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THE TIMETABLE

17.30 Saturday 7th October in the Lecture Hall of the Science Museum, London, SW7, by kind invitation of the Railway and Canal Historical Society our members may attend an Illustrated Lecture by Dr John R.Kellett on "The Impact of Railways on Victorian London". Free admission, but due to limited accommodation by ticket only, obtainable from W.A.Roose, 4a Alandale Drive, Pinner, Middlesex, HA5 3UT. Enclose 1st Class sae.

19.00 for 19.15 Friday 13th October at Hammersmith Town Hall. The President's Address for 1972 will be given by J.S.Brook Smith, who has chosen for his subject "The Concept of Protofour". This is the first time in the history of the Society that the President's Address has been devoted to a modelling subject, and will provide an interesting new aspect of our interests to be covered by the annual addresses.

14.00 Wednesday 18th October Visit to the LT Building and Maintenance Depot, Parsons Green. Names, accompanied by a 1st Class stamped addressed envelope, to S.E.Jones, 113 Wandle Road, Morden, Surrey.

19.00 for 19.15 Friday 10th November at Hammersmith Town Hall. An Illustrated Talk by John R.Day, Senior Executive Assistant to the Press Officer, LT, entitled "London Transport and the Press: A Two-Way Relationship". Mr Day was LT's official representative to the Society Inaugural Meeting eleven years ago; he has been a good friend to us ever since, but has never before addressed the Society. Here is an opportunity to meet someone to whom the Society owes a great deal and to learn about yet another aspect of LT's work at the same time.

Saturday and Sunday 11/12 November Stand at the annual Norbury Exhibition. Details next month.

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## MATTERS TECHNICAL

No 3

H.C.Lynes

This month I am dealing with the auxiliary electrical supply of Underground stock. Auxiliary supplies are those required for the heaters, and compressors, and motor-generator motor (at the line voltage of 600); for the control equipment, doors and electro-pneumatic brakes (nowadays at 50V), and for the lighting (at 50V d.c., or 110V a.c. for fluorescent lighting).

Originally, and for many years on the Underground, surface stock had a 600V 'busline' cable along the whole length of the train, so that power was available as long as at least one positive and one negative shoe on the train was in contact with the current rails. Auxiliary supplies were taken from this busline via fuses, so that a fault on these supplies would readily blow the fuses, and therefore the auxiliary equipment and wiring was properly protected. However, the busline also carried the very heavy currents required for the motor circuits, and to protect these circuits high capacity fuses had to be fitted. A fault on the power circuit would not necessarily blow these fuses, so there was a slight risk of fire in the event of a serious fault.

This risk of fire was considered (by the Board of Trade) to be unacceptable in a deep level tube tunnel, so, from the beginning, tube stock was not allowed to carry power buslines. The shoes on a tube motor car therefore supplied current to its motors only, and auxiliary supplies to other cars. The auxiliary circuits and cables were supplied through suitable fuses, so that any dangerous overloads would blow them. From this tube practice then, has evolved today's system, which applies to modern equipments on all lines, whereby a driving motor car usually supplies the auxiliary circuits on itself and the adjacent car. The rest of this article shows how this is applied, with its minor variations, on today's types of stock.

The first diagram (Fig 1) shows the layout of auxiliary circuits as applied to 1956/59 tube stock. The 600V d.c. supply is collected from the line by the shoes of the

motor car, and passes (via fuses not shown) to the motor generator (MG), heaters and traction equipment on the motor car. It also passes, via a jumper cable, to the heaters and compressor motor on the adjacent trailer car. The motor of the MG drives two generators, one supplies 110V a.c. for the main car lighting (which is fluorescent and arranged to operate on alternating current) on both motor and trailer car; the other generator supplying 50V d.c. for the emergency lights and all driver's and guard's control circuits. A switch is provided in the cab so that the driver's control circuits can be isolated from the supply when that cab is not in use, and a similar switch is provided to isolate the guard's panels. Normally, the MG on the leading motor car of a train will supply the driver's circuits, while the MG on the rear motor car will supply the guard's circuits.

