THE METROPOLITAN RAILWAY ELECTRIC TRAIN

by Piers Connor

with Charles Horsey

17. MORE DREADNOUGHTS

MORE DREADNOUGHTS

In 1919, with post-war traffic expanding, a plan for rolling stock improvements was prepared. Amongst other things, it led to an order in January 1920 to the Metropolitan Carriage, Wagon & Finance Co. for more Dreadnought trains. The order comprised 7 x 6-coach trains, each made up of two 3rd brake coaches, two 3rd coaches and two 1st coaches in the formation –

3rdB – 3rdT – 1stT – 1stT – 3rdT – 3rdB.

The entry into service of these trains, between April and November 1920, released the remaining five bogie stock trains being used on the loco-hauled Extension line services so that they could be modified to enable them to work in electric trains (see Article 9 in this series) and, at the same time, provided an uplift in the quality of stock used on the longer distance trains.

Another order was initiated in 1923 with the new line to Watford in mind. It was for another 3 x 5-coach trains in the formation 3rdB – 3rdT – 1stT – 1st/3rdT – 3rdB. The introduction of a composite coach in place of a 1st class coach suggests that the inclusion of two 1st class coaches in a 5-coach set was considered too much and that more 3rd class accommodation was needed. Also, it seems to have been quickly realised that the total provision of 17 trains was well in excess of what was required in the timetable. The most ever required was 11 trains, and soon, some of the new coaches were used to increase the existing 5-coach sets to six coaches. Table 1 above shows the ordering and original formations of the trains.

Table 1: A list of the Metropolitan Railway's 'Dreadnought' stock showing the original ordering sequence. It indicates the coaches converted for use in Metropolitan Vickers electric trains from 1927 onwards. Compiled from Metropolitan Railway Stock Book ca.1930.

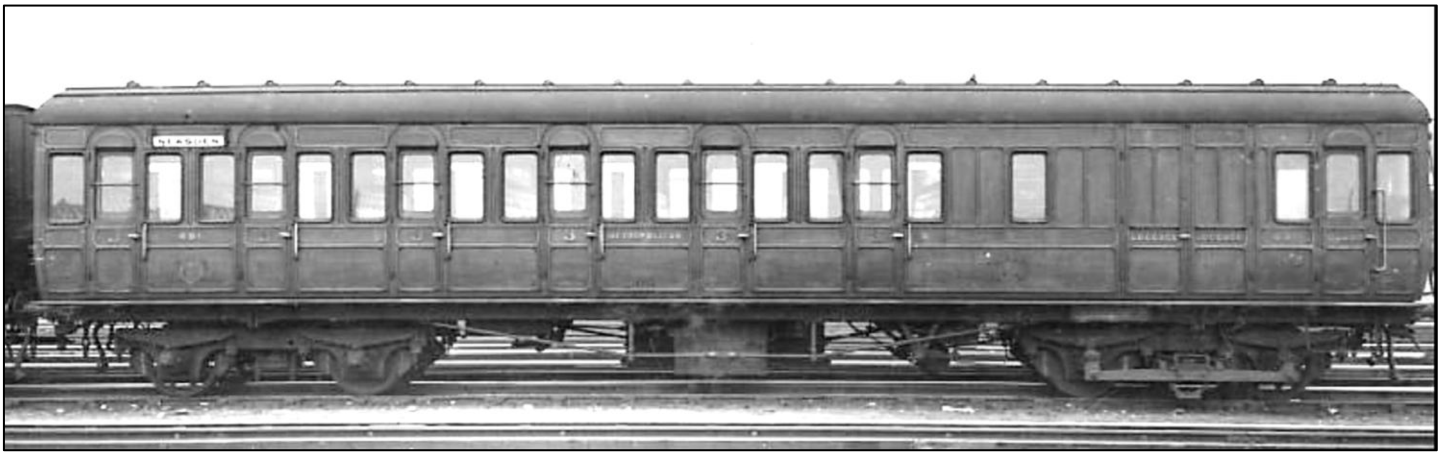
Date	Type	Number	Sub total	Vehicle Nos.	Comp'ts.	Seats	Purpose	Notes
1910	3rd Brake	4		425-428	7	62	2 x 5-coach trains	
	3rd Coach	2		423-424	9	78		
	1st Coach	4	10	419-422	7	56		
1912	3rd Brake	8		441-448	7	62	4 x 5-coach trains	
	3rd Coach	4		437-440	9	78		
	1st Coach	8	20	429-436	7	56		
1920	3rd Brake	14		477-490	7	70	7 x 6-coach trains.	Nos. 477-482 later converted to DTs for MV trains
	3rd Coach	14		463-476	9	90		No. 476 later used in MV train
	1st Coach	14	42	449-462	7	56		Nos. 460-462 later used in MV trains
1923	3rd Brake	6		491-496	6	60	3 x 6 coach trains plus 2 spare 3rd coaches	
	3rd Coach	8		497-504	9	90		Nos. 500 & 501 used later in MV trains
	1st Coach	3		505-507	7	56		Later used in MV trains
	1st/3rd Coach	3	20	508-510	7	64		
Totals		**92**	**92**				**17 trains**	

