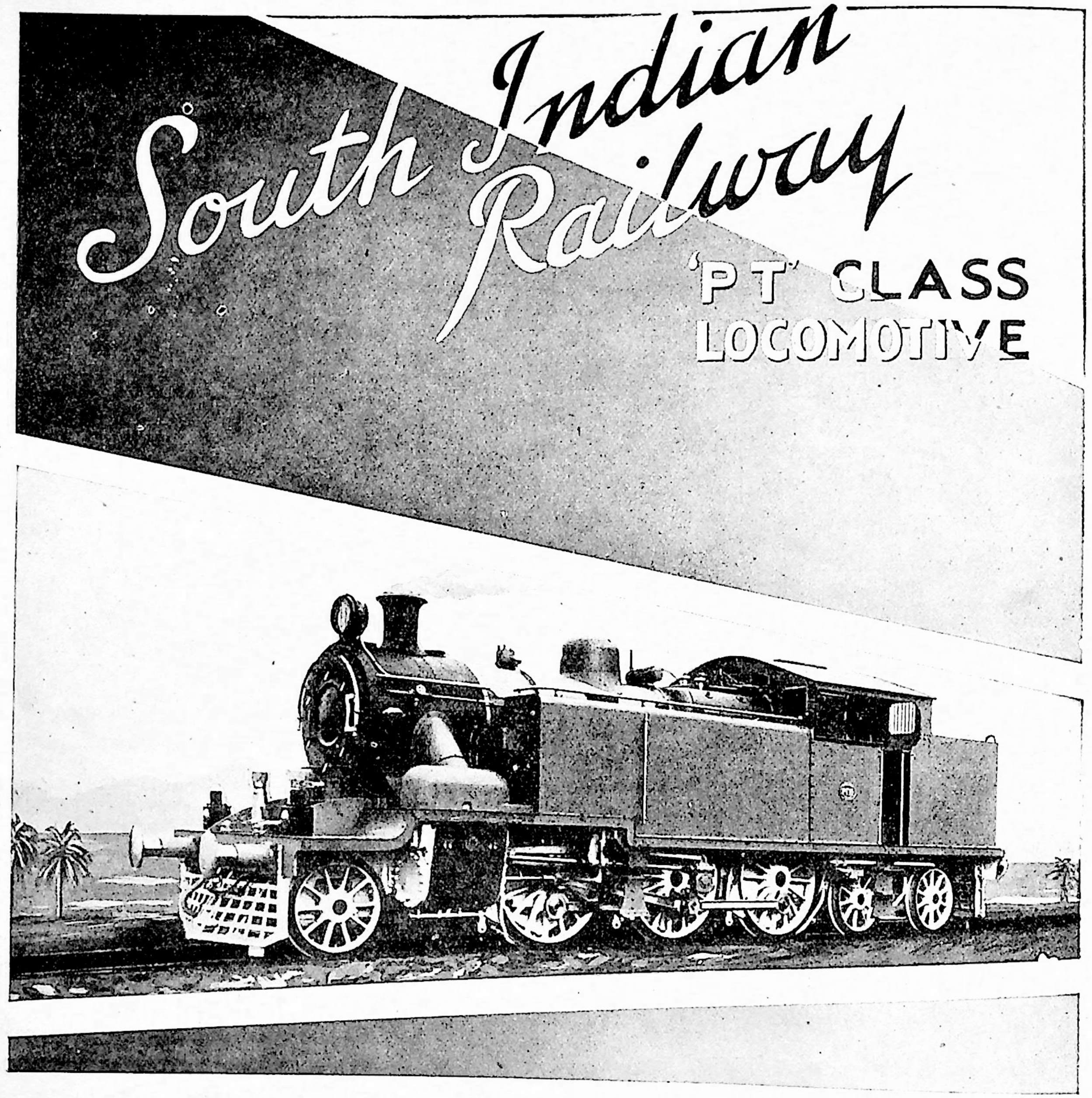
THE LOCOMOTIVE

RAILWAY CARRIAGE & WAGON REVIEW

Vol. XLVII. No. 585. MAY 15, 1941 ONE SHILLING



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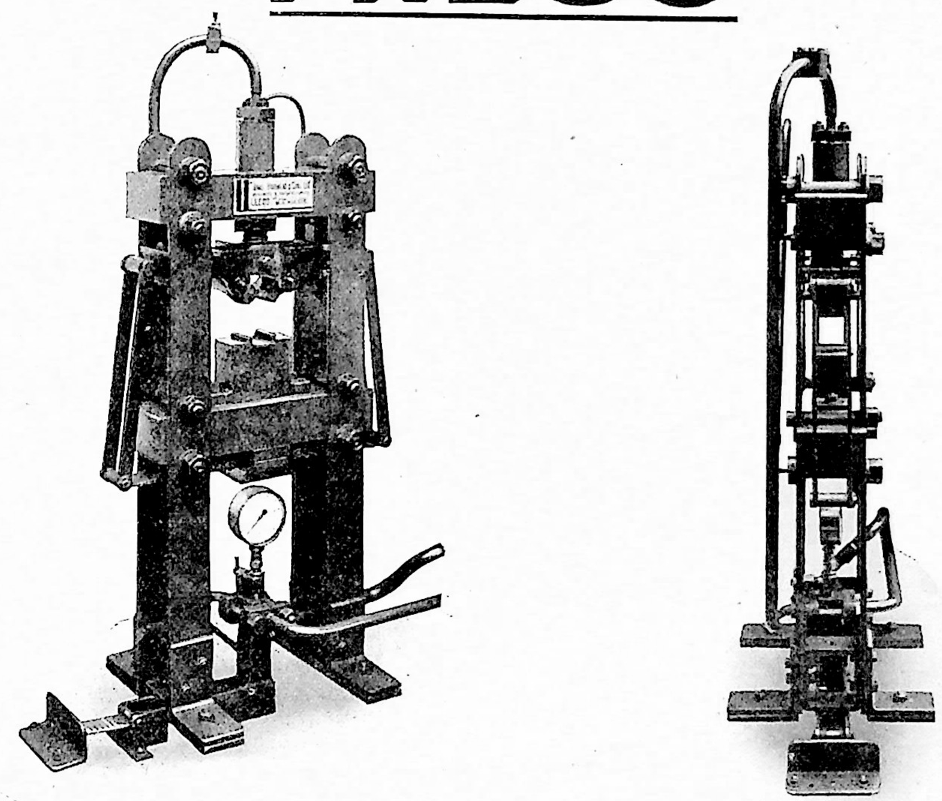

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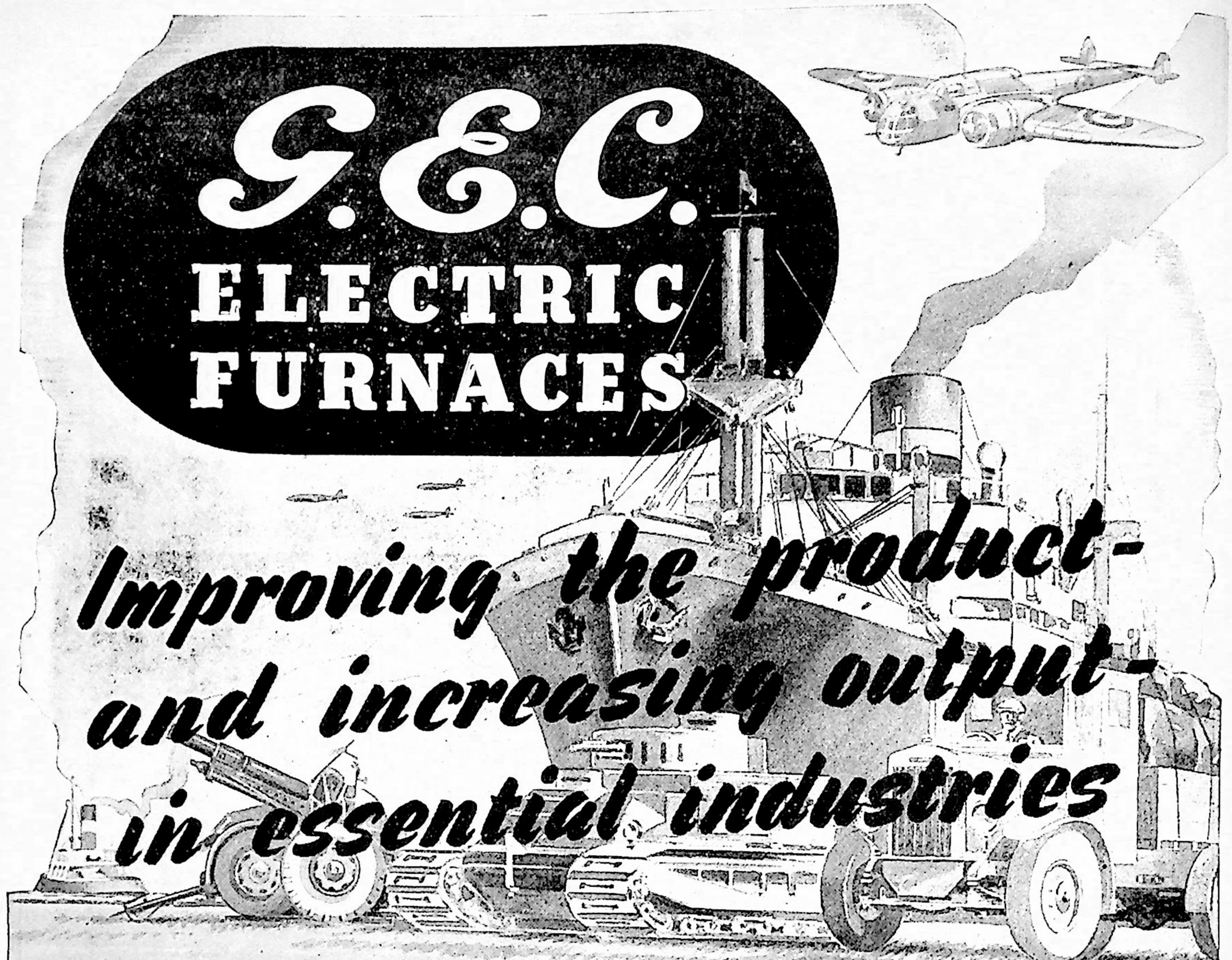

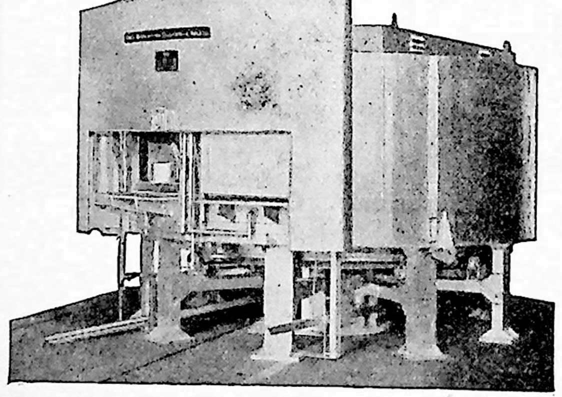

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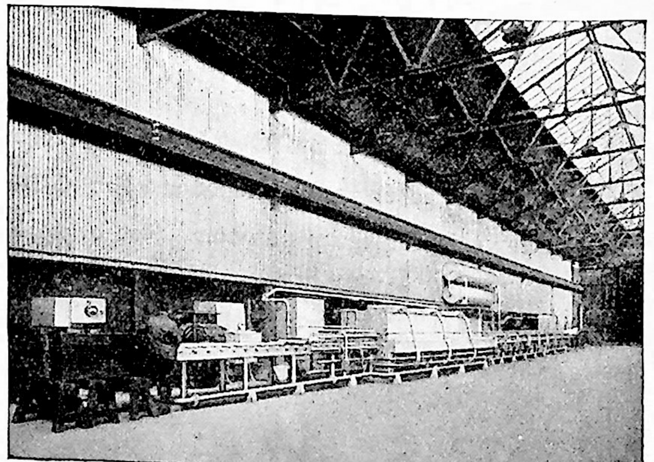

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In a recent broadcast speech, Mr. Ernest Bevin, Minister of Labour and National Service, showed how urgent was the need for more workers—especially women—in Great Britain's War Industries. Employers who are playing *their part* in the drive for greater and still greater war production will find this 4-point plan a sure guide.

HERE ARE THE FOUR VITAL POINTS LAID DOWN BY THE MINISTRY OF LABOUR.

1 Skilled men are needed for the really skilled jobs. Be sure that each of your men is employed up to the very limit of his skill. Combat skilled labour shortage by breaking down processes wherever you can, and by training up your workpeople, men and women, to jobs of greater skill.

2 Training Schemes must be developed to the greatest possible extent. Take in more new workers for training on the job in your own works. Remember that the Government will help you with semi-skilled men and women trained under official schemes.

3 Prepare, now, to employ more and more women. Look constantly to women for your new recruits: they are excellently suited to many types of semi-skilled work. Hundreds of thousands must enter war production this year and every factory must play its part.

4 Efficient personnel management is essential. Remember that you must secure the whole-hearted co-operation of your workpeople. Look closely to their welfare. Many of them may be new to industry: be patient and help them all you can during the first difficult weeks. A little foresight will reduce your labour turnover.

THE MINISTRY OF LABOUR AND NATIONAL SERVICE HAS DISTRIBUTED A GUIDE TO THE EMPLOYMENT AND WELFARE OF WOMEN WORKERS. EVERY RESPONSIBLE EXECUTIVE—WHETHER HE BE EMPLOYER OR MANAGER—MUST INSIST ON SEEING IT.

You should make a special point of reading the new booklet "THE EMPLOYMENT OF WOMEN ... SUGGESTIONS TO EMPLOYERS." Problems created by the increasing influx of new women workers into war factories are dealt with clearly ... concisely; and the suggestions contained in the booklet will be of interest and great value to YOU! If you have not yet received your copy, instruct your secretary to write for one TO-DAY, to the local Employment Exchange, asking for pamphlet P.L. 87/1941

These are the contents in the Booklet:

1 *Appointment of a Woman Personnel Officer.*
2 *Functions of a Woman Personnel Officer.*
3 *Consultations preparatory to the introduction of Women.*
4 *Interviewing of Candidates.*
5 *On engagement.*
6 *On reporting for duty.*
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8 *Working hours.*