Fig 1 also shows the battery, which will supply the same 50V circuits as the MG should it stop running, if for example, the current has been switched off from the line, or if the train passes over a gap in the current rails. A 'battery contactor' is provided to connect the MG, when running, to the battery to keep it fully charged; or to connect the battery to the auxiliary circuits if the MG stops running.

Although the diagram refers specifically to the 1956/59 tube stock, the principle is the same on all stocks built since 1938. In that year the 1938 tube stock and the CO/CP stocks entered service, and their MG arrangements are similar, but without the 110V a.c. generator, as the car lighting is supplied by the 50V d.c. generator. The R Stock arrangement is almost identical to the diagram, and its introduction in 1949 saw the first application of fluorescent lighting on a large scale on the Underground. With the introduction of the 1960 tube stock the MG was replaced by a motor-alternator-rectifier set, in which there is only one generator which supplies alternating current to a transformer, which in turn supplies 110V a.c. for lighting, and about 50V d.c. to a rectifier, which produces 50V d.c. for the control circuits.

Turning to Fig 2, in which I have shown all types of stock currently in service (the 1960 stock is now largely confined

to test train working), the allocation of equipment on each car can be seen. The arrows from the MG's point to the trailer(s) whose lighting is supplied by the MG concerned. Some MG's supply one car and some the normal two, while the motor-alternator-rectifiers (MA) on the 1967/72 stocks are located on the trailer cars as there is insufficient room under the motor cars. In this case the 600V d.c. supply comes from the motor car via jumpers, and the MA feeds the auxiliary circuits on the motor car via more jumpers. The batteries, however, remain on the motor cars. Fig 2 also shows the type of coupler in use (about which more in a future article); and the positioning of the compressors, and from where they obtain their 600V supply, indicated by the broken arrows.

The first stock dealt with in Fig 2 is the R Stock, and it is shown as now formed in 5-, 3- or 2-car units. This new formation is a result of the introduction of 7-car trains on the District line, and it is unusual in that the 232xx car was removed from the old 4-car unit (leaving a 3-car unit as shown), and was inserted in the middle of another 4-car unit to give 5 cars. The letter A was added to this car's number and the lighting circuits arranged so that half the lights are fed from different MG's. The 2-car formation remains unchanged, and a 7-car set will be made up of either 5 + 2 cars or 3 + 2 + 2 cars.

The CO/CP stock is also unusual as the MG supplies all the cars in the unit, and is located on the 'D' motor car, together with the compressor. This is a throwback to the days when the stock was fitted with the Metadyne control equipment and the large Metadyne machine was located under the 'A' motor car, leaving little room for anything else. Until recently the 'A' cars ran at the East end of the CO/CP stock on the District, which was the reverse of the normal position, but between April and June of this year (1972) the whole stock was turned the right way round. On both the CO/CP and the R stocks the compressors are fed by the shoes on their own car. It must also be remembered that the CO/Cp stock has a power busline running the length of the UNIT only.

The A60/62 and C69 stocks have the normal auxiliary equipment arrangements, but there are some variations on the

different tube stocks. The trailer cars of the 1956/59/62 tube stocks have 2 compressors, as opposed to the 1938 stock which only has one per trailer. Since 1969 however, some of the 3-car units of 1959 stock have lost one compressor, which was removed and used to replace older compressors on the 1938 stock. Note also that the NDM cars do not supply 600V to compressors, either on adjacent trailers (1959/62 stocks) or on the same car (1938 stock), even though they are equipped with shoes. In the case of the 1956/59/62 stocks this necessitates running a special cable the whole length of the NDM car so that the 'D' DM can supply one compressor on the trailer. No one has explained to me the reason for this curious arrangement.

I have already mentioned the arrangement on the 1967/72 stocks, whereby the MA is located on the trailer car, but note that the MA on the 3-car sets of 1972 stock supplies all cars on that unit. The 1960 tube stock has a similar layout to the 1960/62 stock.