It is possible that the building of so many Dreadnought coaches was a result of the influence of Dudley Docker, the chairman of Met Carriage, whom we met in an earlier article, and who was also a member of the Metropolitan Railway board of directors. He offered cheap finance as part of any new carriage manufacturing deal, and he had soon manoeuvred the Metropolitan into a long term relationship that, today, would probably be considered anti-competitive.

EQUIPMENT

The new Dreadnought coaches all had the standard 7'-0" wheelbase, Fox designed, pressed-steel bogies, set at 35'-0" centres, as on the original Saloon Stock. They had the usual 3'-0" diameter wheels and were provided with two 18" diameter vacuum brake cylinders. The provision of two vacuum brake cylinders on a single coach demonstrates the difference between the efficiency of the vacuum brake and the Westinghouse brake. The Westinghouse brake used a single 12 inch brake cylinder that provided a brake force of 78.5% of the weight of a similar design of coach, whereas the vacuum brake needed two larger cylinders to provide a brake force of 81% of the coach weight.

Figure 1: A 3rd class brake coach of the 1923 order showing the shoebeam fitted to the outer end bogie as part of the scheme to provide improved contact with the current rails for locomotive-hauled trains. The shoes were



connected to a train line that ran the length of the train and which was connected to the locomotive by a twin (positive and negative) jumper cable. The photo also shows the larger luggage compartment adopted on the 1923-built brake coaches. They had six passenger compartments, a luggage compartment and, at the end, the guard's compartment. Photo: LT Museum.

One of the new features of these trains was the provision of a passenger alarm system. It had been tried experimentally in 1902 on one of the Bogie Stock sets. The idea for a system that allowed passengers to alert the crew to an emergency was first mandated in the Regulation of Railways Act 1868. It was only required on trains that worked a service of more than 20 miles without stopping. Trains were *'to be provided with a means of communication between the passengers and the servants of the company in charge of the train'*. It consisted of a cord running down the length of the train along the roof, connected to a bell on the locomotive.

Over 20 years later, in a further Regulation of Railways Act of 1889, the system was required to operate the brakes. The cord was now a chain inside a tube that could be accessed from inside each compartment; however, the old term 'communication cord' survived for the next century. When pulled, it operated a valve on the end of the coach that opened the brake pipe to cause an uncontrolled brake application. The valve had to be closed manually before the train could be restarted. The Underground's electric trains didn't have a chain but had valves positioned inside cars at suitable locations along the train. Despite almost a century of misuse, both deliberate and accidental, and incidents of trains being stopped in remote locations where help wasn't available but was actually needed, it took until the mid-1980s for the system to be modified so that trains didn't have to be stopped if they were outside station limits.

OPERATION

In 1913, the work on rebuilding the station at Baker Street to provide a full double track junction with the Circle line was completed. This allowed a better peak-hour service of through trains from the Extension line to the City. When the Dreadnought sets began working through to the City, hauled by the electric locomotives, it became very obvious that problems with their acceleration were affecting service performance. The electric locomotives had to negotiate a number of switches and crossings at many of the stations along the route to and from Aldgate and these created gaps in the current rail. The short span of the collector shoes on the locos meant they often lost power at these locations. Also, it didn't help that drivers were taught to shut off power at gaps to avoid the risk of causing arcing and possibly opening the main circuit breakers. All this would have made getting away from stations a slow and uncomfortable process, quite apart from causing a strain on the couplings. It was also causing delays to other trains waiting to get into the stations or use the junctions.

In 1915, in an experiment to see if it would overcome the problems, one train was fitted with shoebeams and shoes on the outer end bogies of the brake coaches. These were connected to the locomotive by power train lines and jumpers fitted along the train, so that if the shoes on the locomotive lost contact at current rail gaps, the shoes at the rear would feed the locomotive from the rear. While this one train seems to have worked, it was a while before any more were done. Then, at the end of 1916, the War Office complained that the arcing made at gaps by passing trains infringed the newly imposed blackout regulations[1]. All the sets were then equipped with a similar arrangement of additional shoe-beams, collector shoes, train lines and jumpers. Jumper receptacles must have been fitted to the electric locomotives too[2].

