three locomotives—one at the head of the train and two of Type 23 acting as "pushers." Otherwise they are used to haul goods trains over certain sections, and it has been suggested that they also should work passenger trains, those most recently built being fitted with the quick-acting Westinghouse brake for this service.

In addition to the various types referred to in this series of articles, a number of shunting engines have been built of the class illustrated in our issue of June, 1898, p. 86, but with more modern chimneys, and the later examples have been equipped with steam-heating apparatus for warming up trains previous to starting on their journeys.

Since 1900 more than 900 locomotives have been built for the Belgian State system, and many others are now in course of construction. Our esteemed correspondent, M. A. Jacquet, of Brussels, who has furnished the illustrations and particulars for this series of articles, wishes to express his indebtedness for his information to the Bureau of Management of the State Rys. and to the firms of builders who have so largely contributed to the equipment of this important system of railways with up-to-date and noteworthy locomotive stock.

OLD LOCO., NORTHERN COUNTIES COMMITTEE, MIDLAND RY.

THE accompanying illustration shows the oldest engine now at work on what was until recently known as the B. & N.C.R., and one of the oldest in the British Isles. Originally constructed by Messrs. Bury, Curtis & Kennedy in 1847, it was one of the original engines of the Belfast & Ballymena Railway. When rebuilt at the Belfast works of the B. & N.C. Ry. in 1871, which date it bears on the number plate, the type of the engine was considerably altered, plate frames being substituted for the bar framing, while the original "Bury" boiler was superseded by one of ordinary type. It was again rebuilt at Belfast in 1887, as illustrated. Now superseded by one of Mr. Malcolm's large standard compound bogie engines, No. 4A is working out an honoured old age with passenger trains on the Dungiven branch. The tender is not the original, but one taken from an engine built by Messrs. Sharp, Stewart & Co. in 1856. It is also interesting as being one of the last survivors of this design once common on almost all British railways.

FOUR-WHEELS COUPLED PASSENGER LOCOMOTIVE No. 4, NORTHERN COUNTIES COMMITTEE, MIDLAND RY.

THE LANCASHIRE, DERBYSHIRE & EAST COAST RY. AND ITS LOCOS.

(*Concluded from page* 195.)

THE 34 engines comprising the locomotive stock of the L.D. & E.C. R. which will be taken over by the Great Central Ry. are all tank engines of four distinct types. The original motive power consisted of eight engines, numbered 1 to 8, constructed by Messrs. Kitson & Co. in 1895, under the supervision of Mr. C. T. Broxup (now loco. superintendent of the Manila Ry.). We illustrated one of these engines in the "Locomotive Magazine," Vol. II., page 126. They are known as the "A" class and have six wheels coupled with a trailing pair of radial wheels. The inside cylinders are 18-in. in diameter with a stroke of 26-in., the driving wheels are 4-ft. 9-in. diameter, and the radial wheels 3-ft. 9-in. The total wheelbase is 22-ft. 6-in., the leading to driving centres being 7-ft. 10-in. apart, the driving to trailing 7-ft. 2-in., and the trailing to radial 7-ft. 6-in. The radial axleboxes have 3 inches play on either side. The heating surface of the tubes is 1,142 sq. ft., and that of the firebox 107 sq. ft., giving a total area of 1,249 sq. ft. The grate area is 21 sq. ft., and the working pressure is 170 lb. per sq. in. The side tanks have a capacity of 1,825 gallons, while $2\frac{1}{2}$ tons of coal can be carried in the bunker.

Photo by SIX-COUPLED RADIAL TANK No. 7, CLASS A, REBUILT, L. D. & E. C. RY. *Loco. Pub. Co. Ltd.*

The weight in working order is 58 tons 4 cwt. They are fitted with the Gresham & Craven combined steam brake valve and vacuum steam ejector, the former working the engine brake and the latter that on the train. As these engines come in for heavy repairs they are fitted with Belpaire pattern fireboxes, as shown herewith.

Engines Nos. 9 to 12 constitute the "B" class, and were built by Messrs. Kitson & Co. in 1897-98 for shunting and light work. They are six wheels coupled side-tank engines with cylinders 17-in. diameter by 26-in. stroke. They have 4-ft. 3-in. diameter driving wheels, and the boiler pressure is 160 lb. per sq. in.

In 1897 Messrs. Kitson & Co. designed and constructed the "C" class of passenger engines, of which there are six, Nos. 13 to 15 being built in 1897, and Nos. 16 to 18 in 1898. They are four-coupled engines with a trailing bogie, the leading and driving wheels being coupled. The diameter of the coupled wheels is 5-ft. 6-in., the bogie wheels being 3-ft. in diameter. They have cylinders 17-in. in diameter by 24-in. stroke; the boiler pressure being 160 lb. per sq. in. There are 174 tubes with an outside diameter of $1\frac{3}{4}$-in. in the boiler, giving a heating surface of 866·8 sq. ft., which, added to the 94·3 sq. ft. of the firebox, provide a total of 961·1 sq. ft. The grate area is 16·6 sq. ft. The side tanks have a capacity for 1,300 gallons, and the bunker carries 2 tons of coal.

Photo by SIX-COUPLED TANK LOCOMOTIVE No. 10, CLASS B, L. D. & E. C. RY. *Loco. Pub. Co. Ltd.*

The weight of these engines in working order is 50 tons.

The "A" class having proved so satisfactory, a further 10 engines of this type, numbered 19 to 28, were built during the years 1901 and 1902 by Messrs. Kitson & Co. They are identical with the earlier engines of the same class, except that they all had Belpaire fireboxes when built.

Four-coupled Bogie Locomotive No. 16, Class C, L. D. & E. C. Ry.

No. 26 has been fitted with Marshall's patent valve gear, by the application of which it is stated the hauling capacity is increased by 20 per cent., as compared with a similar engine fitted with the Allan motion. With the new gear a larger blast pipe is used, and in consequence the fire is not disturbed by a heavy blast. There is certainly a marked absence of vibration when running, and the engine steams freely.

On the occasion of the King's recent visit to Rufford Abbey, he travelled from King's Cross to Ollerton Station on the L. D. & E. C. R. The L. & N.W. Royal train was used, consisting of six heavy bogie carriages. It was worked from London to Tuxford (G.N. station) by the G.N. Company, and was then taken in charge by the L.D. & E. C., over whose line it travelled to Ollerton. On previous occasions the L. D. & E.C. Co. worked the train with two of the passenger engines, but on this occasion No. 26 worked the train easily, unassisted, round the junction curve of 15 chains radius at Tuxford up a rising grade of 1 in 132 for 37 chains on to Ollerton.