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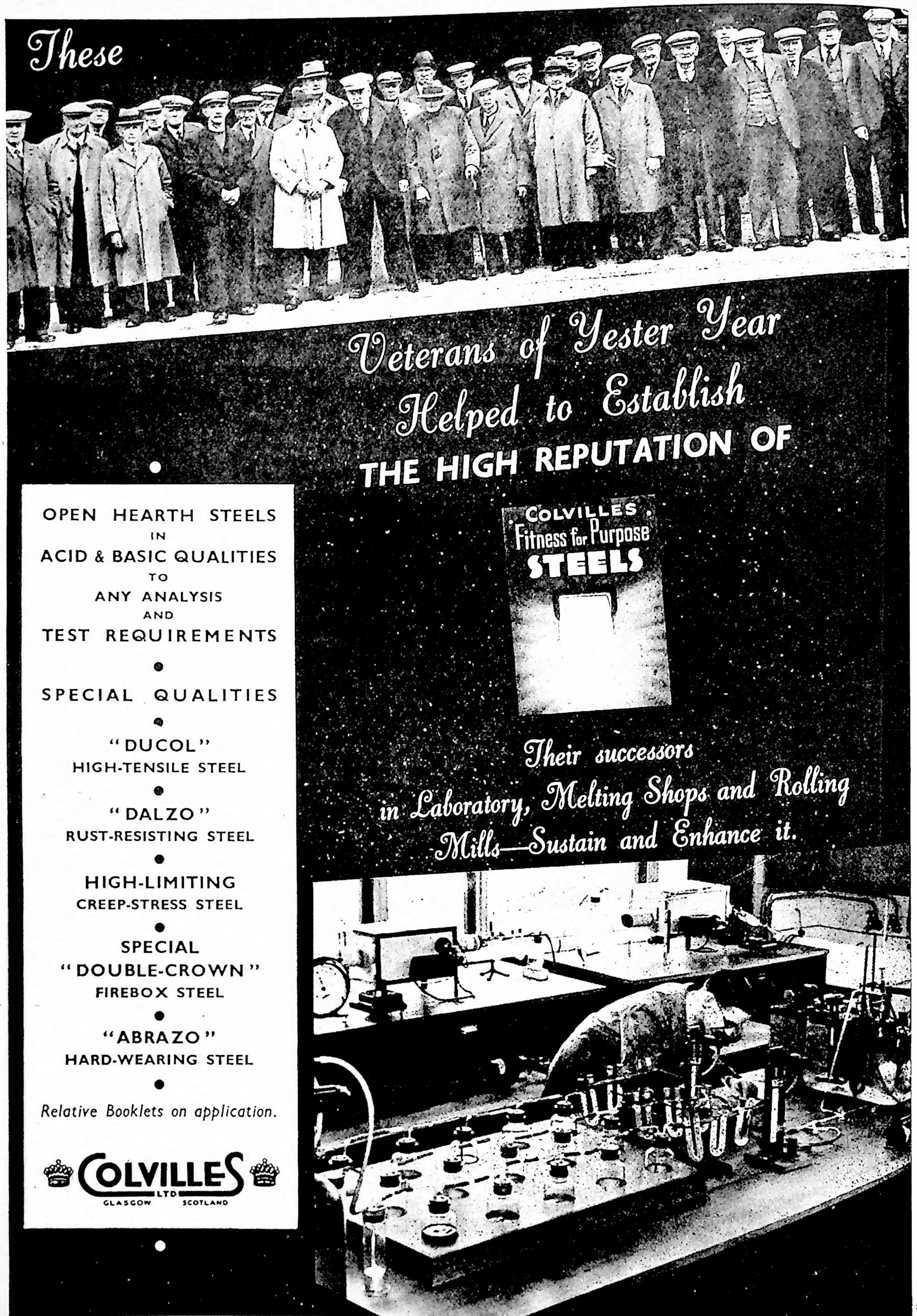

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MAGAZINE *and* RAILWAY CARRIAGE *and* WAGON REVIEW

88, Horseferry Road, Westminster, S.W.1 *Telephone: Abbey 2252*

Volume XLVII May 15, 1941 No. 585

Combustion Turbine Locomotives

IN all classes of motive power the tendency in recent years has been to replace reciprocating units with those of a continuously rotating type. The electric motor and steam turbine are familiar examples which have shown that operated *under favourable conditions* substantial advantages accrue to machinery of this type.

The gas turbine is a logical development of the reciprocating internal combustion engine and has been the subject of experiments over many years, but in the same way that other branches of engineering have sometimes outstripped metallurgical progress—in fact the development of the steam locomotive itself was considerably handicapped in the early days by inadequate strength of rail materials—little headway was made due to the enormous difficulties of obtaining materials to withstand the exceptionally high temperatures.

Once again the metallurgist has proved more than equal to the demands made upon him and materials are now available capable of standing up to the heat encountered.

In a report recently made to the American Railway Fuel Association the opinion was expressed that the reciprocating internal combustion engine will be followed by the combustion turbine; these prime movers are already being built for stationary use and the design has now been prepared of a 500 H.P. combustion turbine locomotive. The availability of material capable of standing temperatures considerably in excess of the 1,000 deg. Fah. at present encountered allows of higher pressures being economically employed and in anticipation of reduction in the size and weight which will permit of the incorporation of 6,000 H.P. in one locomotive unit, details are now in preparation of a locomotive containing a plant of this size. Power will be derived from four gas generating units supplying combustion turbines of 1,500 H.P. each. It is intended that each unit would transmit the drive to one of the four driving axles, power transmission being effected by an hydraulic converter and hydraulic coupling; this layout will result in the power applied to each axle being three times that available on an oil-electric locomotive where considerations of space normally prohibit the use of a motor exceeding 500 H.P. The estimated weight of the 6,000 H.P. engine is 250 tons—an exceptional power weight ratio.

The consumption of fuel-oil will be nearly double that of an oil-electric locomotive of equivalent power but a lower grade of fuel-oil can be utilised. It is estimated that by reason of the combustion turbine locomotive weighing some 250 tons against the 470 tons of an oil-electric locomotive of similar power the former will be able to haul a heavier train showing a 25 per cent. saving in the cost of fuel-oil.

We welcome any experiment intended to increase the thermal efficiency or profit-earning capacity of the locomotive but without in any way wishing to appear sceptical of such a courageous venture we await with interest the results of operating such a locomotive in normal traffic over a period. The paramount requirement of a locomotive is reliability and from the infinite variety of experimental locomotives, with their many diverse and complicated operating conditions, the orthodox reciprocating steam engine has so far emerged as possessing that reliability in a degree not readily obtained, at an equivalent cost price, from other designs.

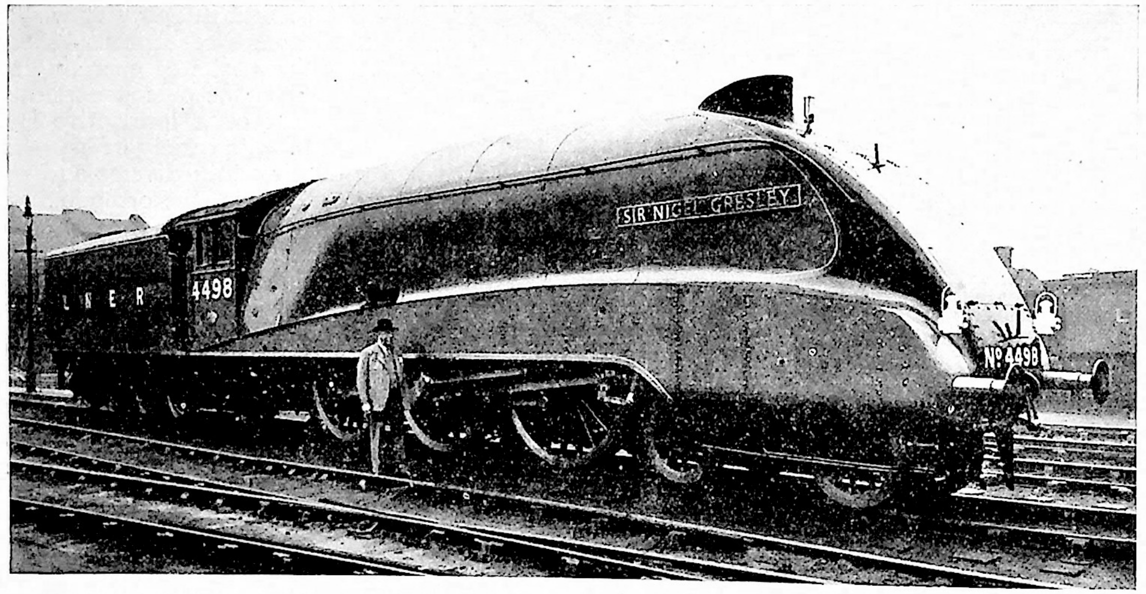
Sir Nigel Gresley, C.B.E., D.Sc.

THE recent lamented death of Sir (Herbert) Nigel Gresley, C.B.E., D.Sc., which we recorded in our last issue, brought to a close a remarkable career. Sir Nigel was born in 1876 and was educated at Marlborough College. He began his engineering life as an apprentice at Crewe Works of the L.N.W.R. and subsequently became a pupil at the Horwich Works of the L. & Y.R., after which he went to Newton Heath where he was appointed Works Manager in 1902. Two years later he became Assistant Carriage and Wagon Superintendent of the L. & Y.R. and in 1905 he was appointed Carriage and Wagon Superintendent of the G.N.R. at Doncaster. His next advancement came in October, 1911, when he was appointed, at the age of 35, Chief Mechanical Engineer of the Great Northern Railway, in succession to Mr. H. A. Ivatt, which position he held until the formation of the L.N.E.R. in 1923 when he was selected to occupy a similar position with that Company which he filled with distinction until his decease.

Sir Nigel devoted all his energies to the technical improvement of the steam locomotive and was a member of the Institutions of Civil, Electrical, Mechanical, and Locomotive Engineers, and of the Institute of Transport. In addition he was a past President of the Mechanical and Locomotive Engineers' Institutions, and in 1936 he received the honorary degree of Doctor of Science of Manchester University. It was due mainly to his efforts that the L.N.E. and L.M.S. Railways decided to establish a joint locomotive testing station which, but for the present war, would now, in all probability, be in use.

Sir Nigel served on a number of Government Committees including the Automatic Train Control Committee in 1920 and the Weir Committee on the subject of Main Line Electrification in 1929. He was awarded the C.B.E. in 1920 for services during the Great War and was Knighted in 1936.

During the period of nearly thirty years that Sir Nigel occupied the position of Chief Mechanical Engineer a remarkable transformation has taken place in train speeds and loads and consequently in locomotive power. At the time of his



SIR NIGEL GRESLEY and L.N.E.R., No. 4498.

Photo by Bedford, Lemere & Co.

appointment the express trains on the Great Northern Railway were worked mainly by Atlantic type locomotives and the remainder of the passenger services by engines of the 4-4-0, 2-4-0, 4-2-2 and 2-2-2 types whilst the largest engines in use on the freight trains were the eight coupled mineral locomotives of Mr. Ivatt's design.

The first new class of engine to be designed by Sir Nigel was a series of ten 0-6-0 goods locomotives (Nos. 71 to 80) built in 1912. These engines were in the nature of an improvement on a similar design of his predecessor. In the same year he revived the Mogul type on the G.N.R. in the shape of the 1630 class and in the following year he introduced the 2-8-0 type for working the heavy mineral traffic over the G.N. main line. During the war years, when little new construction was practicable, Sir Nigel carried out a number of interesting conversions of some of the non-standard Atlantic type engines. The year 1918 saw the introduction of the first 3-cylinder 2-8-0 locomotive (No. 461) to run on the G.N.R. and so satisfactory did this class prove in service that in 1920 a 3-cylinder Mogul (No. 1000) was placed in traffic. At the time of its debut this engine had the largest diameter boiler so far used on any British locomotive. It was in 1922 when probably the most epoch making event in Sir Nigel's career occurred when the Pacific type engine, No. 1470, made its appearance. This locomotive, with others which were built afterwards, was adopted as the standard class (A1) for express passenger traffic by the L.N.E.R. in the following year. During the year which followed the Pacific type multiplied rapidly and various improvements were made to the design when the "A3" class was introduced. The introduction of the first streamlined high-speed train, *The Silver Jubilee*, in September, 1935, will for ever be associated with Sir Nigel Gresley, to work which he built the now famous "A4" class of streamlined Pacific engines. The success of *The Silver Jubilee* led to the introduction of the *Coronation* and *West Riding Limited* high-speed trains in 1937.

In the matter of innovations of all kinds Sir Nigel and his assistants were always in the forefront as was evidenced by the introduction in 1925 of the first Garratt locomotive to run on any British main line railway and of two booster fitted Mikado type mineral engines. The latter type was also introduced by Sir Nigel for working express passenger trains on the former N.B. line in 1934 when *Cock o' the North* made its appearance. The first 2-6-2 tender locomotive to run in regular traffic in this country was Sir Nigel's product in the shape of the "V2" class the first of which appeared in 1936 and his last design was a smaller version of the same type, the *Bantam Cock*, completed at the beginning of this year.

The famous No. 10,000, the only 4-6-4 type tender engine in the British Isles is worthy of special mention. Built at Darlington in 1929 as an experimental 4-cylinder compound with a water tube boiler, it was afterwards converted to a 3-cylinder simple.

Space does not permit of other than passing mention of other productions of the Gresley era such as the " Shires," " Hunts," " Lochs," the " V1 " and " V3 " and other classes of tank engines, etc., or of the "Sandringhams " of the Great Eastern section, with the East Anglian train, of the rebuilding of various designs of Sir Nigel's predecessors, or of the improvements in carriage and wagon design.

It can only be said in conclusion that Sir Nigel's name will always be synonimous with the development of the steam locomotive to the high state of efficiency which it has now reached. It can truthfully be said that seldom, if ever, was so much attributable to the genius of one engineer.

LORD STAMP OF SHORTLANDS. The tragic death of Lord Stamp of Shortlands by enemy action is an irreparable loss to the nation and particularly to transport interests dependant upon his outstanding knowledge of finance.

His speeches as Chairman at the L.M.S. Meetings will long be remembered for their interest and the manner in which he handled economic questions.

Boards, committees and councils occupied most of his time. He was a fluent, informative and interesting speaker, and his presence at any gathering—technical, religious or social—usually meant his being called upon for a speech.

4-8-4 Locomotive

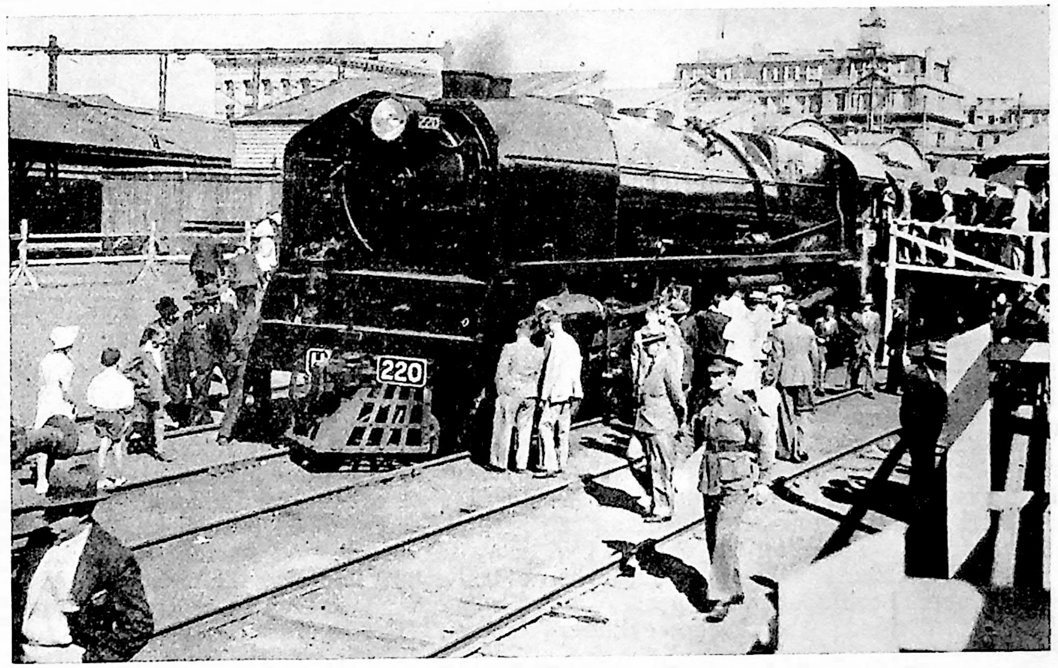
VICTORIAN RAILWAYS.

By GUY BAKEWELL.

THE completion of the "Pocono" type (4-8-4) "H" class No. 220 at the Newport Workshops marks a further advance in locomotive construction in Victoria. The engine was on view at No. 6 Platform at Spencer Street Station, Melbourne, on Saturday and Sunday, the 15th and 16th February last, and was inspected by over 10,000 people.

Standing on the track in front of it was "T" class No. 94 (0-6-0 type) built by the Phoenix Foundry (now defunct), at Ballarat in 1884.