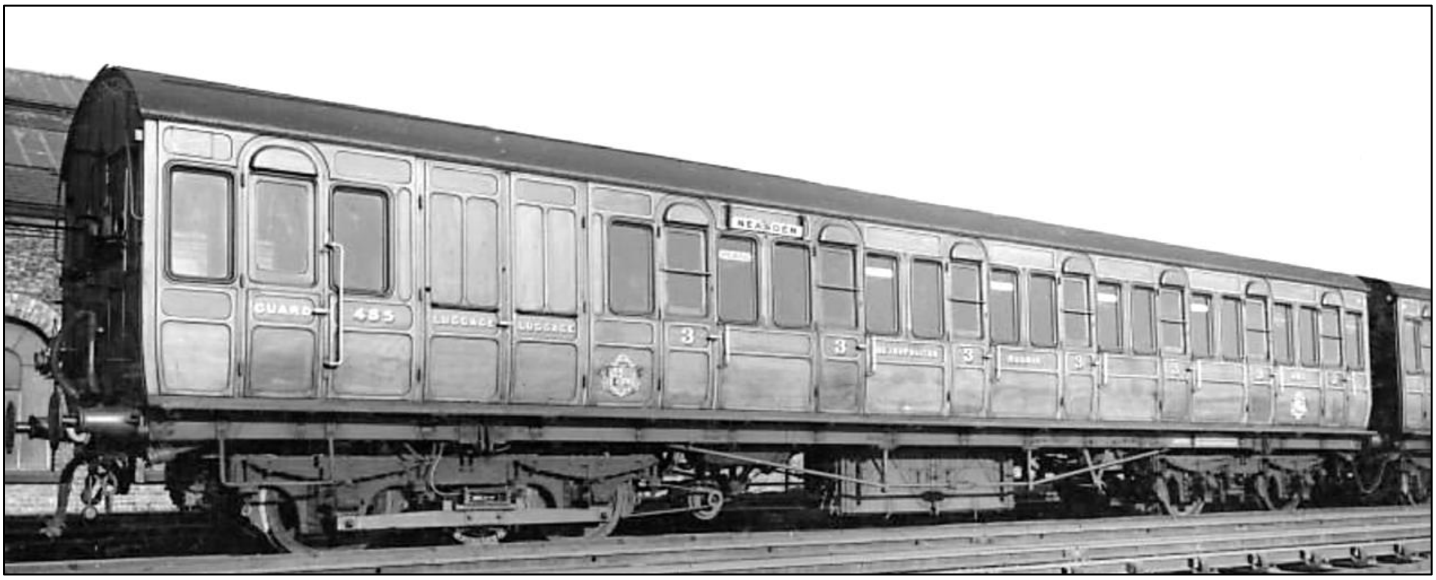


Figure 2: Metropolitan Railway 1920 Dreadnought Stock 3rd Class Brake coach No.485 in the yard at Neasden Depot. This version has a smaller luggage compartment allowing an extra passenger compartment. The shoegear fitted to overcome the problems with current rail gaps can be seen on the bogie at the brake end of the coach. Next along the underframe is the battery charging dynamo and then a battery box and finally a vacuum brake cylinder. Photo: LT Museum.

Another problem was with train heating. Trains working north of Harrow were provided with steam heating piping, the steam being supplied from the locomotive through a valve operated by the driver. When trains were being uncoupled, shunters had to be careful to ensure that the isolating cocks provided on the heating hoses at the ends of coaches were closed before disconnecting them. Failure to do this could result in an unpleasant and possibly life threatening scalding.

Guards were provided with a temperature gauge in the brake van. They were told to allow the heat in the van to reach 45 degrees (Fahrenheit) at which temperature the passenger compartments would be at 55 degrees, '*which is the most agreeable heat for passengers'* (allegedly)[3]. They had to tell the driver when to turn the heating on or off to keep the temperature at the required level.

These trains, when working south of Harrow and hauled by an electric locomotive, had no heating. By the time a train had worked to Baker Street or the City and got back to Harrow, it must have been quite cold in the winter. Eventually, in 1921, on each coach, a set of 100 volt, 350 watt electric heaters was installed, on the basis of twelve per coach in two circuits of six in series. These were supplied from the power train lines provided to overcome the problems at gaps. Despite the trains now getting some heat south of Harrow, this clearly wasn't enough and, in 1926, in line with the extension of electric working to Rickmansworth and Watford, more heaters were added to give three per compartment.

DREADNOUGHT CONVERSIONS

Although the 1923 Stock was ordered as 5-coach sets, the post war increases in traffic soon resulted in a need for more capacity and some of these trains were split up and used to add to the existing trains to make them up to six coaches where necessary.