It may be mentioned that the fitting of the Marshall gear has not entailed any alteration of the existing cylinders and slide valves.

Running powers over the G.C.R. from Lincoln to Grimsby were first exercised in July, 1901, and a considerable development in the mineral

Photo by Six-coupled Radial Tank Locomotive No. 26, Class A, with Marshall's Valve Gear, L. D. & E. C. Ry. [*Loco. Pub. Co. Ltd.*

traffic followed, consequently more powerful engines were required; therefore the D class of six-coupled bogie engines were built in 1904-5 by Messrs. Kitson & Co. There are six in this series, Nos. 29 to 34, and they are among the largest tank locomotives working in this country. The cylinders have a diameter of 19-in., with a 26-in. stroke, driving the middle pair of coupled wheels, which are 4-ft. 9-in. in diameter, and the bogie wheels 3-ft. diameter. The fixed wheelbase is 16-ft. 6-in., and the total wheelbase 29-ft. 6-in. The boiler carries a working pressure of 180 lb. per sq. in., and has a heating surface of 1,560 sq. ft., 1,436 sq. ft. being furnished by the tubes, and 124 sq. ft. by the firebox. The grate area is 21·75 sq. ft. The boiler contains 252 tubes of mild steel, solid cold drawn, $1\frac{3}{4}$-in. external diameter, swelled to $1\frac{13}{16}$-in. at the firebox end, expanded at both ends and beaded. The balanced slide valves are on top of the cylinders operated by Allan straight link motion with rocking arms.

The engines carry 3,000 gallons of water, each of the side tanks having a capacity of $812\frac{1}{2}$ gallons, and the bunker tank 1,375. The bunker also holds $4\frac{1}{2}$ tons of coal. These engines all have extended smokeboxes and fireboxes of the Belpaire type. Two (Nos. 29 and 30) have brake gear applied to the bogie wheels. The weight in working order is 77 tons 2 cwts., of which 52 tons 8 cwts. are on the coupled wheels. The rear buffers are fitted with elliptical heads, the movement of the frame at such a distance from the fixed wheelbase being considerable.

These engines regularly work through from Langwith Junction to Grimsby with trains of 45 loaded coal wagons and a 20 ton brake, equivalent to 744 tons.

All the engines are fitted with the vacuum, steam and hand brake. Siren whistles, similar to the Caledonian, are fitted. Black is the color adopted by the L. D. & E. C. R. for its locomotive stock, lined out with grey bands edged with chrome outside and vermilion inside. The engine number plates on the bunker sides are of brass with raised bright numbers on a red ground, while the Company's initials are on the tank panels in gilt letters shaded with blue. The first eight engines originally did not carry plates, but had the numbers painted on. The coupling rods are painted vermilion, and the motion plates, etc., light blue.

The L. D. & E. C. Ry. has at different times possessed no fewer than six locomotive superintendents, their chronological order being as follows: C. T. Broxup, T. B. Grierson, W. Greenhalgh, J. Connor, J. W. Dow and R. Thoms.

The coaching stock consists principally of six-wheeled carriages 36-ft. long, painted bright red with yellow lining and gilt lettering. The wagons are chocolate colour with white lettering.

The trains running between Sheffield and Mansfield *via* the Sheffield District Ry. and Langwith Junction (making connection there with the Chesterfield and Lincoln trains) are made up of L. D. & E. C. carriages worked by Midland Co.'s engines. It may be mentioned that the G. E. R. work their own coal trains over the L. D. & E. C., as also the G. N. R. from the Dukeries Junction.

Photo by] SIX-COUPLED TRAILING BOGIE LOCOMOTIVE NO. 53, CLASS D, LANCASHIRE, DERBYSHIRE & EAST COAST RY. [*Loco. Pub. Co. Ltd.*

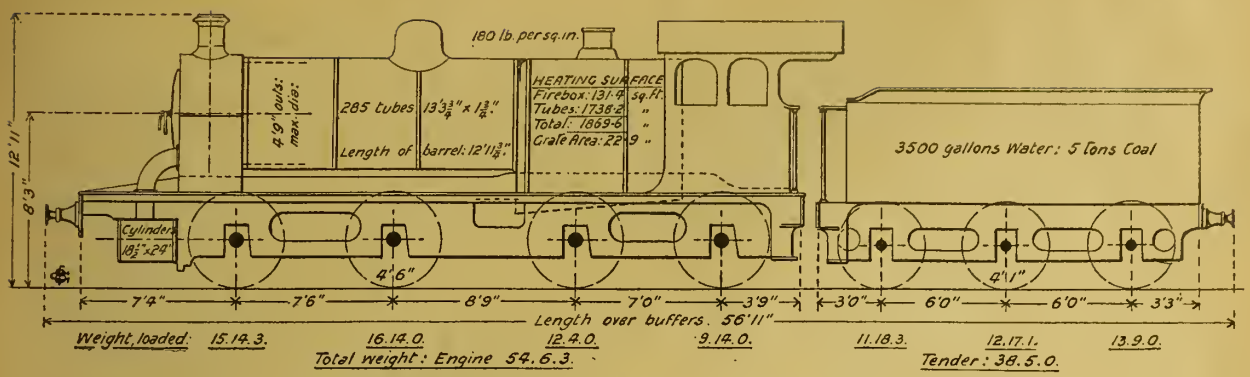


Diagram of Eight-coupled Goods Locomotive No 20, Great Eastern Ry.

EIGHT-COUPLED GOODS LOCO., GREAT EASTERN RY.

We are indebted to Mr. James Holden, the locomotive, carriage and wagon superintendent of the above railway, for the accompanying particulars of a new type of goods locomotive recently built at Stratford. It bears the running No. 20, and is to some extent a rebuild of the famous "Decapod" tank engine, which was withdrawn from service for reasons connected with the permanent way department after amply vindicating its ability and power as a traffic-hauler. The engine as now illustrated has, as can be seen, eight coupled wheels occupying a long wheelbase, which is mitigated by fitting leading and trailing axleboxes of the radial type. There are two cylinders, placed outside the frames, actuated by ordinary Stephenson link-motion; the connecting rods are 8-ft. $2\frac{3}{8}$-in. long between centres, and the eccentrics have a throw of $5\frac{3}{4}$-in. The boiler is of large dimensions, with a barrel 12-ft. $11\frac{3}{4}$-in. long and of 4-ft. 9-in. maximum diameter, measured outside the first ring; the firebox is of the Belpaire type, 8-ft. long by 3-ft. $9\frac{3}{4}$-in. wide. The frames are 34-ft.

