

GEC



**DIESEL ELECTRIC MULTIPLE UNITS
for Northern Ireland Railways**

GEC Traction Limited

ENGLISH
ELECTRIC **AEI**

Sets of two- and three-car formations incorporating single power-cars for 5-ft 3-in gauge lines powered by above-floor English Electric diesel sets supplied by GEC Traction Limited and designed and built by British Rail Engineering Limited, Generator set for unloading at 72 mile/h to enable general-traffic trailing load of 600 tons to be handled

Diesel-electric 560/600 hp multiple-units for mainline services, Northern Ireland Railways

Northern Ireland Railways (NIR) is currently taking delivery of nine diesel-electric 560/600 hp train sets from British Rail Engineering Limited (BREL), powered by GEC Traction. Five of the sets are two-car units comprising a driving power car and a driving trailer whilst the remaining four are three-car sets having an additional intermediate trailer. There are gangway-connections for passenger use between cars within a set and between sets at the driving-trailer end so that the train make-up can be varied between two and six cars.

The majority of operations on NIR are carried out by diesel multiple-units. There are however three Bo-Bo diesel-electric main line locomotives used primarily on international trains to Dublin, and a few diesel shunting locomotives. International freight trains are usually hauled by locomotives from CIE whilst internal freight and parcels traffic is carried in goods

wagons hauled by the diesel multiple-units themselves. The majority of multiple-units are diesel mechanical but in 1966 NIR (then the Ulster Transport Authority—UTA) obtained eight 600 hp diesel-electric train sets from English Electric Co. Ltd. (now GEC Traction Limited) and from an operating point of view the latest additions are very similar to these.

It is normal practice for NIR to participate in the building of its new rolling stock and that tradition is continuing with the present contract, in that BREL is building one three-car set complete, the power car at York and the trailers at Litchurch Lane, Derby. For the remainder, BREL is completing installation of the power equipment in the power cars but the fitting out of these, and of all the trailers, is being carried out by NIR in its own workshops using material and fittings supplied by BREL.

The vehicle bodies are based on BR Mk II



General view of Northern Ireland Railways diesel-electric mainline multiple-unit designed and built by BREL for two-three-car formation photographed at its York works