This 0-6-0 type engine is one of the oldest still



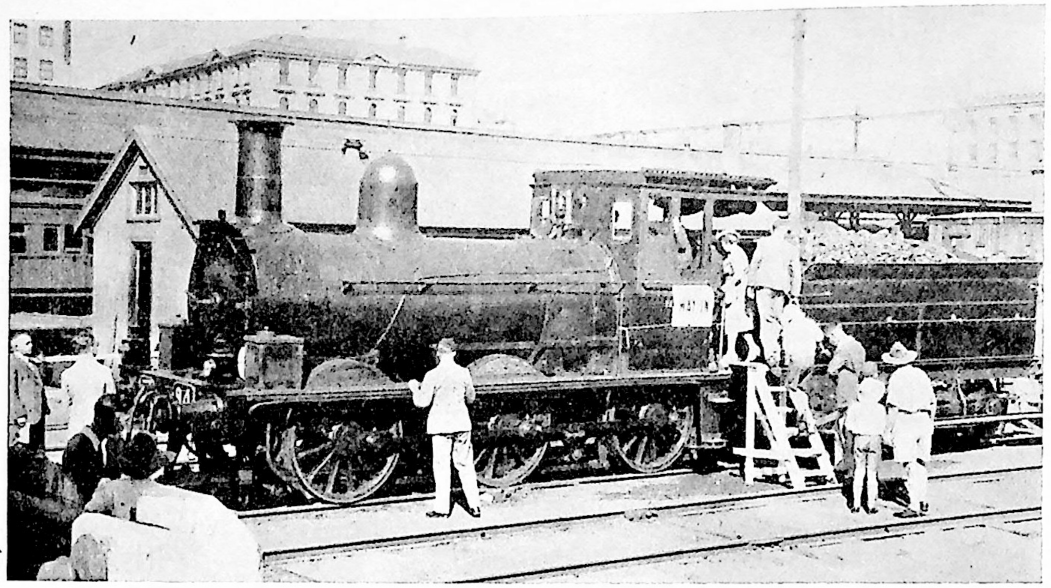
VICTORIAN RAILWAYS "H" CLASS (4-8-4) LOCOMOTIVE, No. 220 at No. 6 Platform, Spencer Street Station, Melbourne.

working and was placed there by way of contrast with the latest product of 1941. By means of specially constructed ramps the public was able to file through the cabs of both the new and old engines.

The "H" class is the largest locomotive ever constructed in Australia and is designed primarily for hauling the "Overland" Express to Adelaide on the Melbourne-Ararat section, a distance of 131 miles.

Heavy grades are encountered on this line and at present the Express is hauled by two of the much smaller "A2" class (4-6-0 type) engines.

The new locomotive is designed to haul a 550 ton passenger train up a 1 in 48 grade at 20 miles per hour. She will have an excellent opportunity of proving her "metal" when she takes up her duties on the "Overland" Express in negotiating



VICTORIAN RAILWAYS "T" (0-6-0) CLASS LOCOMOTIVE, No. 94.

the famous Ingliston Bank between Melbourne and Ballarat. This heavy grade of 1 in 48 commences after leaving the little wayside station of Rowsley beyond Bacchus Marsh and is almost continuous for nearly 10 miles to Ingliston which is over 1,500 feet above sea level.

No. 220 possesses several outstanding features which are unique in Victorian practice.

Among them are double chimneys, double domes, mechanical stoker and hydrostatic control on the tender brake; also noticeable is the absence of buffers. Her two cast steel bar frames each weigh 4 tons 6 cwt. and are 36 ft. 6 in. in length. Three cast steel cylinders are 21$\frac{1}{2}$ in. diameter with a 28 in. stroke. Those on the outside are equipped with Walschaerts valve gear and the inside one with special conjugate valve gear.

The drive is divided; the inside cylinder driving the leading coupled wheels and the outside cylinders the second pair of coupled wheels. Roller bearings are applied to all axles of engine, trailing and tender trucks, but the coupled axle boxes have plain bearings. Reversing is by Franklin "Precision" power gear. A Wakefield 6-feed, No. 7, 8-pint mechanical lubricator is located on the left-hand foot plate. Air brake equipment is of the A-6-ET system with pedestal-mounted brake valves, with one 7 in. cross-compound compressor located over the right-hand leading bogie wheel. There is no hand brake on the engine. Two high capacity non-lifting injectors with top-feed arrangements are used.

The rectangular type tender of all-welded construction has a coal capacity of 9 tons and tank capacity of 14,000 gallons and is carried on two six-wheeled bogies. The four-wheeled engine trailing truck is of novel design completely fabricated from mild steel plate by welding. The boiler is the largest in Australia. Some idea of its size may be appreciated by the length between tube plates of 20 ft. 10$\frac{3}{4}$ in., its maximum outside diameter of 7 ft. 3 in. at back and 6 ft. 8$\frac{3}{4}$ in. at front and the overall length of smokebox, barrel and firebox of almost 45 ft. A combustion chamber extends 2 ft. 8$\frac{3}{4}$ in. into the barrel thus reducing the tube length.

The modified Belpaire type welded steel firebox has a grate area of 68 sq. ft. and is 9 ft. 11$\frac{3}{4}$ in. long by 6 ft. 10$\frac{1}{8}$ in. wide. It is fired by an M.B. Simplex mechanical stoker, the driving engine for which is placed on the left-hand side of the cradle under the cab. The firebox has two Nicholson thermic syphons which increase the heating surface where it is most effective and improves the circulation of water in the boiler. Two arch tubes are also fitted in the firebox. The combined total heating surface of 4,780 sq. ft. is greater than that of any other locomotive in service in Australia and is made up of 367 sq. ft. in the firebox (including the combustion chamber, arch tubes and thermic syphons), 3,613 sq. ft. in the tubes and flues and 800 sq. ft. in the superheater elements. The boiler pressure is 220 lbs. per sq. in. The smokebox is 9 ft. 8 in. in length and 7 ft. 7 in. in diameter, and incorporates twin blast pipes with radial ported nozzles. Two tangential steam dryers are located in the rear dome and dry steam is fed by two internal steam pipes to the balanced throttle which is in the leading dome. The spark arrester is of conventional V-R. type.

LOCOMOTIVE FUELS. As a substitute for coal, peat is being tried in Ireland. A 4-4-2 tank engine on the G.N.R. (Ireland), No. 142, has been specially fitted for making tests.

On the Riazan-Ural Railway, U.S.S.R., rushes are being used instead of wood for firing some of the locomotives. The rushes are gathered in the Astrachan district.

British Locomotive Working 1934-9

LOCOMOTIVE WORK ON HEAVY GRADIENTS.

By O. S. NOCK, B.Sc., A.M.I.Mech.E.

(Concluded from page 85.)

Before the grouping of the railways, each of the individual Scottish companies built special locomotives for working on the mountain sections. Nowadays, with the exception of the West Highland section of the L.N.E.R., the tendency is to use standard types of the mixed traffic category even though, with modern loads, this entails a good deal of piloting. On some stretches of line, however, operating conditions are complicated by engineering restrictions which do not allow of certain double-header combinations, and on the same sections other locomotive types are not permitted to be piloted at all. The contrast between past and present workings is very interesting, particularly as in the course of some extensive footplate journeyings in the Highlands of Scotland the Author had opportunities of riding on several of the special pre-grouping types designed expressly for these arduous conditions.

Some of the most successful of Scottish mountain locomotives were the "Castle" class 4-6-0s of the former Highland Railway. Fig. 1 shows diagrammatically an excellent hill-climbing performance in which one of these veterans figures in partnership with an L.M.S. standard Class 5 mixed traffic 4-6-0. It might at first seem impossible to assess with any degree of certainty the merit of the work of either engine, on account of the double-heading of the train; but the similarity of the driving methods used suggest that a division of the load in proportion to the nominal tractive effort of the two locomotives would be quite fair, at the comparatively low speeds attained. On the heavy gradients, between Mile Posts 85 and 88, and throughout from Carr Bridge to Slochd Summit both locomotives were driven with regulator full open; the "Castle," on which the Author rode, was worked at 40 per cent. cut-off, and the Class 5 4-6-0 at between 40 and 45 per cent. The out-of-course stop at Carr Bridge, to cross an up express, made more difficult than usual the final ascent to Slochd; yet as the graph shows the two locomotives accelerated quite rapidly on the 1 in 60 gradient, attaining 25 m.p.h. in about 1$\frac{1}{2}$ miles from the start. This speed was gradually increased on the 1 in 60 length, and rose rapidly to 32 m.p.h. on the short stretch at 1 in 92, where the "Castle" driver brought his regulator back a little; on the final pitch, at 1 in 70, speed settled down to a steady 29$\frac{1}{2}$ m.p.h., the "Castle" once again working on full regulator. The load of 430 tons can be assumed to have been divided in the ratio of about 190 tons to the "Castle," and 240 tons to the Stanier 4-6-0. For a locomotive design dating back to 1900, and not superheated, the climbing shown in Fig. 1 was excellent. Weather conditions were very bad, with a high wind and driving snow, but at such speeds these conditions were a handicap more in the way of visibility, than a serious hindrance to weight haulage. Apart from the actual speeds the all-round behaviour of the "Castle" engine was very impressive during this short, though strenuous spell; the acoustics were a clear indication that things were going very sweetly at the front end, while on the footplate the steaming was observed to be excellent. All outward signs pointed, indeed, to this heavy collar-work being near to the ideal performance of the type. On the other hand records taken as an ordinary passenger on previous occasions showed that the "Castles" were inclined to be sluggish on

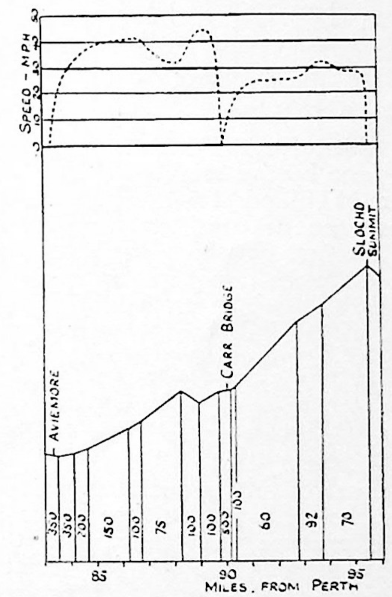


FIG. 1.

the level stretches of the Highland line, such as that between Dunkeld and Ballinluig; this was probably due to their small coupled-wheel diameter of 5 ft. 9 in. The Stanier 4-6-0s, with their modern front-ends are most at home on the easy stretches, though as usual with this type cut-offs of the order of 25 to 30 per cent. are employed, with regulator openings to suit the load. The varied demands made upon the locomotives of down Highland expresses in the early stages of the journey is well illustrated by the diagram in Fig. 2 which shows the running of a Stanier 4-6-0, heavily loaded, in the 3.55 p.m. from Perth. Some hard work, with full regulator and 40 per cent. cut-off was needed up the 1 in 93 incline from Stanley Junction, and up the 1 in 80 from Murthly to Kingswood Crossing, but the moderate speeds made on the easy and favourable stretches, nowhere attaining as much as 60 m.p.h., are fully indicative of the easy steaming required elsewhere.

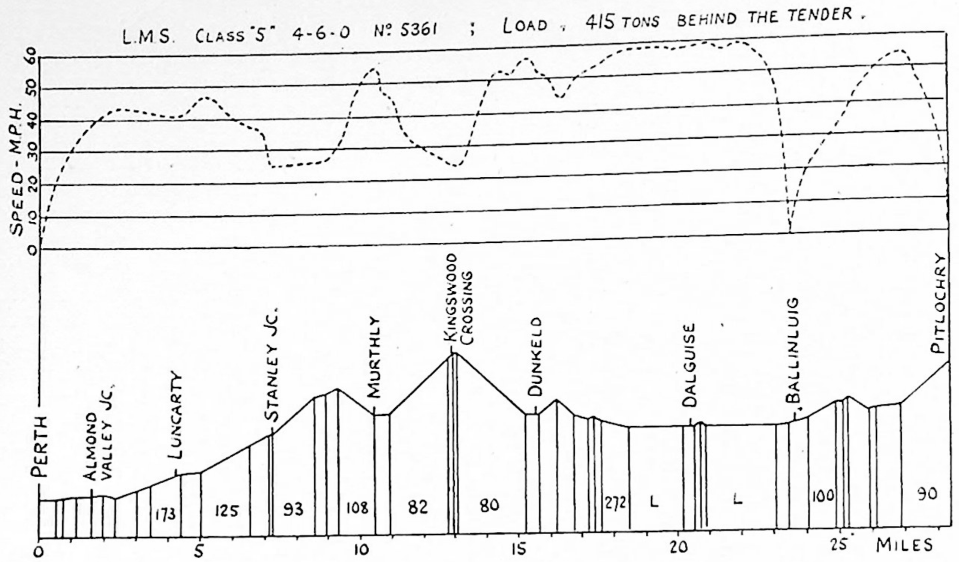


FIG. 2.

Schedule time from Perth to Ballinluig was improved upon by two minutes.

Another Highland 4-6-0 type, the work of which has been of considerable interest, is the "Clan," the first of which was put on the road in 1919. Although designed for the same duties as the "Castles" their characteristics are somewhat different, with Walschaerts gear instead of Allan's, 6 ft. diameter drivers, as against 5 ft. 9 in., and cylinders 21 in. diameter, against 19 in. Also, of course, the "Clans" are superheated. Although their grate area is slightly less than that of the "Castles," the "Clans" have proved themselves very powerful engines, for their weight, on the banks; at no time in the Author's footplate experience with them, was there any difficulty in meeting the heaviest demands for steam. Drivers rarely used a full regulator opening, for the most part working at about 2 notches, out of 4, and the regulator handle about three quarters over on the quadrant plate. With this method of handling they would lift almost anything, the most exceptional being the haulage of 315 tons, unassisted, up the 1 in 60 gradient from Balquhidder to Glenoglehead on the Oban line; up this incline a steady speed of 17 to 18 m.p.h. was maintained. This was engine No. 14766 *Clan Chattan*, and the sister engine *Clan Mackinnon*, hauling 275 tons, attained 18½ m.p.h. up the 1 in 50 gradient from the start at Connel Ferry Junction.

Fig. 3 shows the work of engine 14762, *Clan Campbell*, on the Highland line proper, in a fine piece of hillclimbing with a load of 295 tons. The train in question, the "second mail," does not ordinarily stop at Newtonmore, and the acceleration up the 1 in 95 gradient that follows was not so energetic as the Oban line runs just mentioned; but the schedule did not require anything more, and the engine was being worked well linked up. The numerous sharp recoveries in speed on the various easier parts of the climb, as revealed in the graph, emphasises the mastery of the engine over the load, on this portion of the road. On the level stretches, however, the "Clans" were not noticeably superior to the "Castles" in free running, which is partly to be expected with short-lap valves.

Since the transference of the class from the Highland to the Oban line of the former Caledonian Railway the "Clans" have worked regularly over the main line as between Dunblane and Glasgow (Buchanan Street); their running has provided many an interesting contrast to that of other types. Up the 3-mile incline at 1 in 79-98-126 from the Glasgow terminus out to Robroyston the "Clans" would tackle comfortably loads up to 400 tons, without the rear-end banking assistance always provided with Caledonian types

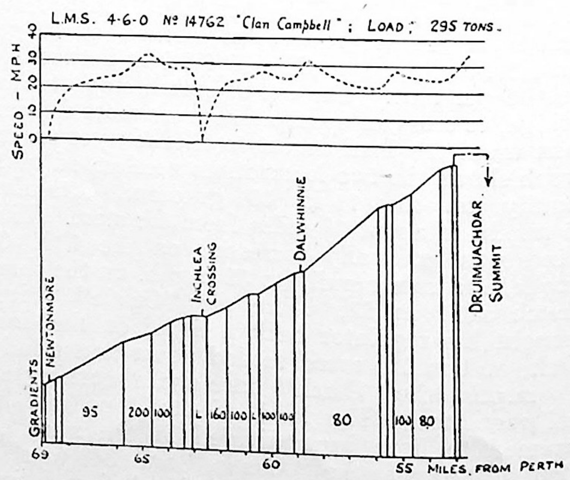


FIG. 3.

