LOCOMOTIVES of 1907

CHAS. S. LAKE.

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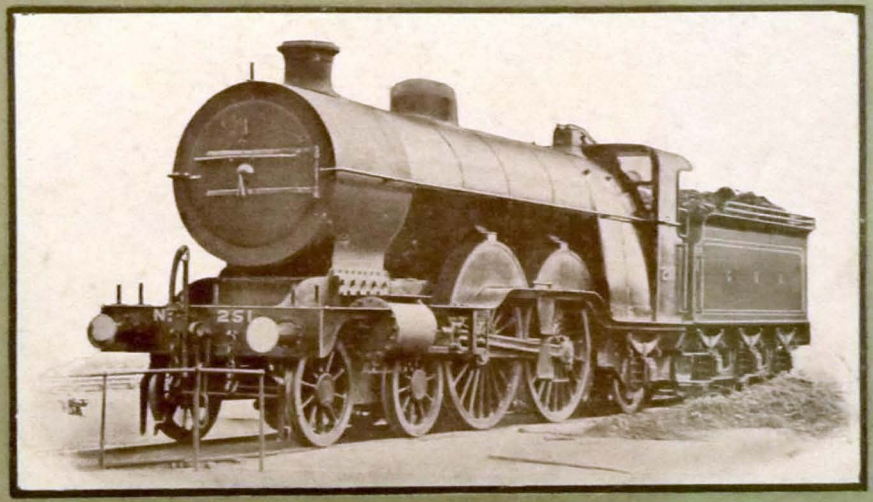

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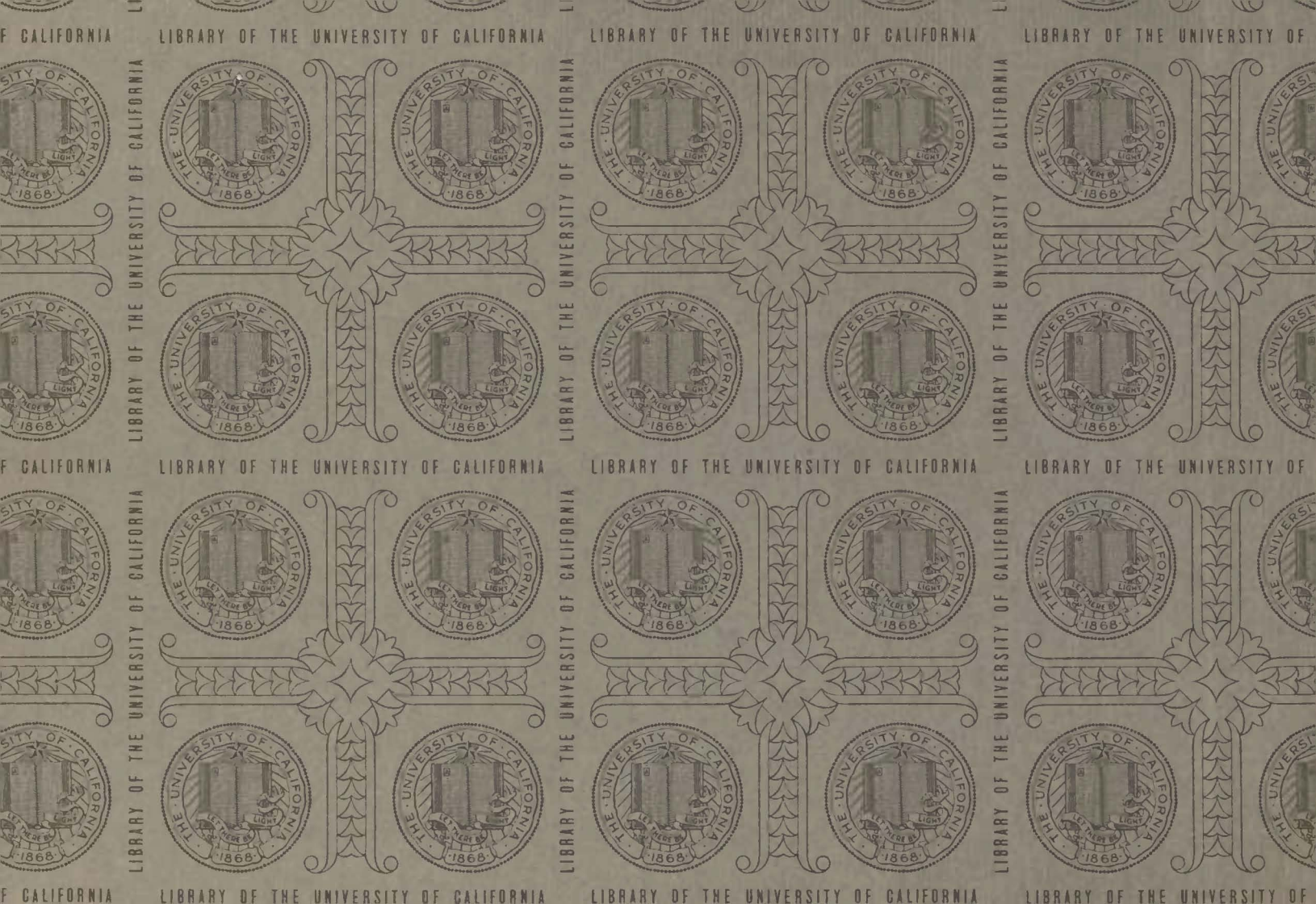
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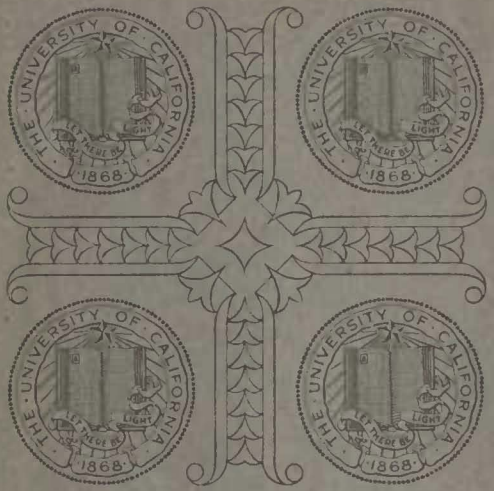
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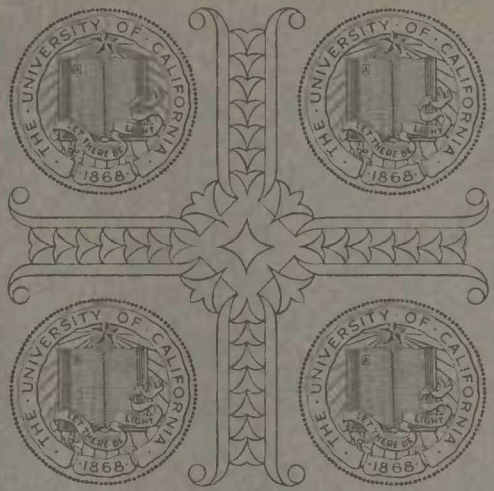
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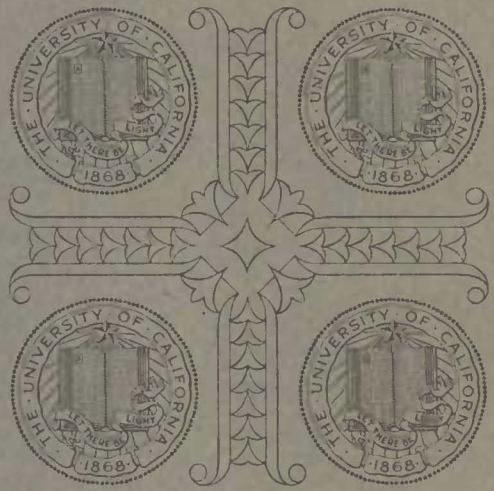
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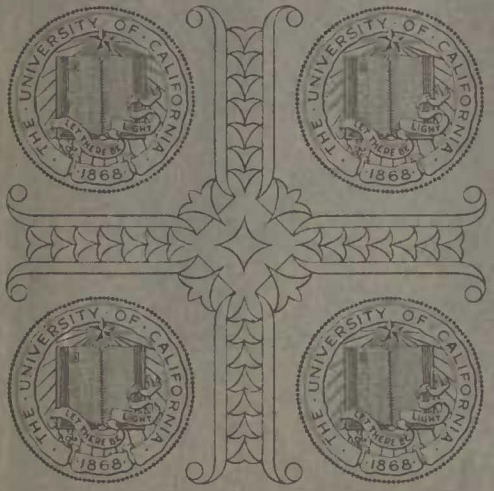
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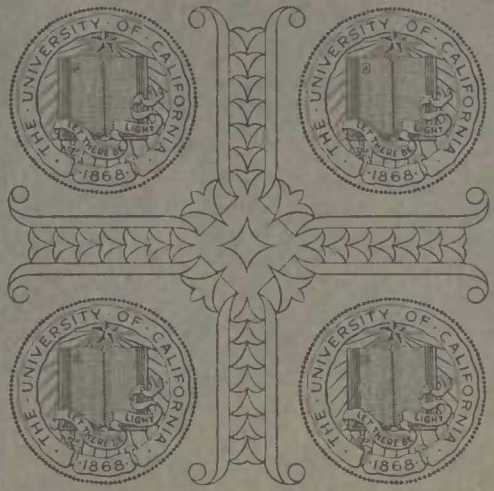
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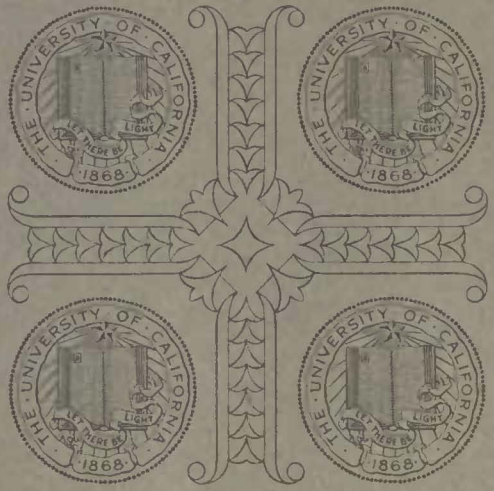
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LOCOMOTIVES

OF

1907.

By CHAS. S. LAKE, A.M.I.Mech.E.,

Member Society of Arts.

Author of "The World's Locomotives," "The Locomotive Simply Explained," "Locomotives of 1906."

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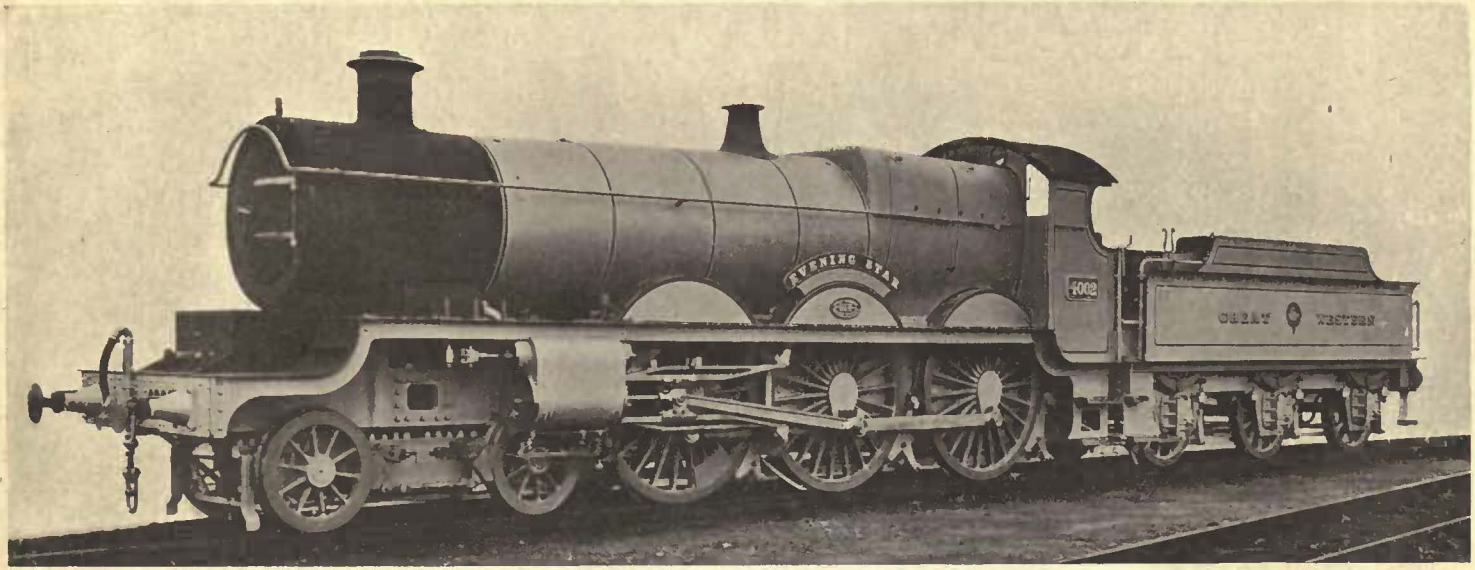


FOUR-CYLINDER SIMPLE (4—6—0 TYPE) EXPRESS LOCOMOTIVE, GREAT WESTERN RAILWAY.

MR. G. J. CHURCHWARD, M.Inst.C.E., *Locomotive Superintendent*, SWINDON.

Leading Particulars.

Cylinders (4): Diameter, 14¼ ins.; piston stroke, 26 ins.
Bogie wheels diameter, 3 ft. 2 ins.
Coupled wheels diameter, 6 ft. 8½ ins.
Wheelbase: Rigid, 14 ft. 9 ins.; total, 27 ft. 3 ins.
Boiler: Diameter at front, 4 ft. 10¾ ins.; diameter at back, 5 ft. 6 ins.; height of centre above rail, 8 ft. 6 ins.
Heating surface: Tubes 1988·65 sq. ft.; firebox, 154·26 sq. ft.: total, 2142·91 sq. ft.
Grate area, 27·07 sq. ft.
Working pressure, 225 lbs. per sq. in.
Weight on coupled wheels, 58 tons 16 cwts.; weight of engine (in working order), 76 tons 14 cwts.
Tender: Water capacity, 3,500 gallons; coal capacity, 6 tons.
Weight of engine and tender (in working order), 116 tons 14 cwts.
Tractive force, 26,560 lbs.

LOCOMOTIVES OF 1907.

By CHAS. S. LAKE, A.M.I.Mech.E.,

Member Society of Arts.

WITH the close of the year 1907, a favourable opportunity presents itself for reviewing the progress made in the world's locomotive practice during the twelve months which have elapsed since the same purpose was fulfilled at the end of 1906.

Whilst it cannot be said that the present year has produced any very startling developments connected with locomotive engineering, it has, nevertheless, witnessed a general advancement on recognised principles, and indications of a noteworthy character have not been wanting.

With an additional twelve months of experience at their disposal, designers of locomotives the world over are showing an increased disposition to investigate more closely, and in practice, the claims of others; and, although it cannot be truthfully stated as yet that there exists what may perhaps best be described as a current of settled international opinion, there are unmistakable signs that in regard to many essential points the general body of locomotive engineers are coming more nearly into agreement.

This influence, if carried far enough, would doubtless have a beneficial effect upon the branch of engineering under consideration; but it must, of course, be a long time before ideas have become sufficiently consolidated to allow of the adoption of anything in the nature of international locomotive standards, even for practically identical conditions of service.

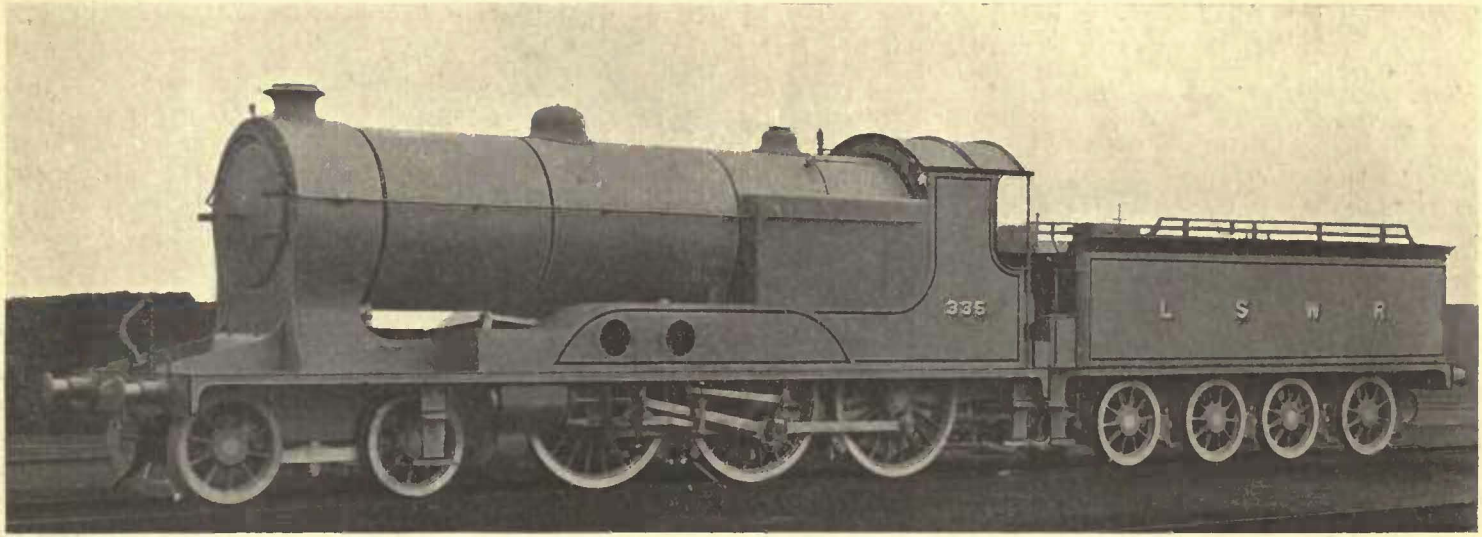
When we come to pass in review what has been done in Great Britain during the year 1907 in connection with locomotive engineering, it is seen that on the majority of railways a policy of steady adherence to existing standards has been maintained—a course which, so long as those standards remain adequately efficient

for the work to be performed, is perhaps on the whole the best. On other lines the spirit of investigation has been manifested, and, although little of the results obtained has publicly transpired, a great deal has been done, effectively if quietly, in the way of experimental work with methods new to the practice of this country, and, doubtless, when the proper time arrives the outcome will be duly announced.