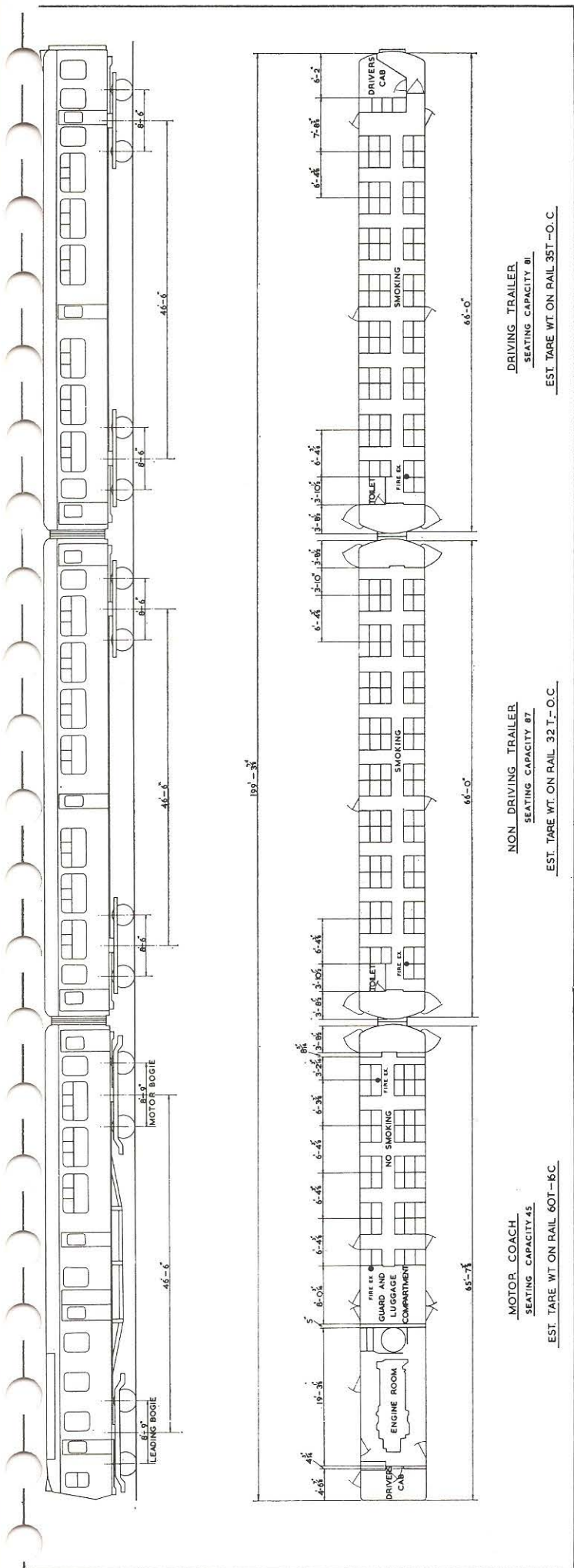


Fig. 1. Diagram of 5-ft-3-in gauge Northern Ireland Railways multiple-unit as a three-car formation comprising power car, trailer and driving trailer

locomotive-hauled coaches but a number of variations have been necessary to meet the particular requirements of the application. The non-driving trailers are very similar structurally to the Mk II coaches supplied by BREL for the NIR "Enterprise" locomotive-hauled train, but with an extra door in the bodyside to speed up passenger flow. The driving trailers are similar except at the driving end where a corner driver's cab has been fitted. Both of these vehicles are of integral construction.

For the power cars, such a structure is inadequate to accommodate the weight of the power unit so a BR Mk II type coach body has been mounted on to a Mk I underframe. The full-width cab is based on that developed for BR High Density suburban stock (PEP), currently undergoing evaluation trials on the Southern Region. A BR-type 11c Pullman gangway is fitted at the non-driving end and to both ends of the intermediate trailers and driving trailers.

Bogies on all trailer cars are standard BR Type B4 modified to suit 5-ft 3-in gauge whilst the power cars are mounted on bogies of the Mk 6 type. These are similar to those fitted to "tractor" units of the "Inter-City", Bournemouth stock but because of axle-load limitations on NIR the Mk 6 bogie at cab ends is un-motored.

The traction motors have therefore been mounted on the bogie at the further end below the passenger compartment. These motors require forced ventilation from two blowers located in the roof, this being necessary because on occasions NIR uses these units for hauling freight—sometimes as much as 550 tons with two power cars.

An unusual feature for BR-type stock is the provision of headlights (10-in Tonum units) at each end of the train set above the gangway on the driving trailer.

Buckeye-couplers are fitted throughout, those within the train set with fixed heads whilst those at the ends are drop-head types.

Passenger accommodation

Accommodation is in open saloons with seats arranged two and three each side of a central gangway. The seats are of tubular construction on 6-ft 4³/₈-in centres generally similar to those fitted to BR suburban multiple-units, and in most cases, arranged back-to-back. The saloons in the trailer cars are sub-divided by partitions without doors. Smoking is permitted in the trailer cars but not in the power car. Longitudinal luggage racks run the length of each side of each saloon and there is additional luggage accommodation beneath most seats and in the guards compartment in the power car.

Electric heating is provided with power taken directly from the output of the main generator, under the overall control of the driver. The heaters are located in skirting running the full length of each saloon. Air is extracted into the hollow roof space and then to atmosphere. There is no pressure ventilation/air conditioning, as is fitted to the most recent Mk II stock, and hence roof ducting has been omitted. For this

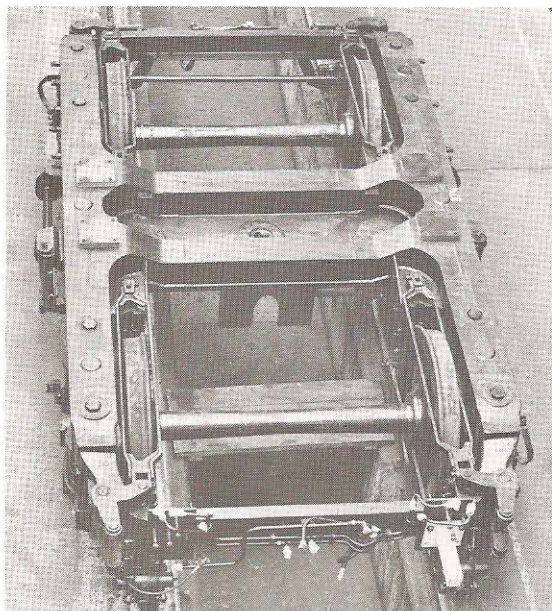
reason also the windows have sliding-ventilators. The windows are single glazed but can be converted to double if desired. Lighting is fluorescent throughout the passenger accommodation from individual inverters, and incandescent in the driving cabs, engine room and guards compartments.

