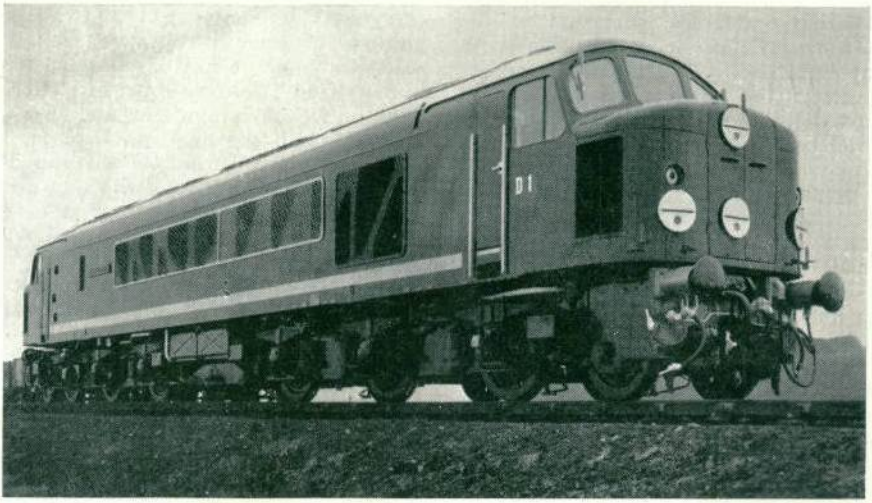
Type "4" Diesel Locomotives for the L.M.R.



No. D1, "Scafell Pike," the first British Railways type "4" 2,300-h.p. diesel-electric locomotive built at Derby

THE first of a series of 147 type "4" main-line diesel-electric locomotives to be built at Derby and at Crewe Works for the London Midland Region, No. D1, *Scafell Pike*, has been completed. They will be the largest and most-powerful diesel locomotives to be introduced in the L.M.R. under the British Railways modernisation programme. The design is for mixed-traffic duties, and is capable of hauling a heavy express passenger train at speeds of up to 90 m.p.h. or a freight train of 660 tons gross weight at 74 m.p.h. on level track. No. D1 is of 2,300 h.p., but some of the later locomotives are to have similar engines with an improved power rating of 2,500 h.p.

The L.M.R. is to name the locomotives after peaks in the Lake District, the Pennines and in North Wales which are either the highest in their areas or have some other distinctive characteristics. The names selected for Nos. D2 to D10 are *Helvellyn, Skiddaw, Great Gable, Cross Fell, Whernside, Ingleborough, Penyghent, Snowdon* and *Tryfan* respectively. Nos. D1 to D10 will be allocated to Crewe North motive power depot for express duties. The other 137, which were not ordered until earlier this year, will be allocated to depots on delivery. All the locomotives are expected to be in service by the end of 1961.

They have been designed and are being constructed to the requirements of the British Transport Commission under the general direction of the Chief Mechanical and Chief Electrical Engineers, British Railways Central Staff, B.T.C., the detailed design and supervision of construction is the responsibility of the Chief Mechanical and Electrical Engineer, Derby, L.M.R. The whole design has been co-ordinated with Sulzer Bros. (London) Limited, the diesel engine manufacturer, and with Crompton Parkinson Limited, which is supplying the electrical equipment.

The locomotives have driving cabs at each end, and a 1-Co-Co-1 wheel arrangement (two four-axle bogies, each of which has three of the four axles driven by separate electric traction motors). They are equipped to work in multiple with others of the same design and with all British Railways locomotives with British Thomson-Houston, Crompton Parkinson

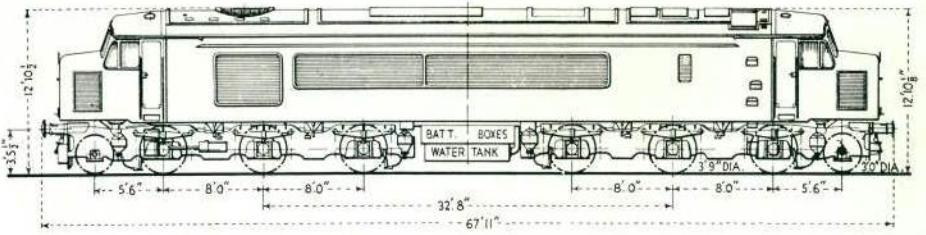
or English Electric electrical equipment. Principal particulars are as follow :

Max. weight in working order	138 tons 2 cwt.
Max. axle load in working order	19 tons 2 cwt.
Diesel engine h.p. at continuous rating	2,300 at 750 r.p.m.
Max. tractive effort	70,000 lb.
Continuous tractive effort	41,000 lb. at 16.5 m.p.h.
Max. service speed	90 m.p.h.
Wheel diameter: driving	3 ft. 9 in.
,, ,, : carrying	3 ft. 0 in.
Length over buffers	67 ft. 11 in.
Height overall	12 ft. 10⅛ in.
Width overall	9 ft. 1¼ in.
Distance between bogie pivot centres	32 ft. 8 in.
Bogie wheelbase (including carrying wheels)	21 ft. 6 in.
Fuel oil capacity (engine and boiler)	840 gal.
Water capacity (for boiler)	1,340 gal.