The railway service of the United Kingdom was never more efficient than at the present time, and, speaking generally, it would be difficult to find a strict parallel for it in any other part of the world. The weight of the trains comprising the most important passenger services and the average speeds at which they are run, have both had an upward tendency, and the demand for locomotives capable of hauling these increasing loads without any diminution in the average velocity has advanced commensurately.

In locomotive matters, as well as in many others, the Great Western is among the most progressive of British railways, and this reputation was further enhanced during the year just closed by the introduction of powerful express passenger locomotives of a new type having four simple cylinders, a leading four-wheeled bogie and six-coupled driving wheels. Engines of this description are exceptionally well adapted for hauling the heaviest of modern passenger trains, and the diameter of the driving wheels in the present case, viz., 6 ft. 8½ ins., allows of the highest necessary speed being reached without inconvenience. The design of these locomotives provides only two valve gears of the Walschaerts' type for actuating the four slide-valves, and although many engineers, especially those upon the Continent, consider it better practice to work each steam-distributing valve independently by a separate set of motion, there are advantages for the simpler method of coupling the valve spindles and working them in pairs by means of a single valve gear which cannot be overlooked. The two inside cylinders of the Great Western engine—an illustration of which, with dimensions, forms the frontispiece—are placed in advance of the bogie centre, whilst the outside ones are at the rear of the same, the inside cylinders driving the crank-axle of the leading coupled wheels and those outside the middle pair.

The inside and outside valve spindles on each side of the engine are connected by a cross-lever having two arms, which is fulcrumed at about the centre on the main engine frames. The gear is directly applied to the valves of the inside cylinders, and motion is transmitted to those outside through the double-armed lever before mentioned. Full details of this valve gear, with drawings, having appeared in several of the technical engineering journals, it will be unnecessary to go further into the subject of its construction and method of working here, where space is an important consideration. These 4—6—0 type four-cylinder locomotives are employed for working some of the heaviest



FOUR-CYLINDER SIMPLE (4—6—0 TYPE) PASSENGER LOCOMOTIVE, LONDON AND SOUTH-WESTERN RAILWAY.

MR. DUGALD DRUMMOND, M.Inst.C.E., *Chief Mechanical Engineer*, NINE ELMS.

Leading Particulars.

Cylinders (4): Diameter, 16½ ins.; piston stroke, 26 ins.
Coupled wheels diameter, 6 ft.
Bogie wheels diameter, 3 ft. 7 ins.
Wheelbase: Rigid, 13 ft. 4 ins.; total, 26 ft. 7 ins.
Boiler: Diameter, outside (maximum), 5 ft. 9½ ins.; length between tube plates, 14 ft. 2 ins.; height of centre above rails, 9 ft.
Heating surface: Boiler tubes, 2,210 sq. ft.; firebox tubes, 357 sq. ft.; firebox, 160 sq. ft.: total, 2,727 sq. ft.
Grate area, 31·5 sq. ft.
Working pressure, 175 lbs.
Tender capacity: Water, 4,000 gallons; coal, 4 tons.
Heating surface of tubes in tender well (feed-water heated with exhaust steam), 382 sq. ft.
Diameter of tender wheels, 3 ft. 7 ins.
Total length over buffers (engine and tender), 63 ft. 0¼ in.

Weight on coupled wheels, 54 tons.
Weight of engine and tender in working order, 118 tons.

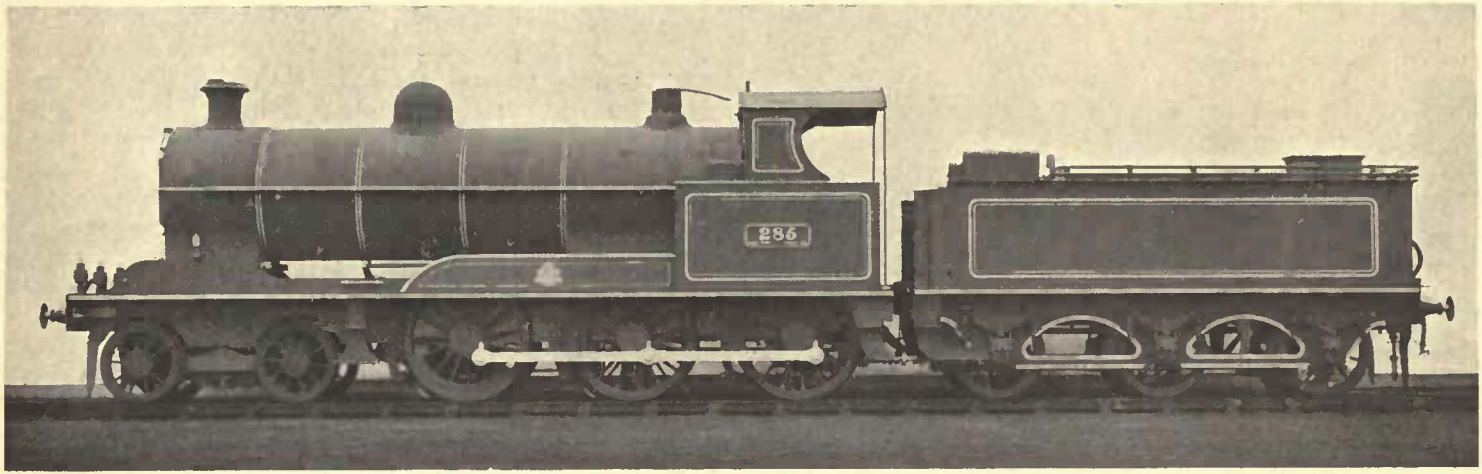
and fastest main line long-distance expresses of the Great Western Railway, and they are doing much to uphold the character always possessed by that line for speed and punctuality.

At the time of writing, the new "Pacific" or 4—6—2 type express locomotive of the Great Western Railway was about making trial trips. This engine, which is the first of its kind to be introduced on the railways of the United Kingdom, approximates in size and power to those of the same type employed on the Paris-Orleans Railway, which were placed in service about midway during 1907, when they marked the initial introduction of the type on the European Continent.

A marked difference between the two designs is that whereas the French locomotives are four-cylinder compounds, with a separate valve mechanism for each cylinder, that of the Great Western Railway has four single-expansion cylinders using superheated steam and the simplified form of valve gear applied to the 4—6—0 type locomotive above referred to. It transpired during 1907 that the utilisation of the "Atlantic" or 4—4—2 type of engine was to be discontinued on the Great Western Railway in favour of the six-coupled designs; and the reason for this step appears to be that the "Atlantic" type offers what, after all, only practically amounts to the same opportunity of utilising adhesion weight, as the 4—4—0 type of engine, so that with the larger cylinder capacities of the latest practice it becomes difficult to employ the increased tractive power effectively, owing to lack of adhesion, once a certain point has been reached in the steam distribution. With only two axles to carry the adhesion load and an outside limit of 20 tons per axle, it cannot be expected that any four-coupled locomotive will utilise to advantage the same cylinder tractive power as a six-coupled engine with nearly 60 tons of adhesion. In addition to these powerful four-cylinder locomotives, several additional engines having the same wheel arrangement, but with two cylinders only, were added to the locomotive stock of the Great Western Railway during the past year.

On the London & South-Western—the only other British railway beside the Great Western to employ the 4—6—0 type of locomotive in conjunction with four simple cylinders—the close of the year saw the introduction of a new series of such engines, commencing with No. 335, which forms the second illustration. In "Locomotives of 1906," the corresponding volume to the present one, published at the end of the year from which it takes its title, an illustration appeared showing No. 330, the first locomotive of the 4—6—0 type to be tried on the London & South-Western Railway, and the only material difference between that engine and the one appearing on page 5 lies in the diameter and stroke of the cylinders.

In this later series the tractive power of the engine has been materially added to by increasing the diameter



4—6—0 TYPE FAST GOODS LOCOMOTIVE, LONDON AND NORTH-WESTERN RAILWAY.

MR. GEORGE WHALE, M.Inst.C.E., *Chief Mechanical Engineer*, CREWE.

Leading Particulars.

Cylinders: Diameter, 19 ins.; stroke, 26 ins.

Wheels: Radial truck, 3 ft. 3 ins. diameter; coupled wheels, 5 ft. 2½ ins. diameter.

Wheelbase: Rigid, 13 ft. 7 ins.; total engine, 26 ft. 8½ ins.

Boiler: Barrel—mean diameter, 5 ft. 0¾ in.; length, 12 ft. 6 ins.: height from rail level to centre of boiler, 8 ft. 7 ins.

Heating surface: Tubes, 1840·5 sq. ft.; firebox, 144·3 sq. ft.: total, 1984·8 sq. ft.

Grate area, 25 sq. ft.

Boiler pressure, 185 lbs. per sq. in.

Weight on coupled wheels, 44 tons 4 cwts.

Weight of engine (in working order), 63 tons.

Tender: Water capacity, 3,000 gallons; coal capacity, 6 tons.

Total weight of engine and tender (in working order), 100 tons.

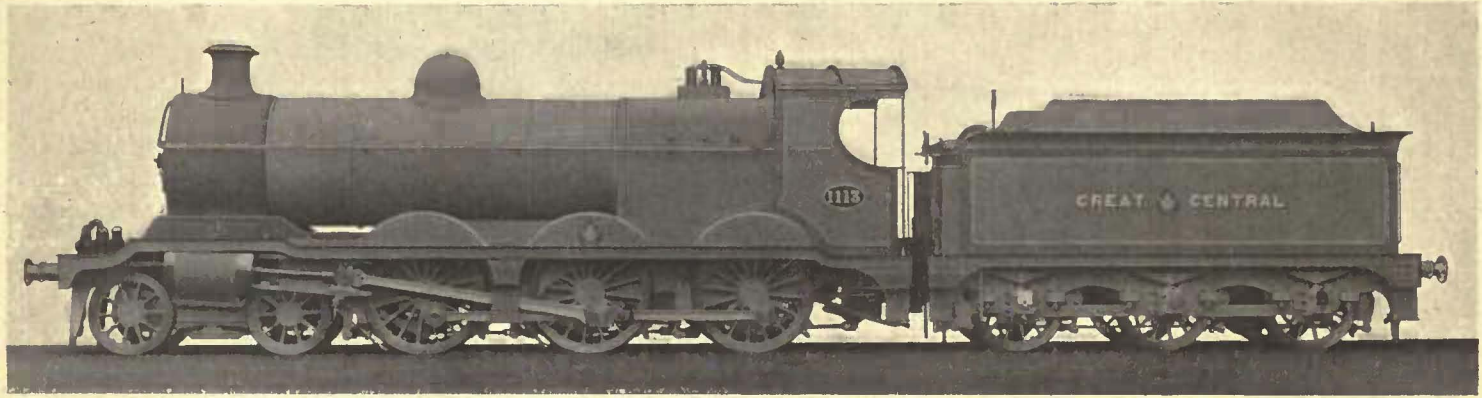
of each of the four cylinders by ½ in. and adding 2 ins. to the length of the stroke. In this manner, not only is the general capacity of the cylinders for the expansion of steam rendered greater, but the increased leverage of the longer stroke will be of much assistance when starting away with heavy loads. The new engines are fitted with the arrangements patented by Mr. Dugald Drummond, Chief Mechanical Engineer, and applied by him to all London & South-Western Railway locomotives. These comprise his well-known spark-arresting and fuel-economising device fitted in the smokebox; water tubes in the firebox and a feed-water heater, by means of which the temperature of the feed is raised to a degree at which ordinary injectors are incapable of delivering it to the boiler, and therefore duplex pumps are utilised for the purpose.

Reversing of the four valve gears, of which the outside ones are Walschaerts' and the inside ones Stephenson link type, is effected by means of steam-operated gear. Comparison of the two classes of engines shows that the outside slide valves work above the cylinders in the new series, instead of below as in the older one.

Of the other British railways employing the 4—6—0 type of locomotive, the Caledonian, London & North-Western, and Great Central Railways each added to the number already in service. New locomotives of this description, similar in general design to those already employed in passenger service, but with smaller coupled wheels for mixed or goods traffic purposes, were introduced on the two last-mentioned lines, and illustrations of these will be found on pages 7 and 9. In the case of the London & North-Western Railway engine, inside cylinders, with Joy's valve gear, are employed; but the Great Central locomotive has outside cylinders and Stephenson link motion. These are both powerful locomotives, of simple and straightforward design, admirably suited for giving reliable service under varying conditions in hauling heavy trains at moderate speeds on all sections of the railways over which they have been designed to work. The Great Southern and Western Railway of Ireland built more of the 4—6—0 type locomotives of the 365 class* introduced during 1906, and these, with their predecessors, are proving highly successful in working fast goods trains and other traffic on the main line between Dublin, Cork, and Queenstown.

None of the railways of the United Kingdom placed the "Atlantic" type locomotive in service for the first time during 1907, and only a comparatively few engines of this description were added to the locomotive equipment of the home railways, taken as a whole. On the other hand, a large number of 4—4—0 type engines were built to the standard designs employed on the respective lines, and, in the case of the Midland Railway, some important departures from previous practice were introduced. The illustration, page 11, shows

* Illustrated on page 23 of "Locomotives of 1906."



4—6—0 TYPE FAST GOODS LOCOMOTIVE, GREAT CENTRAL RAILWAY.

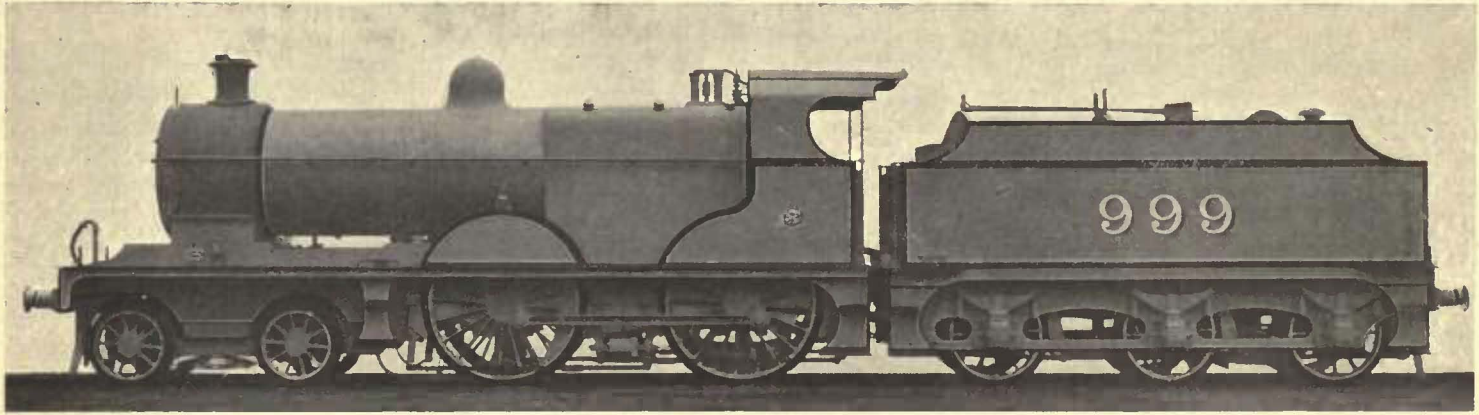
MR. J. G. ROBINSON, M.Inst.C.E., *Chief Mechanical Engineer*, GORTON.

Leading Particulars.