Photo by Eight-coupled Goods Locomotive No. 20, Great Eastern Ry. *Loco. Pub. Co. Ltd.*

4-in. long and $1\frac{1}{8}$-in. thick, and are placed 3-ft. $10\frac{3}{4}$-in. apart. The engine weighs 50 tons 4 cwt. 1 qr. empty, and 54 tons 6 cwt. 3 qrs. in working order, and the tender weighs 17 tons 11 cwt. 3 qrs. empty and 28 tons 5 cwt. full. Other dimensions will be found on the diagram reproduced from particulars furnished by Mr. Holden. The engine is provided with the steam brake.

STEAM RAIL MOTOR COACH, BAVARIAN STATE RYS.

THE motor coach shown in the accompanying illustration presents some rather exceptional features, not fully apparent from the outside. It has two cylinders, each 8-in. in diameter, but each cylinder has two pistons, with separate lengths of stroke of $10\frac{1}{4}$-in., and the four pistons are connected to crank pins on the four wheels of the steam bogie, set on all quarters so as to obtain the maximum power. In order to maintain these relative positions, the two pairs of wheels are coupled by means of side rods on return cranks outside the connecting rod crank pins. The engine is therefore practically a four-cylinder four-wheels coupled locomotive of considerable power. It may be mentioned that the idea of two pistons moving simultaneously towards different ends of the same cylinder is not altogether new, since an engine designed by Mr. J. G. Bodmer, of Manchester, was built for the London, Brighton & South Coast Ry. in 1845, which for some time worked with cylinders arranged on that principle.

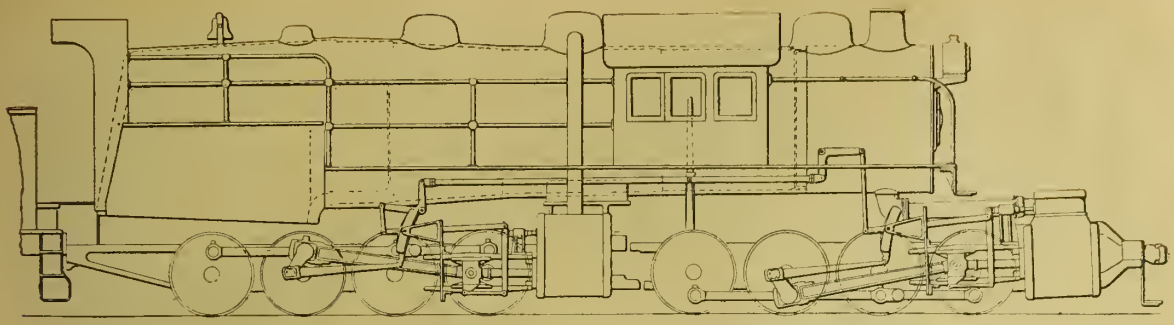
The engine bogie of the motor coach under notice was supplied by the well-known firm of J. A. Maffei, of Munich, and has the following leading particulars: diameter of coupled wheels 3-ft. 3-in.; wheelbase 9-ft. $0\frac{3}{4}$-in.; working pressure of boiler, which is of the locomotive type and supplied with a superheater, 235 lb. per sq. in.; heating surface: firebox 37·3 sq. ft., tubes 405·6 sq. ft., total 442·9 sq. ft.; superheater surface 74·8 sq. ft.; grate area 9·3 sq. ft.; bunker capacity about $\frac{1}{2}$ ton; weight empty 16 tons, and in working order 18 tons.

The car body, which was the joint product of the Vereinigten Maschinenfabrik, Augsburg, and the Maschinenbaugesellschaft, Nürnberg, is carried on a four-wheeled bogie having wheels 3-ft. 3-in. in diameter on a wheelbase of 8-ft. 2-in. The total wheelbase of the coach is 51-ft. 6-in., and the total length is 78-ft. 7-in., with an extreme width of 9-ft. 6-in. and a height of 14-ft. 9-in. It has a seating capacity for 55 passengers, and weighs in working order 50 tons. The minimum radius of curves on the line it is built to work is 600-ft., and it is restricted to a maximum speed of 47 miles per hour. We understand that it has been found to work with efficiency and economy.

STEAM RAIL MOTOR COACH, BAVARIAN STATE RYS.

NEW LOCOMOTIVES, ISLE OF MAN RAILWAY.

IN our issue of December, 1903, pp. 201 and 202, we published an account of the Isle of Man Railway and its rolling stock. At that time the locomotive stock comprised nine four-coupled tank locomotives, all built by Messrs. Beyer, Peacock & Co., Ltd. Since then the amalgamation of the Manx Northern line, from St. John's to Ramsey and to Foxdale, and the taking over of its rolling stock has added four engines. These are of no less than three classes, No. 1 "Ramsey" and No. 2 "Northern" being four-coupled outside cylinder tank engines with a leading pair of wheels, built by Messrs. Sharp, Stewart & Co. at Manchester in 1879; No. 3 "Thornhill," identical with the Isle of Man Ry. engines described in our article and built by the same firm, Messrs. Beyer, Peacock & Co.; and



Proposed Four-cylinder Compound Freight Locomotive, Erie RR.

No. 4 "Caledonia," built by Messrs. Dübs & Co., of Glasgow, similar in general appearance to Nos. 1 and 2, but with all six wheels coupled.

A service of express trains in addition to the special boat trains from Douglas to Ramsey, 26½ miles, to compete with the electric line along the east coast, has been in operation during the summer season for the past year or two, and to work the increased mileage two additional locomotives of increased dimensions have been recently constructed by Messrs. Beyer, Peacock & Co. Ltd. They are numbered and named

Four-coupled Radial Tank Locomotive No. 11 "Maitland," Isle of Man Ry.

respectively, 10 "G. H. Wood" and 11 "Maitland." These engines have boilers 3-ft. 3-in. in diameter and 7-ft. 8¼-in. long, as compared with 3-ft. diameter on the older engines, and work at 160 lb. pressure; wheelbase: leading to driving 8-ft., driving to trailing 6-ft. 6-in.; length of firebox 5-ft., 121 tubes of 1⅝-in. diameter; heating surface: firebox 51·4 sq. ft., tubes 409 sq. ft., total 461 sq. ft., as against 391·98 sq. ft.; capacity of tanks 480 gallons and of bunker about ½ ton; weight in working order 20 tons 10 cwt. 2 qrs. Other dimensions are as in our previous article.