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1 The complaints about flashing at current rail gaps suggests that the rule about shutting off power over them was not regularly followed, doubtless because the crews were trying to get away as quickly as possible. Interestingly, the rule about shutting off over gaps lasted a long time after no-volt relays on all trains made it unnecessary. I was, during my driver training in the mid-1960s, still taught to 'shut off over gaps'.

2 Benest, in his article mentioning this, is vague on what was done. He refers to 'some, if not all' the locomotives were fitted without any further details. Certainly, drawings of the rewiring that Locos No.1-10 underwent in 1910 show train line jumper boxes were intended to be added back then.

3 Metropolitan Railway, Appendix to the Working Timetable, August 1921, p.86.

By this time, the extension to Watford was under construction and the line from Harrow to Rickmansworth and Watford was being electrified. Electric operation on the line to Rickmansworth began on 5 January 1925, followed by the extension to Watford on 2 November. With the opening to Rickmansworth, the changeover from electric to steam haulage was moved there from Harrow.

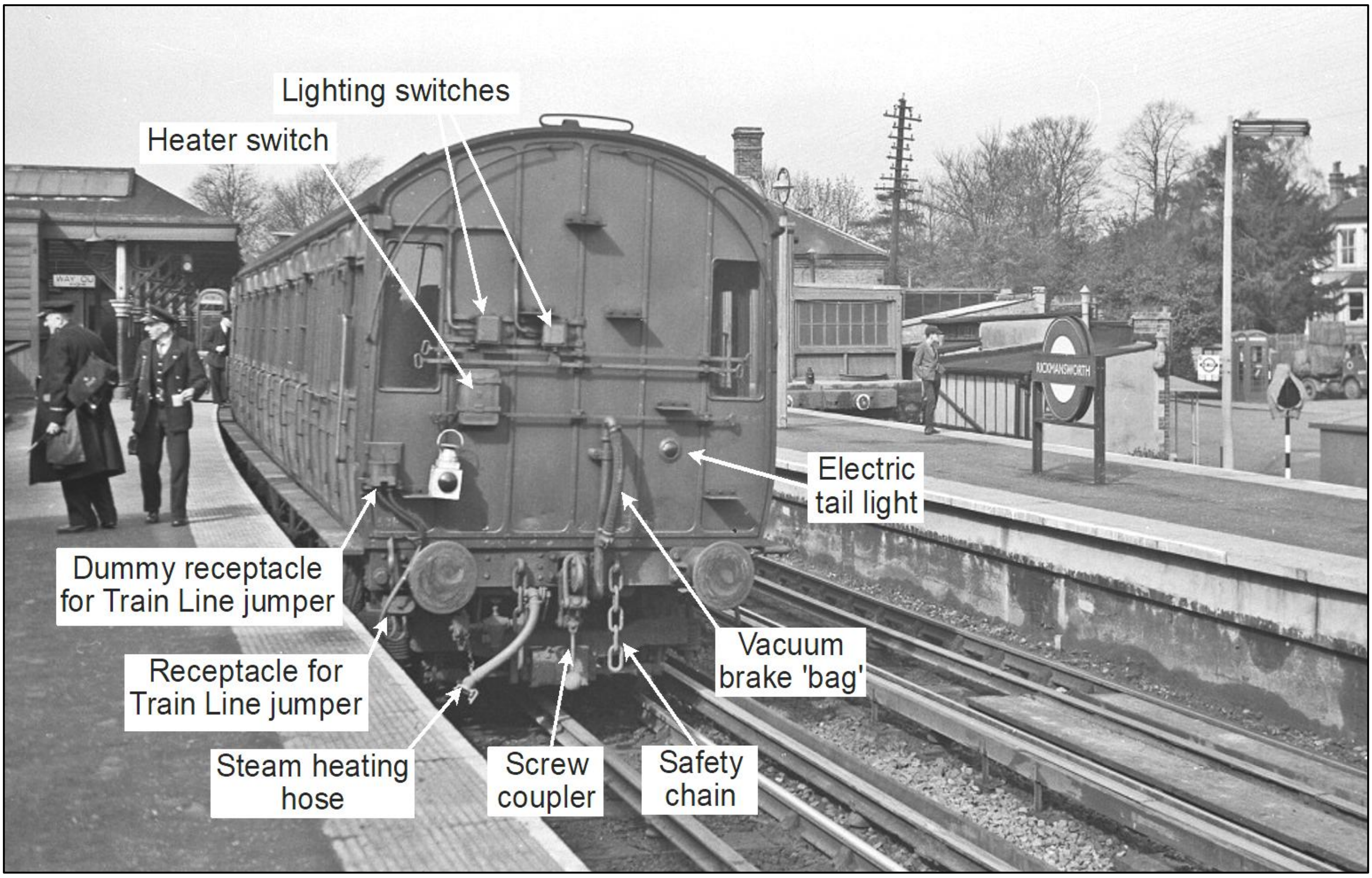


