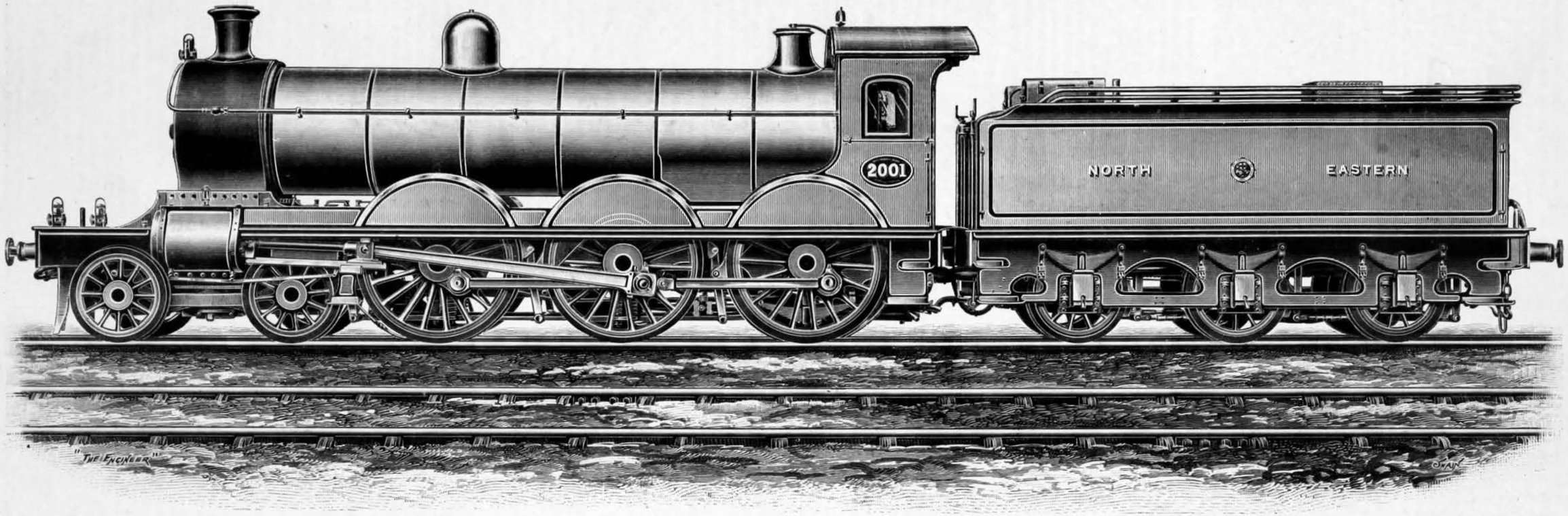
SIX-COUPLED EXPRESS ENGINE, NORTH-EASTERN RAILWAY

MR. WILSON WORSDELL, M. INST. C.E., ENGINEER



THE NEW SIX-COUPLED EXPRESS ENGINES FOR NORTH-EASTERN RAILWAY.

By Charles Rous-Marten.

In the number of The Engineer which appeared on the 21st ult., I described at some length the new type of express engine which had been specially designed by Mr. Wilson Worsdell, locomotive superintendent of the North-Eastern Railway, for the heaviest Anglo-Scottish services in which that railway takes part.

Since that article appeared Mr. Worsdell has courteously forwarded to me an excellent photograph of the new engine, which is reproduced in the present issue of The Engineer. It will be remembered that in addition to a description of the engine and an outline elevation, I gave in my article of the 21st ult. a detailed account of a special trial trip with the pioneer of the class.