We are indebted to the builders, Messrs. Beyer, Peacock & Co., Ltd., for the photo.

MALLET COMPOUND LOCOMOTIVE, ERIE RAILROAD.

In the accompanying diagram is shown the general design of three immense compound freight locomotives, on the Mallet system, an order for which has been placed, we understand, with the American Locomotive Co. In weight and dimensions these engines easily hold the record, exceeding the previous Mallet compound built by the same firm for the Baltimore and Ohio, which was illustrated in our issue of October, 1904, and even the larger Baldwin engine supplied to the Great Northern (U.S.). The three engines here illustrated will have four cylinders 25-in. and 39-in. in diameter, with a stroke of 28-in., and 4-ft. 3-in. driving wheels occupying a total wheelbase of 39-ft. 2-in. The boiler will have 6,108 sq. ft. of heating surface and 100 sq. ft. of grate area, and will carry a working pressure of 215 lb. per sq. in. It will have a barrel 7-ft. in diameter containing 468 tubes 21-ft. long and 2¼-in. in diameter. The estimated weight of each engine in working order will be 183 tons, exclusive of the tender, which, with 8,500 gallons of water and 16 tons of coal, will weigh a further 72 tons, or 255 tons in all. The total wheelbase of engine and tender will be 72-ft. 2-in.

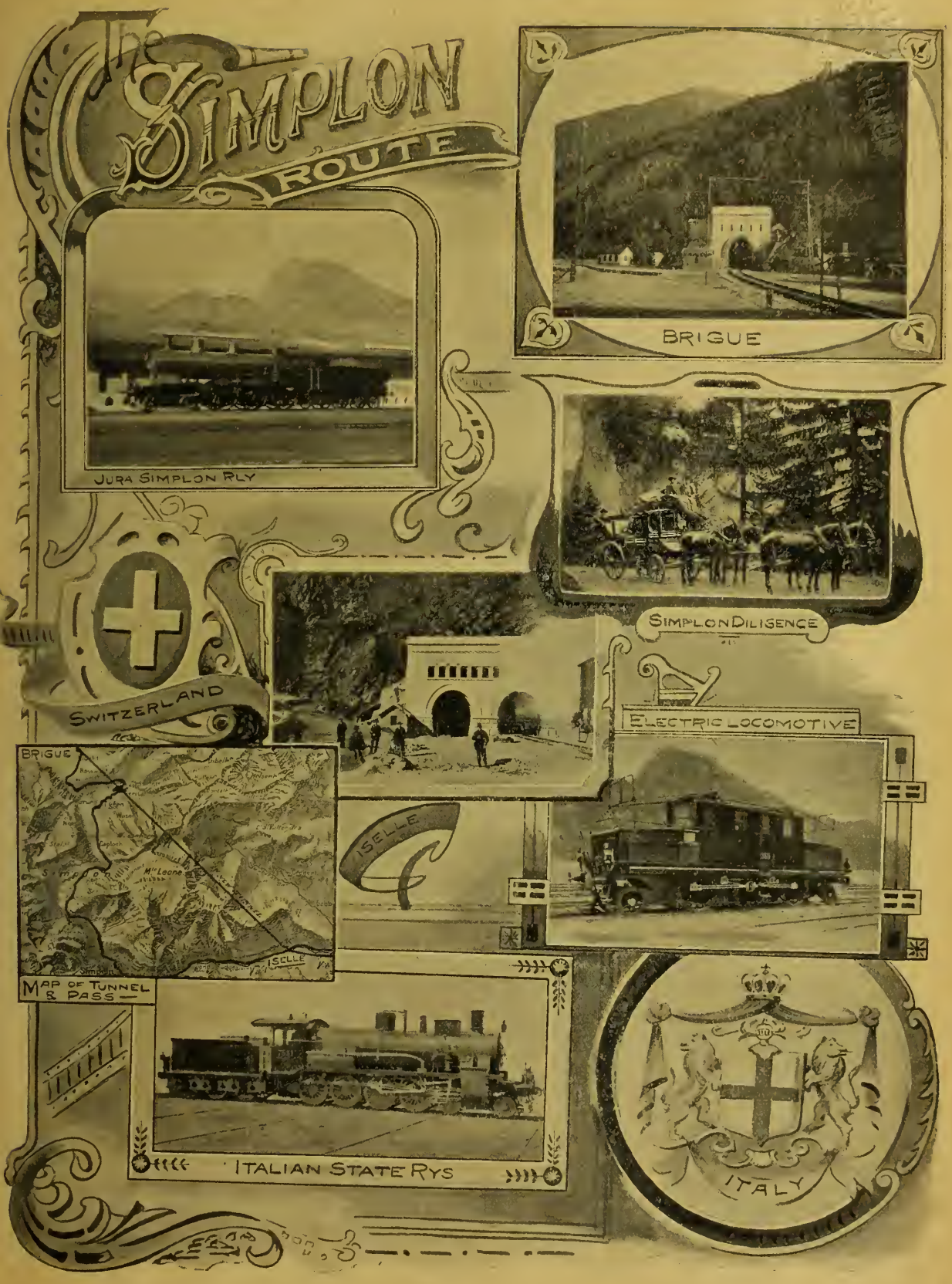
Messrs. J. E. Hopkinson & Co., Ltd., inform us that they have been awarded a gold medal at the Milan Exposition for their exhibition of india-rubber fittings for continuous brakes for railways and tramways, and a silver medal for railway buffers and springs. The firm also received the award of the Grand Prix, in addition to a gold medal for their patent solid tyres for motors.

Photo by TRAIN WITH ELECTRIC LOCOMOTIVE ATTACHED AT BRIGUE STATION JURA-SIMPLON RY. *Loco. Pub. Co. Ltd.*

THE SIMPLON ROUTE.