Figure 3: A Down train at Rickmansworth shortly before the abandonment of locomotive operation in 1961. The photo shows the brake end of a Dreadnought 3rd brake with the names of the various bits of equipment. The switches were operated by pull bars that could be operated from a platform on either side of the train. Note the boards between the rails on the Up road. These were to allow the crew who were uncoupling and coupling the locomotives during the swap to stand on an even base, avoiding the negative rail. The drivers of engines arriving here would be expected, as a matter of courtesy, to stop with the rear of their machine over these boards. Photo: P. Connor collection.

The excess provision of Dreadnought stock, combined with the need for more electric trains to work to Watford and Rickmansworth, led to the idea that, if they got some new electric motor coaches, they could be used with existing Dreadnought stock but the Dreadnoughts also could still be used in locomotive hauled trains when required.

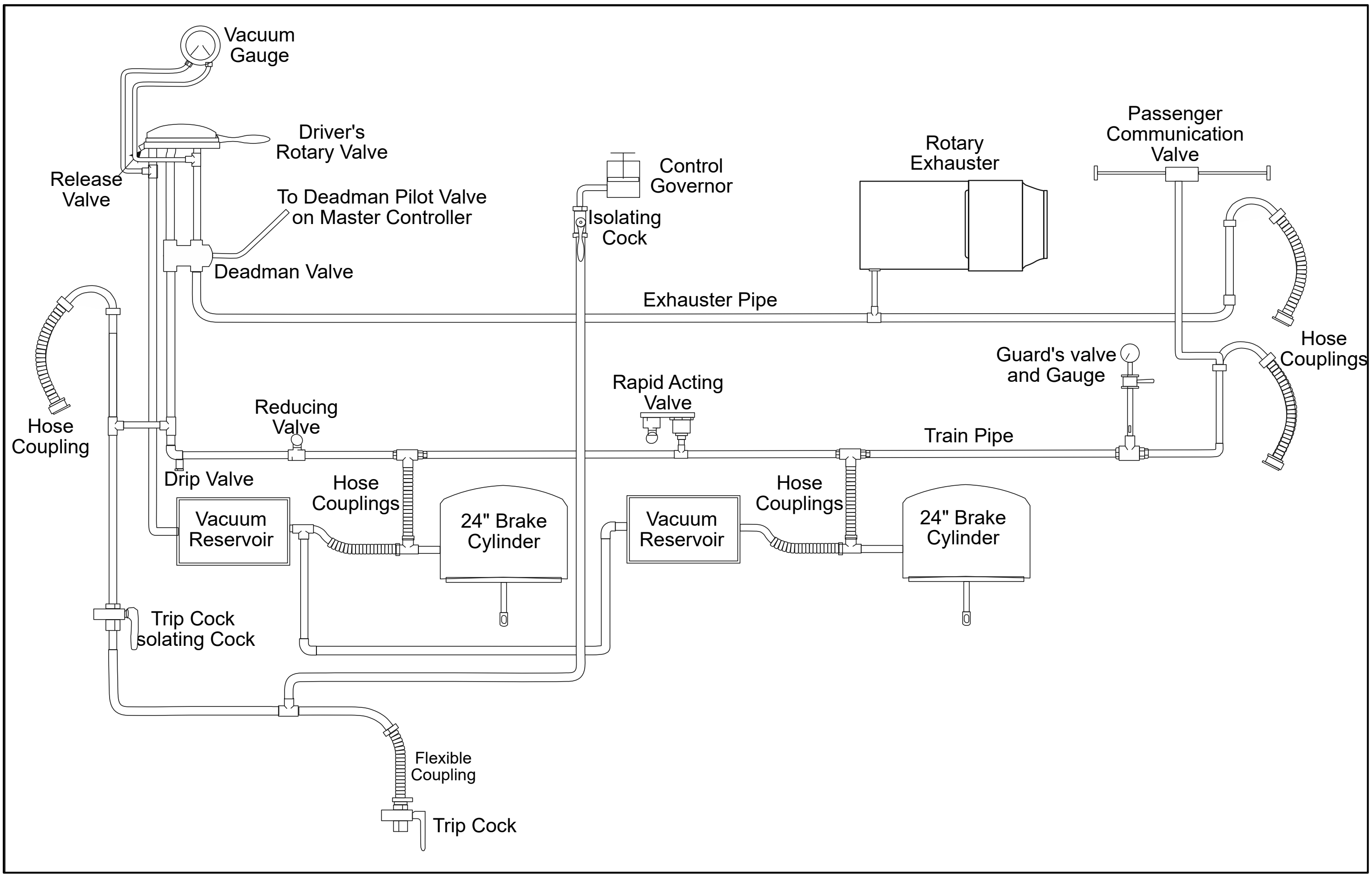
The idea resulted, as shown in Table 1 above, in a total of 15 coaches from the 1920 and 1923 batches being modified to work with six new motor coaches delivered in the summer of 1927 to form 3 x 7-coach trains. The modifications included the conversion of six 3rd class brake coaches into driving trailers. These allowed trains to be split into three and four-coach units during the slack hours. There were other conversions of the stock in later years, and the full story of the initial and subsequent conversions will be told in a future article.