The new engines, class "S," Nos. 2001—2010, have six coupled wheels, each 6ft. 1½in. in diameter with new tires, the bogie wheels being 3ft. 7½in. The nominal wheel diameters are 6ft. and 3ft. 6in. respectively. The cylinders are 20in. by 26in. The boiler is 15ft. long and 4ft. 9in. in diameter. It has 1639 square feet of heating surface in the tubes, and 130 in the fire-box, or 1769 square feet in all. The length of the fire-box is 8ft., and the fire-grate has an area of 23 square feet. The centre of the boiler stands 8ft. 7in. above the rail level, and the chimney top 13ft. 1in. The weights are: on bogie 16 tons 10 cwt., on leading coupled wheels 16 tons, on driving-wheels 17 tons 10 cwt., on trailing coupled wheels 16 tons; total weight of engine 66 tons, tender 39 tons, engine and tender in working order 105 tons. This is, of course, greatly in excess of anything hitherto seen in British locomotive practice.

It will be remembered that the new engine did some remarkably good work under several unfortunately adverse conditions. Hampered by these conditions—one being the absence of a clear road—it proved impracticable to obtain any complete start-to-stop run that should illustrate the capacity of the engine to perform its future allotted duty. But some of the detailed work, especially when examined at greater leisure than was available before my earlier article was written, clearly proves the capacity of the engine to do what is demanded of it.

For instance, the present normal weight of the chief Anglo-Scottish expresses may be taken as 220 to 240 tons, exclusive, of course, of engine and tender. The new locomotive easily drew 352 tons, starting readily with that load on a triple curve and on a rising gradient of 1 in 190. At another time, with the same load, practically a fresh start was made from almost a dead stop on a bank of 1 in 78. Again, at the end of a five-miles ascent of 1 in 190, the start being made at its foot, the engine had averaged 36 miles an hour, and the rate was still rising, while up a long rise of 1 in 200 a steady speed of 40 miles an hour was maintained, a brief temporary drop to 37·5 being quickly recovered, and 40 again attained before the summit was reached. In another instance the speed averaged 40 up a five-mile ascent of 1 in 170, the lowest point reached being 37·5.

A point that should be more particularly noticed is the ease and vigour with which the boiler produced ample steam to fill those vast 20 by 26 cylinders driving 6ft. wheels. The engine was blowing-off "hard" at 200 lb. pressure nearly all the way, especially during the ascent of the long banks. Not a suspicion of shortness of steam existed for a moment. This in itself is a very important factor of success.

Doubts have been expressed to me by eminent engineers whether an engine of this type could have sufficient speed capacity to fulfil the requirements of a fast-timed service. As to this I can only say that No. 2001 ran very easily and steadily at 65·2 miles an hour with the full load, down the Cockburnspath bank, and at 67·2 with 175 tons behind the tender. These rates are ordinarily found sufficient for time-keeping, but there is no reason to doubt that the new engines will be able to run very much faster when they get into full working order and clear of their initial stiffness. When No. 2001 was going at 67·2, it was running well within its powers, and only the hot excentric prevented a far higher velocity being attempted. With the similar type of engines on the French Northern Railway, which, however, have wheels 4½in. smaller, I several times attained 70 to 73 miles per hour, and I have seen them maintain 70 miles per hour for ten miles on end without the slightest difficulty. I do not, therefore, anticipate that deficiency of speed will be experienced in the case of these new North-Eastern locomotives.

It is still my opinion that they will be found to mark a very valuable and efficient new departure in British locomotive engineering.

THE LARGEST DOCK IN GERMANY.