Now to the last diagram, in which Fig 3a shows the actual circuit controlling the switching on and off of the MG. This circuit, with its 'set' (on) and its 'trip' (off) coils is representative of those on the train which use a low voltage control wire to operate a switch carrying a heavier current. Compressors and lighting, as well as MG's, are provided with 'contactors' of this type, while many other functions on the train are carried out by means of relays, which operate as shown in Figs 3b and 3c: on these the contacts are kept closed by continuous energising of the coils.

To return to older stocks for a moment, it will be remembered that on all stocks built prior to 1938, all auxiliary circuits were supplied at 600V d.c. There were however, some exceptions to this, notably the early Metropolitan stocks with control equipment by British Westinghouse, whose control circuits were fed by a 14V battery. From 1901 these cars were equipped with a pair of motor generators, one acting as a standby, which supplied only the control circuits. Other auxiliaries were still supplied at 600V. All other Underground stocks were provided with the British Thompson-Houston (BTH) control system,

which used 600V, and it wasn't until the introduction of electro-pneumatic brakes and air worked doors, in the late 1920's that low voltage supplies were generally needed. The 50V d.c. required was obtained from batteries provided for each driver's cab and guard's position, those not in use on the train being charged through a resistance by the 600V supply from the line. The charging circuit was set up, and the battery disconnected from the auxiliary circuits, whenever the driver or guard opened the switch isolating his position. Extra batteries were provided on tube stock for emergency lighting, a feature of the tube lines from 1913, but they were not fitted on the surface stocks.

Some interesting new developments in auxiliary equipment have recently been taking place, including low voltage supply by means of solid state equipment involving no moving parts. It is possible that this is the beginning of the end for the MG, and that future generations of stock will have solid state devices supplying their auxiliary circuits.

The assistance of Mr.B.J.Prigmore in compiling this, and future articles, is greatly appreciated by the author.

#### PIMLICO STATION OPENED

The Victoria Line as at present envisaged was finally completed with the opening of Pimlico station on Thursday 14th September 1972.

Pimlico was an afterthought twice over; situated on the Brixton Extension of the line, which was not authorised until long after the main part of the Victoria Line from Walthamstow to Victoria, there was at first no provision for a station in Pimlico. However, after much pressure from local residents and Westminster City Council, plans were submitted and approved for a station at the junction of Bessborough Street and Rampayne Street, right in the heart of Pimlico and a few hundred yards from the Tate Gallery.

By this time, however, the Brixton Extension was well advanced in building, and to have waited for the new station

Fig 3a

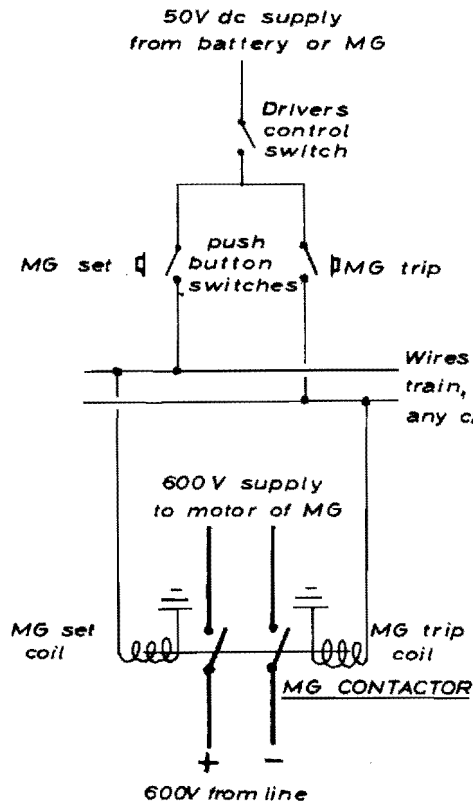


Fig 3b

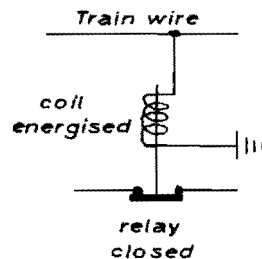
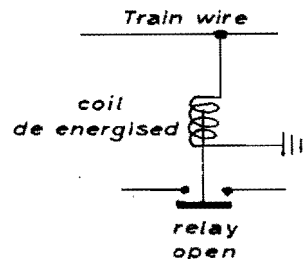