Another modification that should be noted here is that, in 1930, with continuing pressure on passenger accommodation, it was decided to increase the seating by modifying the so-called ‘corridor’ coaches built in 1910-12, so that they had conventional separate compartments like the rest of the fleet. This increased the seating from 62 to 70 in a 3rd brake coach and from 78 to 90 in a 3rd class coach.

DREADNOUGHT BRAKES

The Dreadnought stock had vacuum brakes. The Metropolitan was a vacuum brake railway until Westinghouse brought in the air brake with its electric stock. The vacuum brake gets its name from the control medium used to operate the system. A vacuum is created in the brake pipe running along the train by an ejector (on a steam locomotive) or an exhauster (on an electric train). The level of vacuum achieved by this process is measured in inches of mercury (Hg) supported by the vacuum. In Britain, it was normally 21 inches Hg, except on the Great Western Railway, which used 25 in. This peculiarity meant that every train changing its motive power from a GW locomotive to any other had to have the brakes manually released on every vehicle before the new locomotive could couple up. It's called 'pulling the strings', since each coach has a release wire attached to a valve on the brake cylinder that allows the system to be equalised by removing the vacuum. This would have been a requirement for those Great Western trains changing locomotives at Bishops Road (Paddington) to complete their journey over the Metropolitan to the City.

Figure 4: A diagram of the version of the vacuum brake system used by the Metropolitan Railway on its three 1927 'MV' electric trains. The information available on this particular system is vague but a sketch exists of the system, even though it is of poor quality. This diagram is derived from it. This arrangement is