The Germans are congratulating themselves upon the completion, which has just taken place, of the largest dry dock in that country. Situated at Bremerhaven, the new dock is of such dimensions, and possesses such facilities for the repair of vessels belonging to the Imperial navy and of ocean-going steamers, as have hitherto been lacking at any port in the North Sea. The German Admiralty has from the commencement been exceedingly anxious to promote the construction of this dry dock, and to obtain the right of participating in its services as occasion may arise, and for this purpose the Navy Department offered to contribute a considerable sum towards the cost of construction. It was found that the expenditure would amount to £300,000, and of this amount the Government undertook to provide £120,000, the remainder being furnished by the City of Bremen. When the vote was introduced in the Imperial Diet it was agreed to without opposition, as it was recognised that the Government would in this manner obtain the dry dock accommodation so urgently required in the North Sea at less expense than by the construction of an Imperial dock at Wilhelmshaven. The necessity for such facilities from the German standpoint is shown by the fact that the existing docks at Wilhelmshaven do not meet the present requirements either in regard to size or number. There are no dry docks at Cuxhaven, and although Bremerhaven has several under private ownership, they are too small for the needs of the German navy. It is possible that the new floating dock at Hamburg might have been sufficient for the purpose, but this was considered too distant in view of the necessity of having dry dock accommodation in the neighbourhood of a suppositious locality in the North Sea, where a future naval battle might take place. It was thought that it would only be with great difficulty that a heavily-leaking man-of-war would be able to reach Hamburg, apart from the fact that the depth of the Elbe at that port is scarcely sufficient for a leaky war vessel having a much greater draught under the circumstances of the case. It was for these reasons, among others, that Bremerhaven was selected, and the dimensions of the dock arranged accordingly. The length of the new dry dock is 220 metres, the width at the entrance 28 metres, and the depth from 9½ metres to 10 metres, and it is possible to dock vessels both before or after high water. The dock is built of concrete and brick, and has been carried out by the Constructional Department of the State of Bremen. The North German Lloyd has taken a lease of the dock on terms which ensure the payment of 3½ per cent. on the expenditure incurred by the State of Bremen, and that company will undertake the working of the dock in the future.

The Army Service Corps at Aldershot have just come into possession of a road locomotive and train of four wagons and passenger carriage, altogether capable of hauling forty tons of material.

and tear on the brakes, the running gear, car body, &c., by the steady pull on the drawbars of a train which did not have to be slowed down by hand brakes at the summit and foot of every gradient.

It must be borne in mind that the complete equipment of all goods rolling stock with these devices will enable great economies to be effected in operation, and will ensure greater safety to the trainmen. As long as any considerable proportion of the rolling stock remains unequipped, however, and thus prevents a complete uniformity of equipment, the full benefit of the great expenditure already incurred will not be realised in service.

The railways soon began to understand that the use of these safety devices, besides being desirable from a humane point of view, would be of direct practical advantage to the railways. Besides saving life and limb, and saving the expenses for litigation and compensation over damages, the general introduction of these devices would result in a reduction of cost and increase of facility in train service, and a material improvement in the handling of freight trains.

Trains would be run faster, there would be less banging of cars, and less delay in yards, and there would be fewer cases of couplings parting when a train is on the road. A train with tight couplings—like the M.C.B. automatic coupler—and power brakes, can be operated at higher speed over the gradients, as all the energy stored in the train during its descent of a grade will be exerted to help it up the next ascending grade, and "float" it over the summit. With slack couplings, like the link-and-pin—or the English chain coupling in greater degree—the energy stored in each car will simply be exerted to crowd it up against a run back from the next car, causing a continual succession of jerks on the couplings. With the tight couplings, also, there is no violent "snatching" of the cars in accelerating speed, and no bumping of the cars together in slackening speed. With the brakes applied to every wheel of the train by the engineman, it is safe to run at speeds which would be highly dangerous if the retardation or regulation of speed was effected simply by the brakes on the engine and brake-van. At the present time, many freight trains on American railways are run at speeds as high as those of passenger trains.