L.M.S.R. STANIER CLASS 5-MIXED TRAFFIC 4-6-0 No. 5362, ON GLASGOW-OBAN EXPRESS.

equally loaded. But on any incline that could be tackled at speed, as for example the rise from Larbert to Cumbernauld shown graphically in the second article of this series, the "Clans" would be easily outpaced by smaller locomotives, equally loaded. Between Carmuirs West Junction and Cumbernauld *Clan Mackenzie*, working hard, averaged 44.7 m.p.h. with a load of 210 tons behind the tender; a Midland compound with an identical load averaged 47.2 m.p.h. between the same two points. The behaviour of these three types of 4-6-0 locomotives, "Castle," "Clan" and Stanier Class 5P5F, does indeed serve to emphasise the difficulty of producing a design that will at the same time be a powerful hillclimber, and swift on the level. The Staniers, among mixed traffic engines, could scarcely be surpassed for their speed capabilities, but on the Highland banks—Blair Atholl to Druimuachdar summit, Aviemore to Slochd and so on—their maximum unpiloted tonnage is 255, against 220 permitted to the "Clans."

For the Oban line special 4-6-0 types were designed by successive Locomotive Superintendents of the Caledonian Railway; with the latest of these, the Pickersgill type, the Author had an interesting footplate experience, again, however, on a double-headed train. No. 14624, of this class, was turned out to assist a "Clan" with a load of 375 tons up from Oban; the performance, from the tractive point of view, was much what one might expect on such heavy gradients from a locomotive with so small a boiler and firebox. The assistance provided was, it must be admitted, on the modest side, and the tendency for boiler pressure to drop when the demand was heaviest was in contrast to the wisps of steam constantly showing from the safety valves of the robust "Clan" locomotive behind. Although the ex-Caledonian engines of which 14624 is a representative are non-superheated, and have slide valves, such features of their design are not in themselves too much of a handicap on a heavy road, as the work of the Highland "Castle" class showed. The experience on 14624 was extremely interesting however from the riding point of view. A route so infested with curves would hardly be expected to provide very smooth going on a locomotive footplate; yet in striking contrast to the "Clans," on which there was always a sensation of grinding on the curves, the ex-Caledonian engine glided along in a smooth, buoyant way that classed her at once as most efficient, as a vehicle. The coupled wheelbase is, however, only 12 ft. 4 in., as against 14 ft. on the "Clans," while the bogie used on most Pickersgill designs on the Caledonian had longer wheelbase than that used on the Highland engines. Both these factors probably contributed to the riding of 14624; in this connection it is interesting to recall that the McIntosh "Oban" 4-6-0s had compensated springing for the bogie wheels, whereas the Pickersgill type did not.

Coming finally to the West Highland section of the L.N.E.R., it is interesting, and rather surprising to recall that the passenger traffic on this line, probably the hardest of all in the Highlands, was worked entirely by 4-4-0 locomotives until after the grouping of the railways in 1923. Here again a special design had been prepared, a design that must certainly be put down among the most successful that have ever operated in Great Britain, the ex-North British "Glens"; the engines of this type, which were a small-wheeled variant of W. P. Reid's well-known "Scott" class of express passenger locomotives, are now classed "D. 34" in the L.N.E.R. stock. Since then two other types, both of the Mogul wheel arrangement have been put into service on this line. The following table gives the leading dimensions of the three types, together with the maximum load that each is permitted to haul unpiloted over the West Highland line.

WEST HIGHLAND LOCOMOTIVES.

Class	"D. 34"	"K2"	"K4"
Type	4-4-0	2-6-0	2-6-0
Coupled Wheels dia.	6 ft.	5 ft. 8 in.	5 ft. 2 in.
Cylinders	(Two) 20 by 26	(Two) 20 by 26	(Three) 18½ by 26
Boiler Pressure lb./sq. in.	165	170	200
Tractive Effort at 85 per cent boiler pressure lb. ...	19,700	21,500	35,600
Adhesion Weight, tons	38	51¾	58
Maximum permitted load, tons ...	180	220	300

On a route so exposed to wild weather conditions adhesion is a factor that must always loom large when fixing load limits; otherwise there is not a great enough difference between the tractive effort developed by the "Glens" and the "K.2" Moguls to account for the increase in load from 180 to 220 tons. With a dry rail tractive effort alone counts on such steep gradients, and the maximum efforts of the "Glens," loaded to 180 tons, tare, have been, in the Author's experience, definitely superior to those of the "K.2" Moguls, with their maximum permissible tonnage. Both types are excellent steamers, and the performances in similarly good weather conditions are a true reflection of that sometimes misleading measure of power in a locomotive, the nominal tractive effort. The stretch of 28.2 miles from Fort William to Corrour crossing provides the most severe test of continuous hard steaming, since in the distance the line rises from a few feet above sea level to an altitude of 1,347 ft.—an average inclination of 1 in 110. On this section two successive runs with "Glens," both loaded to 180 tons tare, and 190 tons gross, gave running averages of 30.1 and 30.8 m.p.h., including slowing down and restarting from two intermediate stops; a "K.2," with 216 tons tare, 225 tons gross, made a running average of 27.4 m.p.h. on the same service, and another engine of the same 2-6-0 class with 219 tons tare, heavily loaded to 240 tons gross, averaged only 26.3 m.p.h., even though this figure included slowing down and re-acceleration from but one intermediate stop.

The remarkable hill-climbing ability of the "Glens" is shown in Fig. 4, which illustrates diagrammatically two stages of a southbound journey by two engines of this class, hauling a load of 320 tons tare, and 345 tons gross. With a little over 170 tons apiece these two locomotives accelerated, on the 1 in 59 gradient succeeding the start at Tulloch, to 28 m.p.h.; then, having fallen to 26 m.p.h., on the long 1 in 67 ascent, a recovery to nearly 30 m.p.h. was made while still on this grade, despite a squall of wind and heavy rain. Again on the 1 in 55 grade south of Bridge of Orchy, a speed of 26 m.p.h. was sustained approaching the summit. On this occasion the Author was riding on the footplate of the leading engine, and throughout the two ascents shown 42 per cent. cut-off was being used, in conjunction with a varying regulator opening, the handle being mainly one-half to five-eighths of full stroke. With full load, 180 tons tare, and 190 tons gross, another engine of the class sustained 25 m.p.h. on the long 1 in 67 leading to Corrour, and, still better, went over the summit at the Perth-Argyll County March at 25 m.p.h., the speed at the beginning of the 1 in 55 gradient here being 31½ m.p.h.

The "K.2" engines with their full load of 220 tons tare, which may mean anything up to 240 tons gross behind the tender, need sometimes as much as 60 per cent. cut-off on the heaviest grades,

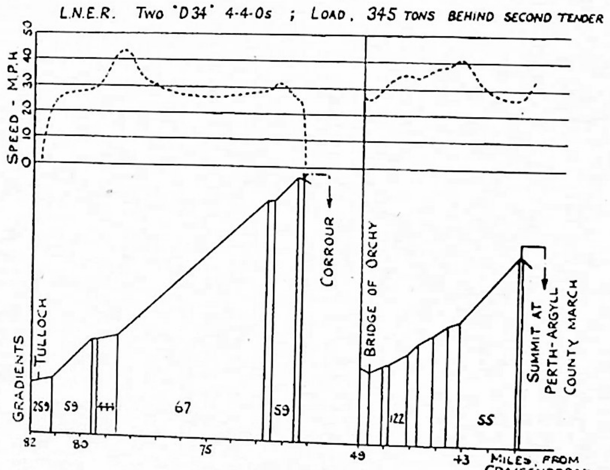


FIG. 4.

though 45 to 50 per cent. is normally used. On this route these Moguls are working at a certain disadvantage compared to the 4-4-0s owing to their longer wheelbase; on the sharply-curved sections, which are many, the flange friction must result in some lessening of the power transmitted through the drawbar, and helps to explain the long-continued use, by the North British Railway, of four-coupled locomotives.

The "K.4" Moguls require to be considered in a class apart. Like the "Glens" they were specially designed for the West Highland line, but they include many modern refinements, such as long-lap valves, large direct steam passages, and a boiler and firebox of high steaming capacity. Fig. 5 gives details of a remarkable, though characteristic performance recorded by the Author on the first engine of this class, No. 3441, *Loch Long*. In contrast to the driving technique almost invariably seen on the "Glens" and "K.2s," this locomotive was worked with regulator full open, not only on the steep ascents but also on the

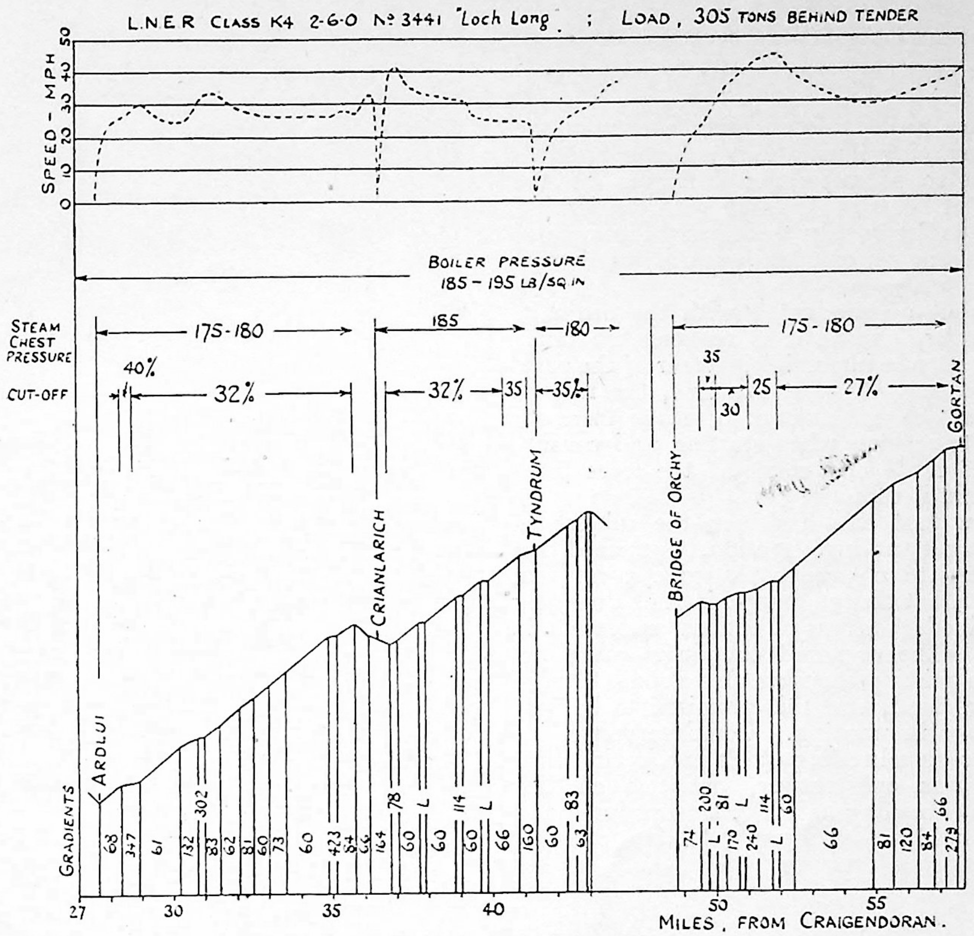


FIG. 5.

level stretch between Dumbarton and Craigendoran. A high steam-chest pressure was maintained on all the climbs and the driver rarely found it necessary to advance beyond 32 per cent. cut-off. On the section shown in the diagram, bad weather caused occasional slipping on the Ardlui-Crianlarich, and Crianlarich-Tyndrum ascents both of which include much sharp curvature; the combined effect of better weather and a straighter road is seen in the fast climbing of the 1 in 66 gradient between Bridge of Orchy and Gortan crossing, achieved on no more than 27 per cent. cut-off.

Conclusion.

These extensive footplate experiences provided not only a wealth of interesting data, but also pleasant memories of the warm and spontaneous hospitality of engine crews. And since the steam locomotive, perhaps more than any other motive power unit of today, is dependent upon the skill of the enginemen for its efficient performance it will not be out of place to close on a more personal note. The vagaries of individual drivers must inevitably remain a considerable factor in the operation of locomotives under ordinary service conditions, but in the vast majority of cases the observer was left with a happy impression of keen intelligent work; such failures as were noted were nearly all errors of judgment in timekeeping, but considering that the majority of the locomotives under review were not fitted with speed indicators at the time it is, in the Author's opinion remarkable that these cases were so few. There were, too, some instances of astonishing grit and determination, in the face of circumstances altogether exceptional for peacetime; the memories of these occasions are particularly treasured, as affording just a fragmentary glimpse, in advance, of the spirit that animates British enginemen today in the discharge of their duties in the face of the enemy.

Diesel-Line Electric Locomotive for London Transport Maintenance Work. Using parts from two old Central Line motor cars, London Transport's engineers have built in the works at Acton a "diesel-line" electric locomotive to haul ballast and works trains by day or night. The only parts that had to be bought were the diesel and its generator and some switchgear. It is called a "diesel-line" locomotive because it runs on the 600 volt traction current, picked up from the line, or on current generated by a diesel electric generator set. On the level it can haul trains of 600 tons and on a gradient of 1 in 34, trains of 300 tons. In an emergency it can be used in the tubes. If the results in service are satisfactory, further locomotives of this type will be built after the war.

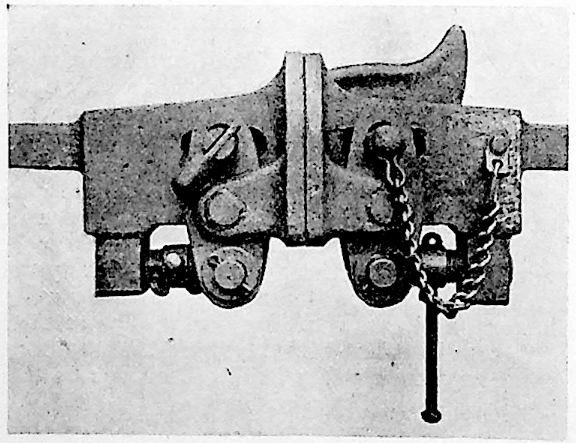
Screw Adjustable Coupling

WESTERN AUSTRALIAN GOVERNMENT RAILWAYS.

THE new adjustable coupling shown in the accompanying illustrations is being fitted to a number of passenger carriages of the W.A.G.R. It helps to do away with the jerking and jolting so frequently the cause of complaint from passengers when a train starts fitted with chopper couplers.

Slack cannot be eliminated with the ordinary chopper coupler, and if it is reduced too much engagement may be impossible. Wear of the parts adds to trouble and, what is worse, the rate of wear increases as the amount of slack increases giving rise to jerking when starting and causing a continuous rattle and clank of the loose parts when the train is running.

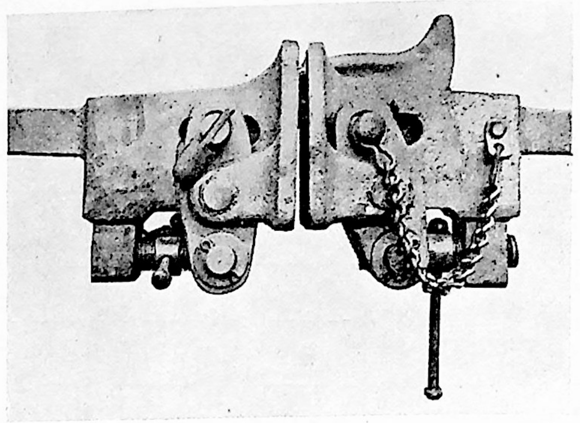
For years past this has been the subject of anxious thought and investigation. It seemed that only a complete change could give permanent improvement, but though many kinds of drawgear were examined, serious objections appeared in every case. The proposed couplings would not engage with existing choppers unless some form of adapter were used, and this promised to be very unsatisfactory in working. Complete conversion of drawgear on all rolling stock in a period of a few years was one answer, but this entailed expenditure exceeding half a million pounds, and even then would not have resulted in a completely tight coupling. In every case the distance between headstocks of adjoining carriages was increased



COUPLER-SCREWS TIGHT.

and this raised a host of problems. Not one of the designs or types submitted by specialist firms offered a satisfactory solution.