Cylinders: Diameter, 19½ ins.; piston stroke, 26 ins.
Bogie wheels diameter, 3 ft. 6 ins.
Coupled wheels diameter, 5 ft. 3 ins.
Wheelbase: Rigid, 14 ft.; total, 26 ft. 1½ ins.
Boiler: Diameter, 4 ft. 9½ ins.; length, 15 ft.
Heating surface: Tubes, 1777·9 sq. ft.; firebox, 131·6 sq. ft.: total, 1909·5 sq. ft.
Grate area, 23·4 sq. ft.
Working pressure, 200 lbs. per sq. in.
Weight on coupled wheels, 52 tons.
Weight of engine (in working order), 67 tons 8 cwts.
Tender: Water capacity, 4000 gallons; coal capacity, 5 tons.
Weight of engine and tender, 111 tons 8 cwts.

that the design, taken generally, resembles that of the numerous Belpaire engines of the two-cylinder 4—4—0 type in service on this railway; but this engine —No. 999—is fitted with a boiler of similar proportions to those of the three-cylinder Midland compounds, and a marked difference is found in the method of steam distribution. This is effected by piston valves actuated by a special valve gear, which Mr. R. M. Deeley, locomotive superintendent of the Midland Railway, has designed, and the principal feature of which is that no eccentrics are employed, neither is there any return crank or similar device, such as are employed in the Walschaerts' and kindred valve motions. The travel of the valve for lead is derived from a pendulum link, and a rod attached to the crosshead of the adjacent motion is utilised for the purpose of oscillating the suspension link. The arrangement gives an excellent steam distribution, and it offers the advantage of dispensing with eccentrics on the crank axle. The engines of this class are fitted with axle-boxes of a new design to the driving and trailing axles. Each box is provided with two cylindrical brasses, which are free to adjust themselves to the bearings. Another departure from the practice usually followed on the Midland Railway consists in the provision of a bogie of the swing-link type under the leading end of the locomotive. All the axle-boxes are fitted with sight-feed lubricators, and the piston valves and cylinders are lubricated by displacement sight-feed and special suction lubricators respectively. The cylinders are cast in one piece with the steam chests and smokebox saddle, and the steam chests are carried beyond the main walls of the cylinders, and extend across the ends of both piston-valves. This design represents a marked advance in British simple 4—4—0 type locomotive practice, and the general appearance presented by it is excellent. Many people think it would be improved if the huge figures, denoting the engine number, which are painted on the sides of the tender to a height of over 1 ft., were absent; but this is a matter of small importance when compared with the question of efficiency.

The 4—4—0 type of engine still remains—at the end of 1907—the standard for express passenger traffic, not only on the Midland and London & North-Western, but also on several other of the more important British railways, and this is one of the points where the locomotive practice of this country differs so widely from that of the majority of others. The type is an exceedingly useful one, and in its two-cylinder single-expansion form is lighter and simpler, and therefore cheaper to build and maintain, than other types having more extended wheel arrangements and a greater number of parts can possibly be. The author found, when visiting some of the leading locomotive engineers and builders upon the Continent towards the end of the year just closed, that most of them regarded it as somewhat astonishing that the simple 4—4—0 type should still be retained in the front rank for express passenger services



LATEST TYPE OF EXPRESS LOCOMOTIVE, MIDLAND RAILWAY.

MR. R. M. DEELEY, M.Inst.C.E., *Locomotive Superintendent*, DERBY.

Leading Particulars.

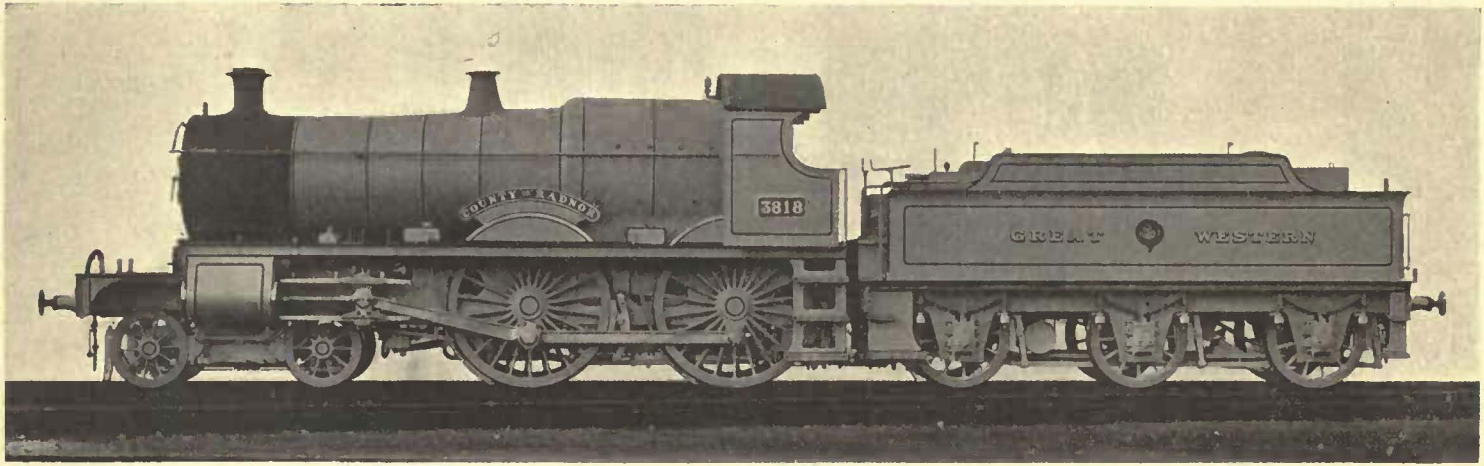
Cylinders: Diameter, 19 ins.; stroke, 26 ins.
Bogie wheels diameter, 3 ft. 3½ ins.
Coupled wheels diameter, 6 ft. 6½ ins.
Wheelbase: Engine, 24 ft. 4½ ins.; rigid, 9 ft. 6 ins.
Boiler: Diameter, 4 ft. 9⅛ ins.; length between tube plates, 12 ft. 3⅜ ins.; height of centre above rails, 8 ft. 6¼ ins.
Heating surface: Tubes, 1404·6 sq. ft.; firebox, 152·8 sq. ft.: total, 1557·4 sq. ft.
Grate area, 28·4 sq. ft.
Working pressure, 220 lbs.
Weight on coupled wheels, 38 tons 15 cwts.
Weight of engine (in working order), 58 tons 10 cwts. 2 qrs.
Weight of engine and tender (in working order), 104 tons 9 cwts.
Tender: Tank capacity, 3,500 gallons; coal capacity, 7 tons.
Tractive power, ·0534 ton per lb. pressure of steam.

on English railways, where, admittedly, some of the heaviest trains in the world have to be hauled at average speeds which are second to none of those normally attained in other countries. That such a diversity should exist between the practice of any one country and those of most others has, of course, its noteworthy side; but, when the whole of the circumstances have been taken into account and the subject threshed out in discussion, the reasons for the marked difference become more clearly apparent. Certain it is that the British 4—4—0 locomotives are daily performing work of which the designers of larger and much more complicated machines might quite well be proud.

Further, locomotives of the "County" class were introduced on the Great Western Railway during 1907. These are 4—4—0 type engines, with outside cylinders, and a distinctive feature of the design is the long piston-stroke employed, viz., 30 ins., as compared with the customary 24 ins. or 26 ins. of British practice. The added length of stroke permits of a reduction in the cylinder diameter, and the expansion of steam is carried out under somewhat different conditions. The long stroke assists the engine at starting, but must necessarily be something of a disadvantage when travelling at the highest speeds, owing to the great piston velocity set up. The engines, in common with all modern types of the Great Western Railway, are fitted with the coned pattern of boiler. These "County" locomotives have a meritorious record of service, and for all but the heaviest and fastest traffic they are a wholly successful type.

On other railways where the 4—4—0 type is employed for working the principal services, the number of such engines was materially added to during 1907, and no disposition was shown to abandon this class of locomotive for those having more extended wheel arrangements.

In regard to tank locomotives, some noteworthy developments occurred during 1907 on the British railways. New types were introduced on several lines, and the tendency was to materially increase the power of this handy form of engine. The Midland led the way with some large tank locomotives of an entirely new design having the 0—6—4 wheel arrangement (see page 15), and the Great Western and Great Northern each placed in service six-coupled passenger tank engines — the step, in the last as in the first-named case, constituting a new departure in the locomotive standards of the line. The Midland engine ranks among the largest and most powerful of its kind in the United Kingdom, and some interesting features are incorporated in the design. The wheel arrangement is an unusual one, but it possesses certain advantages. The presence of the four-wheeled bogie at the trailing end permits of a greater coal and water carrying capacity than when a single pair of radial wheels is employed. In these new Midland tank engines



EXPRESS LOCOMOTIVE OF THE "COUNTY" CLASS, GREAT WESTERN RAILWAY.

MR. G. J. CHURCHWARD, M.Inst.C.E., *Locomotive Superintendent*, SWINDON.

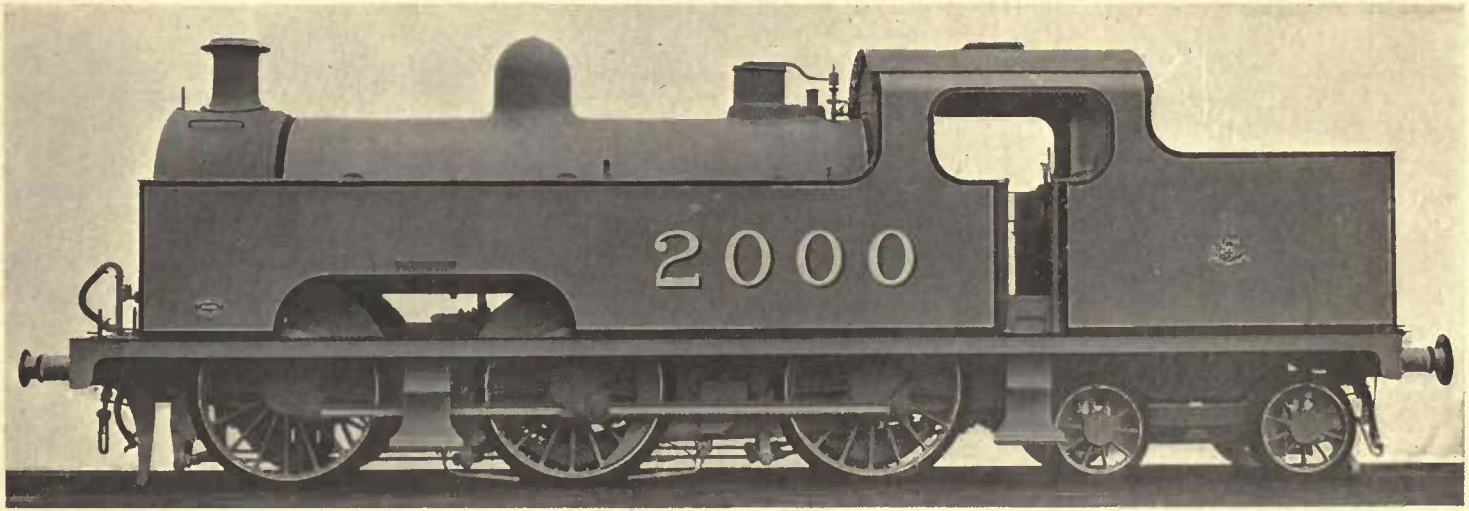
Leading Particulars.

Cylinders: Diameter, 18 ins.; piston stroke, 30 ins.
Bogie wheels diameter, 3 ft. 2 ins.
Coupled wheels diameter, 6 ft. 8½ ins.
Wheelbase: Rigid, 8 ft. 6 ins.; total (engine), 24 ft.
Boiler: Diameter—smokebox end (outside), 4 ft. 10¾ ins.; firebox end (outside), 5 ft. 6 ins.; length of barrel, 11 ft.; height of centre from rail, 8 ft. 6 ins.
Heating surface: Tubes, 1692·14 sq. ft.; firebox, 128·21 sq. ft.: total, 1,820·35 sq. ft.
Grate area, 20·56 sq. ft.
Working pressure, 200 lbs.
Weight on coupled wheels (with engine in working order), 37 tons 12 cwts.
Weight of engine (in working order), 58 tons 16 cwts.
Weight of tender (in working order), 40 tons.
Weight of engine and tender complete (in running condition), 98 tons 16 cwts.
Tractive force, 21,734 lbs.

the cylinders are placed inside the frames, at an angle of 1 in 8½ ins., for driving the crank-axle of the middle pair of coupled wheels. The connecting-rods are provided at their small ends with a ball-and-socket arrangement which permits of the rods adapting themselves freely to the side play of the driving axle; and in addition to this ball and socket, bushes are fitted in the pin-joint connection of the side rods in front of the driving-wheel crank-pin. The leading axle is provided with a modification of the "Cartazzi" type axle-box, the spring gear of which is placed below the journal. This axle is free to move laterally to the extent of 1¼ ins., or ⅝ in. on each side, while the four-wheeled bogie at the other end of the locomotive is allowed a total side play of 5½ ins.; so that the engine is well adapted by these combined means for negotiating curves of 4 chains radius with ease. The balanced slide-valves with which the engine is fitted work between the cylinders, and are actuated by Stephenson link motion. The angle of the eccentrics is 105½ degs., and the eccentric-rods are 4 ft. 3⅞ ins. in length. The boiler is made in two telescopic rings, of 9-16ths-in. steel plate. It is similar in proportion to that of the standard Midland Railway goods engine, and carries a working pressure of 175 lbs. per sq. in. Water pick-up apparatus is provided, and double scoops are fitted to allow of water being taken up from the track troughs in whichever direction the engine is travelling. These new locomotives represent a considerable advance in the practice of the Midland Railway, where hitherto large tank engines have not been the rule. With their increased cylinder and boiler capacities, ample adhesion weight and general flexibility of wheelbase, they are proving a highly efficient type for working heavy suburban traffic, and they are equally well adapted for goods train service.

The latest Great Western tank engines are of the 2—6—2 type (see page 17). Officially, these engines are described as having been converted into their present condition from 0—6—0 type goods engines with tenders; but, inasmuch as nothing except coupled wheels centres remains as before, it is difficult to see what connection there can be between the two designs. The boiler, as now fitted, is totally different, both as regards size and pattern, to that originally used in the goods engines; new cylinders have been fitted, the spacing of the coupled wheels is altered, and the frames have, of course, had to be lengthened. As it now stands, the engine presents a very smart and up-to-date appearance, and it has a distinctive character on the Great Western Railway, as combining the 2—6—2 wheel arrangement with inside cylinders. The classing of the engines as "converted" has its purpose, no doubt, for departmental reasons, but from any other point of view it appears rather wide of the mark.

The Great Northern locomotive, illustrated on page 19, was, as before said, the first of its kind to be employed on that line, and this design was specially



0—6—4 TYPE TANK LOCOMOTIVE, MIDLAND RAILWAY.
MR. R. M. DEELEY, M.Inst.C.E., *Locomotive Superintendent*, DERBY.

Leading Particulars.

Cylinders: Diameter, 18½ ins.; piston stroke, 26½ ins.
Coupled wheels diameter, 5 ft. 7 ins.
Bogie wheels diameter, 3 ft. 1 in.
Wheelbase: Rigid, 16 ft. 6 ins.; total, 29 ft.
Boiler: Height of centre from rail, 8 ft.; length between tube plates, 10 ft. 10⅝ ins.; diameter, outside (maximum), 4 ft. 9⅛ ins.; number of tubes, 242; outside diameter of tubes, 1¾ ins.
Heating surface: Tubes, 1,206 sq. ft.; firebox, 125 sq. ft.: total, 1,331 sq. ft.
Grate area, 21·1 sq. ft.
Working pressure, 175 lbs.
Tractive power per lb. of steam pressure, ·0593 ton.
Weight on coupled wheels, 52 tons 13 cwts. 1 qr.
Weight of engine (in working order), 72½ tons.
Tender: Tank capacity, 2,250 gallons; coal capacity, 3½ tons.

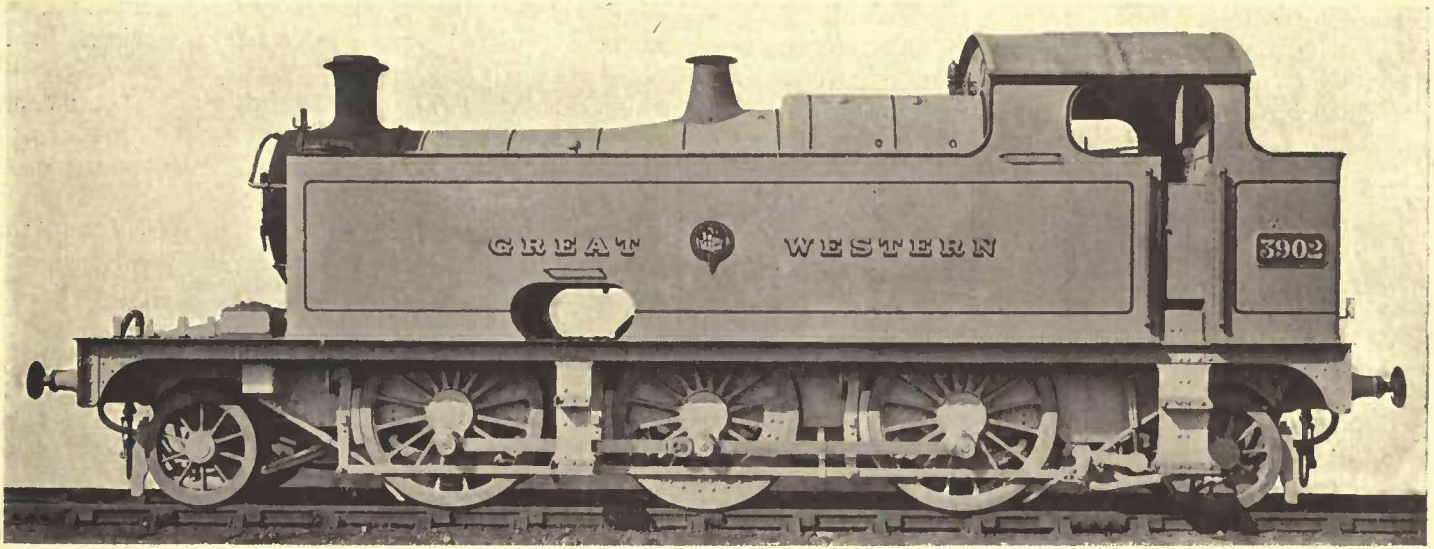
prepared to take the place of the heavy eight-wheels-coupled radial tank engines, which, since 1904, had been employed for working some of the heaviest suburban passenger traffic of the Great Northern Railway between Moorgate Street and outlying districts in the London district; but which engines have since been withdrawn, and are now working coal trains and doing heavy shunting work in the Midlands. The design is admirably proportioned, and in it Mr. H. A. Ivatt, the chief locomotive engineer of the Great Northern Railway, combines six coupled wheels of moderate diameter with a large boiler capacity and ample cylinder area. Altogether, this engine may safely be regarded as among the best designed of its kind in the country, and, having proved so uniformly successful in an all-round capacity, it will doubtless be adopted as a standard pattern on the Great Northern Railway.