During the time that the question of the use of automatic couplers was under investigation by the Master Car Builders' Association, that association was subjected to much blame for delay, although, as a matter of fact, this was entirely undeserved. The importance and complication of the matter, and the importance of the interests involved, made it necessary to proceed with great care and deliberation. The safety of the employés was not the only point to be considered. Many of the couplers examined would have been good safety appliances, but it was necessary to ascertain—at least approximately—their service practicability, their cost, and the expenses of their renewal and maintenance. It was also most desirable to ensure as great a majority as possible in favour of some one form of coupler, in order to reduce the opposition to and delay in the application of that coupler which might be adopted. It must be remembered that there are now over 1,200,000 freight cars, any one of which may, in interchange traffic, be sent to any point on a railway system aggregating 185,000 miles, passing over lines owned perhaps by four or five companies during its journey. It is evident, therefore, that unanimity of opinion and of action were most desirable to ensure such uniformity of coupler equipment as would enable this interchange traffic to be carried on easily and promptly.

EFFORTS are being made in Norway to supersede sailing by steam vessels. At the close of 1897, the Norwegian mercantile navy numbered 1004 steamships, aggregating 383,120 tons, and 6143 sailing vessels, with a total tonnage of 1,169,079 tons. These figures represented an increase of 42 steam, and a decrease of 87 sailing vessels during that year, with a total increase—reckoning one steamship ton as equivalent to 3·6 sailing-ship tons—of about 67,000 tons. The majority of the largest and medium-sized steamships are constructed in British shipbuilding yards, which supplied Norwegian owners last year with 29 steamships, totalling 22,690 tons, compared with 14,200 tons in 1897, and 28,300 tons in 1896.

SIX-COUPLED EXPRESS ENGINES FOR NORTH-EASTERN RAILWAY.

By CHARLES ROUS-MARTEN.

FOR some years past, and especially since so remarkable an impetus was given to Anglo-Scottish travel by the competitive "acceleration" to Aberdeen—which we are forbidden to call a "race"—of 1895, the difficulty of running to time the increasing loads has steadily grown on the North-Eastern Railway as on the Great Northern. For not only has the number of passengers to be conveyed mounted up with surprising rapidity, but so no less has the deadweight, owing to the additional comforts so generously accorded now-a-days by most of the leading railway companies to their customers, while these latter grow yearly more exacting in their demands upon the accommodation for their luggage.

Even the latest type of standard engines built by Mr. Wilson Worsdell for the main line service, those numbered 1871—1880, 1901—1910, and 1921—1930, in spite of their great power, with cylinders 19½in. by 26in., 7ft. coupled wheels, 175 lb. steam pressure, and a weight of over 50 tons, have often been overpowered by the loads they were required to haul at very high speeds over gradients by no means easy. That is to say, they were overpowered to the extent of being compelled to take "pilots," and this involves a costly anomaly. The loads were too much for one of these engines at the booked speeds and over the existing gradients. But they were not nearly enough to form a sufficient paying load for two engines. Sometimes it was just a single extra coach that made it impracticable for one engine to run the train to time, and so virtually the second engine was required for one coach. I do not mean, of course, to say that in scientific precision this was so, because naturally the train engine would be much more severely pressed when hauling its standard load *a* unassisted than when aided by a pilot to haul *a* + 1. But the fact remains that sometimes the addition of a single coach, and very often the addition of two coaches, necessitates the employment of two engines and four men, instead of one engine and two men; and this cannot be deemed an economical method.

Another feature in this anomaly, particularly as it affects the North-Eastern service, is that even the heaviest train could be run without assistance over the greater portion of its Anglo-Scottish route. It is really only the lengths—about five miles each—of 1 in 150 near Ferryhill and Chester-le-street, of 1 in 150 and 170 near Littlemill, and especially the 4½ miles of 1 in 96 at Cockburnspath on the North British length, not more than ten miles each way in all, that beat the engines even with huge loads. And in specially favourable circumstances of weather, &c., even these adverse grades might not cause loss of time, for it must be borne in mind that the point is merely one of losing time. The engine could take the trains up the banks easily enough, but the difficulty has been that when the conditions are temporarily unfavourable, as in the case of a side wind or a slippery rail, this cannot be done fast enough to enable booked time to be kept, and hence the recourse to piloting.