The final solution was found within the Department. Previous efforts had been directed toward dispensing with the chopper and providing something quite different and yet capable of mating with existing buffers. Finding this impossible, one of the engineers in the Mechanical Branch had



COUPLER-SCREWS SLACK.

the idea of retaining the troublesome chopper and providing means for adjusting its position.

This has proved to be quite satisfactory and does away with all the slack which has caused so much trouble. More than this, the range of adjustment, two inches with all parts new, is sufficient to take up wear for a long period. In place of having uncontrolled movement, each carriage now helps to steady its neighbour, and the result is a great improvement in riding.

Since the new coupling employs exactly the same chopper, with the buffer face exactly the same distance from the headstock, there is no difficulty whatever in joining up with old-style buffers. In fact, with screws slack as shown in the second photograph, the adjustable coupling can be used the same as a non-adjustable coupling. This, of course, facilitates shunting when making up or disconnecting trains. It goes without saying that reasonable attention on the part of the staff is necessary to see that the screws are tightened properly before the train is started.

We are indebted to Mr. F. Mills, Chief Mechanical Engineer of the W.A.G.R., for the foregoing particulars of this interesting device.

EIGHT-COUPLED LOCOMOTIVES FOR N.Y.C.R.R. Fifty engines with the 4-8-2 wheel arrangement have recently been placed in service by the New York Central Railroad and are employed on both heavy passenger and freight service.

Although equipped with driving wheels of moderate diameter the results obtained in fast passenger service have been satisfactory, largely due, no doubt, to the extensive use of light-weight alloys in the design of motion, driving axles, etc. Hollow axles of vanadium steel run in roller bearings.

The chief dimensions are: cylinders 25½ in. by 30 in., driving wheels 5 ft. 9 in., leading wheels 2 ft. 9 in. diam., trailing wheels 3 ft. 8 in. diam. Boiler diameter 7 ft. 10 in. Total evaporative heating surface 4,657 sq. ft. Superheater 2,080 sq. ft. Boiler pressure 250 lb. per sq. in. The total weight of the engine is 139 tons, of which 130 tons is available for adhesion. Tractive effort equals 60,100 lb. The tender carries 15,500 gallons of water and 43 tons of fuel, the weight loaded being 185 tons.

SOUTHERN RAILWAY. As a war-time measure all engines are to be painted black, unlined, except the express passenger types.

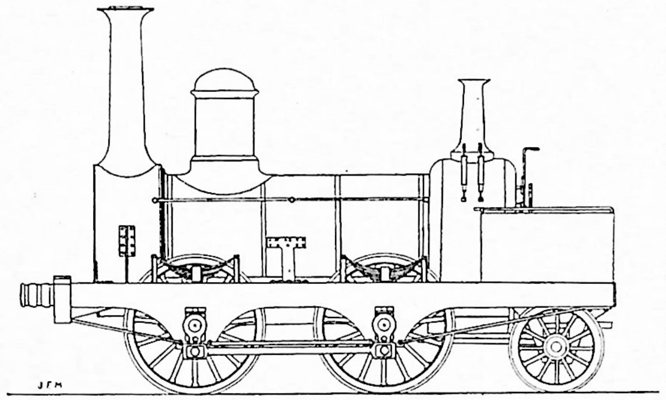
The Locomotives of the Caledonian Railway

By JAS. F. McEWAN.

(Continued from page 79.)

Wishaw and Coltness Railway (continued).

In 1844 and 1845, R. & W. Hawthorn, delivered six similar locomotives of the 0-4-2 wheel arrangement. The cylinders were 14 in. diam. by 20 in. stroke and the diameters of the wheels were 4 ft. 6 in. and 2 ft. 11 in. Unfortunately the original drawings of this class of engine cannot be found by the makers and from various odd records and sketches kindly loaned a reconstruction of the design has been attempted. The design appears to have followed the makers usual



WISHAW & COLTNESS RAILWAY, R. & W. Hawthorn 0-4-2 type, 1844-5.

practice having double frames and outside cranks. Pressure was 60 lb. per sq. in. at first, but was later raised to 70 lb. The names, etc., of the class were as undernoted:—

Name.	Date.	Makers No.	C.R. No.	Withdrawn.
Jupiter	1844	388	89	1861
Hercules	,,	389	95	1858(a)
Vulcan	1845	421	91	1861
Venus	,,	422	87(b)	1863
Vesta	,,	454	88(c)	1859
Lucifer	,,	455	86	1861

Note (a). No. 95 is said to have been hired to Wm. Dixon & Co. for the haulage of their own coke traffic, in exercise of their running powers between Calder and Blantyre and the Govan Ironworks, from 1855 or earlier to 1858 in which year the engine was sold out of service. Although nothing definite can be traced it is suggested that Messrs. Dixon were the purchasers and that this locomotive was the first "Calder No. 5." The late John Smith—the last main line driver at Dixon's—always declared that the first "No. 5" was of similar wheel type to the second No. 5, 0-4-2, and that when he came to Calder some wheels and axles lying there were pointed out as belonging to the earlier engine which was "of the Coltness type" and got for working the main line trips and retained after the larger engine had been sold to the Caledonian Railway. This sale will be referred to shortly when dealing with the history of the Traders' locomotives.

Notes (b) and (c). Nos. 87 and 88 were renumbered 84 and 85 respectively either in 1853 or early in 1854.

Some years ago the reminiscences of John Mann were given in a Lanarkshire Club and one concerned the Wishaw and Coltness Railway.

It was claimed that the line had only one mishap prior to its amalgamation with the C.R., happily without serious consequences. On the occasion referred to, two of the locomotives, *Hercules* and *Venus* had been sent to Morningside on the previous evening to work an extra train early next morning. The leading engine was *Hercules* and the train engine *Venus*. The usual early trip from the Holytown Works, and depot, to Morningside was being hauled by *Lucifer*. Both trains were coming along their own set of rails near Cambusnethan (Wishaw) and had almost met when *Lucifer* suddenly left the rails, slewed over towards the other set and pitched in to *Hercules*. Luckily the driver and fireman were thrown clear of the *Hercules* before it fell over.

At the inquiry into the accident it was suggested by the company's superintendent that the only solution which could be advanced was that *Lucifer* had the idea that *Venus* was being led away by his rival. Referring to John Mann, it is interesting to note that he came to the Monkland and Kirkintilloch Railway with Mr. Dodds. He had been a driver with the Stockton and Darlington Railway previously. Later he left the M. & K.R. to become a "foreman driver" with the Wishaw and Coltness Railway and later joined the Caledonian.

When the stock was taken over by the C.R. it was seemingly numbered in the rotation the engines arrived at the Holytown Shops for repainting.

TRADER'S LOCOMOTIVES.

When the C.R. was formed it was understood that all the haulage required at collieries, etc., was to be performed by the Company, and this meant the removal of loaded wagons from the pithead to the nearest mineral yard on the main line for marshalling, including the setting in of empties. The C.R., however, had spent so much money in other directions that when the line was opened some of the stations were only half completed, while owing to debt all the locomotive stock necessary could not be provided; some of the singles worked on goods trains. In consequence it was arranged with the colliery people and others interested that until the time when the Company could undertake the shunting themselves the owners would acquire suitable locomotives and undertake the haulage. In consequence of this the C.R. were to give the colliery and ironworks locomotives running powers over the section of the main line adjacent to their works. Some of the running powers granted were of a limited nature while in two cases they were extensive. Those of Colin Dunlop & Co. permitted that company to operate from Crossbasket, near Blantyre to Gushetfaulds (Glasgow) and over the former Drumpellier Railway. Later when the line was extended to Strathaven and the Quarter Collieries were brought into use, Dunlop ceased to use the running powers and sent the engines still retained to this district. The most extensive were those granted to Wm. Dixon & Co. who were permitted to run their own trains over the line from Calder to Glasgow (Port Dundas) traversing the route of the Glasgow, Garnkirk and Coatbridge Railway, and also from Calder to Govan Ironworks, via. Motherwell. Later the powers were exercised mainly between Calder and the ironworks, via. Langloan and an occasional trip from High Blantyre. These powers have not been used since 1937 as the trips were becoming sporadic and there was little traffic for a large locomotive of limited power.

One part of the arrangement with the various owners was that the Company would purchase the stock acquired, as soon as was practicable, but the owners would have the option of retaining the facilities for a short period after the notice to purchase had been intimated. Some of the owners parted with their facilities in whole, others in part as soon as the C.R. indicated that they purposed taking the engines over. Some retained the locomotives for internal traffic.

A few of the owners got the C.R. to operate the engines for them when obtained and it is said that frequently locomotives were seen bearing a C.R. road number and also the inscription that the owner was a private individual (e.g., Arch. Russell). This may have given rise to the story that at one period the C.R. was so poorly off that creditors put their names on the engines to indicate ownership.

TRADER'S LOCOMOTIVES.

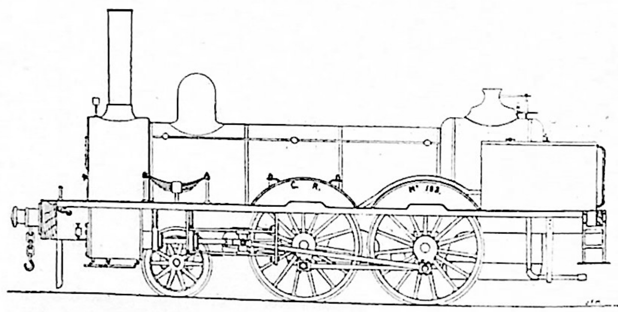
C.R. No.	Type	Cyls.	D.W.
80	2-4-0T	14 by 21	5 ft. 0 in.
81	,,	,,	,,
83 (a)	0-4-0	15 by 18	4 ft. 6 in.
87 (b)	0-4-2	16 by 20 0	5 ft. 0 in.
88 (c)	,,	,,	,,
95 (d)	,,	17 by 20 0	,,
182	2-4-0	15 by 22 0	,,
183	,,	,,	,,
184	0-4-2	14 by 21 i	4 ft. 6 in.
185	,,	,,	,,
186	,,	16 by 22 0	5 ft. 0 in.
187	,,	,,	,,

For details of makers, etc., see separate list.

Notes—(a) Renumbered 240 in 1862 and 118 in 1864.
(b) ,, 241 in 1862 and 255 in 1864.
(c) ,, 242 in 1864.
(d) ,, 111 in 1866, 120 in 1867, 123 in 1872, 451 in 1876 and 680 in 1877.

So far as is known some twelve locomotives came over to the C.R. The details of the numbers are somewhat confused and contradictory and the basic details are taken mainly from the notes made by the late Inspector John McInnes who joined the service of the Garnkirk and Glasgow Railway in 1844 and retired from the Company's service in 1902.

R. & W. Hawthorn are credited with the construction of at least four engines, but these makers, despite great search, are not able to trace the manufacture of any of them, therefore the makers appear to be Hawthorns of Leith, as No. 95 has builder's number 47 of 1851 and Hawthorns had then not long started general engineering. No. 83 is said to have been Neilson's No. 50 of 1851, but as this was the Summerlee Iron Co's. engine the maker would be Hawthorns and their No. 50. This engine bore the name "Neilson," hence the possible mistake in the makers name. Nos. 80 and 81 were sold to owners in Co. Durham. The former rejoiced in the nickname "The Cuddy" (Horse) and 81 in "The Bird." The source of the latter is said to have come from the knowledge that its first owners had named it *Hawk*. Both are stated to have been very efficient and powerful and were employed until their disposal in shunting the old yard at Glasgow (South Side). These two locomotives are said to have been the first two made by Hawthorns, all four previous jobs being marine.



CALEDONIAN RAILWAY, G. England 2-4-0 taken over from C. Dunlop & Co., 1857.

Nos. 182 and 183 were short coupled locomotives and had the same boiler details, cylinder and wheel dimensions as those numbered 144 to 151 previously described. The wheelbase, however, was 5 ft. 11 in. plus 5 ft. 6 in., and 11 ft. 5 in. total. The piston rod had a trunk guide. These appear to have been engines from the cancelled order for Russia.

Nos. 184 and 185 seem to have been Hawthorns copy of the earlier R. & W. Hawthorn design which had been assembled at Leith, but of slightly increased dimensions.

Nos. 186 and 187 were of Neilson & Co's. standard design and had in consequence quite a number of parts which were standard with C.R. designs. They were rebuilt at Perth in 1867 and 1865 respectively. No change appears to have been made in the boiler design. No. 187 was the first "foreign" engine to be overhauled at the

TRADERS' LOCOMOTIVES ACQUIRED BY THE CALEDONIAN RAILWAY.

No	New	Acq'r'd	Maker	M.No.	Name	Owner	W'drawn
80	1850	1855	Hawthorns	?5	?	Coltness Iron Co. ..	1860
81	1850	1854	,, ...	?6	?Hawk	A. Russell & Co. ..	1861
83	1851	1854	,, ...	50	Neilson	Summerlee Iron Co. ..	1873
87	1850	1854	,, ...	—	Newton	Kidson	1874
88	1851	1854	A. Neilson & Co. ..	46	Arch. Russell ..	A. Russell & Co. ..	1872
95	1851	1858	Hawthorns	47	Glencairn	J. Watson & Co. ..	1878
182	1852	1857	G. England & Co. ..	—	Cuilhill	C. Dunlop & Co. ..	1870
183	1852	1857	,, ..	—	Monkland	,, ..	1872
184	1852	1857	Hawthorns	83	?Tewsgill	Coltness Iron Co. ..	1872
185	1853	1857	,, ...	84	?Garion	,, ..	1874
186	?1855	1857	A. Neilson & Co. ..	—	Calder	W. Dixon & Co. ..	1881
187	?1855	1857	,, ..	—	Cambusnethan ..	Thos. Barr & Co. ..	1882

former Scottish Central Railway shops. The names were removed by the C.R. when the locomotives were taken over.

Sinclair was succeeded by Ben. Connor, but no alteration was made to the locomotives ordered prior to Sinclair's departure and still to be built. Sinclair did little experimental work and apart from the attempt to improve combustion by the additon of argands to the firebox, his main alterations were the fitting of chimneys of correct diameter and blast pipes of correct diameter and height as found by trial and error methods under actual conditions. He discontinued the use of stay rods in the boiler barrels, and adopted longitudinal stays between the smokebox tube plate and the firebox tube plate.

(To be continued).

Unfortunately in the preparation of the script for the first instalment of these articles two notes were transposed. Mr. Smellie's death in 1891, not Mr. Lambie's, was the result of a wetting and resultant pneumonia (pp. 152, June, 1940). Mr. Lambie's death followed a serious illness during his last few months in office.

A few misprints have occurred owing to the difficulties under which the publishers and printers have been working.

In the list of the first 58 locomotives No. 7 was renumbered 25 in 1869, renumbered 50 in 1871 and withdrawn 1874. No. 30 withdrawn 1871 and not renumbered as first intended. No. 31 as No. 32 withdrawn 1872, 13 as 45 in 1873. In footnote No. 3 should read No. 2. It is suggested that Nos. 25, 26 and 27 were makers' numbers 236, 220 and 221 and that Nos. 20 to 27 were dated 1847. No. 102 was sold in 1886 to a colliery company. Nos. 104, 106, 108 (1870), and 109 were rebuilt similar to 102. Nos. 111, 112, and 118 had 5 ft. coupled wheels although stated by makers to have had wheels 4 ft. 6 in., but possibly this dimension refers to the size on the wheel rim. Nos. 136 to 143 (page 12, Vol. XLVII), Cylinders 12 in. diam. by 18 in. stroke. Wheels 4 ft. 7 in. diam., and page 13, Class 65 to 76, Cylinders 15½ in. diam. by 20 in. stroke. Wheelbase 6 ft. plus 7 ft., total 13 ft., page 14.

When referring to the locomotives built by Geo. England & Co. it was implied that the non acceptance of the order by Russia caused the collapse of the firm. It is learned that this was not so, and the alteration of the Russian gauge to 5 ft., apart from difficulties of payment, caused non acceptance of the engines.