Although the first tank locomotive of the 4—4—2 type on the London, Brighton & South Coast Railway was completed shortly before the close of 1906, the type must be regarded as belonging to the year 1907, as it was then that the engine began regular work, and it has since been followed by a number of others of the same class. This is another handsome-looking and effective design, with many points in resemblance to the engines having the same wheel arrangement on the Great Northern Railway. While these engines are easily able to make non-stop runs between London and Brighton, if required, they are extremely useful for working heavy suburban traffic and also frequently-stopping longer distance trains on the main line.

Mr. J. G. Robinson, Chief Mechanical Engineer of the Great Central Railway, added, during 1907, to the number of 4—4—2 type tank engines already working on that line; and the same course was followed on the London and North-Western and Great Northern Railways, whilst the Great Western also built a few more.

The close of the year saw the practical completion of some very remarkable tank engines on the Great Central Railway, at the works of Messrs. Beyer, Peacock and Co., Ltd., at Gorton, near Manchester. These engines, which have been specially designed for working in the "hump" or gravity yards of that Company, at Wath, near Doncaster, have, as the drawing on page 21 shows, the 0—8—4 wheel arrangement. They are fitted with three simple cylinders, of which the inside one drives the crank axle of the second coupled wheels, while the outside cylinders actuate the third pair of wheels. The author was courteously permitted by the builders to inspect these engines during their construction, and it is obvious to anyone who sees them that for sound principles of design and excellence of workmanship and material the engines stand in the foremost rank.

The construction of tank locomotives of varying types was proceeded with on the whole of the railways of the country, and that this medium of working the great bulk of the suburban and shorter distance passenger



2—6—2 TYPE TANK LOCOMOTIVE, GREAT WESTERN RAILWAY.

MR. G. J. CHURCHWARD, M.Inst.C.E., *Locomotive Superintendent*, SWINDON.

Leading Particulars.

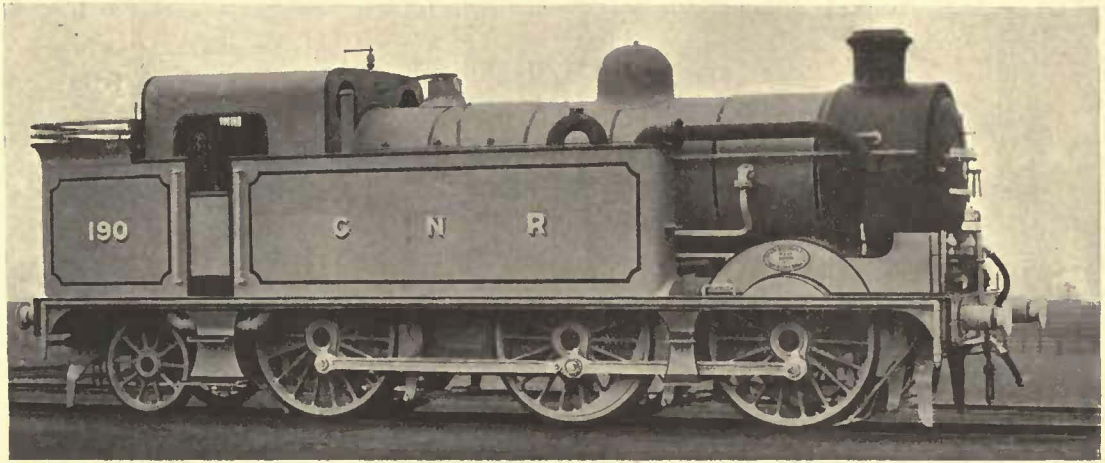
Cylinders, 17½ ins. by 24 ins.
Truck wheels diameter, 3 ft. 2 ins.
Coupled wheels diameter, 5 ft. 2 ins.
Wheelbase, 28 ft.
Boiler: Diameter (outside), 4 ft. 9½ ins. and 4 ft. 2 ins.; length, 10 ft. 6 ins.
Tubes: Number, 255; diameter, 1⅝ ins.; length, 10 ft. 10 5-16ths ins.
Heating surface: Tubes, 1178·01 sq. ft.; firebox, 93·85 sq. ft.: total, 1271·86 sq. ft.
Grate area, 16·6 sq. ft.
Working pressure, 200 lbs.
Tractive force, 21,339 lbs.
Weight (in working order), 62 tons 4 cwts.
Height of boiler centre, 8 ft. 3 ins.

and other traffic will continue for some very considerable time to come is abundantly recognised on all sides. The electrification of the suburban lines around large centres is, of course, a desirable thing; but it is one of those developments which must, for numerous reasons, come slowly, and anything like a general establishment of this newer means of conducting railway traffic in congested districts is practically as much as ever a thing of the future.

In the region of goods locomotive design, the past year marked a general tendency to adhere to the existing most popular types on the home railways, viz., those having the 0—6—0 and 0—8—0 wheel arrangements.

Additional "Consolidation" type engines were built by the Great Western Railway, and more of the Webb four-cylinder eight-coupled compounds on the London & North-Western Railway were converted to the 2—8—0 wheel arrangement. The former Company also built some further "Mogul" (or 2—6—0) locomotives. Other railways were content to retain the six- and eight-coupled wheel arrangements, without the addition of carrying wheels. The cause of locomotive compounding—otherwise flagging in this country—received a marked impetus by the introduction by Mr. George Hughes on the Lancashire & Yorkshire Railway of a new class of eight-wheels-coupled (0—8—0 type) engines having four compound cylinders (see page 23). The introduction of these engines followed upon exhaustive trials made with one engine which Mr. Hughes had converted from a simple into a compound, and which had proved very successful in service. In the locomotives of the type illustrated on page 23, the two inside (low-pressure) cylinders drive the crank axle of the second pair of wheels, while the third pair is actuated by the high-pressure cylinders outside the frame.

Steam distribution is effected by piston valves for the high-pressure and Richardson's balanced valves for the low-pressure cylinders, and motion is imparted to the four valves by means of one set of gear of the Joy type for each pair of valves, viz., one high-pressure and the other low-pressure, this being effected through the medium of a two-armed rocking shaft. These valves travel together in the same direction, while the pistons move oppositely to one another. For efficiently starting the engine, or in case of emergency when working on heavy gradients, an arrangement, patented by the designer of the engines, is fitted whereby steam direct from the boiler is admitted automatically to the low-pressure steam chest through a starting valve. The arrangement, which is an extremely simple one, comes into operation when the driver places the reversing lever in either full forward or backward gear, and its action is positive and automatic, and cannot be tampered with. The appearance of these engines must be considered as one of the most noteworthy events of the year in British locomotive circles, for, not since



SIX-COUPLED RADIAL (0—6—2 TYPE) TANK LOCOMOTIVE, GREAT NORTHERN RAILWAY.
MR. H. A. IVATT, M.Inst.C.E., *Chief Locomotive Engineer*, DONCASTER.

Leading Particulars.

Cylinders: Diameter, 18 ins.; piston stroke, 26 ins.
Coupled wheels diameter, 5 ft. 8 ins.
Radial wheels diameter, 3 ft. 8 ins.
Wheelbase: Rigid, 16 ft. 3 ins; total 23 ft. 7 ins.
Boiler: Diameter (outside), 4 ft. 8 ins.; length of barrel, 10 ft. 7 ins.; height of centre above rail, 8 ft. $0\frac{3}{8}$ in.

Heating surface: Tubes, 1,130 sq. ft.; firebox, 120 sq. ft.: total, 1,250 sq. ft.
Grate area, 20·8 sq. ft.
Working pressure, 170 lbs. per sq. in.
Weight on coupled wheels, 51 tons 14 cwts.
Weight of engine (in working order), 64 tons 14 cwts.
Tender: Water capacity, 1,400 gallons; coal capacity, 4 tons.

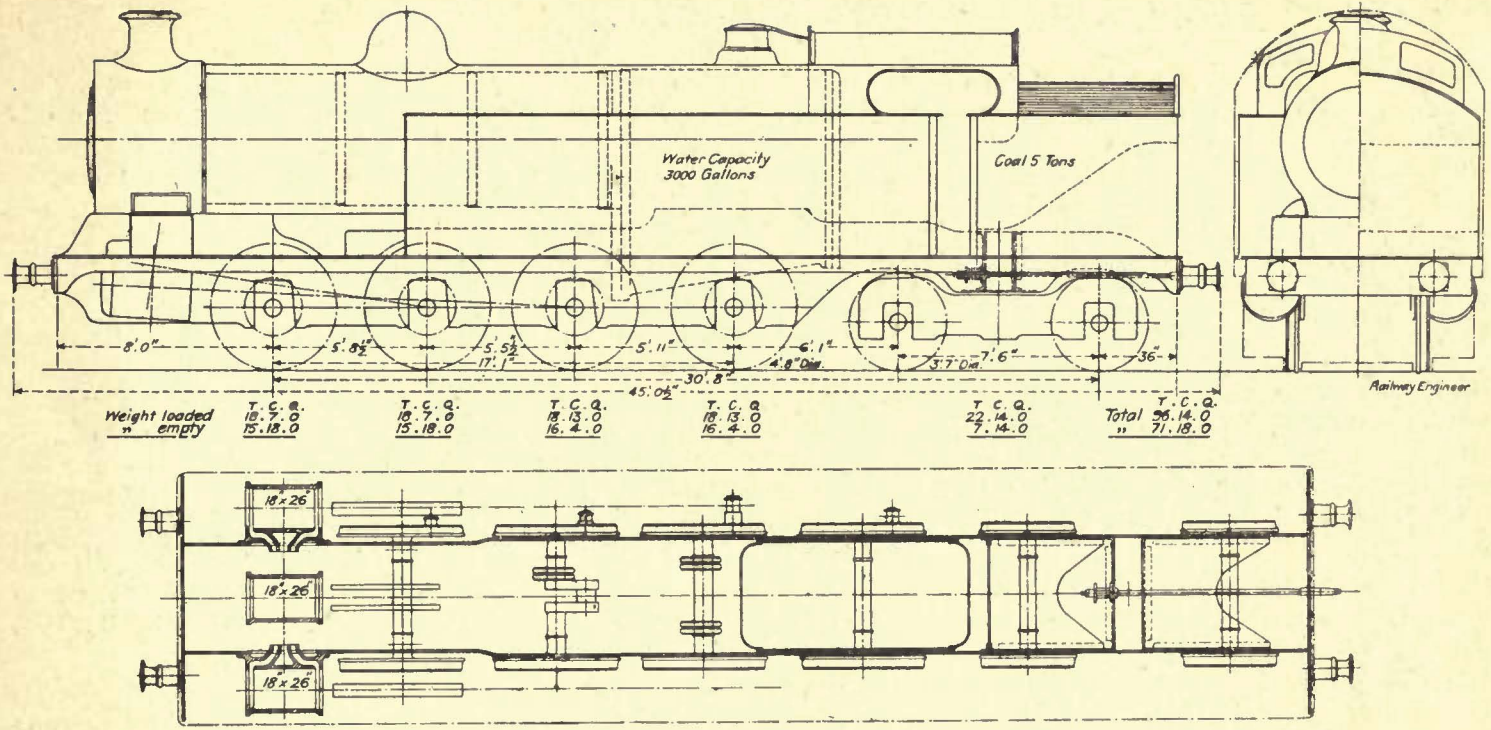
the late Mr. Webb built four-cylinder eight-coupled compound goods engines on the London & North-Western Railway has any other locomotive engineer adopted the type in freight service. Apart from the question of wheel arrangement and the class of service, the step taken by Mr. Hughes directly revives the waning interest in locomotive compounding in this country.

The locomotive building firms of Great Britain, although perhaps not enjoying anything in the sense of a "record" year, did much during 1907 to further enhance the national reputation and position in this branch of industry. Some exceptionally fine locomotives were exported, and the demand from India and South America was larger than usual. The Vulcan Foundry, Ltd., whose works at Newton-le-Willows rank among the best equipped of any in Europe, built a very large number of locomotives for India, as well as for other parts of the world.

A "Consolidation" type goods engine completed at the works of this firm towards the end of the year, and which represented the first of an order of forty similar locomotives, is illustrated on page 25. These rank among the largest and most powerful two-cylinder locomotives yet built in this country, and the author, having been privileged to inspect the engines during building, can testify to the excellence of the workmanship and materials put into them. The two-wheeled bogie is of the swinging bolster type, compensated through the beam to the spring of the leading coupled wheels. The radial arm is pivoted to the frame stretcher behind the cylinders, and is fixed to lugs on the axle-box steel casting, which is continuous from side to side. The springs are placed transversely one on either side of the axle, and are carried at the centre on a pin fixed in the centre casting which straddles the axle-box, and at the ends by swing-links connecting to the top of axle-box. The lateral movement is $5\frac{1}{4}$ ins., or $2\frac{5}{8}$ ins. each way. The weight of the bogie complete is $2\frac{1}{2}$ tons.

The total weight of the engine without tender, in working order, is $71\frac{1}{4}$ tons. The engines, with their large cylinder and boiler capacities and ample adhesion weight, are admirably adapted for the work of hauling heavy train-loads over difficult sections of line, and they will doubtless prove highly successful under these conditions in India. The combination of simplicity and straightforwardness of design, care and skill in manufacture, and the ample character of the proportions present in these engines, place them in the most favourable position possible for the accomplishment of the purpose for which they have been built.

The design follows in all essential respects the recommendations of the Engineering Standards Committee for Indian Locomotives. The Vulcan Foundry, Ltd., also had in hand at the close of the year an order for several 0—6—4 tank engines, intended for heavy suburban passenger service on the East Indian Railway, and at an earlier period despatched some remarkably fine four-cylinder balanced compounds of the type



0—8—4 TYPE THREE-CYLINDER TANK ENGINE, GREAT CENTRAL RAILWAY.

MR. J. G. ROBINSON, M.Inst.C.E., *Chief Mechanical Engineer*, GORTON.

BUILT BY MESSRS. BEYER, PEACOCK & CO., LTD., GORTON.

Leading Particulars.

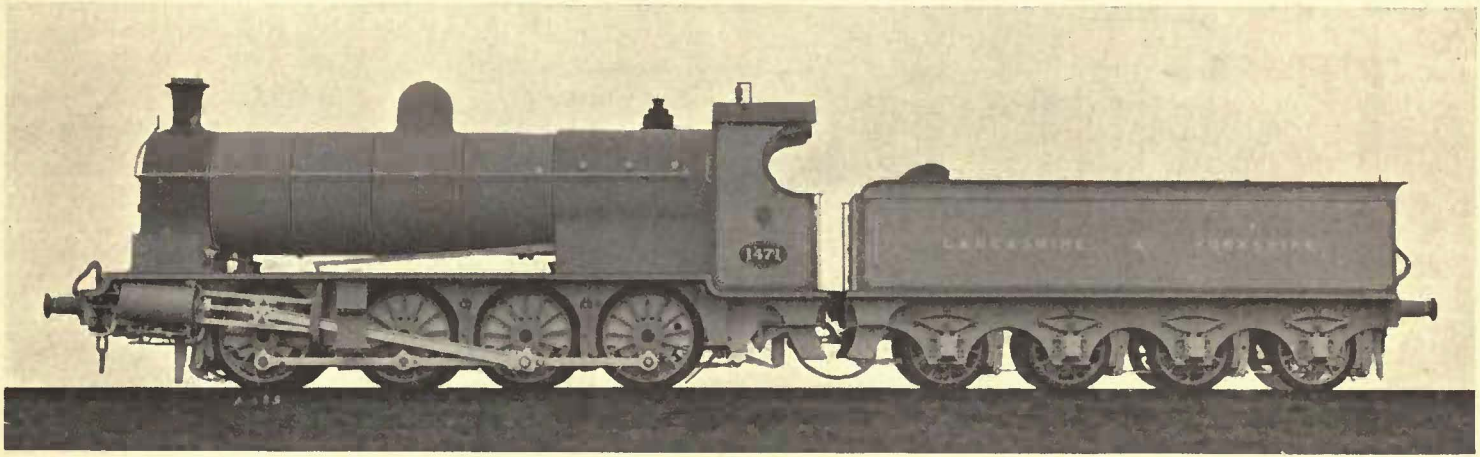
Cylinders: Diameter, 18 ins.; piston stroke, 26 ins.
Coupled wheels diameter, 4 ft. 8 ins.
Bogie wheels diameter, 3 ft. 7 ins.
Wheelbase: Rigid, 17 ft. 1 in.; total, 30 ft. 8 ins.

Boiler (Standard G.C.R. "Atlantic" pattern): Diameter, 5 ft.; length, 15 ft.
Grate area, 26 sq. ft.
Working pressure, 200 lbs. per sq. in.