Fig 3c



Note on operation of MG contactor

With the drivers control switch closed, if the MG set button is pressed, 50V dc passes to all MG set coils on the train thus closing the MG contactors. A similar sequence opens the MG contactor if the MG trip button is pressed. The contactors are held open or closed by latches.

Fig 2 ALLOCATION OF EQUIPMENT ON LT PASSENGER ROLLING STOCK AUGUST 1972

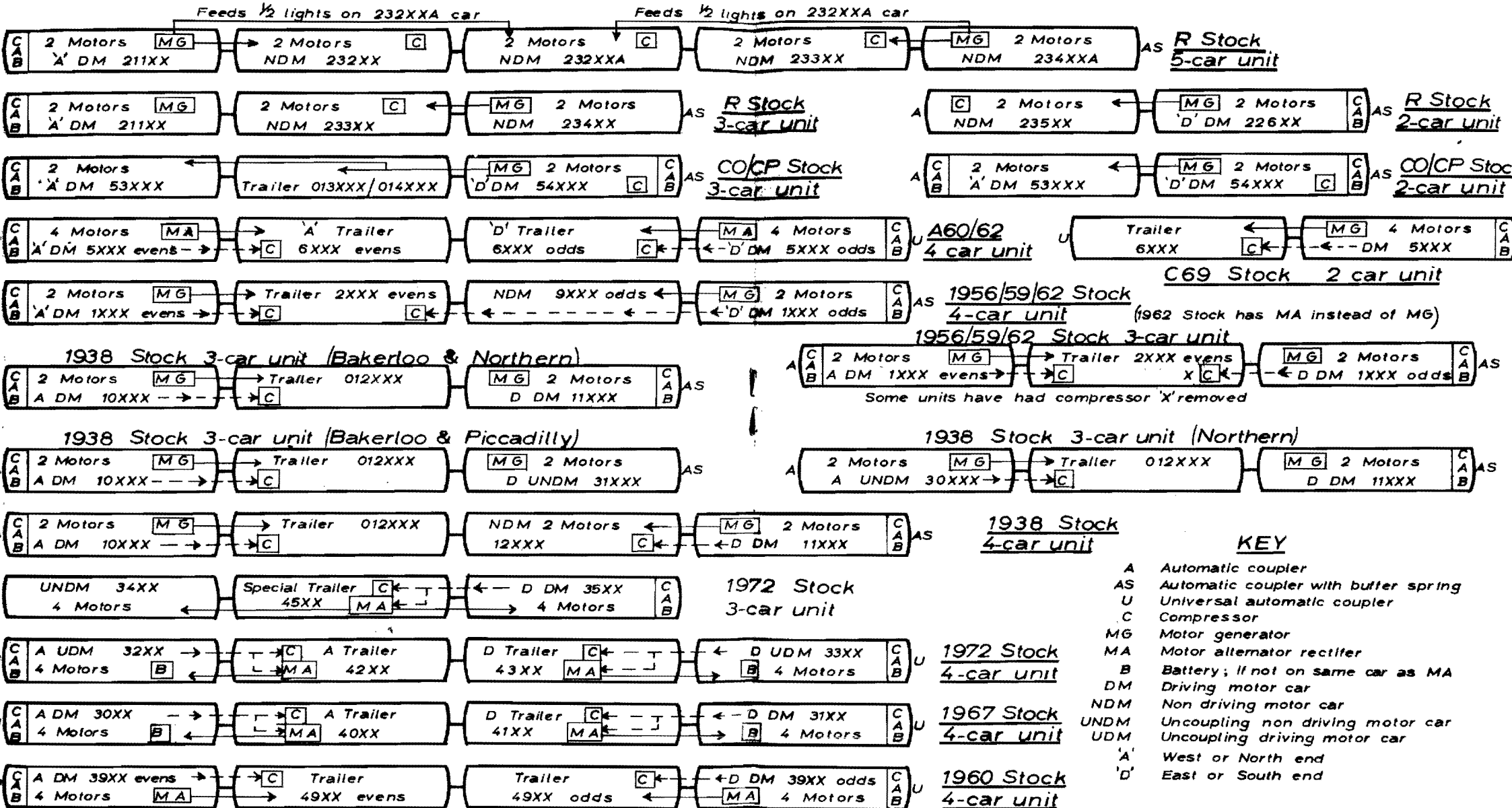
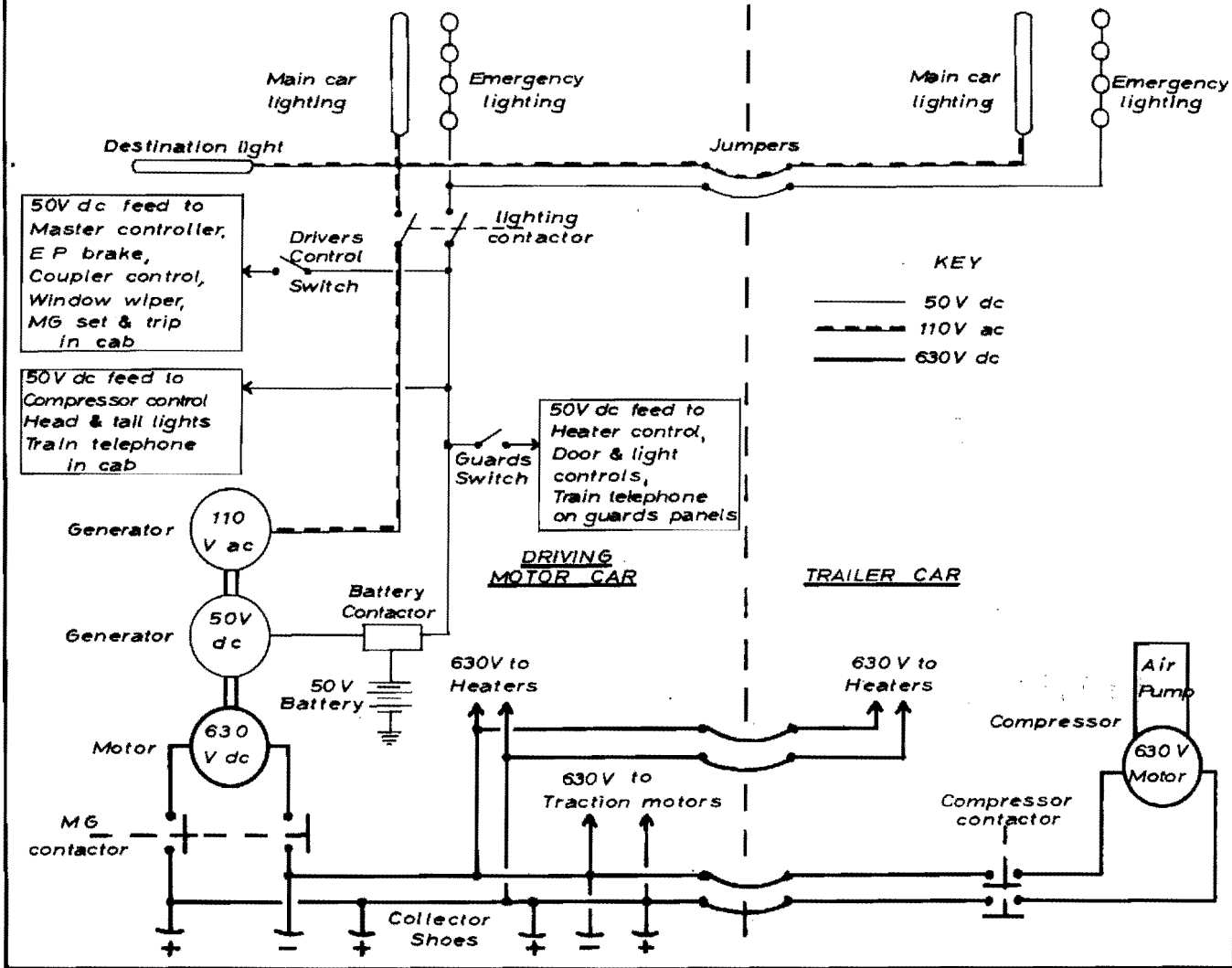