THE engineering event of the year 1906 has doubtless been the opening of the Simplon Tunnel, providing a sixth Trans-Alpine route. The first railway constructed over the Alps was the Semmering, in 1848-53, between Austria and Styria, on the through route between Vienna and Venice. The Semmering tunnel is under a mile in length, but severe grades were necessary to enable such a short one to be possible. Next in order came the Mont Cenis in 1861-70, about $7\frac{3}{8}$ miles long, and following this the Arlberg, between Switzerland and the Tyrol, in 1884, about $6\frac{1}{3}$ miles long. The Brenner route was opened in 1867, but has no very long tunnel on it. A great undertaking was completed in 1882 by the opening of the St. Gothard, $9\frac{1}{4}$ miles long, which took ten years to construct. Although not surpassing the last-named as an engineering feat, the Simplon exceeds its rival in length by nearly 3 miles.

Photo by TRAIN WITH STEAM LOCOMOTIVE ATTACHED AT BRIGUE STATION, JURA-SIMPLON RY. *Loco. Pub. Co. Ltd.*

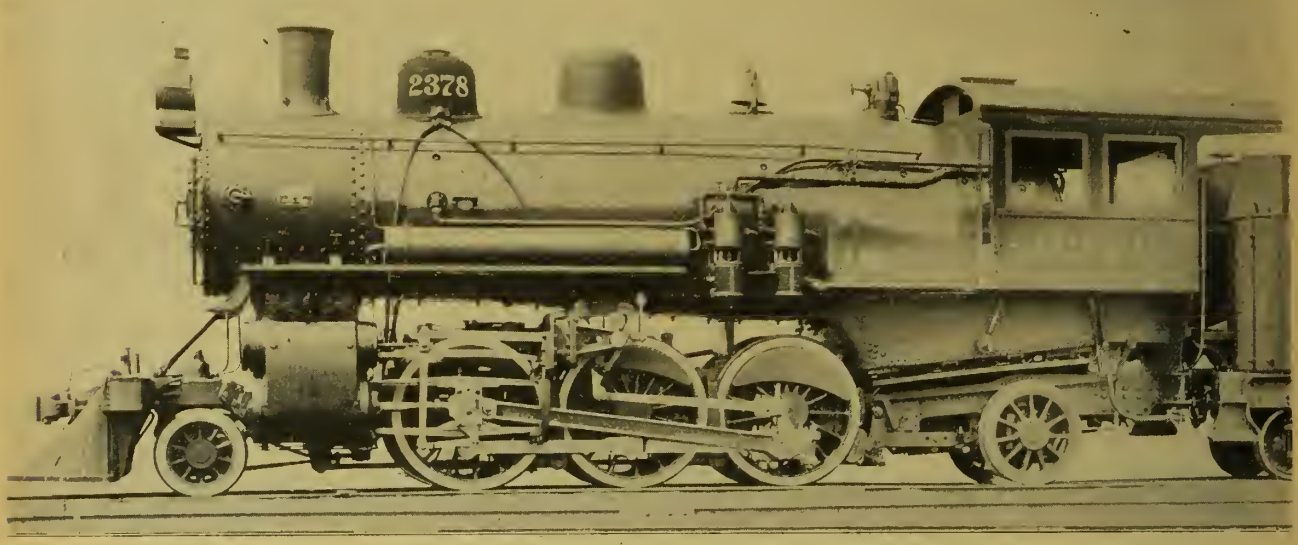

The Simplon Route
Jura Simplon Rly
Brigue
Simplon Diligence
Switzerland
Electric Locomotive
Brigue
Iselle
Map of Tunnel & Pass
Italian State Rys
Italy

The *diligence* road over the Simplon was constructed by order of Napoleon in 1805, and a beautiful triumphal arch in Milan commemorates the opening. This year's exhibition at Milan celebrated the completion of the tunnel and railway, and it included many exhibits intended primarily to recognise the event. Among the most notable was a full-size model of the portals of the tunnels, leading to galleries rèpresenting the actual workings. At present only one tunnel is complete, but the second exists as a ventilating passage, and will be proceeded with later.

The entrance at Brigue is 2,250-ft. above sea level, and that at Iselle 2,073-ft. The summit of the tunnel is almost exactly under the frontier line, and is 2,312-ft. above sea level, with about 7,000-ft. of solid mountain overhead. The gradient from the Swiss end is 1 in 500, and that from the Italian 1 in 143. There is a short level stretch near the middle. The extreme width of the completed tunnel is 16-ft., and the height 17-ft. 3,500 workmen were employed in its construction, and the estimate for cost was £2,780,000.

The task of boring this gigantic work was carried out by Messrs. Brandt, Brandau & Co., the contract being signed in August, 1898. In the following November operations were started, when a daily progress of 9·86 metres was anticipated, but the actual average worked out at less than this. Early in 1901 operations had to be temporarily suspended owing to a serious incursion of water, which sometimes necessitated the pumping to waste of as much as 15,000 gallons per minute.

By the courtesy of Messrs. Brown, Boveri and Co., of Baden, who have charge of the electrical department in connection with the working of the tunnel, we were recently given facilities for viewing the power plant and tunnel works at Brigue. Water turbines actuated by the copious natural flow of a mountain torrent drive dynamos which supply sufficient horse-power for all present requirements, with capacity for increased power when needed. Nearly all the trains passing through the tunnel will be worked by electric locomotives of the type described and illustrated in our issue of March last, which are attached and detached at Brigue and Iselle, the two stations immediately outside the tunnel entrances, but at present some of the passenger traffic, and most of the goods trains, are hauled by steam locomotives. The best time is made in running south, electric-hauled trains occupying about 18 minutes in running from Brigue to Iselle, while the longest time is taken by steam-hauled trains travelling in the reverse direction with its long steep grade, the journey from the Italian to the Swiss entrances occupying from 25 to 28 minutes by this means.



"Prairie" Type Locomotive No. 2378, Northern Pacific Ry.

"PRAIRIE" TYPE LOCOMOTIVE, NORTHERN PACIFIC RY.