The underframe consists of a continuous 10 in. × 3½ in. channel which forms its outline, with cross-stretchers forming engine and bogie bearer and pivot supports. Longitudinal box-section members run down the centre of the underframe from each end of the locomotive to the cross-stretchers carrying the engine. These act as structural members, and also form air ducts for ventilation of traction motors. The side girder frames are welded direct to the channel section of the underframe and are tied together at the top by the roof frames. A cable duct with oil- and water-tight covers runs along one side of the underframe, and pipe lines run underneath the floor on the opposite side. Each bogie is fitted with buffers and centre drawhook, but provision has been made for the fitting of automatic couplers if required in the future.

A driving cab is provided at both ends of the locomotive, each with a nose compartment in which the traction motor blower units are housed. Air is drawn by the blowers through louvres in the sides of the nose compartments. The superstructure also embraces separate compartments for the power unit and carriage warming boiler, with communication doors between each and the driving cabs. Side access covers and light-alloy roof doors above the engine are provided to facilitate servicing. For major overhauls detachable roof sections are provided for easy removal of the major units of equipment.

Air for cooling the main and auxiliary generators is drawn from the engine room and expelled through the floor to prevent re-circulation. Provision has been made for the fitting of air filters in the body side. Apertures are provided in the radiator ducting through which warm air from the engine compartment is extracted by the radiator fan. A self-draining sealing plate is provided under the floor, running the full length between the cab bulkheads, to prevent leakage oil and water getting on to the bogies and



Side elevation, showing principal dimensions

battery equipment. Clean fuel-oil spillage is collected separately and ducted back to the main fuel tank. A silencer of large volume is mounted in an external roof pocket to assist heat dispersal. The complete locomotive is lined with fibre-glass navy board.

The spacious cabs are fitted with side doors behind the driver's and assistant's adjustable-type seats. The windows immediately in front of the seats are double-glazed, with an electric heating element fitted in the intervening air space which acts as a demister and defroster. Screen wipers are also provided. The cabs are heated by electric radiators and ventilated by two-way roof cowls. An electric cooker is provided in each cab.

A minimum of instruments confront the driver, and the various controls and indicators are conveniently and neatly arranged. A wheel slip light and " engine stopped " light are provided together with boiler and power equipment fault lights.

These lights glow dimly under normal conditions, but come up brightly when a fault occurs. A detailed indicator in the engine compartment shows which part of the equipment is giving trouble.

The bogies, each of which has three driving and one carrying axle, are of the side frame plate type, based on the design developed for the electric and diesel-electric locomotives on the Southern Region. They are fitted with manganese steel liners to axleboxes and guides, and rubber bushes are used in the radial linkage pivot points. The load is carried on radial quadrant bearers with an auxiliary support placed forward of these to spread the load on to the front carrying axle. Each bogie carries three nose-suspended traction motors. Side play is allowed on the centre driving axle and this motor has freedom sideways with the axle. The motors on the two outer driving axles are resiliently held irrespective of the movement of the axles, which have only nominal side play.

Brake blocks are fitted to both sides of each driving wheel and each block is operated by an individual brake cylinder with a totally-enclosed lever system and slack adjuster. A straight air brake is provided for the locomotive, operated through a valve in the driver's cab. An automatic vacuum brake is provided for the operation of the brake on the train, this being controlled by a driver's vacuum brake valve in each cab. The operation of this valve also controls, through a vacuum/air proportioning valve, the air brake on the locomotive independent of the driver's straight air valve. The vacuum/air proportioning valve is designed so that the air brake on the locomotive is automatically applied and released in proportion to and in synchronism with the application of the vacuum brake on the train. In addition to conventional sanding, an anti-slip brake is fitted; this generally assists starting under bad adhesion conditions. Separate operating switches are provided for the anti-slip brake and for sanding.

The engine is of the Sulzer twin-bank pressure-charged twelve-cylinder four-stroke type, rated at 2,300 h.p. at 750 r.p.m. In later locomotives some of the engines will have an increased rating of 2,500 h.p. at 750 r.p.m. The first ten engines are being supplied from Sulzer Bros. works in Switzerland and the remaining 137 are being manufactured by Vickers Armstrong (Engineers) Limited, Barrow-in-Furness, to the order of Sulzer Bros. (London) Limited. They are the largest type in the Sulzer range of rail traction engines and many of the parts are identical and interchangeable with those fitted in the six and eight cylinder engines supplied for the type "2" and type "3" locomotives.