Fig1. Simplified Diagram of Auxiliary Circuits – 1959 Tube Stock



to catch up would have delayed the opening of the extension far too long. The contractors were therefore told to get the rail-level work finished as quickly as possible, so that trains could run through without endangering engineering workers, and then to continue with the escalator shafts and surface buildings.

And so it was that, when the extension opened, press representatives were allowed to look round the platforms at Pimlico, gaining access from a press train specially stopped there, when those platforms were quite inaccessible from the street - although there was a most impressive hole where the escalators now are!

Work now completed, the station was advertised as opening to the public at 15.00 on 14 September. A short opening ceremony took place in the morning, by the Lord Mayor of Westminster in the presence of other civic and IP dignitaries, and the gates were actually opened to let in the cash customers at approximately 14.52. A small group of enthusiasts and sightseers - including several TLURS members! - were eagerly awaiting the event, and rushed the booking hall, presumably with but one object in mind - to purchase the first ticket. Rather a futile effort, really, for with about a dozen ticket machines and a booking office all in good order and eager to take money, it is very doubtful if anyone will ever know exactly who did get the very first ticket.

Slightly early access to the station did not mean that departure therefrom by train was going to be any sooner, for the first trains to stop were already planned and set out in the traffic circular. As one official said, the only reason for allowing people in a bit before time was for them to have an opportunity to look round and still be in time to catch the first train. This was a nice thought, for it would not have been possible to do both if the gates had not opened until 15.00, - the first trains scheduled to stop being timed at 15.01 northbound and 15.04 southbound. Both duly did so, and carried away their satisfied clients.

The station is on very similar lines to the rest of the Victoria Line stations and those who have passed through the platforms will already be familiar with the tile motif used to symbolise the proximity of the Tate Gallery - the existence of

which is also acknowledged by the display of a replica sculpture in an alcove in the station. There is a ground-level direct entrance to the booking hall down a flight of steps, and also another from a subway incorporated in the design at the request of the Westminster Council - and it is believed at their expense as well - which provides pedestrian facilities for crossing Bessborough Street in addition to another entrance to the station

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- continued from page 160

used to carry sandwiches and a bottle of lemon squash, together with the London Transport system map, London buses map, an Underground Guide, and a Nicholson's London Street Finder. A rubber, sharpener and a spare pencil were also useful. A clipboard was used to hold the point to point schedule with estimated arrival and departure times. The actual times were noted and the running number and driver's car number were recorded. It was sometimes necessary to "leap-frog" along the train to get these numbers. Also a running list of stations to be stopped at was made out and the departure times from each one was recorded together with arrival times at termini and interchange stations. Two other points; a sweater was particularly welcome in the early morning and late evening, and there is a very convenient toilet on the platform at Upminster.

To round everything off, on Thursday a trip was taken on the two-hour Round London Sightseeing Tour to get full value from the Go-As-You-Please ticket.

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#### NEWS FLASHES

1172 At about 09.30 on Sunday 17-9-1972 a train, bearing the train number 115 was observed standing in the eastbound platform at Dagenham East (not in the reversing bay), bearing on its eastern end the somewhat confusing pronouncement "Circle Line - District". It appeared not to be in service, and an Upminster-bound train was held at signals behind it. Could someone have taken the wrong turning at Aldgate?