In his book "Early British Locomotives," Mr. C. F. Dendy Marshall states on page 62 that the engineer for the Monkland and Kirkintilloch was Isaac Dodds, but this should be George Dodds as mentioned. It would appear that Mr. Marshall has been mislead by an inaccurate statement by Snell in his book "A Story of Railway Pioneers." Isaac Dodds was only employed as repairs foreman, presumably by his younger son.

Railcar Radiators

By J. L. KOFFMANN.

THE rapid development of railcars faced both designers and operators with several problems, among which the dimensioning of radiators presents some complexities. The action of a radiator in service appears to be very simple, for the hot water circulated through it merely gives up heat to air passing over its hot external surface, but as soon as the sequence of events is examined in detail, and if an effort be made to forecast the performance of every type under every variety of operating conditions, the complexity of the different variables affecting the performance of the radiator concerned soon appears. It is the great number of variables, made more complicated by the design of a particular vehicle, that makes it impractical to produce formulæ suitable for general application to radiators on a true mathematical basis. However, a general idea as to the size and arrangement of the radiators is required when designing a railcar with one or more engines of a definite output in order to be able to compare the various designs contemplated, as well as the costs involved, before more exact data for each individual case is obtained from the manufacturers.

The following data underlaying the proportioning of railcar radiators may be found useful. Of the heat generated per cycle in the cylinder of a Diesel engine, 25-30 per cent. can be converted into useful work on the pistons, 40-45 per cent. is rejected with the exhaust gases and 25-30 per cent. has to be got rid of, partly by direct cooling and partly through the intermediary of the cooling water, which later dissipates the heat to the air in the radiator. The dependance of jacket heat losses upon the output is shown in Fig. 1.

While with any radiator the water always flows from the top to the bottom while the air generally passes from the front to the rear there are two fundamental types of traction radiators (Fig. 2), i.e., the water tube, in which the air cools the exterior of tubes containing water, either in separate units or arranged into blocks; and the air tube or honeycomb, in which the air passes through tubes surrounded by water. The comparative performance

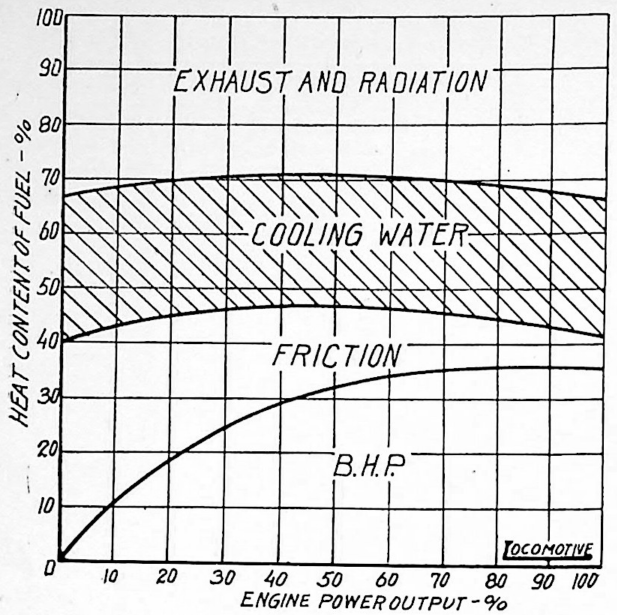


FIG. 1.

of the different types of radiators under similar conditions, and their dependence upon the velocity of the cooling air is indicated by Fig. 3. From this it will be observed that the best performance is ensured by the film core unit (5) made up from suitably formed strips of thin metal, which thus make vertical waterways between which the air passes. This is followed by the hexagon honeycomb core (3) and the normal honeycomb radiator (2). The main data of the radiators concerned are given in the following table, wherein

№	l	f	r	d	X
1	4	0.793	3/32	3/8	36.5
1'	12	0.793	3/32	3/8	109.5
2	12	0.793	3/32	3/8	109.5
3	4	0.617	1/16	1/4	36.8
3'	12	0.617	1/16	1/4	110.2
4	4	0.707	11/64	11/16	16.38
5	4	0.601	3/64	3/16	48.8
5'	10	0.601	3/64	3/16	109.3
6	4	0.776	3/16	3/4	17.1

l is the tube length or depth of radiator block in inches, f is the ratio of the free air space in or between the tubes to the total frontal area, r is

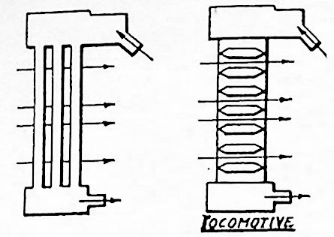


FIG. 2.

the hydraulic radius of the ratio of the area of the individual air tube to its circumference in inches, the equivalent diameter thus being $d = 4r$, while the ratio X represents the relation between the total cooling area to the frontal area of the complete radiator block.

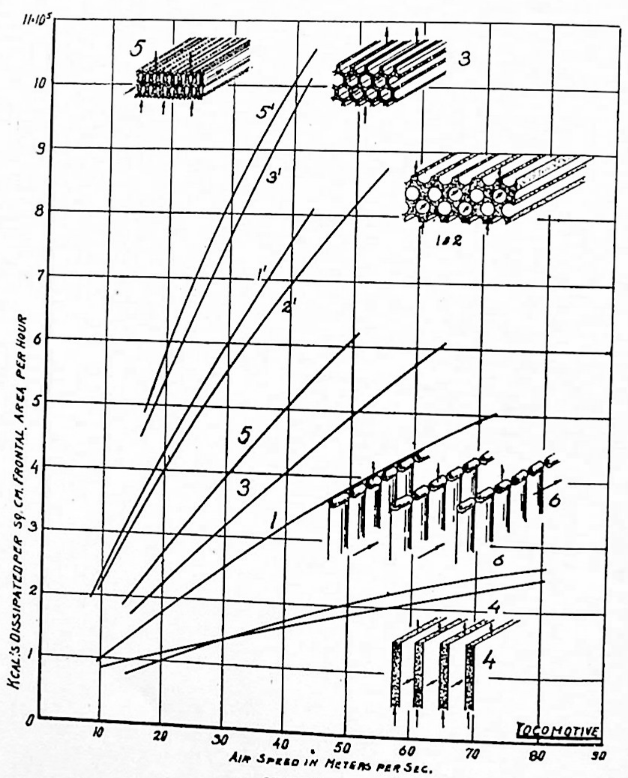


FIG. 3.

The influence of the tube length and air velocity with honeycomb radiators is also shown by Fig. 4 giving values obtained with tubes of 0.394 in. bore and different lengths. Generally it can be stated that the cooler capacity increases with the 0.85 power of the air velocity. This might be compared with the amount of heat to be dissipated, which increases with the 0.71 power of the engine speed.

The influence of the water velocity as represented by the volume rushed through the radiator within a definite time is shown by the curves (Fig 5) plotted for radiator N.1. In accordance with this no advantage is gained in increasing the amount of cooling water passing through the radiator beyond a certain limit as in this instance

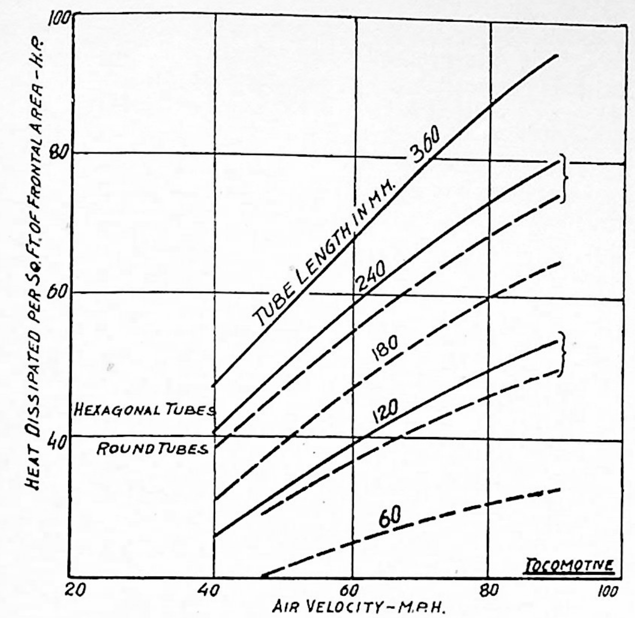


FIG. 4.

represented by 1.5 pints per second, while further increase in the radiator capacity can be gained only by increasing the air velocity.

Turning now to the size of the radiator required for a given engine, this can be determined by the formula for the frontal area in sq. ft. F required.

$$F = \frac{\dfrac{1}{5KX} + \dfrac{1}{165.V.f.y}}{11\left(\dfrac{t_1\ t_2}{Q} - 0.23W\right)}$$

Herein K is the thermal conductivity. This is

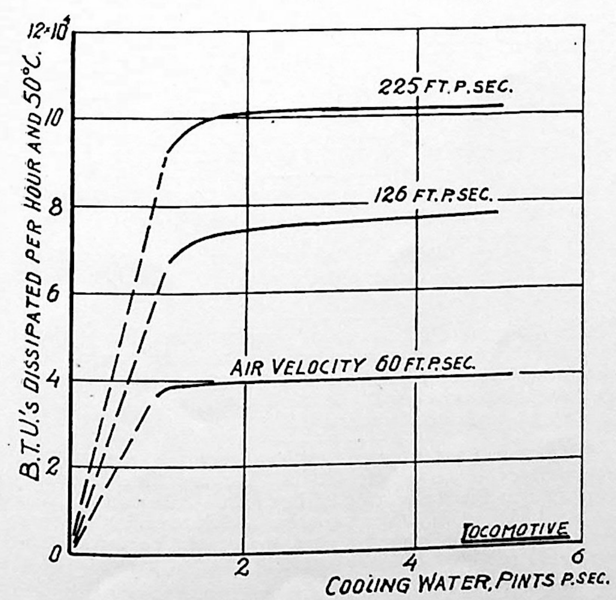


FIG. 5.

made up of the conductivity of heat from water to metal, metal to air, as well as the thermal conduction through the radiator core. Compared with the value of K between metal and air the remaining two K values can be neglected. For an air velocity V in front of the radiator of about 80 ft. per second (55 m.p.h.), the values for K as based upon a number of tests with brass radiator cores are:—

18.5 BTU/ (hr) (sq. ft.) (deg. F.)
for honeycomb radiators.

25 BTU/ (hr) (sq. ft.) (deg. F.)
for watertube radiators with straight rows.

33 BTU/ (hr) (sq. ft.) (deg. F.)
for watertube radiators with offset rows

47 BTU/ (hr) (sq. ft.) (deg. F.)
for watertube radiators with fins and straight tube rows.

54 BTU/ (hr) (sq. ft.) (deg. F.)
for watertube radiators with fins and offset tube rows

The value for the ratio X, which is the ratio of the total cooling area to the frontal area of the radiator is assumed as an average of 37 for honeycomb and 28 for the watertube radiator, while the ratio f has an average value of 0.63 and 0.43 respectively. The figure y represents the ratio of the air velocity inside the radiator to that in front of it. This is dependent upon the radiator type and varies between 0.8 to 0.9 with honeycomb units as against 0.3 to 0.8 with watertube radiators, t_1 is the water temperature before the radiator, i.e., the highest permissible temperature of the cooling water. This should not exceed 180° F.

It should be mentioned here that besides a demand for "not too hot" cooling water a demand for "not too cool" water should be stipulated, as with the cooling water temperature dropping beyond a certain limit before entering the engine jackets the thermal stresses are increased while the engine efficiency is appreciably reduced. Furthermore excessive smoke from the exhaust will be the consequence of imperfect combustion. The average temperature of the water leaving the radiator should therefore be not lower than 160° F.

The temperature of the cooling air before entering the radiator is t_2° F. Next we come to Q—the amount of heat in BTU/hr to be dissipated by the radiator. This is to be derived from the power output, and resultant fuel consumption of the engine concerned. With a being the amount of fuel heat to be dissipated, η being the portion transformed into useful work, i.e., the thermal efficiency of the engine and Qu the heat value of the useful work performed, we have:—

$$Q = \frac{a}{\eta} Qu$$

Furthermore:—

$$Qu = \eta . W_F . N_m . C_1$$

wherein W_F is the amount of fuel in lb. per h.p. hr, N_m is the maximum power output of the engine in h.p. and C_l the lower calorific value of the fuel. With α being 0.35, an average fuel consumption of 0.5 lb. per h.p. hr. and C_l being 19000 BTU per lb.:—

$$Q = 3350 \times N_m \text{ BTU per hour}$$

As, however, in railway service the engine is expected to give the maximum power output only during acceleration periods or when working over heavy gradients, which normally represent only a fraction of the network operated, it is safe to assume that the engine is normally utilized to about 70 per cent. of its maximum output when used with medium speed vehicles, this figure being even further reduced with high-speed railcars, so that

$$Q = 2350 \times N_m \text{ BTU per hour}$$

Finally, we come to W—the amount of cooling water passing through the radiator in lb. per hour. This usually amounts to about 100 lb. per h.p. per hour and should be not less than 50 lb. per hour per 1,000 BTU dissipated per hour.

The most essential check on the adequacy of the water flow is, however, the amount of temperature drop when passing through the radiator, say 20° F.

Considering the shape of the waterways it is to be observed that while the flow must be sufficiently turbulent to prevent any stagnant patches of water impeding the transfer of heat, excessive turbulence may cause difficulties from erosion. The pipes between engine and radiator should be as short and straight as possible while the area required may be calculated by allowing a maximum water velocity at the highest engine speed of 10 ft. per second.

Considering the formula and the figures given above we come to the conclusion that with a certain size of the frontal area as well as air and water velocity the radiator capacity can be improved by increasing the cooling surface. This can be effected by adding more tubes, by reducing their section or by increasing their length. In this way the capacity of the radiator can be increased up to a certain value after which it decreases again, the limiting range being actually very wide. In order to keep first costs low the lower limit of number and length of tubes should be sought. Good results are obtained with diameters of 5/32 in. to 1/4 in., and a length of 4 to 6 inches.

While the shape of the radiator front is of no great influence, its relative size is of importance. Should the amount of cooling water increase in proportion to the increase of frontal area the amount of heat dissipated is—as the amount of cooling air is also proportional to the frontal area—proportional to the volume of water and frontal area. Should the amount of water increase more rapidly than the frontal area, then the amount of dissipated heat also increases accordingly, while on the other hand should the amount of water increase at a slower rate than the size of the frontal area, the amount of dissipated heat will be smaller per unit of frontal area as the cooling property of the air is proportional to its frontal area. While air velocity is of great importance its increase cannot be justified beyond a certain limit as the power absorbed by the fan increases with the third power of engine speed.

A quick, but approximate, estimate of the radiator size can be made with the help of Fig. 6, showing the heat dissipated as a function of the total engine output as well as of the air velocity

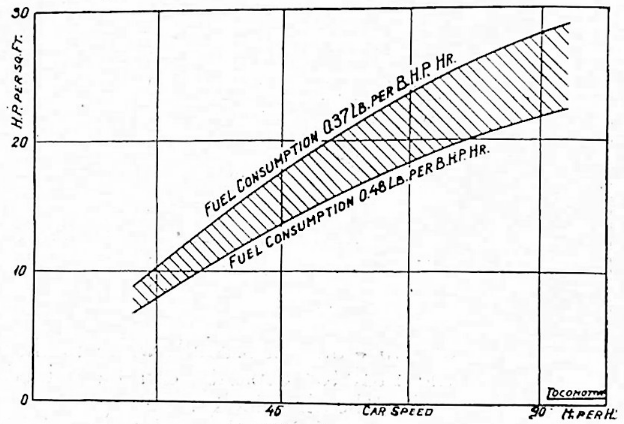


FIG. 6.

and based upon the limits of fuel consumption in modern engines. The values shown vary within ± 20 per cent. for different radiator types.