Heating surface: Tubes, 1777·9 sq. ft.; firebox, 133·1 sq. ft.: total, 1911·0 sq. ft.

illustrated on page 27 to the Buenos Ayres Great Southern Railway. The engines of this class are fitted with a separate set of Walschaerts' valve gear for each slide-valve, and they are also equipped with the Vulcan Foundry Company's patent starting valve and reversing gear, both of which highly efficient devices have been illustrated and described in the columns of the engineering Press on several occasions. The same firm exported "Consolidation" locomotives to the Bengal-Nagpur Railway, 4—6—0 express engines for the Bombay-Baroda and Central India Railway, and "Duplex Fairlie" type locomotives for the Burma Railway, while numerous other orders were executed. Another well-known firm—Messrs. Robert Stephenson and Co., Ltd., of Darlington—sent a large number of locomotives abroad, noteworthy among which were the heavy eight-coupled goods locomotives, one of which is shown on page 29, and tank engines of the type illustrated on page 31. The business done by this firm, which bears one of the most honoured names in the locomotive history of this country, has increased much of late; and as this result comes as the reward of combining enterprise with excellent workmanship, it is merited in the fullest degree. Other British locomotive firms who did a large output during 1907 were Messrs. Beyer, Peacock & Co., Ltd., of Gorton, Manchester, who built a quantity of locomotives both for home and foreign service, of which one of the most interesting types is that to which reference has already been made, and of which a drawing is given on page 21. Another distinctive design representing a product of this well-known firm is the large 2—6—4 tank locomotive built for the Bengal Nagpur Railway and illustrated on page 33. This is the first of a new series of engines, and the design is based on the recommendations of the Engineering Standards Locomotive Committee. The author's thanks are due to Messrs. Sir John Wolfe Barry & Partners, Consulting Engineers to the Bengal Nagpur Railway, for permission to publish this photograph, which was kindly supplied by the builders of the engines. The North British Locomotive Company, Ltd., of Glasgow, also did an increasing trade in locomotives during 1907. The British-built locomotive is, if we are to accept the word of a leading authority who is chief mechanical engineer of a railway abroad, still esteemed, from a constructional point of view, as representing the best all-round production of its kind in the world.

Turning to the locomotive practice of foreign countries, we find that many notable developments took place during 1907. Nearly all the Continental Railways continue the policy of increasing the size of their locomotives, and one, *i.e.*, the Paris-Orleans, achieved notoriety by introducing the 4—6—2 (or "Pacific") type of engine into Europe, a fact to which reference has already been made in the present volume. The two engines, which formed the nucleus of what is now being magnified into an extensive series, were put to



FOUR-CYLINDER COMPOUND GOODS LOCOMOTIVE (0—8—0 TYPE), LANCASHIRE AND YORKSHIRE RAILWAY.

MR. GEORGE HUGHES, M.Inst.C.E., *Chief Mechanical Engineer*, HORWICH.

Leading Particulars.

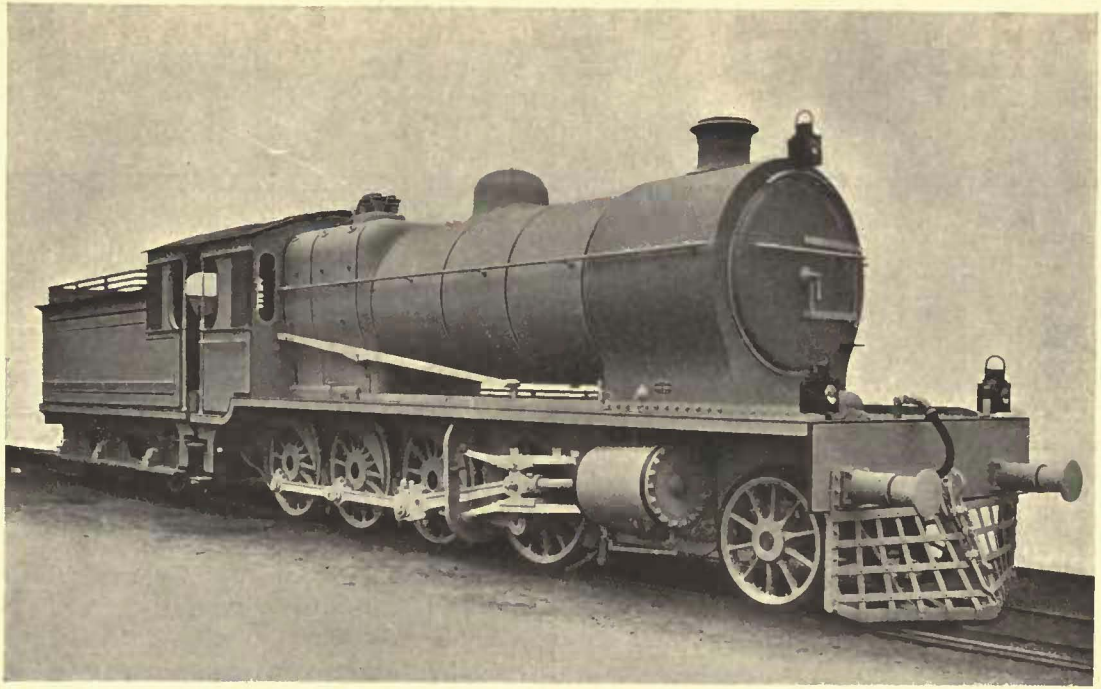
Cylinders: Diameter—H.-P., 15½ ins.; L.-P., 22 ins.; piston stroke, 26 ins.
Wheels diameter, 4 ft. 6 ins.
Wheelbase, 16 ft. 4 ins.
Boiler: Diameter (outside), 4 ft. 10 ins.; length between tube plates 15 ft.; height of centre above rail, 8 ft. 5 in.
Grate area, 23 sq. ft.
Working pressure, 180 lbs. per sq. in.
Weight of engine (in working order), 60 tons 16 cwts. 1 qr.
Tender: Water capacity, 3,600 gallons; coal capacity 5 tons.
Weight of engine and tender (in working order), 102 tons 5 cwts. 1 qr.
Heating surface: Tubes, 1,767 qs. ft.; firebox, 147 sq. ft.; total, 1,914 sq. ft.

work about the middle of the year. They represent the latest development of French locomotive engineering, and occupy a foremost place in the locomotive standards of the world. The author was afforded an opportunity, during December last, of inspecting some of the later additions to the class, then building at the works of the Société Alsacienne de Constructions Mécaniques, at Belfort.

The immense size of the boiler is appreciated when seen completed and apart from the engine portion, and the peculiar construction of the firebox, which, for a part of its length lies between the frames and for the remainder widens out above them, is seen to great advantage. The Société Alsacienne had in hand at the time of the visit above referred to an order for no less than forty-five of these "Pacific" locomotives for the Paris-Orleans Railway, as well as 133 locomotives of varying types for the Alsace-Lorraine Railways.

The Southern, or Midi, Railway of France had on order at Belfort at the same time four "Pacific" type engines of the P.O. design, but with larger coupled wheels. The four cylinders and valve gears in these engines are arranged on the well-known and highly successful de Glehn principle, and the design may generally be regarded as a natural development of the 4—6—0 type of engine, of which a large number is employed on the Continental railways. A leading Company to employ this latter type is the Eastern Railway of France, whereon some exceptionally fine and powerful locomotives designed by Mons. L. Salomon, the chief mechanical engineer, are to be found. Some trial runs made by the author with engines of this class during 1907 demonstrated their wide capabilities both in regard to speed capacity and weight hauling; and a very accurate idea of the work which the engines are doing in the matter of speed at any given time can be obtained by means of the Flaman speed indicator, with which ingenious and highly effective device these, as all other types of locomotives used on the main line of the Est Railway, are fitted, and which has always given the most successful results.

Two notable examples of this pattern of locomotive, built during 1907, are illustrated on pages 34 and 35. Both of these represent very recent developments, and therefore have an especial interest. The locomotive for the Prussian State Railways, page 35, is of the two-cylinder simple type, equipped with a Schmidt superheater of the smoke-tube pattern. The design was, indeed, based more or less upon the fact that highly superheated steam was to be employed, and it has the special form of piston and piston-valves devised by Mr. Schmidt for use in conjunction with his well-known superheating system. This is a very large and powerful engine, the design of which embodies some of the latest ideas held on the subject of locomotive construction in Germany, where the use of superheated steam is being consistently extended. The Saxon State locomotive, page 36, also uses superheated steam, but in conjunction with



"CONSOLIDATION" (2—8—0 TYPE) LOCOMOTIVE, INDIAN NORTH-WESTERN (GOVERNMENT) RAILWAY.

BUILT BY THE VULCAN FOUNDRY, LTD., NEWTON-LE-WILLOWS, LANCS.

Leading Particulars.

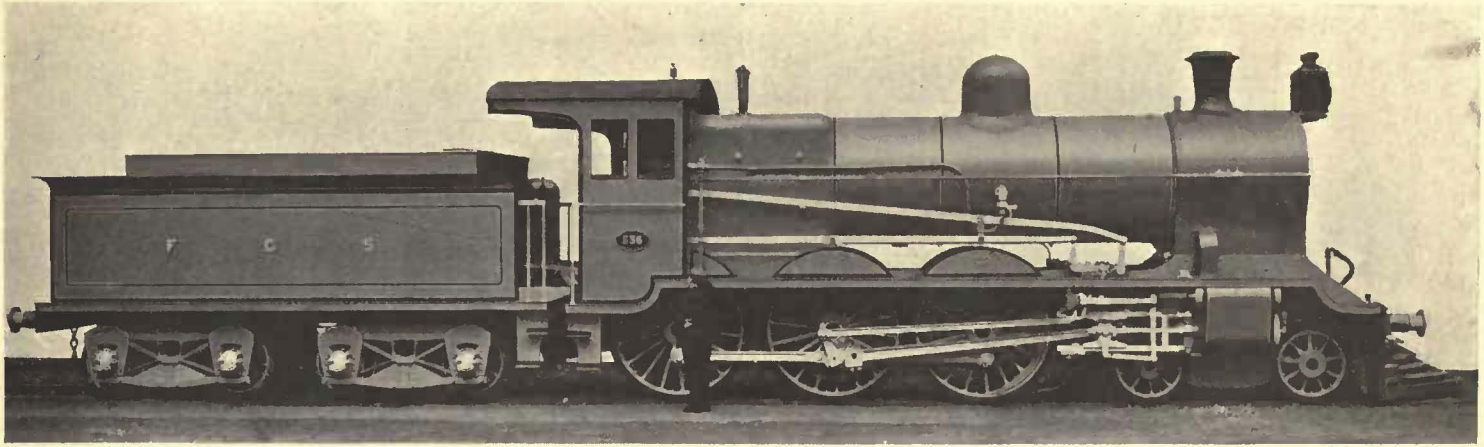
Cylinders: Diameter, 20 ins.; piston stroke, 26 ins.
Bogie wheels diameter, 3 ft. 7 ins.
Coupled wheels diameter, 4 ft. 8½ ins.
Wheelbase: Rigid, 16 ft.; total (engine), 25 ft.
Boiler: Diameter (outside), 5 ft. 6 ins.; length between tube plates, 12 ft. 6 ins.; height of centre above rail, 8 ft. 9½ ins.
Heating surface: Tubes, 1,914 sq. ft.; firebox, 173 sq. ft.: total, 2,087 sq. ft.
Grate area, 32 sq. ft.
Working pressure, 180 lbs. per sq. in.
Weight on coupled wheels, 63¼ tons.
Weight of engine (in working order), 71¾ tons.
Tender: Water capacity, 4,000 gallons; coal capacity, 7½ tons.
Weight of engine and tender (in working order), 118½ tons.

compound instead of single-expansion cylinders. In this engine the four cylinders are arranged in line below the smokebox, and all drive the leading pair of coupled wheels. This cylinder and valve arrangement is now referred to by some as constituting the "Central European" system, in which only two sets of gear are employed for working the four slide-valves. The low-pressure cylinders are outside the frames, and the high-pressure inside, and the slide-valves, which are of the piston type, work above the cylinders. The valve gearing is of the Heusinger pattern, a modification of the Walschaerts' motion. The two gears are applied to the outside low-pressure cylinders direct, and motion is conveyed to the high-pressure spindles by cross-connecting levers at the rear of the cylinders. The boiler is fitted with the Belpaire type of firebox and extended smokebox. The front of the latter is of conical formation, and the cab front sheets are similarly arranged, for the purpose of reducing air friction. The superheater consists of twenty-four tubes of $4\frac{5}{8}$ ins. to 5 ins. diameter and 144 tubes of $1\frac{3}{4}$ ins. to 2 ins. diameter. A large capacity double-bogie tender accompanies the engine.

Some very large passenger locomotives, having the 2—6—2 type wheel arrangement and four compound cylinders, were introduced on the Italian State Railways during the past year, and a number of new locomotives, both for passenger and goods service, were introduced into Italy, the locomotive standards of which country were greatly improved during 1907. The arrangement of the four cylinders of the engine illustrated is peculiar. It is such that the two low-pressure cylinders are located on the same side of the engine, one inside and the other outside the frame, while the two high-pressure cylinders are similarly arranged on the other side of the engine, so that the arrangement is totally different to that commonly adopted in four-cylinder compound locomotives.

Only two valves, of the piston type, are employed for distributing steam to the four cylinders. These are located directly above the outside cylinders (one high-pressure and the other low-pressure), and the steam passages cross one another, which makes the use of only two piston valves feasible. The two valve gears are of the Walschaerts' type, and reversing is, of course, arranged as for an ordinary two-cylinder simple locomotive. The inside cylinders (one high-pressure and one low-pressure) are placed higher than the outside cylinders and inclined downwards towards the crank-axle, this arrangement affording the necessary clearance between the inside mechanism and the leading coupled axle. The 2—6—2 wheel arrangement is an unusual one outside America, it having been, so far as the author can recall, only used in Austria before these new Italian locomotives made their appearance.

One of the few 4—4—0 type locomotives built for heavy express passenger service on the Continent during 1907 is illustrated on page 38. This design, as in the case



FOUR-CYLINDER BALANCED COMPOUND LOCOMOTIVE, BUENOS AYRES GREAT SOUTHERN RAILWAY.

BUILT BY THE VULCAN FOUNDRY, LTD., NEWTON-LE-WILLOWS, LANCS.

Leading Particulars.

Cylinders: Diameter—H.-P., 14 ins.; L.-P., 23 ins.; piston stroke, 26 ins.

Wheels: Diameter—bogie, 3 ft. 2 ins.; coupled, 6 ft.

Wheelbase: Rigid, 12 ft. 8 ins.; total (engine), 25 ft. 11 ins.

Boiler: Diameter, 4 ft.; length, 14 ft. 4½ ins.

Heating surface: Tubes, 1,667 sq. ft.; firebox, 136 sq. ft.: total, 1,803 sq. ft.

Grate area, 28 sq. ft.

Working pressure, 220 lbs. per sq. in.

Weight on coupled wheels, 47½ tons.

Weight of engine (in working order), 69 tons.

Tender: Water capacity, 4,000 gallons; coal capacity, 7 tons.

Weight of engine and tender, 115 tons.

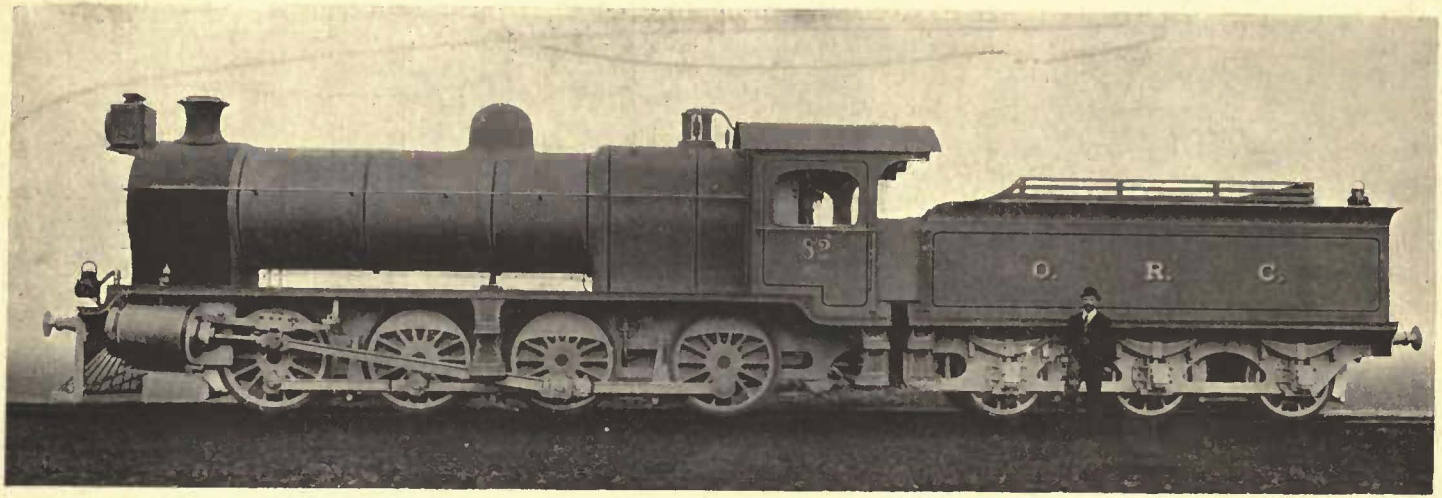
of the 4—6—0 type locomotive of the Prussian State Railways, for which this engine was also built, incorporates two simple cylinders with the use of the superheater. The latter, however, while still being on the Schmidt principle, is of the smokebox instead of the smoke-tube pattern. Writing to the author upon the subject of superheated locomotives and the work they are doing on the Prussian State and other railways, Mr. Wilhelm Schmidt stated that when tested against an "Atlantic" type "saturated" compound, with identical loads and conditions absolutely the same in both cases, the economy of the superheated steam locomotive—based on 1,000-ton miles—was: (*a*) With nine coaches, 25 per cent. in coal and 41 per cent. in water; (*b*) with eleven coaches, 27·8 per cent. in coal and 40·5 per cent. in water; (*c*) with thirteen coaches, 33·3 per cent. in coal and 36·7 per cent. in water. A remarkable result.