The engine here illustrated is interesting on several different counts. It is the first 2-6-2 locomotive built for the above-mentioned railway, it is equipped with Walschaerts valve gear, and it is one of 70 new engines building for the N. P. R. which are provided with combustion chambers—a new departure that is expected to produce noteworthy results. There are 20 of these Prairie locomotives in course of construction by the American Locomotive Co., and they have the following leading dimensions: cylinders, actuated by Walschaerts gear and piston valves, 21-in. in diameter by 28-in. stroke;

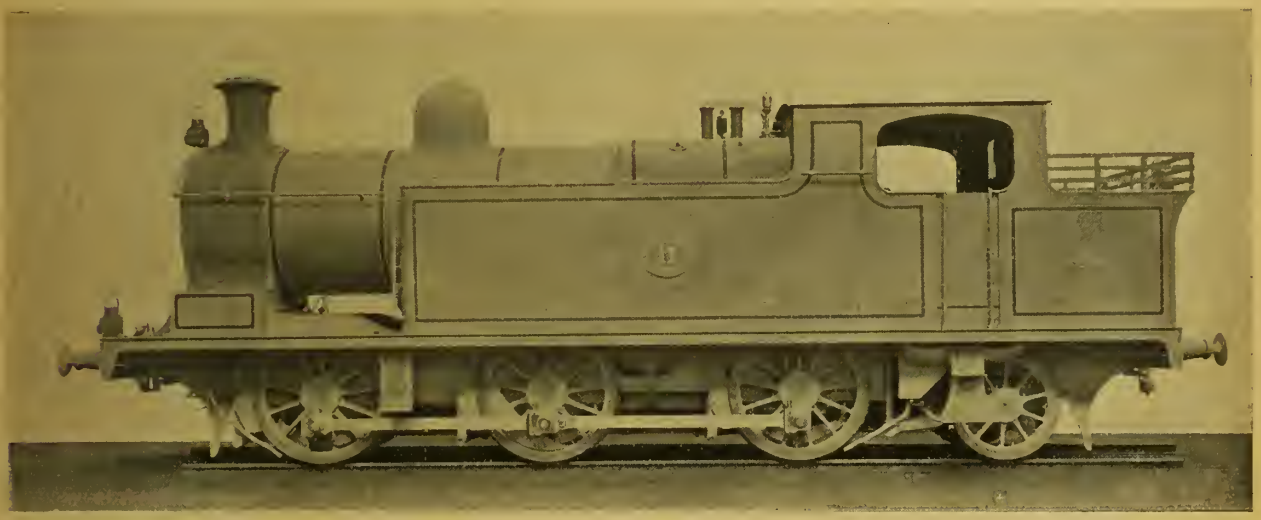
diameter of wheels: leading 2-ft. 9½-in., coupled 5-ft. 3-in., trailing 3-ft. 9-in.; wheelbase: leading truck to leading coupled 8-ft. 9-in., coupled wheels 11-ft., trailing coupled to trailing truck 9-ft. 2-in., total 28-ft. 11-in.; boiler: diameter outside first ring 6-ft. 0⅛-in., height of centre above rails 9-ft. 8-in., working pressure 200 lb. per sq. in.; containing 306 tubes 13-ft. 3-in. long by 2-in. diameter; the firebox measures 8-ft. long inside by 5-ft. 5¼-in. wide at bottom, and it is of the sloping back type illustrated on p. 24 of this volume (but not of the Belpaire pattern). The brick arch is supported on sloping water tubes of 4-in. diameter. A combustion chamber 4-ft. 1-in. in diameter inside projects forward 2-ft. 8-in. into the barrel of the boiler, which is of the extended wagon-top pattern. The heating surface is as follows: firebox with combustion chamber 226 sq. ft., arch tubes 9 sq. ft., tubes 2,105 sq. ft., total 2,340 sq. ft.; and the grate area is 43·5 sq. ft. These engines weigh an average of about 90 tons, of which about 67 tons rest on the coupled wheels, and they are provided with tenders carrying 7,000 U.S. gallons of water and 12 tons of coal.

There are also 20 Pacific (4-6-2) and 30 Mikado (2-8-2) locomotives building for the N.P.R. provided with combustion chambers.

THE CYCLOPS STEEL AND IRON WORKS, Sheffield, inform us that they have opened a branch office in their own name, at 28A and 29, Collingwood Buildings, Newcastle-on-Tyne, under the control of Mr. J. Johnson, who represented Messrs. Cammell, Laird & Co., Ltd., as their agent in the Tyne, Wear and Tees districts.

SIX-COUPLED RADIAL TANK LOCO., NEATH & BRECON RY.

BY the courtesy of the builders, Messrs. Robert Stephenson & Co., Ltd., of Darlington, we are able to illustrate herewith a new tank locomotive recently supplied to the above railway for mineral traffic. It is fitted with ordinary Stephenson link motion, with rocking shafts, which actuate valves of the circular balanced type, placed above the cylinders. A vacuum brake ejector is used in combination with a steam brake cylinder. This engine has the following leading dimensions: cylinders 18½-in. in diameter by 26-in. stroke; diameter of wheels: six-coupled, 4-ft. 6-in., trailing radial 3-ft. 6-in.; wheelbase: coupled wheels 15-ft. 3-in., total 21-ft. 9-in.; working pressure of boiler 165 lb. per sq. in.; heating surface: firebox 122 sq. ft., tubes 1,156·5 sq. ft., total 1,278·5 sq. ft.; grate area 21·5 sq. ft.; capacity of tanks 1,600 gallons, and of bunker 3 tons; weight of engine, empty, 50 tons 1 cwt., and in working order 61 tons 14 cwt.



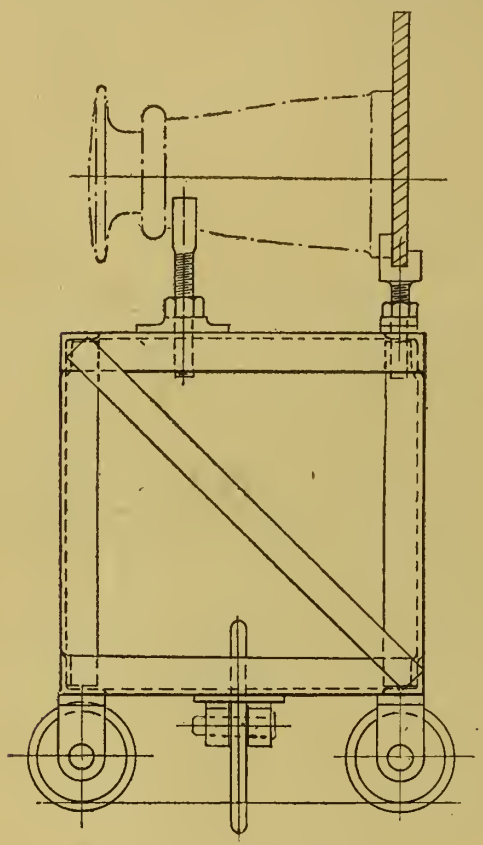
SIX-COUPLED RADIAL TANK LOCOMOTIVE No. 11, NEATH & BRECON RY.