1173 The Heathrow Extension of the Piccadilly Line is to receive Government Grant of 25% of capital cost after all. The GLC has already agreed to pay 50%, now leaving IRT 25% only.

## GO-AS-YOU-PLEASE SOLO

A.B.Morgan

With the recent introduction of the Go-As-You-Please tickets, I dug out some schedules drawn up when investigating the Guinness Book of Records achievement of visiting all London Transport stations in fifteen hours. The plans were shelved on the discontinuation of the Underground rover tickets (Twin Rovers), having already concluded that it was impossible to beat the record solo, the assistance of friends in cars being essential. However, the new ticket, with its additional free travel on London Transport buses, made me decide to see how many stations served by Underground trains could be visited in one day travelling, using only Underground trains and London Transport buses. The train had to stop at each station and I was particularly determined to take in the extremes of the system, not covered by the ticket, beyond Northwood, Harrow and Wealdstone and Debden (duly paying the necessary excesses totalling £1-15) and attempt to catch the two "rush hour only" services. Unfortunately there was no exhibition service to Kensington Olympia during the week picked for the excursion. A brief account of my travels may be of interest to Journal readers.

On Sunday 16th July 1972 a Go-As-You-Please ticket for the next four days (price £2-90) was purchased and at 05.30 the following morning the first train from Uxbridge was awaited at West Harrow. This arrived if anything half a minute early, and was taken as far as Preston Road where the slow train to Chesham was picked up. This is a 4-car A stock unit which spends the rest of the day shuttling between Chesham and Chalfont and Latimer. Returning to Chalfont and Latimer, the train to Amersham was already approaching, and having giving the driver a quick wave, a dash was made via the subway to pick up the connection. At Amersham there was time to buy an early morning paper before returning via Moor Park to Watford. Here the first setback occurred because the 336 bus doesn't start running before eight o'clock. The only thing to do was to set off at a trot and try to connect with the last of the four Bakerloo trains from Watford Junction. Extensive road works in front of Watford Town Hall had to be negotiated, but nevertheless it was the 08.00 train which was caught by a

hairsbreadth when the guard hesitated in closing the doors on hearing my shout. On checking the time it was found that the train had left a bit early!

The next stage was to take in the north-eastern section of the Central Line, and after letting a couple of trains go at Oxford Circus, one came along to Hainault. The Hainault to Woodford section was completed in a modified 1960 Tube Stock 4-car unit, the forerunner of the 1967 Tube Stock for the Victoria Line. From Woodford the route lay via Epping to Ongar. This remote stretch of the Underground has a charm of its own and even station staff, some with noticeably white hair, seem to belong to an earlier generation. Even if the journey had been abandoned at this point, this section together with the Chesham branch had already made the day worthwhile. The time on arrival back at Epping was six minutes past eleven, which was on schedule.

Having returned via Woodford direct to Leytonstone, two buses were used to travel to Walthamstow Central. From here on the Victoria Line the route continued via Highbury and Islington on to the Highbury Branch, up to Drayton Park and back via Old Street and Angel and onto the Piccadilly to Cockfosters. By now the sun was high in the sky and the opportunity to pick up a 107 bus to High Barnet was gratefully taken after some distance had been traversed on foot. A quick connection at Finchley Central progressed the schedule out to Mill Hill East where some sandwiches were consumed before returning into Town on the same train. On travelling back to Edgware, the first or two routine ticket checks during the day was encountered approaching Golders Green. It was very gratifying that, throughout the journey, such a recently innovated ticket was readily accepted by ticket collectors, bus drivers and conductors. Also on this stretch of the line, a new, 1972 Tube Stock train was spotted going in the other direction with a running number of 451 - which may be a special trials number.

