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Push-Pull Trains in Britain

An historical article about their development in Britain contributed by Chris Grace, edited by Piers Connor

Introduction

The term 'Push-Pull' is used to refer to trains comprising unpowered train sets with a propulsive unit (which may be a locomotive or multiple unit) at one end only. The unpowered units have multiple unit control equipment so that they can control the propulsive unit which pushes them in one direction of travel and pulls them in the other.

Most EMUs are, to some extent, push-pull, because often the motored vehicle is in the middle of the unit, not at the ends. Thus in any EMU train, some cars are being pulled and some pushed.

The advantage of this is that the engine or propulsive unit does not need to be removed from the train at termini because the train can be driven from each end. It is an intermediate step between normal locomotive-hauled operation and full multiple-unit operation and which can be used where full electrification of a route is not economic. It can also be used where hauled stock is not life expired and the provision of suitably equipped driving trailers allows it to be used instead of being replaced by new multiple units.

Development

Historically, push-pull also referred to a system used in the steam age where a locomotive was coupled to a special trailer which was fitted with a driver's cab. The cab contained a regulator lever, which was linked to the regulator on the locomotive by vacuum or compressed air lines (or by a mechanical linkage) and a standard brake valve, allowing the driver to control the train from the remote cab when the engine was at the rear of the train. At least, that is how it was supposed to work, although a number of recent works would indicate that the control linkage was rarely connected so the engine was controlled by whistle signals!

French railways had been using push-pull on medium speed services up to 75mph for some years but it had not been used at high speeds prior to experiments on modern high-speed push-pull performed on the Southern Region of British Railways in late 1964/early 1965. For these tests two electro-diesel locomotives of class 73 (73003/4) were used at the head of a train made up from 7 Tourist Open Seconds (TSO) and a Motor Luggage Van (MLV) with the motors isolated at the tail end. The SR had standardised on the English Electric standard 27-way MU control cable from 1951, which allowed diesel engines to be started and stopped from EMU control desks in addition to the normal multiple-unit traction control. Electro-diesel locomotives had electromagnetic control systems similar to SR EMUs, so once the engines were started the EMU master controller fitted to the MLV could control them. This initial rake was operated of speeds up to 100mph between Ashford and Tonbridge very successfully. A further train was made up from two different class 73s (73001/6) powering 3 x 4-car Express EMUs with the last car replaced with the demotored MLV. This train was much

heavier than the previous one was and the fact the electro-diesels only delivered 600hp each on diesel power meant that this train did not exceed 85mph. Both trains demonstrated the stability of propelled coaching stock at high speed, the axles of the MLV being specially instrumented to monitor any lateral forces. They also proved the concept of controlling the electro-diesels remotely.

The control systems of diesel locomotives were different, so further tests were required and another train was assembled in 1965 from redundant 6-PUL and 6-PAN trailer cars and two 4-COR Motor Brakes with the motors removed. The unit's end gangways were removed and panelled over. This train was classified as a 6TC trailer unit and numbered 601. A class 33 locomotive was modified so that the electrical signals from the EMU Master controllers in the 6-TC cabs could operate the pneumatic control system of the class 33 and this locomotive and the 6TC was put into service on the Oxted line in early 1966. This trial proved that the EMU's master controllers could also control a diesel locomotive. The set was transferred to the unadvertised Kensington Olympia - Clapham Junction service and powered by the class 33/2 locomotives which, by that time, had their control systems modified for push-pull. The 6-TC Unit was later destroyed in a collision.

In theory DEMUs could also be controlled in this way but the SR's DEMUs had a different control system from other stocks so that, although the engines could be started and stopped, they could not be controlled by EMU master controllers. Thus this interesting 'multi-modal' power concept was not continued to its logical conclusion, although all 1951 and later SR EMU stock was fitted with the control cables and cases have been recorded of other stock units operating in multiple with diesel locomotives and trailer units. In fact only one DEMU of class 203 was refurbished and modified so that it could then operate in multiple with EMUs, electro-diesel and diesel locomotives. By the time it became possible, attention had moved elsewhere but certainly part of the original testing was designed to see if such 'multi-modal' operation was practicable.

The push-pull aspects of the experiment were however, successful and culminated in the introduction of new push-pull rolling stock for the Bournemouth electrification. Although the South Western main line was only electrified to Bournemouth, many services continued to Weymouth over the non-electrified tracks. In order to avoid running locomotive-hauled services over the main line and because it was not possible to accommodate 12 coaches plus a locomotive in the platforms at Waterloo, it was decided to build 4-car EMUs capable of hauling a further 8 unpowered cars. The train would leave Waterloo with the 4-car unit (4-REP) propelling one 4-car and one 3-car trailer units (3/4-TC) and work to Bournemouth where the powered unit would be detached. The class 33 diesel-electric or class 73 electro-diesel locomotive would be coupled to the leading trailer unit, which it would haul to Weymouth. The procedure was reversed on the return journey. Traffic increases resulted in the 3-TC units being strengthened to 4-car units in 1974.

The TC units started to come into service from 15 August 1966, powered by the converted class 33 or by class 73 or 74 electro-diesels. The 4-REP units started to replace locomotives from 3 April 1967 and the full electric service between Waterloo and Bournemouth started on 10 July 1967, after a month's delay.

Push-pull was later introduced for the Edinburgh to Glasgow shuttle service, using the coach lighting control wires to connect the driver's controls at the end coach to the locomotive. Another, example was the Gatwick Express running between London Victoria and Gatwick Airport. Nowadays, trains are purpose-built for push-pull operation and it is a standard system for main line railways in the UK and on many European railways.