As with rolling stock generally and with light weight units particularly the question of weight is of utmost importance, every effort should be made to reduce redundant weight as far as practicable and as this also concerns the radiator its weight should be considered before deciding the use of a particular design. The following formula based upon a number of radiators in service can be used to estimate the weight, in lb., of the filled radiator.

$$G = 0.2\,F\left(10 + \frac{3.33\,l}{d^{0.75}}\right)$$

wherein F is in sq. ft. and l and d in inches.

SOVIET RAILWAYS. It is estimated there are at least 3,000 women acting as drivers or assistant drivers on the Soviet Railways.

The Dynamo Works in Moscow has designed a high speed electric passenger locomotive of 4,000 kilowatt capacity.

THE ARGENTINE MINISTRY OF AGRICULTURE has authorize the sale of government-purchased corn for use as fuel on the railways. Experiments were made which showed that unshelled corn could be used for locomotive fuel as cheaply as coal, wood or fuel oil.

"MODERN LOCOMOTIVE RUNNING SHED PRACTICE" is the title of a paper by G. M. Pargiter, M.I.Loco.E., presented to the Institution of Locomotive Engineers. The Author explains in a very concise and interesting manner the relationship of running shed to locomotive by sketching in detail the ordinary working day in the life of a locomotive. Each move is dealt with in chronological order cleaning—shed examination—boiler-washing— inspection and general routine.

A Twin Locomotive

By C. R. H. SIMPSON, A.I.Loco.E.

THIS locomotive was constructed by the Swiss Locomotive & Machine Works of Winterthur about 1878 for experimental service on the Villa Real & Villa Regoa Tramway in Portugal. This line, built to a gauge of 35.4 in., contained gradients of 1 in 12½ and reverse curves of 82 ft. radius so it will be readily conceded that something out of the ordinary was necessary in the way of motive power.

The engine was designed by Mr. Charles Brown the manager of the builders and contained a number of novel features—some of which are even today considered comparatively modern and at least one of which is regarded as a very recent innovation.

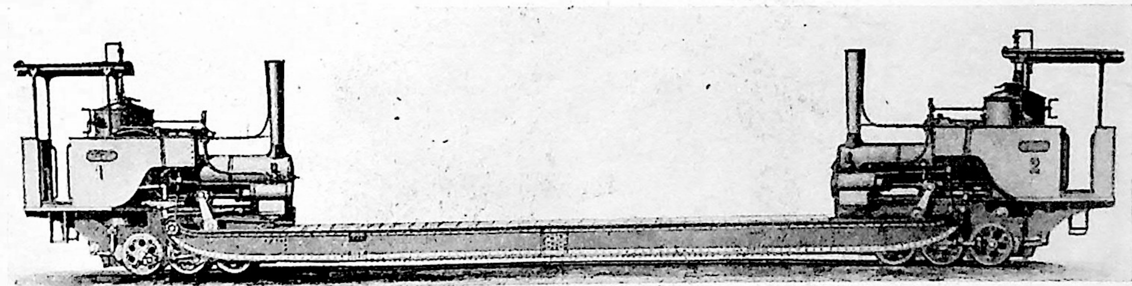
Locomotives had previously been constructed to work in pairs, firebox to firebox, but the idea of running them chimney to chimney was distinctly new.

valuable feature on a steeply graded line. The boiler was constructed for a working pressure of no less than 200 lb. per sq. in.—an exceptional figure for 60 years ago.

It will be observed that the cylinders transmitted the power to the wheels via rocking levers. Three point suspension was employed, a transverse spring taking the weight of the leading end while the ends of a spring at each side bore on the trailing and middle axle-boxes.

The remaining item calling for notice was the provision of counter-pressure braking in addition to the orthodox brake which operated blocks on the rear wheels only.

Leading dimensions were, cylinders 8.6 in. by 12.8 in. stroke; driving wheels 23.6 in. diameter; weight of each engine 7 tons empty, 8½ tons in working order; weight of platform 3¼ tons. The engine wheelbase was 4 ft. 5 in., and the total wheelbase of the two engines with platform 42 ft. 6 in. The total heating surface was 214 sq. ft. of which the firebox contributed 20.3 sq. ft.



TWIN LOCOMOTIVE, VILLA REAL AND VILLA REGOA TRAMWAY, PORTUGAL.

The maximum permissible load of 15 tons was carried on the frame, 26 ft. 7 in. long and 5 ft. 11 in. wide, slung between the engines. A criticism sometimes levelled against tank engines is the fluctuation in adhesive weight which must inevitably occur with the diminution of the water and fuel supplies but this pales into insignificance compared with the extreme variations liable to occur with such an arrangement as that under review.

The feature referred to as considered of recent origin was the manner of supporting the platform; it will be observed that this was suspended from links having spherical bearings at the tops of the side tank—truly an early example of pendulum suspension. Any tendency of the platform to oscillate laterally was prevented by a pin passing through the centre of each end of the platform girders and a suitable frame on the engine; these pins also transmitted the draw and buffing stresses.

Other unusual features were incorporated in the design of both the boiler and the engine. The boiler had a cylindrical inner and outer firebox, the outer one being carried considerably above the boiler barrel which had no steam space; the working range of the water level was 10 in., a

"Southern Belle"

KANSAS CITY SOUTHERN-LOUISIANA AND ARKANSAS LINES.

THE "Southern Belle" of the Kansas City Southern-Louisiana & Arkansas Lines operates between Kansas City and New Orleans a distance of 868 miles between terminals. There are 25 intermediate stops and the overall running time is 21½ hours; the average speed being slightly over 40 miles per hour. To maintain daily schedules in each direction, three trains are required, each consisting of a diesel-electric locomotive, a mail and baggage car, a coach, a Pullman sleeper, and an observation-parlour-diner car.

The locomotives are standard models of the Electro-Motive Corporation, while the cars for each train were designed and built by the Pullman-Standard Car Manufacturing Company to the specification of Mr. Harvey Couch, Chairman of the Kansas City Southern-Louisiana & Arkansas Lines.

The trains are designed to fit the particular needs of the territory they serve. They are largely products of this territory, too. The aluminium from which the trains are made came from bauxite mined in Arkansas; while the glass, paint, woodwork, textiles, and other materials used in the fabrication of the car structures, were selected where practical from the six states in which the Kansas City Southern-Louisiana & Arkansas Lines operates.

The exterior design carries the latest refinements in structural streamlining, assisted by a striking and unusual colour scheme. The front end of the locomotive is painted red and yellow with a dark green background.

The cars have aluminium coloured roofs, with dark green bodies and carry at the girder sheet a wide yellow band with a wide vivid red stripe just above. The coloured bands and stripes are carried in uninterrupted lines from the locomotive front to the train end, and make a striking and complete unit of the train. The aluminium of the roof is separated from the dark green of the car body by a narrow red stripe, and the lettering on the train is in gold colour.

The interior design of the cars is a motif of extreme simplicity, coupled with efficiency and good taste in the selection of materials.

Among the many features incorporated are: Air conditioning; wash rooms and luggage compartment at each end of coach; day room and secretary's room in observation-parlour-diner car; Radio with speakers in all parts of the train; telephone connection for use with regular Bell system during stops en route; telephone connection between cars and engine; private office for conductor at front of each coach, equipped with desk, cabinet for papers, and telephone.

The observation-parlour-dining car has many interesting features. It is divided into six main sections: from front to rear—day rooms, lunch room, kitchen, dining room, parlour and observation. It is 85 feet long.

The semi oval observation section is equipped with a built-in sofa and four chairs, it is designed to accommodate eight passengers. A circular table in front of the sofa, permits the easy serving of refreshments.

The colour scheme in the observation section is green. The floor covering through the entire car consists of a heavy raisin-colour, two tone modern leaf design carpet, laid over thick rubber. The baseboard is dark green, with the walls of a medium green, and the ceiling of a lighter green.

In the parlour section the colour scheme is blue. The baseboards are dark blue, the walls are medium blue, and the ceilings a light blue.

The parlour compartment contains chairs and sofas, writing desk, mail box, magazine table, and other conveniences. Like the chairs in the observation section, the chairs and sofas have satin-finished aluminium frames.

The dining section is designed to serve meals en route and is equipped with four fixed tables, each accommodating four passengers.

Next to the dining section is the kitchen and opening immediately on to this is a lunch counter where inexpensive meals are served.

In front of the lunch room are two day rooms,

"SOUTHERN BELLE," KANSAS CITY SOUTHERN-LOUISIANA & ARKANSAS LINES.

one equipped with studio couch, locker, folding wash stand, and luggage rack; and the other with a secretary's desk, locker, wash stand, wardrobe, and luggage rack. In the secretary's room is the master radio set that serves all the cars.

At the front end of the car, adjacent to and framed into the body end bulkhead, is a wash room, and across the aisle from it is a luggage compartment and clothes lockers.

The three observation cars are named " Kansas City," " Shreveport," and " New Orleans."

The coaches are named "Pittsburg," "Joplin," " Texarkana," " Alexandria," and " Baton Rouge."

There is seating capacity for 74 in each coach, 56 in the white compartment and 18 in the coloured compartment.

Each end of the car has a large wash room. At the front of the car there is a private office for the train conductor, equipped with desk, pigeon holes for papers, telephone, etc.

The base colour of the coach on the inside is brown. The wainscoting and upper frieze panels are yellow, while the bulkhead panels at pier-panel height and the piers are blue. The ceiling is a light yellow. The interior of the vestibules is painted light blue. Both the vestibules and car proper have a dark blue floor covering.

A number of features designed to secure maximum efficiency with minimum effort have been incorporated in the mail baggage car. Among these may be mentioned, shower in wash room, bell operated from the cab to notify mail clerks of approach to stations, folding desk in baggage room, with telephone to locomotive and other cars for inter-train communication.

The interior of the baggage compartment is finished in corrugated metal and the mail room in flat metal.

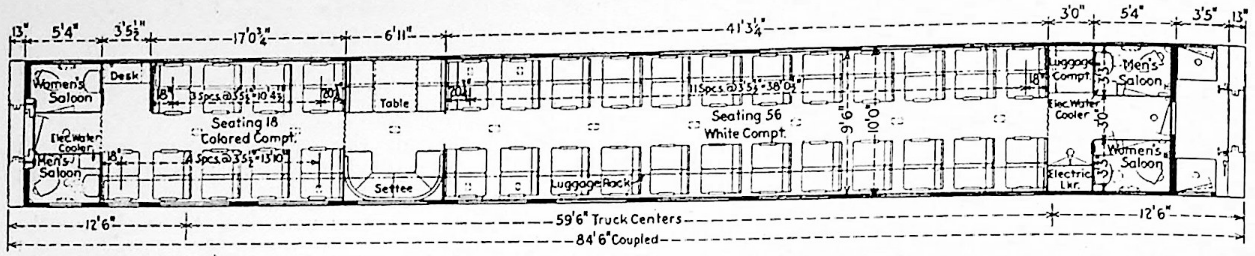
One Pullman sleeper will operate in the southbound train from Shreveport to New Orleans, and another in the northbound train from New Orleans to Shreveport. They are of the ten-section, three double-bedroom type.

The constructional details of the mail and baggage cars, coaches, and observation-parlour-diner cars, embody the same general structural design and are made of fabricated aluminium alloys, except for draft sills, bolsters, end sills, and cross ties, draft lugs and diaphragm post reinforcements, which are of alloy steel.

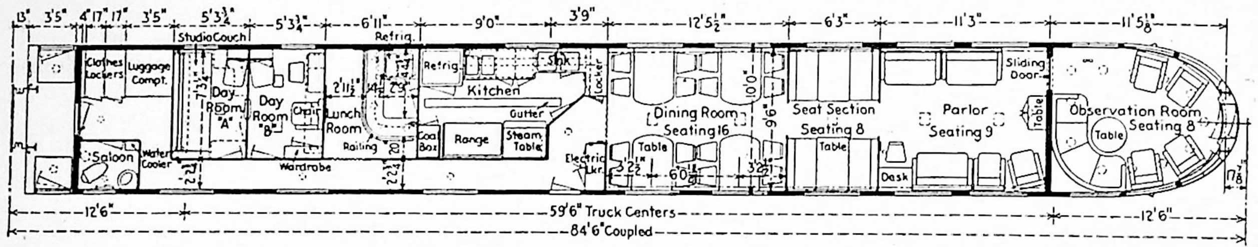
The general type of underframe consists of two main centre sills of 12-in. aluminium alloy channels, reinforced with $\frac{5}{8}$-in. aluminium alloy bottom plate. These centre sills extend from bolster to bolster. The bolsters and end construction are welded alloy steel. Floor stringers, false floor and main floor consist of aluminium alloys, the main floor being Pullman arch construction, with Fiberglas insulation.

The side framing is of a self-supporting type, riveted girder design, of aluminium alloy sheets.

"SOUTHERN BELLE." A CORNER OF THE OBSERVATION-DINER-LOUNGE CAR.



FLOOR PLAN OF THE COACH.



FLOOR PLAN OF THE OBSERVATION-PARLOUR-DINER CAR. *By Courtesy of Railway Mechanical Engineer.*

and shapes, with skirts below the side sills separately applied. The vestibule construction for the wide and dummy-type vestibules is of aluminium alloys. The turtle-back type of roof is continuous from end to end of the cars, without hoods, except the rear end of the observation-parlour-diner cars, which have a sloping hood to conform to the streamlined shape of the train. Roof sheets and framing are of aluminium alloy sheets and shapes.

The draft gear, buffing device, and drawbars are of the tight-lock Association of American Railroads type, of integral yoke, so arranged to absorb all lost motion and provide easy starting and stopping characteristics without any jerk or jar. The vestibule side doors are of the Pullman pivoted type, operating in conjunction with trap doors, and arranged to close up and hide the steps when the doors are shut.

Four-wheel trucks are used on all cars. They are of the single drop equaliser, swing motion type, with alloy cast steel frames having pedestals cast integral. Both equaliser and bolster springs are helical coil design of alloy steel. Vertical motion is controlled by shock absorbers, and truck bolsters are restrained longitudinally by the rubber-cushioned bolster anchor rods. Lateral sway is controlled by the stabilizer arrangement, which replaces the conventional spring plank.

Sound-deadening materials are used at bolster springs, truck centre plates, and body side bearings, to completely isolate track noises from the car body. Sound-deadening materials are also used at moving parts of coupler and face-plate mechanism.

The 2,000 h.p. locomotives are capable of a top speed of 117 miles per hour, but are designed to cover fast schedules at low rather than high speeds.

An automatic oil-burning boiler in the rear of the locomotive provides steam heat for both the locomotive and passenger cars.

Each locomotive carries 1,100 gallons of train-heating boiler water and 1,200 gallons of fuel.

In full working order the total weight of each locomotive is slightly less than 150 tons. It is 71 ft. long, 14 ft. above the rail, and about 10 ft. wide.

British Railways Train Services. Revised timetables were brought into operation in all four of the Main Line Railways on the 5th May. The services as a whole remain much as they were previously but the following items are of interest:—

The passenger train service provided by the L.M.S. and G.W. Railways between Brynmawr and Pontypool (Crane Street) via Abersychan and Talywain has been withdrawn.

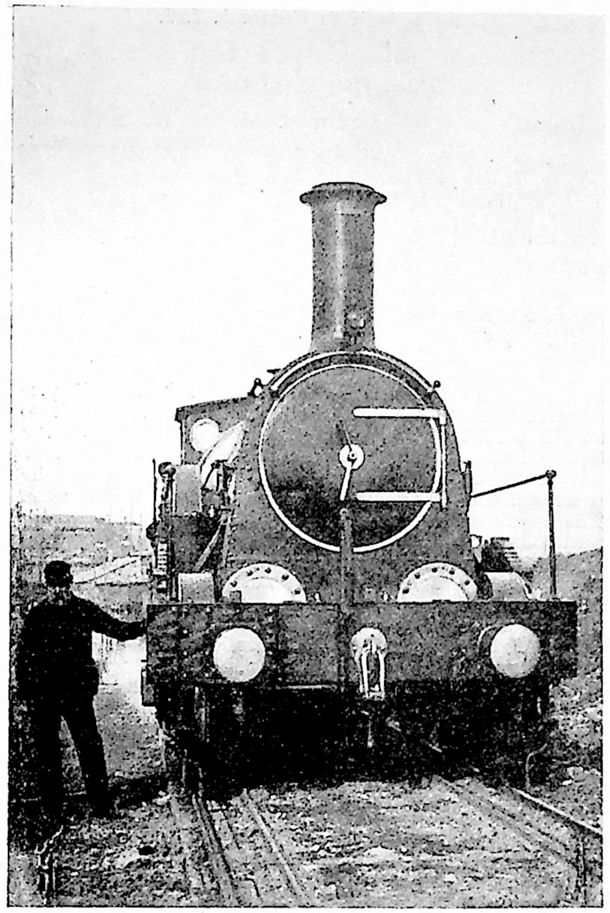
The Easton & Church Hope Railway which has been closed for sometime has now been reopened for passenger traffic.