The exterior finish above waist is Morocco maroon with Caribbean-blue below, the colours being divided by a white band. Saloon interiors are finished with waverite plastic-panels of golden quartered-teak appearance, and afromosia timbers. Floor covering is olive-green marble lino. Light and spacious interior appearance is helped by the white-matt ceiling finish. The seats are covered with blue-green check moquette with head rolls and armrests in blue repp cloth.

Diesel-electric power equipment

The power unit comprises an English Electric 4SRKT 4-cyl change-air cooled diesel engine to which is flange mounted a GEC type 824/6E 8-pole d.c. generator. The auxiliary generator is mounted on the same shaft as the main generator and overhung from it. Notched control is provided with a total of seven power notches. The engine is normally rated at 600 hp, 850 rev/min for railcar duties.

The 1966 NIR railcars were also set at this rating on delivery but were designed to haul parcels/freight wagons and it was expected that normally only a relatively light load would be hauled. In practice, however, it was found that the railcars had a useful haulage capacity and were frequently hauling 550-600 tons behind two power cars. This was more akin to a locomotive duty than a duty normally associa-



BR Type B6 trailer bogie fitted to the BREL-designed and built diesel-electric multiple units for 5-ft 3-in Northern Ireland Railways.

Leading particulars of NIR diesel-electric railcar sets.

Tare weight	2-car	96 ton	3-car:	128 ton
Length		134-ft 3-in		201-ft 0 $\frac{3}{4}$ -in
Seats		126		213
Width				9-ft 0-in
Height				12-ft 8 $\frac{1}{2}$ -in
Gauge				5-ft 3-in
Maximum speed				80 mile/h
Diesel engine	4SRKT		560 hp at 850 rev/min	
Generator	EE824/6E		900 A, 410 V, 370 kW, 850 rev/min	
Traction motor	EE538/4A		450 A, 410 V, 565 rev/min	
Auxiliary generator	EE906/4C		150 A, 90 V, 13 $\frac{1}{2}$ kW, 450-850 rev/min	

ted with railcars and it was considered prudent to experiment with a pair of the railcars by reducing the nominal maximum power to 560 hp, still at the same speed. By doing this, and