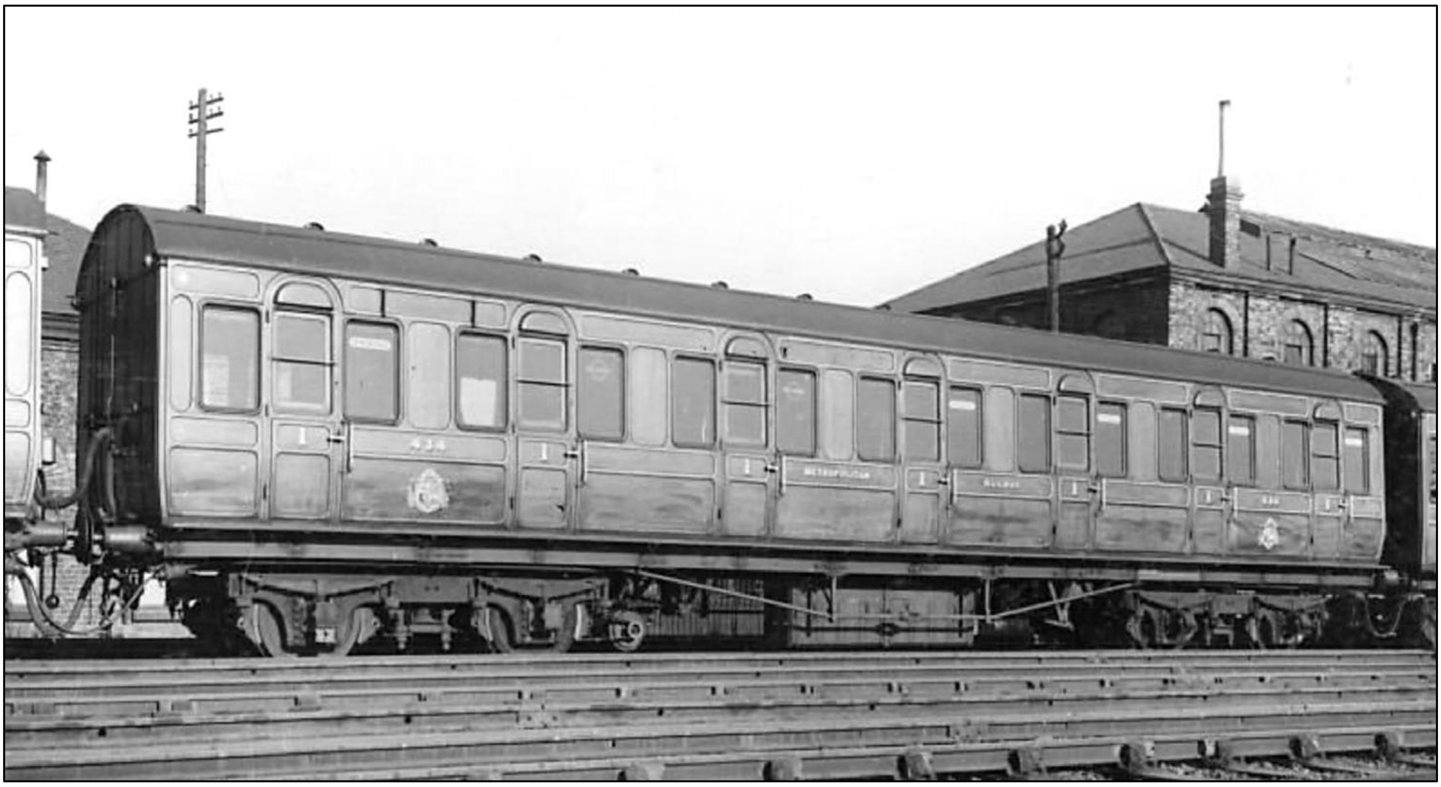


known as a two-pipe system, i.e., there is a train pipe that controls the brakes and an exhauster pipe that replenishes the system, the latter rather like the main reservoir pipe on a Westinghouse fitted train. It was needed to connect the exhauster to the driving trailer cabs. The exhauster pipe wasn't provided on steam stock trains. A motor coach had two 24-inch brake cylinders in order to provide the necessary brake force. Trailers had 21" cylinders. Each cylinder is linked to a vacuum reservoir, which is provided to assist in getting a rapid release for the brakes. There is also a 'Rapid Acting Valve', sometimes referred to as a 'quick acting valve' or an 'accelerator valve', connected to the train pipe. This was designed to react to a reduction in the vacuum level and allow air into the system to increase the brake application rate. The reducing valve in the train pipe seems to perform the function of ensuring the vacuum level doesn't exceed the nominal 21" Hg. This is more commonly known as the feed valve. The passenger emergency valve was located on one end wall of the coach, with a pipe connecting it to the rear of the 'swan neck' supporting the coupling hose. It was operated by a chain in a pipe running the length of the coach. A length of the chain was exposed in each compartment for use by passengers. The 'release valve' on the driver's brake valve is a device to let air into the system quickly to get a quick brake application. Note that the brake is equipped with a deadman valve, a tripcock and a control governor. Diagram redrawn by P. Connor from Metropolitan Railway Stock Book, 1930.

On the Met, each Dreadnought vehicle on the train had two brake cylinders (Figure 4). Each cylinder is vertically mounted inside a vacuum reservoir and comprises a piston that rises and falls to operate the brake. The piston is connected to the brake rigging and this transmits its movement to the brake blocks on each wheel. If the piston rises, the brakes apply, if it falls, the brakes release. When a vacuum is created, it is created on both sides of the piston, so the weight of the piston causes it to fall and release the brakes on each wheel. Brakes are applied by letting air from the atmosphere into the brake pipe. This destroys the vacuum and the air enters the underside of the piston, forcing it up and causing the brakes to apply. The flow of pressure is regulated by a ball valve attached to the vacuum cylinder.

Control is through the driver's brake valve. It's simple in operation, usually having two positions, 'off' (sometimes called 'running') and 'on', with a mid-point usually called 'lap', where the brake can be held to preserve a partial application or release. It's simple to operate and, as long as you remember that it doesn't stop the train as quickly as the air brake, you will find it reasonably easy to use. In my experience, it's easier to use than the air brake.

Figure 5: Metropolitan Railway 1st class coach No.434 of the 1912 batch of vehicles – not 1910 as noted in



LT Museum records. The photo was taken in Neasden yard in March 1934, after the Met. had been taken over by the London Passenger Transport Board. It retained its original number and livery. The large box slung under the coach contains the lighting batteries. The dynamo to recharge them can be seen next to the bogie at the near end. Photo: LT Museum.

Why, you might ask, is a description of the vacuum brake necessary in a story about electric rolling stock? The answer is simply because some of the Dreadnought stock became part of the Metropolitan's electric fleet and some of them retained the vacuum brake in their electric formation. We will see more about this in a future article.