The year 1907 saw an important development in the locomotive practice of both Sweden and Denmark. This was the introduction of the "Atlantic" type of engine, which, of course, constituted a great advance upon previous standards in either country.

The Swedish locomotives, one of which is illustrated on page 39, is a two-cylinder simple engine, and the general design combines features of English and American practice, with those which distinguish Continental locomotives. The cylinders are placed inside the frames, and steam is distributed to them by superposed piston valves worked by Heusinger valve motion. A large and high-pitched boiler is provided, and the smokebox, which is of the extended pattern, contains a spark arrester. This is another instance of the employment of the Schmidt smoke-tube superheater, which is gaining in popularity rather more than the smokebox pattern. The engine ranks among the comparatively few of its type to have inside cylinders. The frames are constructed of cast-steel bars, as in American locomotive practice.

The Danish "Atlantic" locomotives referred to above are four-cylinder balanced compounds, with separate driving axles. If anything, they are larger than the Swedish engine illustrated.

Tank locomotives, although not so generally employed abroad as in this country, were built in large numbers on the Continent during 1907. Many of the designs were remarkable for the largeness of their dimensions, the engines resembling, in some instances, except in the matter of coal and water-carrying capacity, the most powerful express and goods locomotives. Among the French railways, both the Northern and Eastern Railways built more tank engines of their respective standard types. Those of the Nord are 4—4—4 type, with two simple cylinders, and those of the Est 4—6—4 engines, with four compound cylinders. Both are largely employed around Paris and at other centres, and each possesses great hauling capacity, those of the Est more so, of course, because of the extra pair of



EIGHT-COUPLED (0—8—0 TYPE) GOODS LOCOMOTIVE, OTTOMAN RAILWAY.

BUILT BY MESSRS. ROBERT STEPHENSON & CO., LTD., DARLINGTON.

Leading Particulars.

Cylinders: Diameter, 19½ ins.; piston stroke, 26 ins.
Wheels diameter, 4 ft. 6½ ins.
Wheelbase: Engine, 17 ft. 10 ins.
Heating surface: Tubes, 1,634 sq. ft.; firebox, 152·4 sq. ft.: total, 1786·4 sq. ft.
Grate area, 25·35 sq. ft.

Working pressure, 180 lbs.
Total weight (in working order), 58 tons.
Tender wheelbase, 12 ft.
Tender: Tank capacity, 3,000 gallons; fuel capacity, 7 tons.
Weight (in working order), 37 tons 5 cwts.
Engine and tender, total, 95 tons 5 cwts.

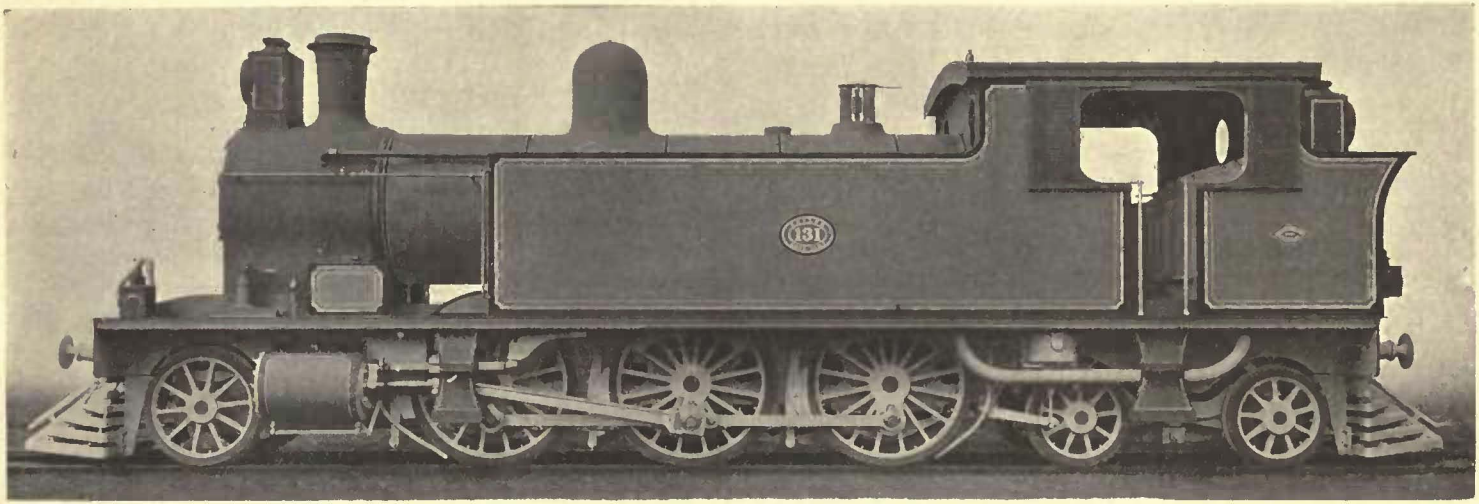
coupled wheels and larger cylinder capacity. During a visit to the Paris-la-Chapelle Works of the Northern of France Railway towards the end of last year, the author saw under construction there two of the huge duplex articulated tank engines designed by Mons. du Bosquet for heavy grade work. These engines have four compound cylinders, and of the fourteen wheels which support them twelve are coupled, these being arranged as two six-wheeled bogies driven independently, the one by the high-pressure and the other by the low-pressure cylinders. There was also to be seen in the shops at the same time a new express locomotive, with 4—4—4 wheel arrangement, a development of the "Atlantic" type. This has been built by Schneiders, of Creuzot, and is fitted with a wide firebox containing water tubes and a special arrangement of pipes, evaporator, etc., for raising the temperature of the steam before the latter reaches the high-pressure cylinders.

As an example of recent Continental goods locomotive practice, the engine illustrated on page 40 has been selected. This was built by Maffei & Co., of Munich, for the St. Gothard Railway, and is a four-cylinder compound in which the four cylinders are arranged in line below the smokebox, with the high-pressure inside of the frames and the low-pressure outside. The second coupled wheels are the drivers. Automatic valves are fitted, by means of which steam from the boiler is admitted to the receiver when the cut-off exceeds 75 per cent. of the piston stroke; but there is no mechanism by which the driver can, at will, turn boiler steam into the low-pressure cylinders. The boiler is of large size, and contains a Schmidt system superheater. The slide-valves are of the piston type, and the valve gear Heusinger's.

The "Consolidation" (or 2—8—0) type locomotive remains well in favour on the European Continent, and a tendency to resort to ten-coupled wheels is also seen.

Progress in connection with locomotive matters was well maintained during 1907 in America. For heavy express service the "Pacific" engine generally, with large capacity simple but sometimes compound cylinders, continued as a favourite type, but the "Atlantic" locomotive also found many adherents. The Walschaerts' valve gear came further into prominence, and now appears to have been adopted almost as a basic principle of American locomotive design. Some extremely heavy goods locomotives of the 2—8—0 and ten-coupled types made their appearance, as did also that hardy annual the "largest locomotive in the world." The credit this time belongs to the Erie Railroad, to whom the American Locomotive Company delivered a duplex articulated engine having the 0—8—8—0 wheel arrangement, and weighing, in working order, no less than 183 tons without tender. A good example of recent American tank locomotive practice forms the concluding illustration.

The general tendencies of locomotive engineering, as indicated by the developments and practice of 1907,



2—6—4 TYPE TANK LOCOMOTIVE, CEYLON GOVERNMENT RAILWAYS.

BUILT BY MESSRS. ROBERT STEPHENSON & CO., LTD., DARLINGTON.

Leading Particulars.

Cylinders: Diameter, 19 ins.; stroke, 26 ins.

Coupled wheels diameter, 5 ft.

Total wheelbase, 32 ft. 6 ins.

Total heating surface, 1,323 sq. ft.

Grate area, 23·5 sq. ft.

Working pressure, 160 lbs. per sq. in.

Total weight (in working order), 71 tons.

Tank capacity, 1,750 gallons.

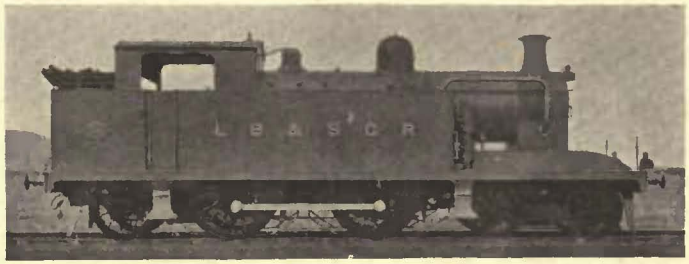
Bunker capacity, 2¾ tons.

Gauge of railway, 5 ft. 6 ins.

remain much what they were at the end of the preceding year. In regard to wheel arrangements, there appears to be a greater disposition to resort to the use of six-coupled wheels for the heaviest passenger service, and the reasons for this have already been outlined. The tendency is not so marked, as yet, in this country as abroad; but signs are not wanting that here, as well as abroad, matters are taking the same direction on the majority of the principal lines. The position of the compound locomotive appears to have become rather a doubtful one in Great Britain, where, except for the one notable exception to which attention has been drawn, a halt would seem to have been called by those controlling the locomotive departments of the lines, where, during 1906, a wider application of the compound principle was noticeable. The use of superheated steam in locomotives made great progress abroad, and experiments have been going on quietly in this country also; indeed, the author was informed in a recent letter that the total number of engines so equipped has now reached 2,411 on seventy different railways, while numerous others so fitted are in course of construction. The Prussian State Railways, as before said, have made this principle the basis of many recent locomotive designs, and in Belgium and Italy, and other Continental countries, the matter is being taken up with increasing energy. America and Canada are also prominently associated with progress in this direction. The proportions of the essential portions of locomotives were still increasing at the end of the year, and the time cannot be far distant when, in its present form and under existing conditions, the steam locomotive will have reached the limitations which govern over-all proportions. In spite of this, however, it cannot be doubted that steam, as the primary motive power for railway purposes, has before it—even in these days of rapid advancement—a very considerable future.

Leading Particulars.

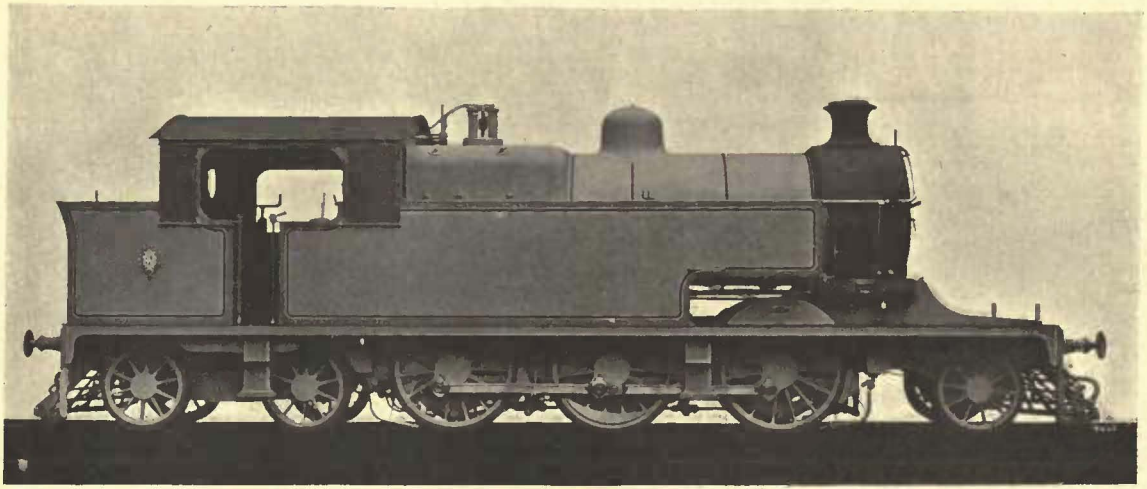
Cylinders: Diameter, 17½ ins.; piston stroke, 26 ins.
Wheels: Diameter—Bogie, 3 ft. 6 ins.; coupled, 5 ft. 6 ins.; trailing, 4ft.
Wheelbase: Coupled, 8 ft. 9 ins.; total, 28 ft. 11½ ins.
Boiler: Diameter (outside), 4 ft. 3 ins.; length, 10 ft. 10¼ ins.
Heating surface: Tubes, 947·63 sq. ft.; firebox, 93·25 sq. ft.: total 1040·88 sq. ft.



4—4—2 TYPE PASSENGER TANK LOCOMOTIVE L.B. & S.C.R.

Leading Particulars

Grate area, 17·43 sq. ft.
Working pressure, 170 lbs. per sq. in.
Weight on coupled wheels, 36 tons 12 cwts.
Weight of engine (in working order), 68 tons 6 cwts.
Tender: Water capacity, 1,983 gallons; coal capacity, 3¼ tons.
Tractive force, 18,720 lbs.



HEAVY 2—6—4 TYPE TANK LOCOMOTIVE, BENGAL NAGPUR RAILWAY.

BUILT BY MESSRS. BEYER, PEACOCK & Co., LTD., GORTON.

Leading Particulars.

ders : Diameter, 18½ ins. ; piston stroke, 26 ins.

upled wheels diameter, 5 ft. 1½ ins.

Radial truck and bogie wheels, 3 ft. 6½ ins.

Wheelbase : Rigid, 13 ft. ; total, 33 ft. 3 ins.

Boiler : Diameter (outside minimum), 5 ft. 1¾ ins. ; length, 10 ft. 1½ ins.

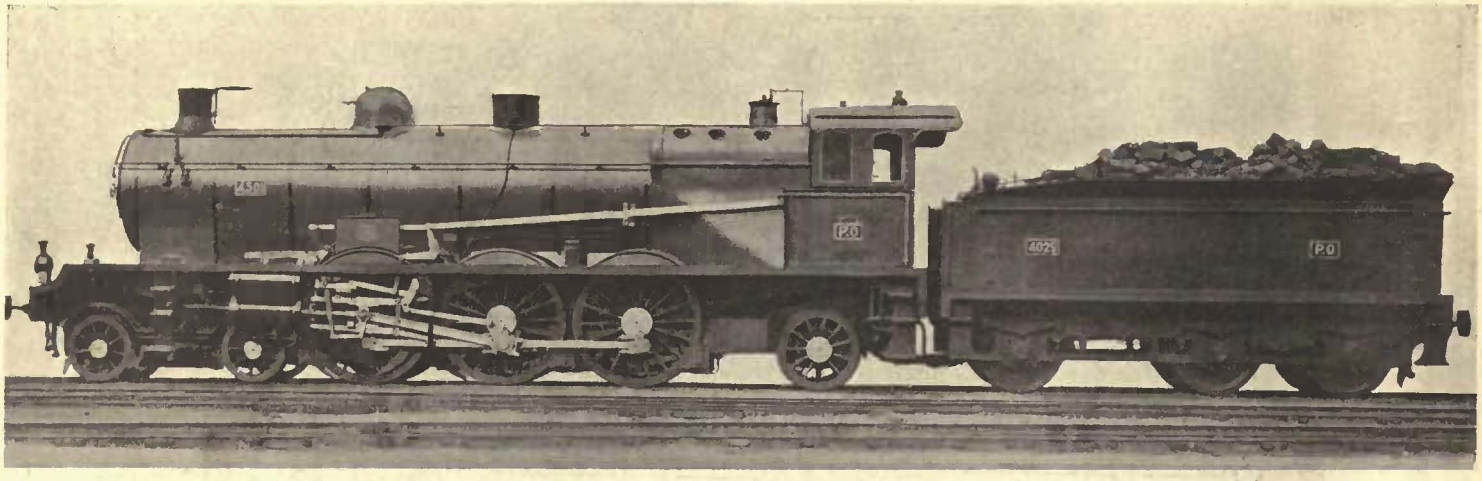
Heating surface : Tubes, 1,275 sq. ft. ; firebox, 137·6 sq. ft. ; total, 1,413 sq. ft.

Grate area, 27 sq. ft.

Tender : Capacity of tank, 2,000 gallons ; fuel space, 135 cub. ft.

Weight (on coupled wheels), 47 tons 0 cwt. 3 qrs.

Weight (in working order), 79 tons 10 cwt. 3 qrs.



"PACIFIC" (4—6—2 TYPE) FOUR-CYLINDER COMPOUND EXPRESS LOCOMOTIVE, PARIS-ORLEANS RAILWAY.

BUILT AT BELFORT BY THE SOCIÉTÉ ALSACIENNE DE CONSTRUCTIONS MÉCANIQUES.

Note peculiar construction of Firebox.

Leading Particulars.

Cylinders: Diameter—H.-P., 15¾ ins.; L.-P., 25¾ ins.; piston stroke, 25½ ins.

Wheels: Diameter—Bogie, 3 ft. 2 ins.; coupled, 6 ft. 1 in.; trailing 3 ft. 9½ ins.