The cylinders are arranged in two vertical banks of six, each bank with its own crankshaft driving a common output shaft through straight spur gearing. A step-up ratio is used in the gearbox to increase the main generator speed to 1,080 r.p.m. at full load. Pumps for cooling water circulation, lubricating oil priming and fuel transfer are all driven by a single traction-type electric motor and can be run independent of the engine. The generator group is coupled to the synchronising pinion of the diesel engine and is mounted on an extension of the engine framing.

The main generator is a ten-pole, self-ventilated machine with a continuous rating of 1,531 kW., 580 V., 2,640 amp. at 1,080 r.p.m. The auxiliary generator is an eight-pole, self-ventilated machine with a continuous rating of 90 kW., 220 V., 410 amp. at all speeds between 650 and 1,080 r.p.m. The main and auxiliary generators are combined, both armatures being mounted on a common hollow bottle-shaped cast-steel rotar.

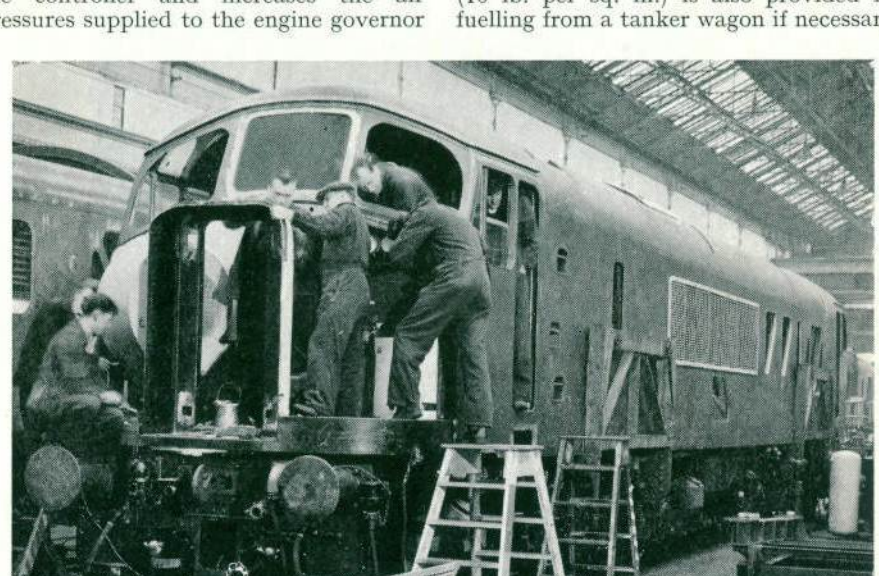
The six traction motors are series-wound force-ventilated machines with a continuous rating of 305 h.p., 440 amp., 580 V., and a one-hour rating of 305 h.p., 485 amp., 530 V., and apart from the gear ratio are similar to those fitted in the type "2" and "3" locomotives with similar power equipment. The motors are axle-hung and are connected in permanent parallel across the main generator. They are force-ventilated by two motor-driven blowers, each of which has its own 11.5-h.p. motor arranged for two-speed operation of 1,180 r.p.m. or 2,360 r.p.m.

The control equipment is housed in a dust-tight cubicle at the generator end of the engine compartment. Engine starting, traction motor and field weakening contactors are all cam-operated. The motor reversers are electro-pneumatic and the contactors for the auxiliary machines are electro-magnetic. The

driver's control equipment in each cab comprises a master controller and instrument panel, together with a set of three indicator lights "engine stopped," "wheel slip" and "fault." The cause of a fault indication is shown on a separate panel in the instrument cubicle.

The control scheme is fully automatic and the driver operates only one power controller. Movement of this from the idling position operates an air valve in the controller and increases the air pressures supplied to the engine governor automatically controlled by the generator load regulator.

Lead acid batteries are contained in four pull-out boxes suspended from the underframe. Battery charging sockets, hand inspection lamp sockets and external lighting connections are provided on each side of the locomotive. Filling and draining points are provided on each side of the locomotive to facilitate servicing, and a compressed air connection (10 lb. per sq. in.) is also provided for fuelling from a tanker wagon if necessary.



No. D1 nearing completion at Derby Works

which in turn increases the engine speed and output to a predetermined value according to the position of the handle. An oil servo-motor in the engine governor drives the generator field regulator which automatically adjusts the excitation of the generator so that the electrical loading balances the predetermined engine output at any particular engine speed. Maximum tractive effort is reached at low engine speed so that racing the engine to start the train is unnecessary. There are five stages of traction motor field weakening

Steam for carriage warming is provided by a boiler having a capacity of 2,750 lb. of steam per hour at 70 lb. per sq. in. the apparatus is automatic and fully protected. Fire detectors are installed throughout the locomotive and these operate an alarm bell in each cab. Full provision is made for the installation of a.t.c. fittings. Lifting and jacking points are provided at suitable points on the locomotive ; these facilities cater not only for workshop needs but also to facilitate re-railing in case of accidents.