MESSRS. ANDREW BARCLAY, SONS & CO., LTD., have recently booked an order for a four-coupled passenger tank locomotive with a leading pony truck, fitted with vacuum and steam brakes and to Board of Trade regulations, for the 3-ft. 6-in. gauge of the Jersey Railway & Tramways, Ltd. They also have in hand a six-coupled saddle tank shunting engine for the Frodingham Iron and Steel Co., Doncaster. Orders for Wilson patent exhaust gas boilers, for taking the exhaust heat from gas engines, are also in hand.

TROLLEY FOR BUFFER BEAMS.

To render the removal of a buffer beam a somewhat less laborious task than is usually the case in locomotive sheds, where no means of overhead lifting are available, the trolley as shown herewith is very useful, inasmuch as the beam can be removed with the buffers still in position.

The trolley consists of a framework of light angle irons, braced diagonally by means of bars. Into the top framework four brackets are rivetted, these forming the guides for the adjusting screws, two with a jaw end to take the buffer beam, and



Trolley for Buffer Beams.

two with semi-circular ends to embrace the buffer. Four small carrying wheels with flanges are provided for running on the ordinary rails.

The trolley is run under the beam to be removed, and the screws are adjusted by means of the nuts until the weight is just taken. The tendency will be for the beam to fall forward, but with the screw ends encircling the buffer casings the weight is evenly distributed.

The wheel in the centre is fixed to a crossbar on the bottom, and facilitates the removal of the trolley to various places where it may be required, as by the addition of two handles on each side (not shown in sketch) the whole contrivance can be lifted bodily off the rails and wheeled along the shed floor similarly to a wheelbarrow.

REVIEWS

"The Theta-Phi Diagram Practically Applied to Steam, Gas, Oil and Air Engines." By Henry A. Golding, A.M.I.M.E. 2nd edition, 3/- net. *Manchester:* The Technical Publishing Co., Ltd.

To render possible an easy interpretation of the application of entropy charts for heat motors is a problem presenting many difficulties, while the growing use of this method of representing graphically the thermal changes of the motive fluid of gas, steam, oil and air engines, and its undoubted utility, have emphasised the demand for an elementary work, and one not too deeply mathematical in its investigations. Mr. Golding treats the subject in a complete and comprehensive, yet simple manner, and in the second edition has brought the matter as nearly up to date as is practicable. The book will be a most useful guide to those studying the subject.

"The 'Practical Engineer' Electrical Pocket Book for 1907. *Manchester:* Technical Publishing Co., Ltd.

The new issue of this useful handbook contains in a convenient form most of the principal facts and formulæ relative to electrical engineering, and has been carefully revised to date. Numerous illustrations help to explain the text, and a number of useful tables, together with a diary, are appended, the contents covering some 500 pp. in all. The book is well printed, and is of a handy form for the pocket. Our readers who are interested in electric traction will find much useful information.

Messrs. Robert Stephenson & Co., Ltd., have forwarded us an attractively printed pamphlet entitled "Notes and Illustrations of Recent Work, No. 1," which we trust promises to be the first of a series of publications giving examples of locomotive construction produced by this old-established firm. Hitherto, the issue of descriptive catalogues has been too exclusively a speciality of American and Continental locomotive builders, and we are glad to see that this veteran firm, though 85 years old, is disposed to keep abreast of foreign competition. The particulars of 12 representative modern locomotives built at Darlington are given in English, French, German and Spanish.

FIRST CLASS CARRIAGE, BELGIAN STATE RYS.

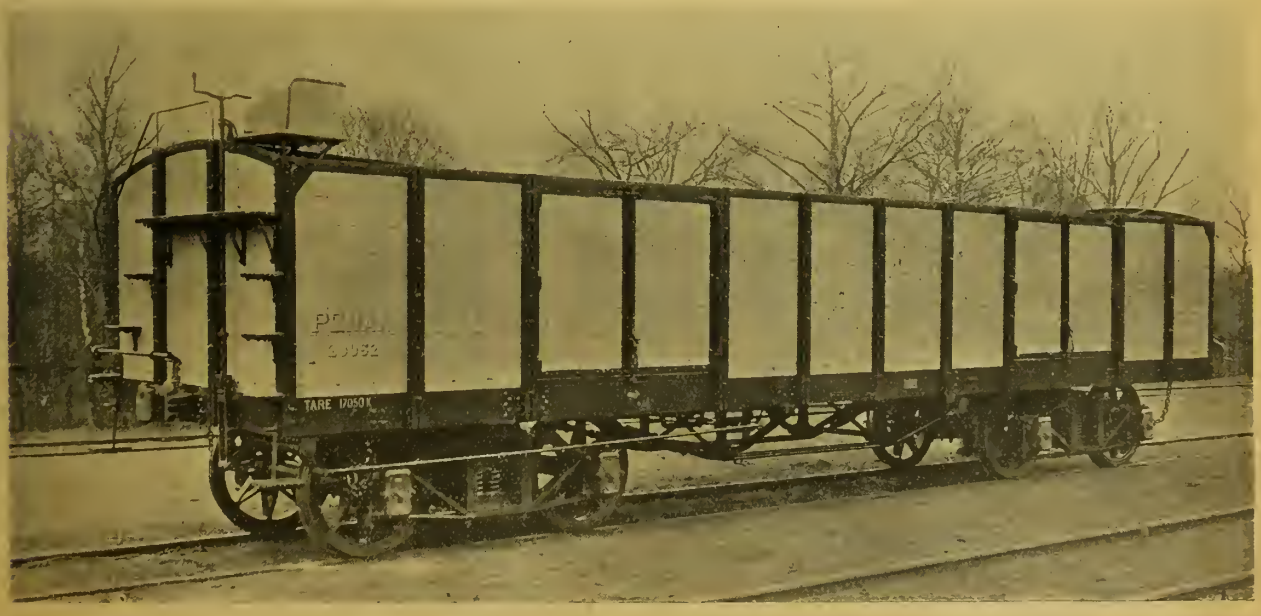
The accompanying photo-reproduction, for which we have to thank the builders, shows a modern railway carriage recently built by the firm of Baume & Marpent (Société Anonyme), of Haine St. Pierre, Belgium, and exhibited at the Milan Exposition this year. The main and bogie frames are of steel, of the standard type adopted on the Belgian State system. The carriage has the following principal dimensions: total length of body 59-ft., width 9-ft. 8½-in., extreme height above rails 11-ft. 11¾-in. It is divided into seven compartments, each arranged for six passengers, and a lavatory compartment, with a corridor running throughout its length,