ICE AND SNOW

One of the big drawbacks of the early track-based traction current collection systems like the Metropolitan's was their performance in cold weather. Any drop in rail temperature below the freezing threshold would lead to ice forming on the top of the current rails, particularly in the non-traffic hours when no trains were running. The forming of ice made contact between the rail and the current collector shoes on the train difficult and could, in the worst conditions, lead to trains becoming stalled.

Even worse was the effect of snow building up on the rails. This could either freeze or, if it was the softer variety, it could pack under the shoes and lift them off the rails. Two solutions to overcome these difficulties were introduced on the Metropolitan during the years following electrification.

The first solution for which information has survived was the provision of steel brushes on a special coach. The vehicle selected was one of the few remaining 'rigid' 8-wheeled coaches, No. 213. In 1909 it was fitted with shoebeams and brushes. To provide ice clearing duties, it had to be towed by a steam locomotive. It was referred to as a 'Slipper Train'. The description arose from the original name for a collector shoe – a 'slipper'. Either then or later, more 'rigid' 8-wheeled coaches were equipped with ice clearing brushes.

The brush equipment became quite sophisticated after years of gradual development. Switches were provided to set up detection circuits that showed when each brush made contact with the rail. The brushes were lowered onto the rails by means of "operating wheels" provided inside the coach[4]. Presumably, the power required to operate the electrical systems was supplied from the coach lighting battery [5].

Additional 'ice and snow clearing' coaches were made available for the Hammersmith & City Line between Paddington and Hammersmith. These were coaches Nos.200 and 210. Instructions issued in the Appendix to the Working Timetable, 1 August 1921 (p.54), required the signalman at Hammersmith to watch the weather and, if he thought it necessary, to call for a Great Western locomotive to be sent from Old Oak Common to Hammersmith to work the two frost and snow clearing vehicles kept there. Another coach (No.268) was allocated to the East London Railway. In 1925, coach No.300 was authorised for conversion to a slipper coach to work on the soon to be opened Watford branch[6].

The systems were not entirely successful. After a particularly cold weekend in January 1917, when the Monday morning train service was decimated due to ice on the rails, it was reported that the steam-hauled slipper coaches 'altogether failed'[7]. Steam hauled shuttles had to be introduced north of Neasden. As a result, some further ideas were tried.

Dated 7 December 1917, a drawing shows a 'brush for cleaning conductor rails'. How it was fitted isn't clear but it was substantial, being shown as 1ft 6ins in length. This is likely to have been provided on the ice clearing vehicles. It was really too large to fit comfortably on a motor car bogie shoebeam[8]. The idea of fitting sleet brushes to electric stock first appeared in November 1918, when a motor car had ice scrapers fitted as a trial. At the Officers Conference that month, they talked about fitting some on a second motor car. They also talked about the use of graphite on the conductor rails, with further experiments possible. Graphite was probably suggested because of its good electrical conductivity and its use as a lubricant. There is no further evidence of it being used to help overcome the ice problem.

In October 1919, two motor cars were recorded as being fitted with sleet brushes. There was also a proposal in 1925 to fit all the rebuilt electric locomotives with sleet brushed but the idea was abandoned because there wasn't room on the shoebeams for all the necessary kit. Instead, a set of 10 motor cars were equipped with sleet brushes. It is possible that it was intended to fit brushes to the experimental 1925 motor cars but it's not clear whether it ever happened. However, they were fitted on some of the 1929 MW Stock. These were later extended to include the 1931 Stock.

Another mitigation for the ice problem was to provide hand operated ice scrapers in driving cabs. When needed, the front guard would have to get down on the track and scrape the ice off as necessary to get the train moving. Anyone who has had to do that will tell you that it is hard work and you have to be careful that you don't dislocate your shoulder when the scraper hits a rail joint. Ice was to remain a problem for the Underground forever onwards although, in recent times, the drift of the climate towards warmer winters, the lack of proper vegetation control and modern braking systems have introduced serious adhesion problems in place of serious ice and snow issues. On the Metropolitan, having all the shoes on the train connected by the power train line was a bonus in that it reduced the risk of going 'off-juice' completely under freezing conditions.

To be continued …

4 Metropolitan Railway, Appendix to the Working Timetable, 1August 1921, p.53.

5 The District Railway was much better prepared in this respect as they had "brushes for cleaning the contract rails" on "some of the motor cars". See 'Instructions Supplementary to those contained in The Instruction Book And Rules For Electric Trainmen', June 1906.

6 Jackson, A.A. (1982), *'Metropolitan Steam Stock in 1925-1928',* Underground News No.239, November 1981.

7 Metropolitan Railway Board paper No.8288, 25 January 1917.

8 Metropolitan Railway Drawing No.E7823, 7 December 1917.