The route then went from Edgware by bus to Stanmore and back into Town on the Bakerloo. At Neasden the sad shell of Metropolitan electric locomotive No 1, John Lyon, was spotted less nameplates. The previous day it had been particularly pleasing to see the remaining two in fine shape on the Brake Van Tour. From Oxford Circus out on the Central Line to

Ealing Broadway, the funny sensation caused by coming up on the "wrong side" at White City due to the old Wood Lane loop was experienced. From Ealing Broadway on the District and then the Piccadilly the journey continued to Hounslow West although there was a setback at Northfields when a young boy just missed flattening me when he literally flew through the doors just as they closed.

After travelling to Richmond by bus and up to Earl's Court on the District, time was running out to catch the last train to Aldwych. Fortunately this was caught with six minutes to spare after what seemed like an excruciatingly long wait at Hyde Park Corner ( $2\frac{1}{2}$  minutes in fact). Then back on to the District where, while waiting for a train to Whitechapel, the train which had been used up from Richmond was spotted returning from Tower Hill. From Whitechapel, after taking in New Cross and New Cross Gate (and some more sandwiches), but not Shoreditch because it was too late due to an earlier mistake in scheduling, the long trek out to Upminster was taken on. During the return journey there was a trackside fire near Upney which it was hoped would not get in the cabling and the second routine ticket check, which was encountered approaching Bow Road.

On meeting up with the Circle Line an almost complete circuit was embarked on, but by now, as the time was getting late, the schedule had to be modified to exclude all the southern sections of the system not yet covered. This was the first opportunity which had arisen to try out the seating in the new C Stock since it was introduced, and this was found to be somewhat hard although the ride was very smooth. By the time the train reached High Street Kensington it was dark and the plan was now to get onto the Central Line from Charing Cross and head out to West Ruislip. The short distance on foot to Ickenham, which was completed with a fruitless sprint to try to catch a train to Uxbridge, almost saw the end of the day's travels. On examining the tail end of the schedule the second major error was realised. 11 p.m. does not occur twice in one day, and as the possibility of catching the last train from Baker Street to Harrow -on-the-Hill had now disappeared, two more sections had to be cut out, and the day's travels completed via Uxbridge back to West Harrow, arriving there just after a quarter to midnight.

On arriving home after calling at 234 different stations and a total of 313 during the day, a welcome pint of cold beer was consumed and the resolve made to take in the remaining 42 stations the following day. This total of 276 includes both Edgware Road and Shepherds Bush stations and passing through Pimlico. This second excursion took just over four and a half hours and included nearly half an hour wait at Whitechapel for the first afternoon rush hour train to Shoreditch. On this occasion the scheduling had been too conservative. From Rayners Lane the route lay on the Piccadilly to Hammersmith and thence on the Metropolitan to Whitechapel. An interesting point noted here was the woman with a baby in a pram who travelled to Shoreditch and back via Whitechapel to some station down the line to save having to negotiate the stairs at Whitechapel to the far platform which is used in the rush hours by southbound trains. Travelling back via the District, a Victoria Line train to Brixton was then picked up. Here a quick change of plan was decided on and the Stockwell interchange onto the Northern Line was used.

Three odd sections had to be taken in before heading out to Morden, so a train was taken to Strand and, after walking to Trafalgar Square, the section of the Bakerloo to Elephant and Castle was covered. From here Borough and London Bridge were visited and at the latter some confusion was caused because the southbound line is to the west of the northbound line. This is a quirk of the original building of the City and South London. It was here, at the height of the rush hour, that a sixteen minute walk for a southbound train occurred. The first train in, very crowded of course, to Kennington was taken and the interchange to a Morden train, equally crowded, was made there. Despite the crush it was still possible to notice the unusual layout of the lines and platforms at Clapham North and Clapham Common. They feature both lines and a central island platform in a single large diameter tunnel. Throughout this section there was a distinct danger of my clipboard operating the alarm signal due to the crush. From Morden a bus was taken to Wimbledon to complete the remaining seven stations of the network. At this point Kensington Olympia could have been taken in if an exhibition service had been running.

It may be of interest to relate what kit was carried, particularly on the Monday marathon. A small haversack was