First Class Vestibuled Corridor Carriage, Belgian State Rys.

doors in the vestibule at each end, and through communication with adjoining carriages. The doors of the compartments opening into the corridor are on the sliding system, so as not to obstruct the passage way, which is 2-ft. 6-in. wide. The various fittings provided in this up-to-date stock include the Chevalier system of balanced windows, torpedo ventilators, Stone's system of electric lighting, steam heat apparatus, and the Westinghouse passenger signalling device. The carriage is fitted with the Westinghouse brake, to which is applied the Chaumont regulating apparatus with an indicating arm.

40-TONS BOGIE COAL WAGON.

The bogie mineral wagon here illustrated was built by the firm of Baume & Marpent (Société Anonyme). It is carried on two diamond-frame bogies having wheels 3-ft. $3\frac{3}{8}$-in. in diameter, on a wheelbase of 6-ft. $2\frac{3}{4}$-in., the centres of the bogies being 21-ft. $9\frac{1}{2}$. in. apart. They are provided with oil axleboxes, and are hung on spiral springs, eight to each bogie. The main frames are composed of two principal members, strongly braced, which support the wagon body. This has a flooring and the two lower rows of planks at the sides, of oak, the upper portion being of fir; it has the following dimensions: length inside 37-ft. 6-in., breadth 8-ft. $10\frac{1}{2}$-in., height 4-ft. 11-in. There are two double doors at each side. To strengthen the structure, a U-shaped top-rail runs all round the body, even over the door openings, and in addition the ends and sides are stiffened diagonally by horizontal stays. The wagon is fitted with the Janney central coupler and a screw brake actuating four blocks on each bogie.



40-tons Bogie Coal Wagon, Peking-Hankow Ry., China.

Correspondence.

Letters containing practical queries for this column are invited, and will be dealt with in rotation. The name and address of the sender should be enclosed, not necessarily for publication, but as a guarantee of good faith.

More Railway Reminiscences.

To the Editor of "The Locomotive Magazine."

Dear Sir,—Perhaps the following paragraph from "Ritchie on Railways," 1846, page 408, may be interesting to those who remember early days on the N. & C. R. :—"A train going west on Saturday evening last, November 29, 1845, after dark, on the Newcastle and Carlisle Ry., encountered something lying across the rails between Haydon Bridge and Haltwhistle, which turned out to be a cow, which was instantly killed. It seems that the animal had jumped out of a truck from a train going east, and had broken its thigh. The engine —the 'Rapid'—was thrown across the rails, and the driver into a hedge, but he escaped unhurt, and no damage was done otherwise."

If this was the original "Rapid" of 1835, built by Stephenson, it is not much wonder that it got off the road, for Whishaw states that it weighed, full, only 8 tons 4 cwt. If so, it must have been a four-wheeler, though described as six-coupled. The paragraph is also interesting on account of the use of the terms "going east" and "going west," as was the custom on the N. & C. R. throughout the whole of its independent existence. The much more concise terms "up" and "down" come from stage-coaching days.

The system of having "search engines" at various points, alluded to in your September article on the above subject in regard to the "Rapid," lasted many years. So late as 1848 Mr. Francis Trevithick stated that there was "generally one every 30 miles" on the L. & N. W. R. at that time.—Yours faithfully,

Chelsea, Oct. 28. W. B. Paley.

The Locomotives of the G. E. R.

To the Editor of "The Locomotive Magazine."

Dear Sir,—Allow me to congratulate you on the accurate drawings of Gooch's engines, illustrating the history of the locomotives of the G. E. R. in recent numbers of your magazine.

I will refer now to Fig. 95, a side elevation of the No. 274 class of engine shown in your October number. It is stated in the letterpress that the diameter of the blast pipe was 5-in. This appeals to me as the inventor of the enlarging variable blast pipe, and although the drivers of those engines who worked by contract ran with an outlet as large as possible in order to draw big balances, the clear area of that would have been too great in all circumstances but for the fact that it was lessened through there being inside the outlet a spindle valve, worked from the footplate, which regulated and diverted a portion of the exhaust steam through a branch pipe to the feed water heater with which those excellent engines were fitted.

I am glad to be able to clear up the apparent diversity conveyed in the letters of Messrs. C. Rous-Marten and H. T. B. in the numbers of May and July last *re* the additional safety valve, etc., which were put on Gooch's engines by Mr. Robert Sinclair.

In February, 1859, two years and a half after the retirement of Mr. J. V. Gooch, trials were carried out in the running of No. 279 engine to discover how the driver earned bigger balances than those of the other engines of that class. It was found that it was due to the fact that he, Alec Keir, was an all-round good man and made far more use of the water-heating arrangement than the others.

It was observed by the individual conducting the trials that the spring balance end of the lever of the safety valve on the firebox was placed so invitingly that the drivers frequently rested one of their hands on it, and at other times even the tea or tallow can, etc., and that added more than was considered advisable to the blowing-off pressure, especially if the hand were a brawny one, or the can well filled.

It was therefore arranged to place an additional safety valve and column on the barrel of the boiler, and after an interval of several months as the loads of the engines became heavier, it was found that water was lifted into the perforated portion of the horizontal steam pipe inside the boiler, and it was decided to place a short vertical pipe upon it, which necessitated a small dome, etc., on the firebox. Both letters are in a measure correct.—Yours faithfully, G. Macallan,

"Argyll," Stansted, Essex. *Retired Works Manager,*
Nov. 2nd, 1906 *G.E.R., Stratford, E.*

Railway Postcards.—We have received from the Midland and Caledonian Railways some new series of picture post cards illustrative of their rolling stock and scenes encountered on their respective systems, which will be detailed more particularly in our next issue.

THE LOCOMOTIVE MAGAZINE.
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