Wheelbase: Coupled, 12 ft. 9½ ins.; total, 34 ft. 5½ ins.

Boiler: Diameter, 5 ft. 6¼ ins.; height of boiler centre above rails, 9 ft. 3 ins.

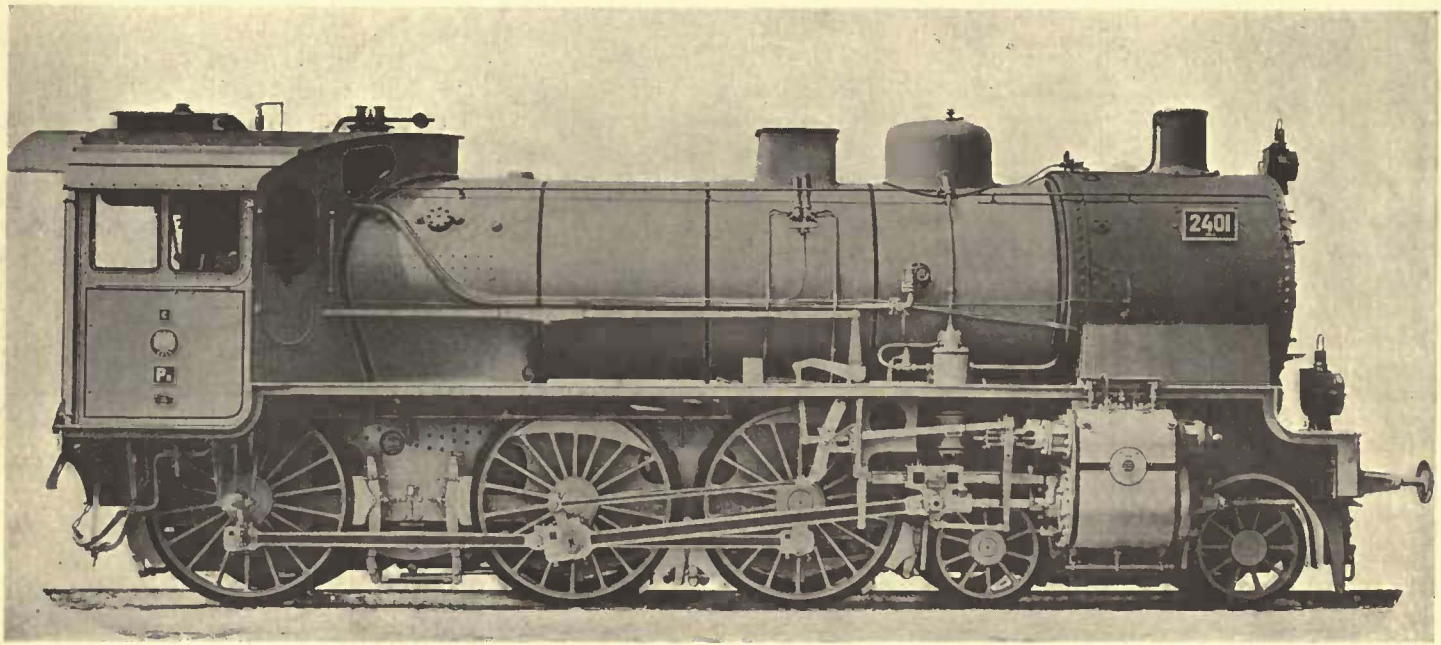
Heating surface: Tubes, 2603·62 sq. ft.; firebox, 165·44 sq. ft.: total, 2769·06 sq. ft.

Grate area, 46 sq. ft.

Boiler pressure, 227 lbs.

Weight on coupled wheels, 53 tons.

Weight of engine (in working order), 89 tons.



4—6—0 TYPE SIMPLE EXPRESS LOCOMOTIVE, PRUSSIAN STATE RAILWAYS.

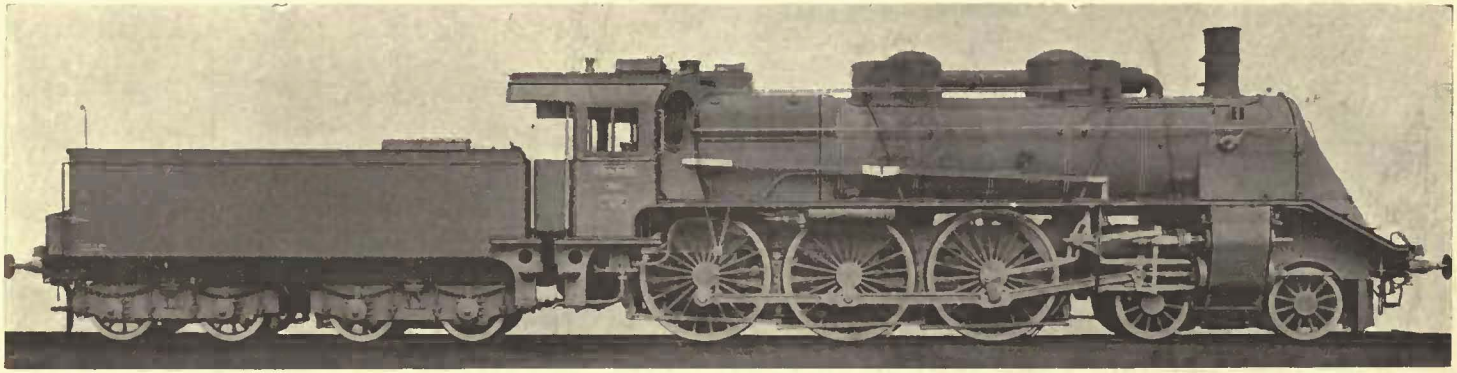
BUILT BY THE BERLINER MASCHINENBAU ACTIEN-GESELLSCHAFT.

Fitted with SCHMIDT SYSTEM *Smoke-tube Superheater.*

Leading Particulars.

Cylinders : Diameter, 23·2 ins. ; piston stroke, 24·8 ins.
Bogie wheels diameter, 3 ft. 2 ins.
Coupled wheels diameter, 5 ft. 8½ ins.
Wheelbase : Rigid, 15 ft. ; total, 27 ft. 6 ins.
Boiler : Maximum diameter (outside), 5 ft. 3 ins. ; length between tube plates, 15 ft. ; height of centre above rail, 9 ft.

Heating surface : Total, 2,153 sq. ft. ; superheater, 532 sq. ft.
Grate area, 28 sq. ft.
Working pressure, 170 lbs.
Weight on coupled wheels, 46·9 tons.
Weight of engine (in working order), 68·4 tons.



4—6—0 TYPE COMPOUND EXPRESS LOCOMOTIVE, SAXON STATE RAILWAYS.

Fitted with SCHMIDT SYSTEM *Smoke-tube Superheater.*

Leading Particulars.

Cylinders: Diameter—H.-P. (2), 16·9 ins.; L.-P. (2), 26·8 ins.

Bogie wheels diameter, 3 ft. 5 ins.

Coupled wheels diameter, 6 ft. 2¾ ins.

Wheelbase: Rigid, 13 ft. 8 ins.; total (engine), 28 ft. 4 ins.

Boiler: Diameter (maximum outside), 5 ft. 5 ins.; length between tube plates, 15 ft. 2 ins.

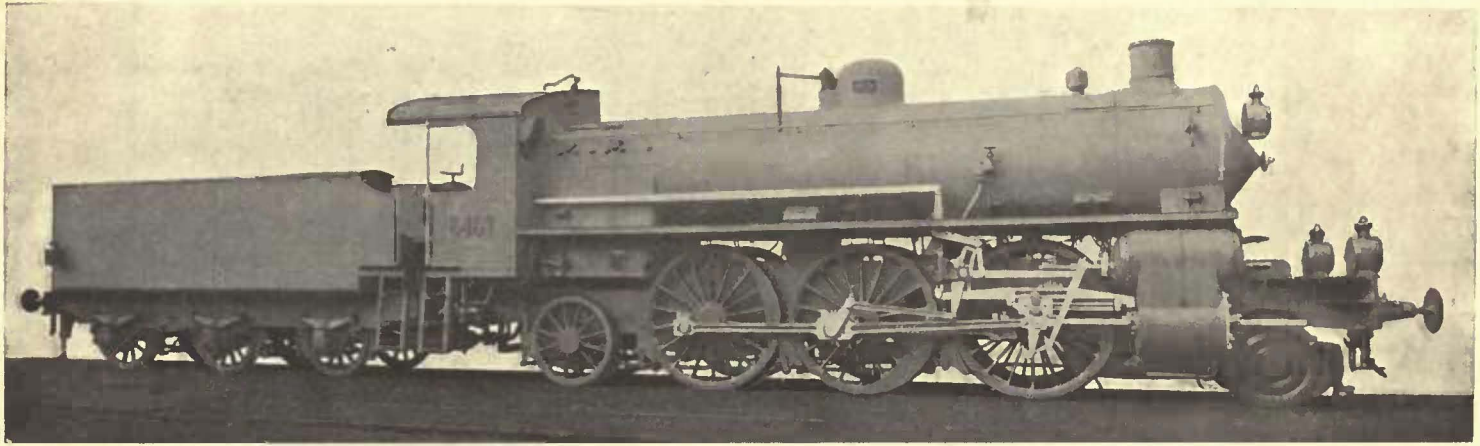
Heating surface: Firebox, 138 sq. ft.; tubes, 1432·7 sq. ft.; superheater, 441·3 sq. ft.: total, 2012·9 sq. ft.

Grate area, 29·5 sq. ft.

Boiler pressure, 213 lbs. per sq. in.

Weight for adhesion, 47 tons.

Weight in working order, 72¾ tons.



2—6—2 TYPE FOUR-CYLINDER COMPOUND EXPRESS LOCOMOTIVE, ITALIAN STATE RAILWAYS.

BUILT BY SOCIETA ITALIANA ERNESTO BREDA, MILAN.

Leading Particulars.

Cylinders: Diameter—H.-P., 12¼ ins.; L.-P., 23¼ ins.; piston stroke, 25⅝ ins.

Wheels diameter: Coupled, 6 ft. 2 ins.; leading truck, 3 ft. 1½ ins.; trailing truck, 4 ft.

Wheelbase of engine, 27 ft. 8¾ ins.

Boiler: Outside diameter (maximum), 5 ft. 2¼ ins.; height of centre above rails, 9 ft. 3 ins.

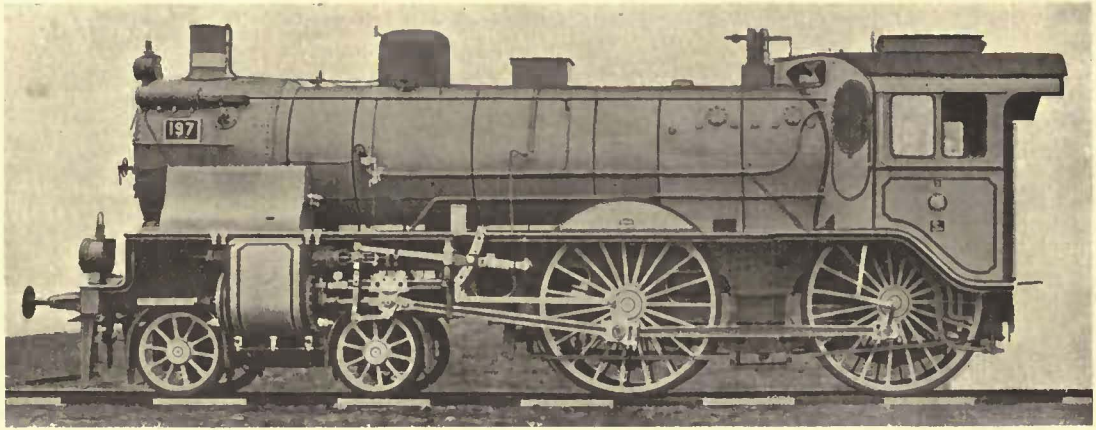
Heating surface, total, 2,430 sq. ft.

Grate area, 37·6 sq. ft.

Working pressure, 235 lbs.

Adhesion weight, 39 tons 16 cwts.

Weight of engine and tender (in working order), 120½ tons.



4—4—0 TYPE SIMPLE EXPRESS LOCOMOTIVE, PRUSSIAN STATE RAILWAYS.

Fitted with SCHMIDT SYSTEM *Smokebox Superheater.*

Leading Particulars.

Cylinders: Diameter, 21·3 ins.; stroke of pistons, 23·6 ins.

Coupled wheels diameter, 6 ft. 6 ins.

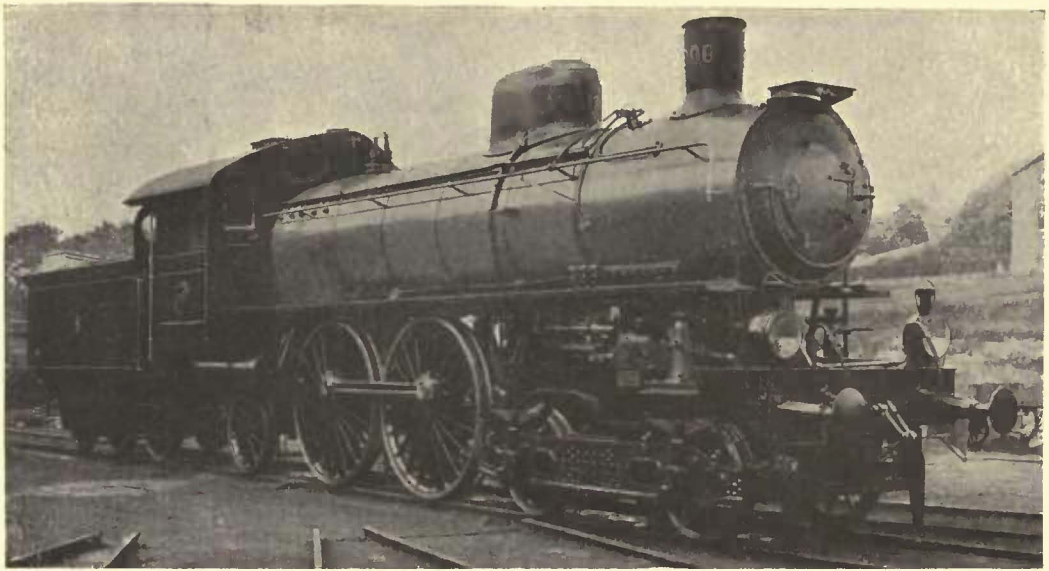
Wheelbase: Coupled, 9 ft.; total, 24 ft.

Grate area, 24·4 sq. ft.

Boiler pressure, 170 lbs. per sq. in.

Weight of locomotive, 54·5 tons.

Heating surface: Tubes and firebox, 1,095 sq. ft.; superheater, 331 sq. ft.: total, 1,426 sq. ft.

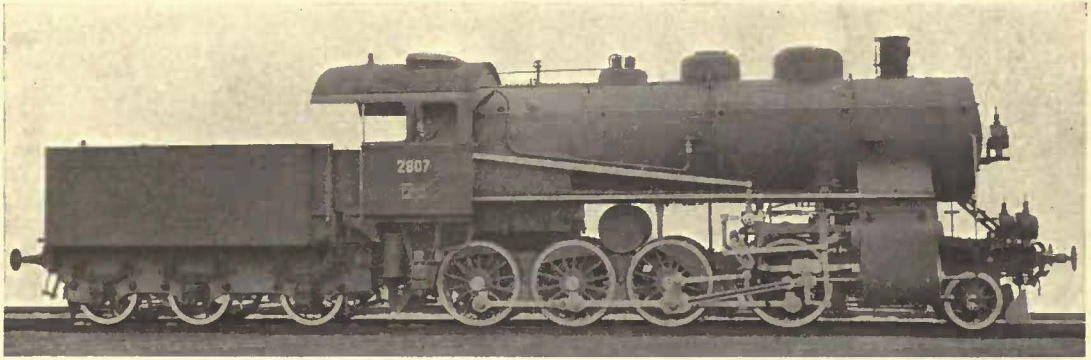


TWO-CYLINDER NON-COMPOUND "ATLANTIC" TYPE LOCOMOTIVE, SWEDISH STATE RAILWAYS.—*Using Superheated Steam on Schmidt's System.*

BUILT BY MESSRS. NYDQVIST & HOLM, TROLLHÄTTAN, SWEDEN.

Leading Particulars.

Cylinders: Diameter, 19⅝ ins.; piston stroke, 24 ins.
Wheels: Diameter—Bogie, 3 ft. 2½ ins.; coupled, 6 ft. 3 ins.; trailing, 3 ft. 8 ins.
Wheelbase: Rigid, 13 ft. 9 ins.; total, 20 ft. 3½ ins.; total with tender, 46 ft. 9 ins.
Boiler: Diameter, 5 ft.; distance between tube plates, 15 ft. 1 in.
Steam pressure, 170 lbs.
Heating surface: Tubes, 1,316 sq. ft.; firebox, 124·6 sq. ft.: total, 1440·6 sq. ft.
Grate area, 28 sq. ft.
Weight of engine (in working order), 60 tons 10 cwts.
Adhesion weight, 29¼ tons.



FOUR-CYLINDER, SUPERHEATED, COMPOUND (2—8—0 TYPE) GOODS LOCOMOTIVE, ST. GOTHARD RAILWAY.

BUILT BY J. A. MAFFEI, OF MUNICH, BAVARIA.

Leading Particulars.

Cylinders: Diameter—H.-P., 15½ ins.; L.-P., 23⅞ ins.; piston stroke, 24 ins.