Interior of passenger saloon. All are arranged with three- and two-aside seating

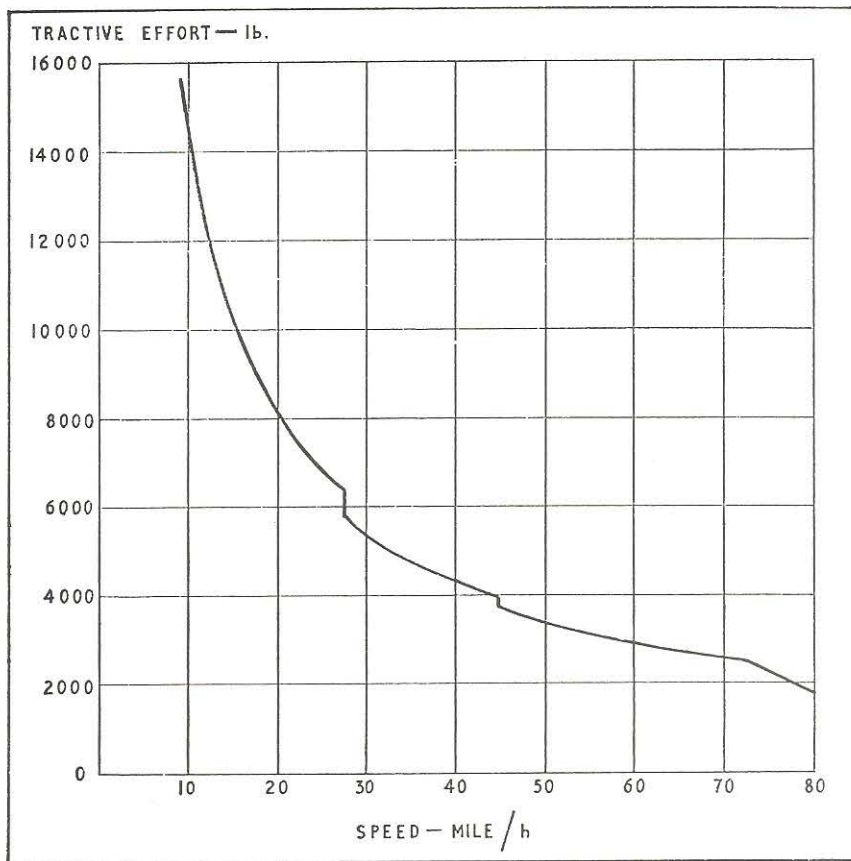


Fig. 2. Tractive effort/speed characteristic, NIR 560-hp power car only. Traction equipment supplied by GEC Traction Limited

taking a weaker motor-field, the unloading speed was raised from 55 to 72 mile/h and point to point timings were actually improved as a result, by 1 per cent. As a result all the earlier fleet were modified to this rating and the new cars also set at this rating.

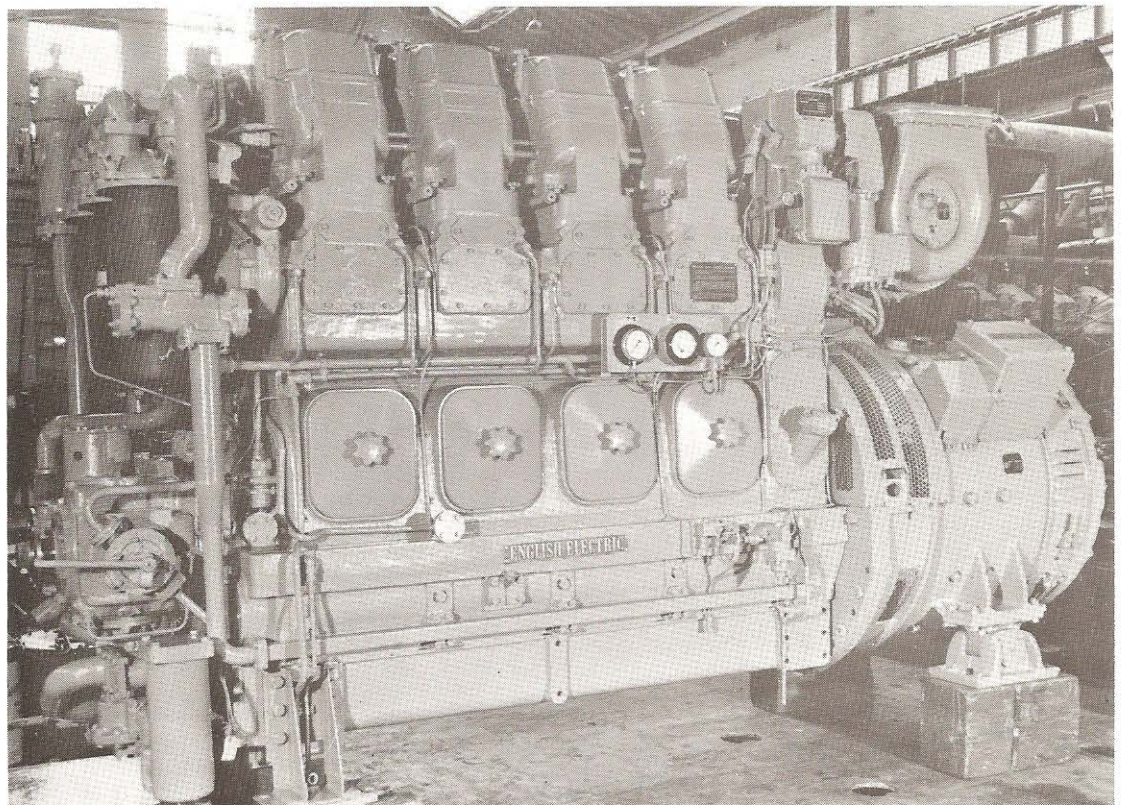
The nominal power for traction is 530 hp but when electric heating is switched on this is reduced. The actual reduction can vary very considerably depending on:—

- (a) the number of cars in the rake (one or two trailers);
- (b) the heating load called for by the thermostats in the different saloons; and
- (c) the actual voltage being generated at any instant—this of course is dependant on the power notch selected and the actual point on the characteristic, which itself is influenced by the vehicle speed.