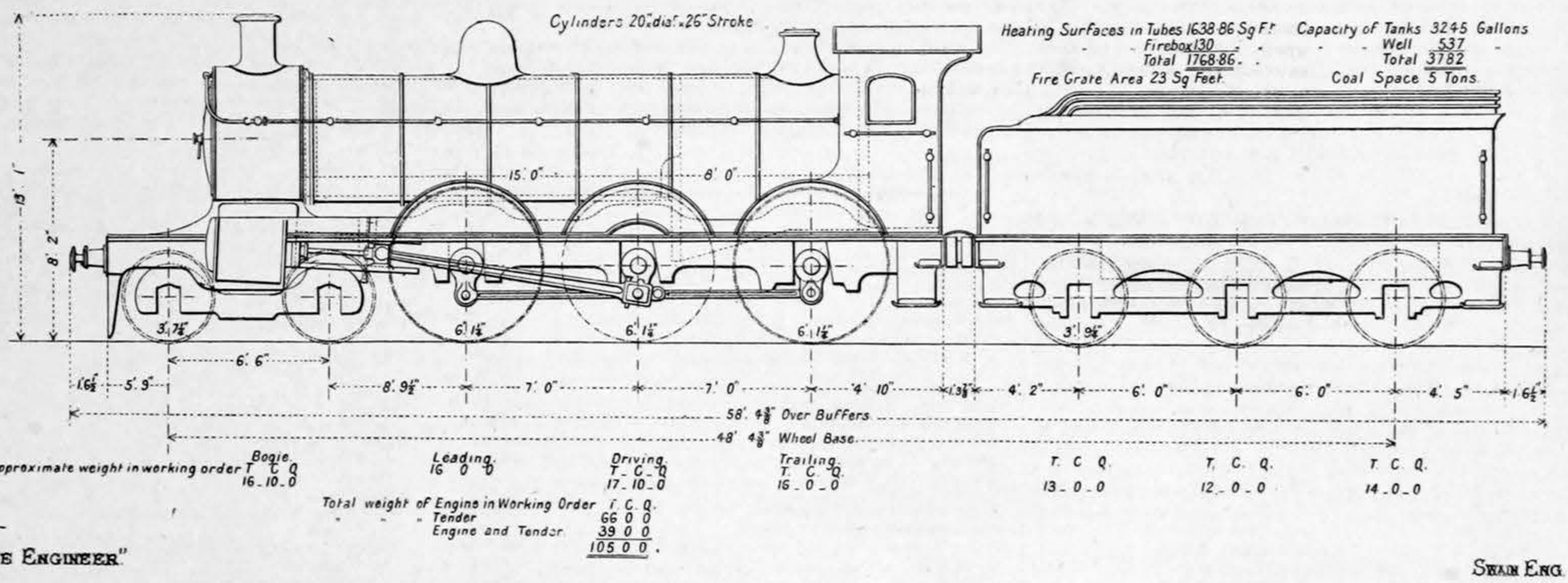
In other words, the expresses are piloted between York and Edinburgh merely for the sake of (1) perhaps 10 miles in all each way out of 205, and of (2), say, about two extra coaches on the average beyond the normal load. Nor can this anomaly be corrected by so combining two trains as to give their full load to the two engines, for in the first place, no train is put on the books which is not deemed necessary *per se*; and, secondly, it would be generally unprofitable to handle and work trains of double the normal size, with the existing station appliances. Thus I often find one North-Eastern engine taking unaided a train of 200 to 250 tons. But if that load were augmented to 400 or 500 tons behind the tender, the train could not be worked under our English system without grave inconvenience and disorganisation. So we get at the point that what we really need just now is a locomotive that can be relied on to take about a train and a-quarter or perhaps a train and a-half, reckoning by the present normal weight, and at the present booked speeds.