Bogie wheels, 2 ft. 10¼ ins. diameter.

Coupled wheels, 4 ft. 5 ins.

Wheelbase: Rigid, 15 ft. 9 ins.; total, 24 ft. 9 ins.

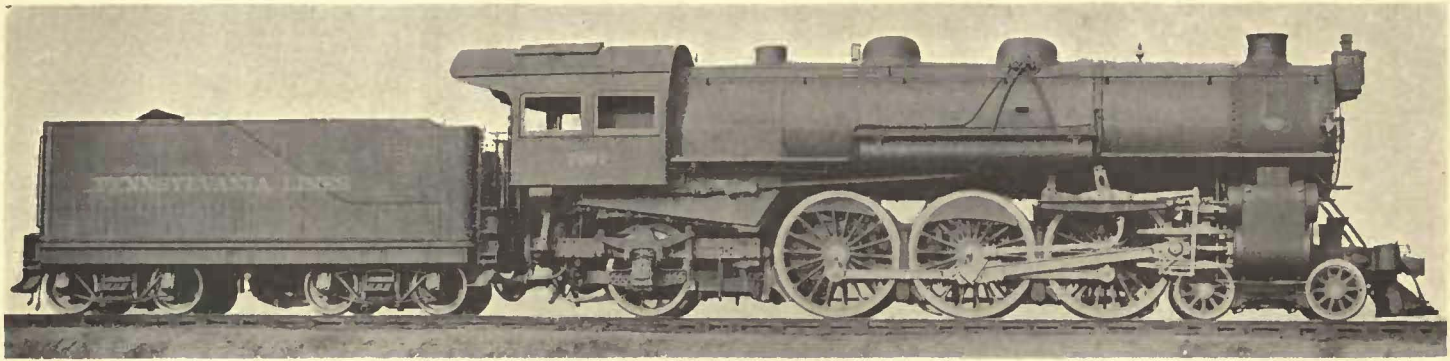
Total heating surface, 2,734·4 sq. ft.

Grate area, 43·8 sq. ft.

Steam pressure, 220 lbs.

Weight on coupled wheels, 62 tons.

Weight of engine (in working order), 76·4 tons.



THE WORLD'S LARGEST PASSENGER LOCOMOTIVE (4—6—2 TYPE), PENNSYLVANIA RAILROAD (WEST OF PITTSBURG DIVISION).

BUILT BY THE AMERICAN LOCOMOTIVE COMPANY AT THEIR PITTSBURG SHOPS.

Leading Particulars.

Cylinders: Diameter, 24 ins.; piston stroke, 26 ins.

Wheels: Diameter—Bogie, 3 ft.; coupled, 6 ft. 8 ins.; carrying, 4 ft. 4 ins.

Boiler: Diameter (inside), 6 ft. 8 ins.; length, 21 ft.

Wheelbase: Rigid, 13 ft. 10 ins.; total (engine), 35 ft. 2½ ins.; engine and tender, 67 ft. 1 in.

Heating surface: Tubes, 4,222 sq. ft.; firebox, 205 sq. ft.; total, 4,427 sq. ft.

Grate area, 61·8 sq. ft.

Working pressure, 213 lbs.

Weights: On bogie, 20 tons 13 cwts.; on coupled wheels, 79 tons 7 cwts.; on trailing wheels, 23 tons 5 cwts.

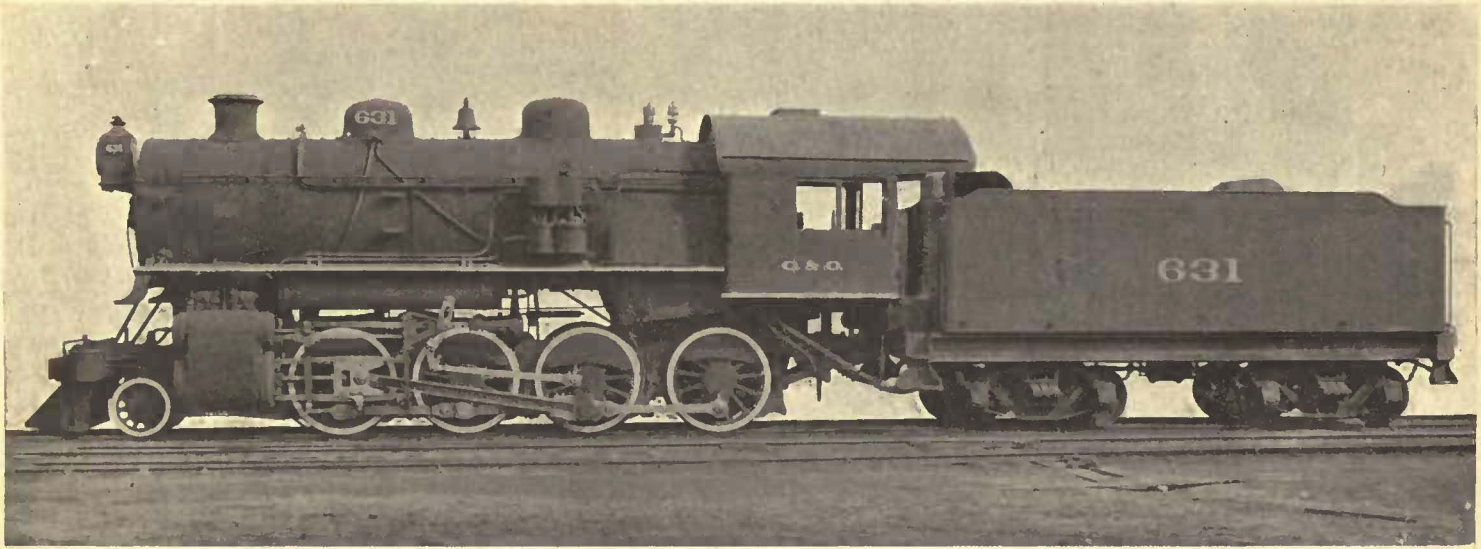
Weight of engine (in working order), 123 tons 5 cwts.

Weight of engine and tender (in working order), 193 tons 5 cwts.

Tractive force, 31,000 lbs.

Tender: Water capacity, 7,000 gallons; coal capacity, 11 tons.

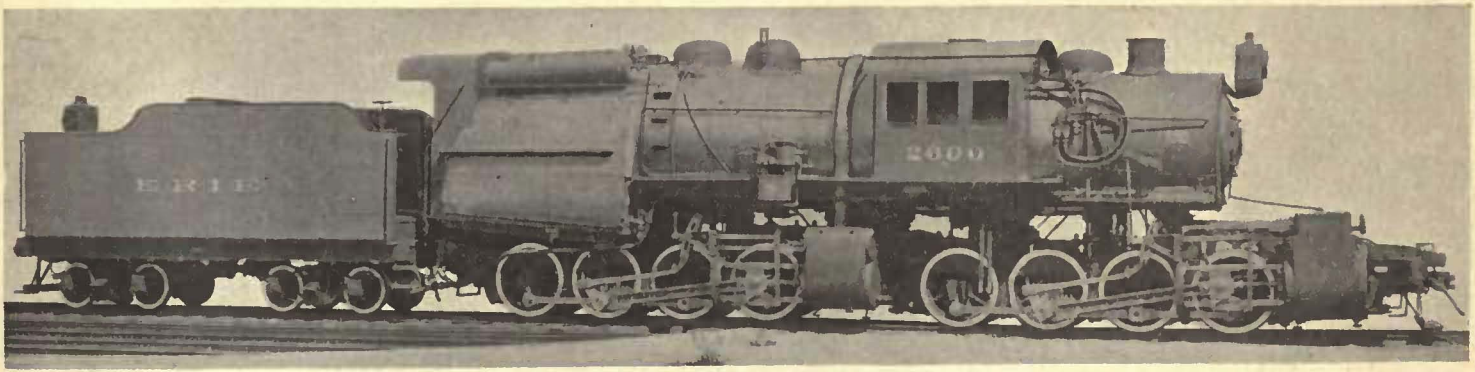
Weight of tender (loaded), 70 tons.



"CONSOLIDATION" (2—8—0 TYPE) FREIGHT LOCOMOTIVE, CHESAPEAKE AND OHIO RAILROAD, U.S.A.
BUILT AT THE BROOKS WORKS OF THE AMERICAN LOCOMOTIVE COMPANY.

Leading Particulars.

Cylinders: Diameter, 22 ins.; piston stroke, 30 ins.
Truck wheels diameter, 2 ft. 6 ins.
Coupled wheels diameter, 4 ft. 8 ins.
Wheelbase: Rigid, 16 ft. 6 ins.; total, 25 ft. 1 in.
Boiler: Diameter (outside), 6 ft. 4½ ins.; length between tube plates, 14 ft. 7 ins.
Heating surface: Tubes, 2,912 sq. ft.; firebox, 169 sq. ft.: total, 3,081 sq. ft.
Grate area, 48·445 sq. ft.
Working pressure, 185 lbs. per sq. in.
Weight on coupled wheels, 111½ tons.
Weight of engine (in working order), 90½ tons.
Coal capacity of tender, 10 tons.
Water capacity of tender, 7,000 gallons.
Weight of engine and tender (in working order), 197½ tons.



"THE MOST POWERFUL LOCOMOTIVE IN THE WORLD."

MALLET COMPOUND ARTICULATED (0—8—8—0 TYPE) ENGINE, ERIE RAILROAD, U.S.A.

BUILT BY THE AMERICAN LOCOMOTIVE COMPANY.

(SCHENECTADY SHOPS).

Leading Particulars.

Cylinders: Diameter—H.-P., 25 ins.; L.-P., 39 ins.; piston stroke, 28 ins.

Wheels diameter, 4 ft. 3 ins.

Wheelbase: Each group, 14 ft. 3 ins.; total engine wheelbase, 39 ft. 2 ins.

Boiler: Outside diameter of front ring, 7 ft.

Heating surface: Tubes, 4,971·5 sq. ft.; firebox, 342·2 sq. ft.: total, 5313·7 sq. ft.

Grate area, 100 sq. ft.

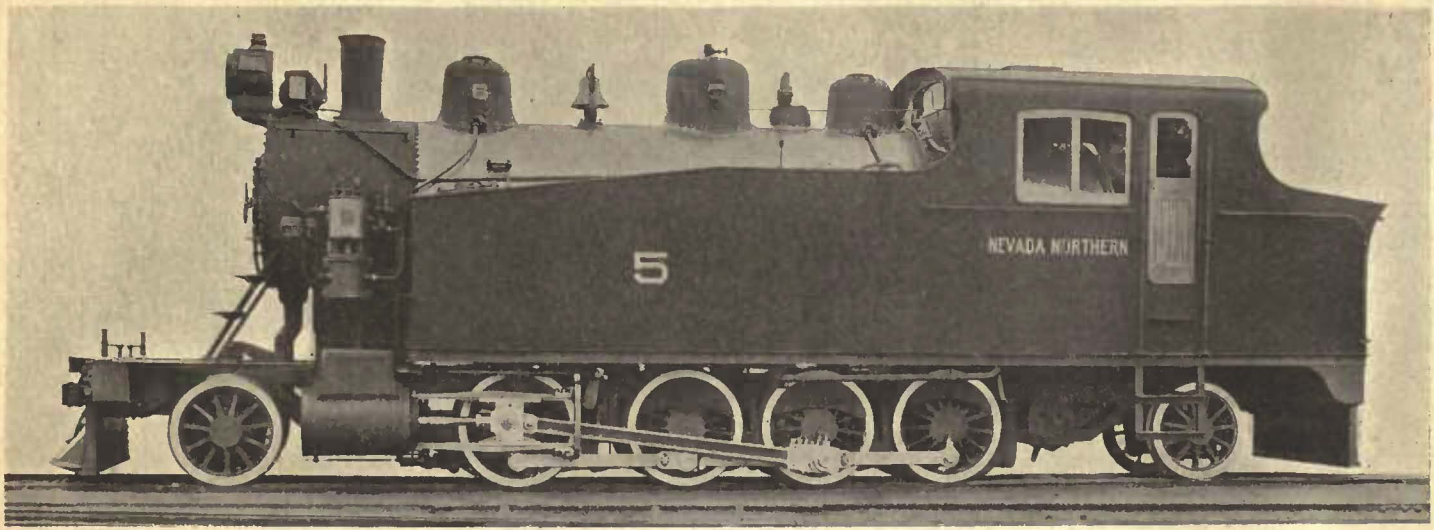
Working pressure, 215 lbs. per sq. in.

Weight of engine (in working order), 180¼ tons.

Tender: Water capacity, 8,500 gallons; coal capacity, 16 tons.

Weight of engine and tender (in working order), 257 tons.

Tractive force (working simple), 94,800 lbs.



HEAVY 2—8—2 TYPE (SIMPLE) TANK LOCOMOTIVE, NEVADA NORTHERN RAILROAD.
BUILT AT THE BROOKS WORKS OF THE AMERICAN LOCOMOTIVE COMPANY.

Leading Particulars.

Cylinders: Diameter, 19 ins.; piston stroke, 26 ins.

Wheels: Diameter—Truck, 3 ft. 6 ins.; coupled, 4 ft.

Wheelbase: Rigid, 15 ft.; total, 34 ft.

Boiler: Diameter (outside), 5 ft. 6⅛ ins.; length between tube plates, 15 ft. 6 ins.

Heating surface: Tubes, 2477·6 sq. ft.; firebox, 166 sq. ft.: total, 2643·6 sq. ft.

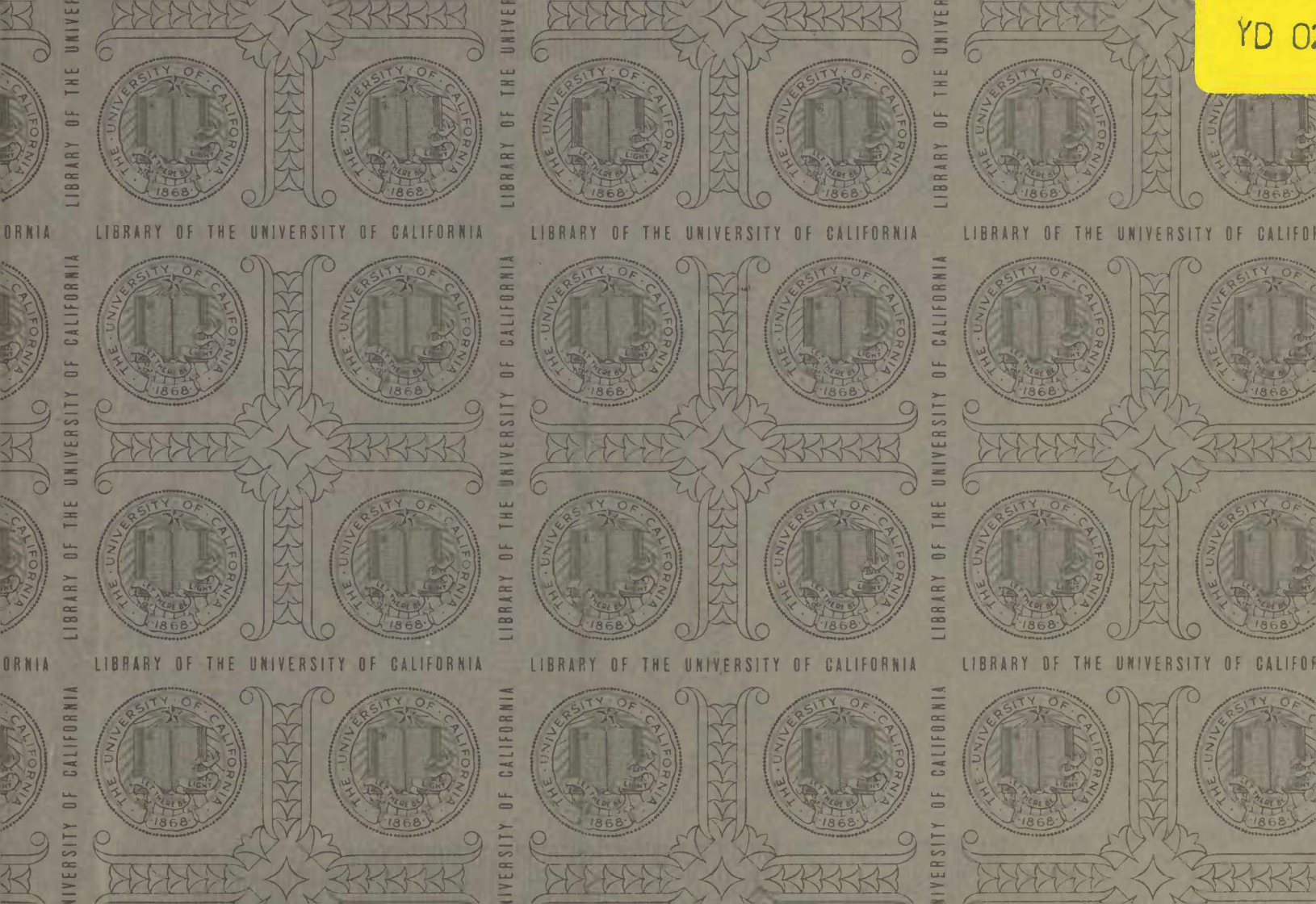
Grate area, 46 sq. ft.

Working pressure, 200 lbs. per sq. in.

Weight on coupled wheels, 76½ tons.

Weight of engine (in working order), 100½ tons.

Tender: Water capacity, 2,500 gallons; coal capacity, 5 tons.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