When the Master Controller is moved to "off", for coasting or standing at a station, the engine runs at second speed and the separately-excited main-generator field is set at its maximum value giving a constant 560-V supply to the heater.

The two type 538/4A traction motors mounted on the inner bogie of the power car—are nose suspended, axle-hung series-wound machines driving through solid spur-gearing (ratio 63:20) and geared for a nominal maximum speed of 80 mile/h (128 km/h). They are connected in permanent parallel and there are two stages of field weakening. The force ventilating of these motors is rather unusual for multiple unit trains.

The first batch of diesel-electric multiple-units purchased by NIR from English Electric in 1966 were originally going to be fitted with the identical equipment as had been fitted to BR Southern Region "Hampshire" stock. These had the EE507 self-ventilated traction-motors as was fitted to many of that region's electric multiple-units, but because NIR wished to use their vehicles to haul freight and it was decided to fit force ventilated motors. These were the same as those fitted to the 1,750 hp English Electric Class 37 main-line locomotives on BR (and the Deltics also) but the NIR ratings are lower and the ventilation has been reduced therefore (1,000 ft³/min per motor as compared with 2,500 ft³/min).



English Electric 4-cylinder mark 11 4SRKT charge-air cooled diesel and EE 824/6E generator group as installed in the NIR railcars

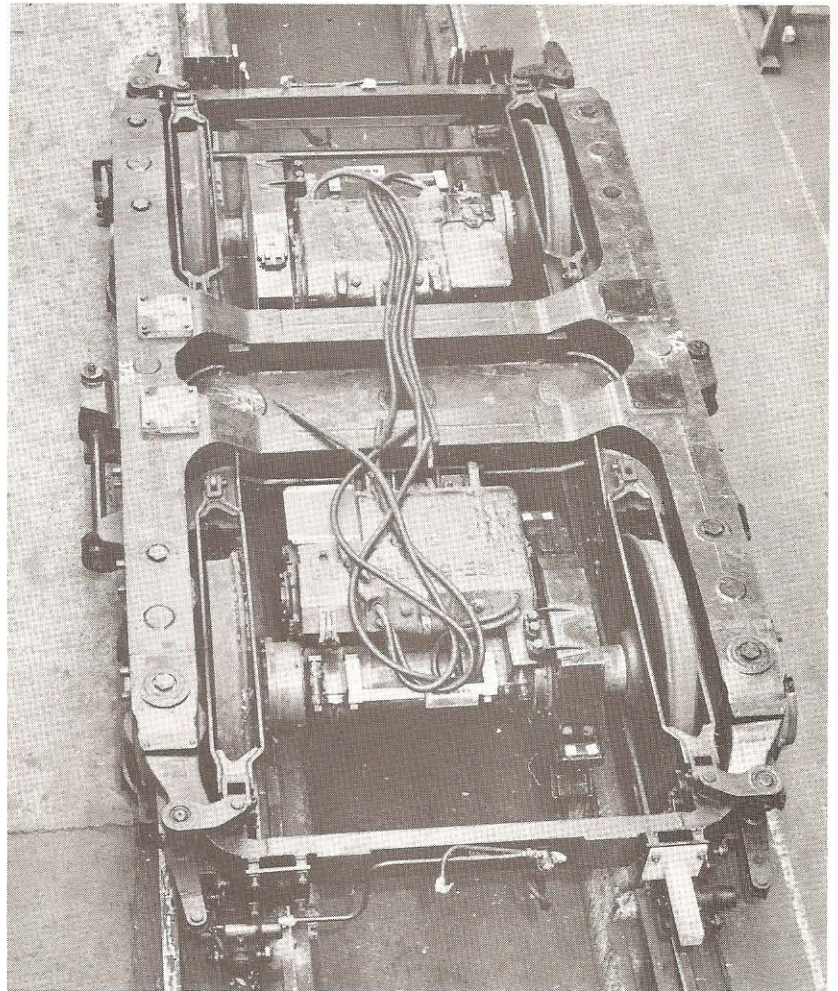
Driving equipment and braking

The deadman/vigilance equipment is the standard GEC "three-position" type with a time-based vigilance system. Normally the pedal is held in the mid position and it must be momentarily depressed every minute (although this period can be varied during manufacture) to prevent the equipment going into the emergency phase and applying the brakes. If the pedal is released, a normal "deadman" emergency-brake application is made after a few seconds. A foot-operated equipment is provided (as compared with most multiple-units where a hand-operated device is used) because the driving duty on these units is more similar to that of a locomotive.