On the L.N.E.R. the G.C. section passenger service between Sheffield (Victoria) and Barnsley (Court House) has been withdrawn.

In the London Area the L.N.E.R. services between Customs House and Beckton and over the P.L.A. line to Gallions Lane have been withdrawn for sometime as have also the L.M.S. (N.L.) service between Broad Street and stations on the G.N. suburban lines. The L.N.E.R. service between King's Cross and Moorgate is also suspended. The West London Railway now has no passenger service, all L.M.S. trains between Willesden Junction and Addison Road, Earls Court and Clapham Junction having been taken off some months ago. The Met. and G.W. joint service between Latimer Road and Kensington (Addison Road) has also ceased. The Crystal Palace (High Level) branch of the Southern Railway is now only served during business hours on weekdays and by means of a shuttle service from and to Nunhead.

A memorial service for Sir Nigel Gresley was held in the Old Parish Church, Chelsea on April 9th. The Rev. R. E. Sadleir officiated. Among those present were a large number representing the engineering societies and professions.

Four-Rail Mixed Gauge, G.W.R. W. M. Spriggs, now resident in Canada, and a very well-known authority on Canadian locomotive history, sends this photograph of a "renewed" Gooch 8 ft. single, G.W.R., which he took at Newton Abbot Station in 1891, the year previous to the abolition of Brunel's 7 ft. Broad Gauge. Interest centres mainly on the disposition of the narrow gauge rails, which are shewn interlaced, thus providing an example of mixed



G.W.R. 8 FT. SINGLE B.G. on four rail mixed gauge.

gauge on a four-rail system. It is well known that the mixed gauge was normally laid with only three rails, one rail being common to both the 7 ft. and the standard gauge tracks, and it seems that a four-rail system existed, as in this instance, to bring narrow-gauge engines centrally over the turntable (which is shewn immediately behind the engine), possibly also to bring them centrally over the inspection pits.

O. J. M.

Pennsylvania R.R. Passengers from Chicago to Miami, Fla., travel on the "South Wind" the new luxury train of the Pennsylvania Railroad. The trip takes 29½ hours each way which is the fastest timing for this run.

The latest design and smartest appointments have been put into the "South Wind." There is an 85-foot observation-lounge buffet car, a solarium forms the semi-circular observation end. Seats number 258 and are of the individual reclining coach type; they are also adjustable to suit the comfort of the passenger. Large dressing rooms for men and women are in each coach; floor lights have been placed beneath seats for illumination at night when overhead lights are turned off.

Luxury, comfort and speed are offered by this newest addition to the Pennsylvania system.

WOODEN RAILS.

C. R. H. SIMPSON, A.I.Loco.E.

Having recently referred to a pole road locomotive (*vide* page 94 of the current volume) it may be of general interest to describe briefly the types of wooden rails in use in America during the closing years of the last century.

There were briefly three varieties, the pole road in which timber of circular section was employed, the flat timber rail and that in which the depth either equalled or exceeded the face width. The pole road demanded wheels with concave treads whereas in those roads utilising flat timber the treads of the wheels were flangeless and the engine was retained on the track by means of guiding wheels acting nearly horizontally in the manner outlined in Prosser's patent. It may here be recalled that the patentee mentioned envisaged the use of wooden rails although engines were constructed on this system to operate on ordinary metal rails, an example is illustrated and described in The Locomotive, Vol. VIII (1903), page 57.

In the case of the square or edge rail wheels with tyres of orthodox contour were used, and light locomotives designed for use on steel rails could be employed without alteration.

The chief advantage of wooden rails was obviously cheapness of first cost and that is about the only point which could be claimed in their favour; their most pronounced disadvantages were high rolling resistance, the difficulty of obtaining adequate adhesion in wet and freezing weather, the need for frequent attention and the necessity of very slow speeds. Pole roads were in the opinion of some unsuitable for steam traction. The best wooden rails were constructed from maple, laid heart uppermost, hard pine also found considerable favour. Lengths usually varied from 16 to 20 ft. the cross-section varying according to the wood used and the weight of the locomotives; 5 in. by 5 in. was a commonly employed size although 5 in. by 7 in. and 4 in. by 6 in. were also encountered.

Sleepers were laid at 4 ft. centres with the larger section rails and at 2 or 3 ft. centres with the lighter sections, the usual section of sleepers was 6 in. by 6in. The rails were recessed some 3 in. into the sleepers and were affixed in the recesses by wooden keys.

In some cases such rails were laid to serve until such time as the road earned sufficient to pay for steel rails whereas in other instances they were used by firms such as logging companies who had timber readily available and frequently required the road moving to another site.

L.M.S.R. The train canteens for troops recently introduced as an experiment by the L.M.S.R. for service between London and Glasgow in co-operation with the War Office, Y.M.C.A. and Salvation Army are to become a permanent feature on certain express trains between these two points. Third Class dining cars for members of the Forces only have been provided on the weekday 10 a.m. Euston to Glasgow and the 10 a.m. Glasgow to Euston.

L.N.E.R. Mr. E. Thompson, O.B.E., has been appointed Chief Mechanical Engineer in succession to the late Sir Nigel Gresley, C.B.E., D.Sc.

Mr. Thompson was a pupil with Beyer, Peacock & Co., Ltd., and served some time with the Midland Railway. He joined the N.E.R. in 1906 and became assistant to the Divisional Locomotive Superintendent at Gateshead in 1909. In 1912 he became Carriage and Wagon Superintendent at Doncaster (G.N.R.) and in 1923 was appointed Carriage and Wagon Works Manager at York (L.N.E.R.). In 1930 Mr. Thompson was appointed Mechanical Engineer at Stratford having served as assistant there since 1927. In 1934 he went to the North-Eastern Area and in 1938 became Mechanical Engineer of the Southern Area, Western section.

Mr. H. W. H. Richards has been appointed Chief Electrical Engineer and will have complete responsibility for the Company's electrical engineering work.

CORRESPONDENCE

To the Editor of "The Locomotive."

A RAILWAY CENTENARY.

Sir,

In the opinion of the late Mr. H. G. Lewin one of the most important railway events in 1841 was the opening of the Great North of England Railway's extension from York to Darlington for passenger traffic on the 31st March of that year. He points out in his "Early British Railways," that with the opening to Darlington an alternative route at a shortened timing was provided between Euston and Edinburgh. A Bradshaw's Companion of 1841, published after the opening, states that the Chevy Chase Coach meets the mail train at Darlington, and shows Edinburgh to be reached from London in 27 hours. Two trains left a temporary station at Darlington Bank Top for York on the operating day consisting respectively of seven and fifteen carriages. The locomotives used were all built by R. & W. Hawthorn, and at the end of the second train was an

GREAT NORTH OF ENGLAND RAILWAY.

TIME TABLE for Passenger Trains,—April, 1841.

STATIONS.	NORTH TRAINS.					SUNDAYS
Trains leave	a.m.	mail p.m.	a.m.	a.m.	a.m.	mail p.m.
London	....	8·30	....	....	6·0	8·30
Birmingham	....	a.m. 12·40	....	6·45	10·30	a.m. 12·40
Leicester	....	1·24	....	7·45	....	1·24
Derby	....	3·10	....	9·30	p.m. 1·0	3·10
Masbro' (for Rotherham and Sheffield)	....	4·43	....	11·14	2·44	4·43
Normanton	....	5·44	....	p.m. 12·20	3·56	5·44
Leeds	....	....	7·40	a.m. 10·55	3·15	....
Manchester	....	....	....	9·0	12·0	....
Hull	....	....	6·30	9·45	2·0	....
York	*6·0	7·20	9·35	p.m. 2·30	6·0	7·20
Shipton	6·17	....	9·52	2·47	6·17	....
Alne	6·34	7·54	10.9	3.4	6·34	7·54
Thirsk	7.8	8.28	10·43	3·38	7·8	8·28
Northallerton	7·32	8.52	11·7	4·2	7·32	8·52
Cowton	7·54	9·14	11·29	4·24	7·54	9·14
Croft	8·12	....	11·47	4·42	8·12	....
Arrive at Darlington	8·30	9·30	p.m. 12·5	5·0	8·30	9·30
Arriving at Newcastle, through by coach	p.m. 12·30	p.m. 1·22	4·0	9.0	12·30	p.m. 1·22

STATIONS.	SOUTH TRAINS.					SUNDAYS
Coaches leave Newcastle	a.m.	a.m. 3·45	a.m. 7·0	a.m. 10·15 mail 11·15	p.m. 1·30	a.m. 10·15 mail 11·15
Trains leave Darlington	5·45	8·0	p.m. 12·30	p.m. 3·0	6·0	p.m. 3·0
Croft	5·53	8·8	12·38	....	6·8	....
Cowton	6·10	8·25	12·55	3·25	6·25	3·25
Northallerton	6·32	8·47	1.17	3·47	6·47	3·47
Thirsk	6·55	9·10	1·40	4·10	7·10	4·10
Alne	7·26	9·41	2·11	4·41	7·41	4·41
Shipton	7·48	10·3	2·33	....	8·3	....
Arrive at York	8·15	10·30	3·0	5·30	8·30	5·30
Hull	....	p.m. 1·45	6·15	9·30	....	8·30
Manchester	....	4·0	6·45	10·30	....	10·30
Leeds	....	12·20	4·40	8·0	....	7·0
Normanton	9·55	12·23	4·46	7·29	....	7·29
Masbro' (for Rotherham and Sheffield)	10·57	1·38	6·30	8·20	....	8·20
Derby	p.m. 12·45	3·45	6·30	10·9	....	10·9
Leicester	2·40	5·30	....	a.m. 12·10	....	12·10
Birmingham	4·30	6·15	....	1·0	....	1·0
London	6·0	11·15	....	5·30	....	5·30

* Every Monday the Morning Train from York will depart at 5 a.m., instead of 6 a.m., and arrive according to the following Time Table:—

LEAVES							ARRIVES AT
York, 5 a.m.	Shipton, 5·17	Alne, 5·34	Thirsk, 6·8	N.Allerton, 6·32	Cowton, 6·54	Croft, 7·12	Darlington, 7·30

Fares between York and Darlington.

PASSENGERS.		CARRIAGES.		HORSES.		
1st Class, 12s.	2nd Class, 9s.	On 2 Wheels, 20s.	On 4 Wheels, 30s.	One, 20s.	Two, 30s.	Three, 36s.

Fares from York.

	1st Class.	2nd Class.	3rd Class.
To London	£2 16 0	£1 17 0	£0 0 0
Do. (Mail)	2 18 6	2 1 0	0 0 0
Birmingham	1 12 0	1 1 6	0 0 0
Derby	1 2 0	0 14 6	0 0 0
Sheffield	0 13 6	0 9 0	0 0 0
Leeds	0 6 0	0 4 6	0 3 0
Manchester	1 0 0	0 13 0	0 0 6
Selby	0 3 6	0 2 6	0 2 0
Hull	0 8 6	0 6 0	0 4 6

	Carriages.	Horses. 1	Horses. 2	Horses. 3
To Leeds	£1 0 0	0 15 0	1 5 0	1 10 0
Hull	1 15 0	1 0 0	1 15 0	2 5 0
Derby	3 5 0	2 5 0	3 15 0	4 15 0
Birmingham	4 9 0	3 3 0	5 6 0	6 10 0
London	7 10 0	5 2 0	8 15 0	11 10 0

Carriages and Horses must be at the Station a quarter of an hour before the departure of the Trains; and, to prevent disappointment, previous notice should be given.

The Company will not be responsible for Luggage, unless it is booked and paid for according to its value: and Passengers are particularly requested to have their Name and Address fully marked thereon, and to satisfy themselves that it is deposited on the Carriages.

[5] D. O'BRIEN, Secretary.

J. & J. Readman, Printers, Darlington.

early form of "Observation Car" lent by the Manchester and Leeds Railway—with plate glass sides and an open platform at each end of the carriage. The opening ceremony is fully described in Tomlinson's "History of the North Eastern Railway, of which railway the Great North of England's line eventually became part.

The first sheet timetable of the 1841 extension is enclosed.

Yours faithfully,

REGINALD B. FELLOWS.

MACROME TREATMENT. Extensions and alterations have again been made to the treatment plant of Macrome, Ltd., to cope with an ever-increasing demand.

The importance of the treatment to the engineering industry under present conditions cannot be too strongly emphasised. It can be applied to all types of High Speed and Carbon Steel Tools, and gives to such tools an additional active resistance to wear, fatigue, and breakage, thus the reduction in the quantity of tools used for a given output is a most valuable contribution to the national effort.

One example from many reports received will give some idea of the benefits obtained. This report was received from a famous factory "Somewhere in England" and is reproduced exactly as sent to Macrome, Ltd.

Material Drilled: NI-CT Steel $\frac{3}{8}$ in.

Size of Drills: 7/64 in. diameter.

Drills used.	No. 1 Brand Untreated.	No. 1 Brand Macrome Treated.
Number of Drills Tested	12	12
Number of Holes Drilled	587	2,148
Number of Regrinds	29	30
Average Number of Holes per Regrind	20.5	70.5

An important feature of the treatment is that it permeates and affects the whole bulk of the steel treated, so that the benefits are effective throughout the life of the article, no matter how many times it is reground or how much it is worn. Another special point is that the dimensions, and heat structure are not affected in any way.

The treatment is applied when the tools are normally regarded as ready for use. Many firms, however, now do not consider a steel tool finished until it has been Macrome treated, and the time is not far distant when the treatment may be regarded as a normal process to which steel tools must be subjected before being used.

Since the beginning of the war application of the treatment to small cutting tools has been the principal aim as this side of the business appeared to be of the greatest service to the war effort. It must be borne in mind, however, that its usefulness is far from being restricted to tools, it is primarily a steel treatment and its application can be beneficial to all types of steel articles subject to wear or fatigue. Railway points and crossings, steel tyres, and motion details have their power of resistance to wear and breakage improved.

THE "PORTALUX" LIGHTING UNIT for 5 ft. 80 w. fluorescent discharge tubes is an important development in workshop lighting. By reason of its portability and adaptability, to vertical or horizontal position, the "Portalux" enables light to be brought up to, in, or under the work. It is almost the equivalent of turning a five foot tube into a hand inspection lamp, and as such its applications are very wide.

The unit consists of an Ediswan trough reflector carried in a tubular frame mounted on a heavy cast iron base; the lamp holders are mounted in felt to protect the lamp against vibration and shock and a detachable cover fitted with armour plate glass is provided to keep the reflector and lamp clean and to protect them against damage.

STEELS OF HIGH CREEP STRENGTH FOR USE AT TEMPERATURES UP TO 550° C. It has been found that certain elements, notably molybdenum, greatly increase the creep strength of steel up to a maximum temperature of 550° C., and the steels dealt with in this brochure have been designed to work within this temperature range. All are characterised by high creep strength and are immune from, or exhibit no practical tendency to, embrittlement after prolonged heating at elevated temperatures, but they differ with respect to their properties at ordinary temperatures. Publication No. 446 issued by Messrs. Hadfields, Ltd., East Hecla and Hecla Works, Sheffield.

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