This is the problem which the able locomotive superintendent of the North-Eastern Railway has set himself to solve. He has approached his task with an open mind, having cast aside certain prejudices which are widely prevalent in this country. For, just as in earlier days it was held quite impracticable—if not perilous—to run express trains with four-wheel coupled engines, so, at the present day, it is generally deemed gravely incongruous and entirely inexpedient to run the fastest expresses with six-wheel coupled locomotives; yet, in other countries, and in several British colonies, six-coupled express engines are largely in use. For many years past such engines have been employed on express duty in Canada, Australia, and New Zealand—to mention only a few instances. It is true that the booked speeds are lower in those cases. Still, I recorded in these columns, more than six years ago, the performance—under my own observation—of a ten-wheeled six-coupled express engine on a railway of 3ft. 6in. gauge, which maintained a speed of 60 miles an hour, and upward, for more than 15 miles continuously, and attained a maximum of 64·2, although the coupled wheels were only 4ft. 1in. in diameter. The principal expresses in New South Wales are run by ten-wheeled engines, with six-coupled 5ft. wheels; and the celebrated Lake Shore run in America was done by a similar engine with 5ft. 6in. coupled wheels.

Moreover, my experiences last year on the Northern Railway of France—recorded in the columns of THE ENGINEER—demonstrated plainly that six-coupled engines could be usefully employed in the fastest express work even on that remarkable line, whose booked speeds greatly surpass anything we have in England, and are only rivalled in Scotland by the Caledonian Railway. Those readers who followed my recorded observations will recollect what splendid work was done by engines having six-coupled 5ft. 8¾in. wheels and four-wheeled leading bogies, which, though not actually designed for express duty, were so constructed that in case of need they could perform this class of service with entire efficiency and success. Theoretically, of course, and practically too, one would prefer a four-coupled to a six-coupled engine for fast running, and a single-wheeler to either. But the problem is, not to attain maximum speed, which some of our forty-years-old engines can do with modern boilers and steam pressures, but to do this with modern huge loads.

Keeping in view these conditions, Mr. Worsdell resolved to reduce the diameter of his wheels from 7ft. to 6ft.—6ft. 1¼in. with new tires; to have a third pair coupled; to adopt the largest cylinders yet seen in British practice, viz., 20in. diameter, 26in. piston stroke; to employ a steam pressure of 200 lb. to the square inch; and to have a boiler capable of supplying ample steam at that pressure for any work that the engine could be called upon to undertake. In these circumstances, as in the case of Mr. Ivatt's Great Northern engine No. 990, the outside position for the cylinders became virtually inevitable, because it would have been extremely inconvenient, if not impossible, to place the cylinders at a sufficient inclination for the connecting-rod when driving the middle pair of coupled wheels to clear the axle of the leading coupled pair. It is not a little curious to note how, just as outside cylinders had become extinct on every British main line, so far as new engines were concerned, that method which is almost universal elsewhere should have been compulsorily and somewhat reluctantly revived in this country owing to the adoption of new locomotive types, *e.g.*, Mr. F. W. Webb's Black Prince, Mr. Ivatt's No. 990, and now Mr. Worsdell's No. 2001. The two brothers Drummond seemed to have given the *coup de grace* to outside cylinders on the only two British railways which had stuck to this method loyally to the last—Mr. Dugald Drummond, on the London and South-Western; Mr. Peter Drummond, on the Highland. And yet the former has brought out a four-cylinder type which necessitates the use of one pair of outside cylinders, and it is rumoured that a new six-coupled express engine, somewhat after the style of the North-Eastern locomotive now under notice, will be seen ere long on the Highland line.

Mr. Worsdell's new giant has a very fine and imposing presence from every point of view. Its vast boiler, immense outside cylinders, and six coupled 6ft. wheels, each with its separate brass-bound splasher, and especially its strikingly effective front, riding on a four-wheeled bogie truck, combine to make it a worthy associate of



SIX-COUPLED EXPRESS PASSENGER ENGINE, NORTH-EASTERN RAILWAY