The brake equipment comprises a self-lapping straight-air brake for normal service use together with an emergency brake which can be applied by the driver and which operates in the event of a breakaway, or a passenger operating an emergency switch or operation of the deadman device. An electro-pneumatic device is superimposed on the straight-air brake to provide simultaneous brake applications throughout the train.

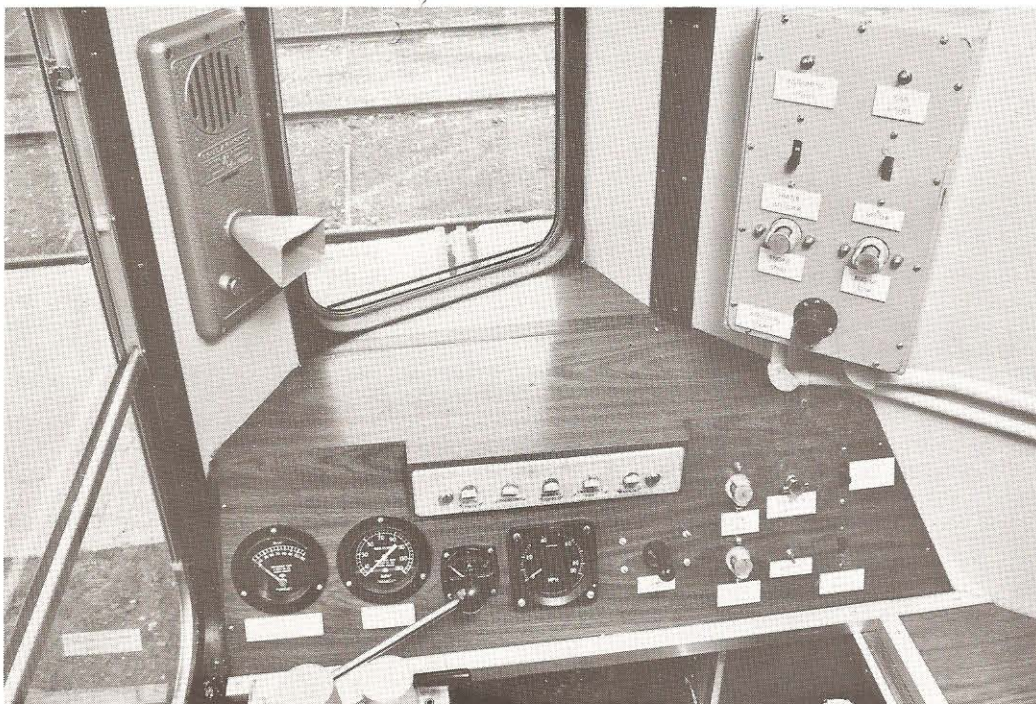
No provision is made for vacuum-brake running on these new vehicles as has previously been the practice. A hydraulic handbrake is fitted to the power car whilst driving trailers have a direct manual handbrake. A Westinghouse DH25 electrically-driven compressor supplies the air for the braking system. The compressor is controlled to deliver to the main reservoir at 90-100 lb/in² and a synchronising-wire between railcar set ensures simultaneous starting and stopping of all compressors. The two traction motor-blowers are each electrically driven and require approximately 1 hp to provide 1,000 ft³/min.

There is Loudaphone voice communication between guard's and driver's compartments but



Power-car bogie fitted with two EE538/4A nose-suspended traction motors. This is a BR Mark VI bogie, the trailers and driving trailers are mounted on Type B4 bogies.

there is no provision for Public Address in the passenger accommodation. Lighting and engine starting are obtained from separate batteries (normal practice on multiple units) but in the interests of standardisation both batteries are diesel starting types (40 cells type RSKA 92M/4).



Drivers cab, NIR diesel-electric multiple-unit

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