

BRITISH RAILWAYS

LONDON MIDLAND REGION

New Carriage Shed  
at  
**WILLESDEN**

Official Opening  
by The Rt. Hon.  
**Lord Hurcomb, G.C.B., K.B.E.**  
Chairman, British Transport Commission

9th March 1953

# BRITISH RAILWAYS

## Working Time Table Reprints

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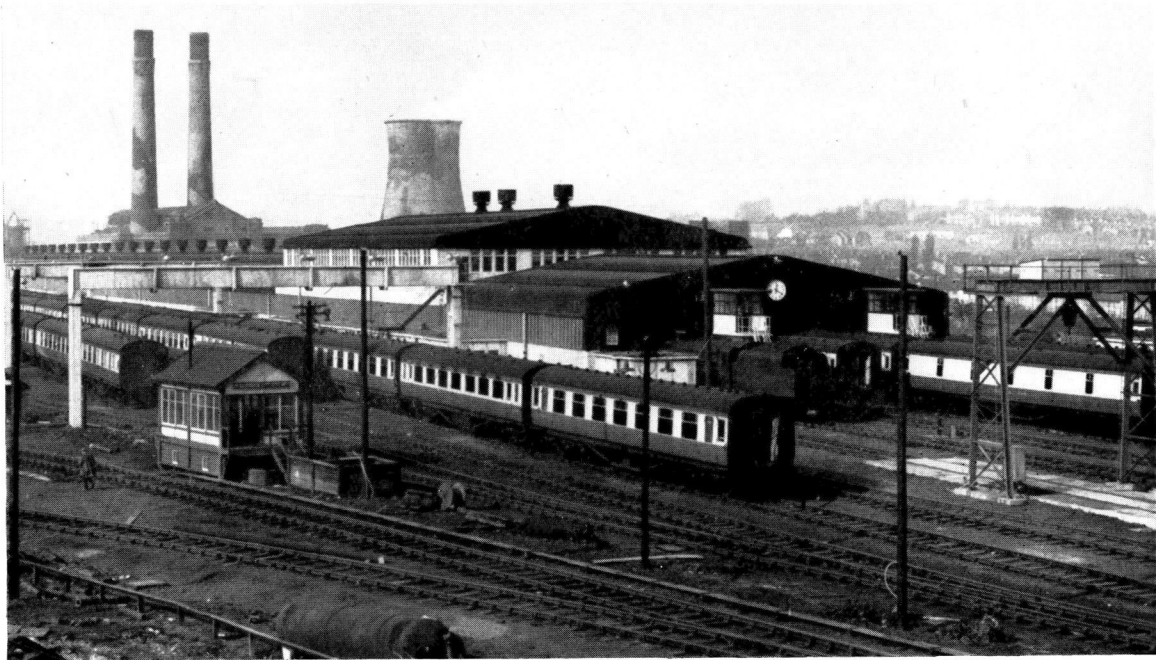
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# BRITISH RAILWAYS

LONDON MIDLAND REGION

## WILLESDEN CARRIAGE SHED

OFFICIAL OPENING 9th MARCH 1953

This up-to-date mechanised carriage maintenance and cleaning depot, which works on a progressive system, will improve the preparation, marshalling and stabling of carriages for the long distance trains from Euston, and concentrate all work at Willesden at one point with greater efficiency and economy.

The new depot will also make for better train operation between Euston and Willesden by relieving pressure on the main line. It includes a modern laundry for sleeping car linen.

The principle of the new depot is to bring the carriages to the operator carrying out the various stages of the work and so reduce unproductive time.

The preparation, marshalling and stabling of coaches forming Euston's long distance trains has been handicapped for a number of years owing to the former widely dispersed facilities which during busy periods caused much inconvenience and made the satisfactory working of trains exceptionally difficult in bad weather.

The previous accommodation consisted of sheds and sidings on the up and down sides of the main line at Willesden, and additional open carriage sidings to the south of Stonebridge Park electric station brought into use just prior to the war to alleviate the difficulties of dealing with the rolling stock.

Each section of the former accommodation has been used to capacity for years and its wide dispersal involved numerous train operating movements across the main lines which seriously affected other operations. In addition separate staffs had to be employed at each depot which caused excessive cost and made supervision difficult.

Owing to the inadequacy of these facilities, particularly at busy periods, accommodation usually used for freight traffic had to be used for stabling and preparing carriages which reacted unfavourably on the freight working over an extensive area. Expensive empty mileage was also incurred before and after busy periods by working stock from and to distant stabling points.

## THE SCHEME

A tentative scheme for a conventional carriage depot of twelve lines, each holding sixteen coaches and with outside sidings was approved by the former L.M.S. Board in 1936 but it was later decided to review the proposals and consider maintaining and cleaning the vehicles on progressive lines. A further scheme was evolved by the carriage and wagon section of the former L.M.S. Chief Mechanical Engineer's department in collaboration with the other railway departments concerned, and this latter scheme formed the basis of the present project.

The new scheme is based on the principle of carrying out specified work of cleaning and maintenance at recognised stages, staff being stationed in the respective stages to deal with their particular section of the work.

To carry this scheme out vehicles had to be brought into the respective stages at regular intervals and this necessitated adopting an entirely new method of moving the coaches. Various methods including diesel locomotives were considered but it was decided to use mechanical hauling gear powered by electrically driven winches of special design.

The new proposals meant that the covered accommodation required could be considerably reduced and a shed with only four lines, each holding sixteen vehicles, was finally adopted. This enabled the apparatus for services such as water, electricity, gas, vacuum and battery charging normally required throughout the whole of the carriage sidings in a conventional arrangement to be reduced to a minimum.

One aspect of the maintenance and cleaning of carriages running into and out of Euston is the large fleet of sleeping cars and as these would be dealt with at the new shed up-to-date laundry facilities for the bed linen have been installed.

The only site reasonably close to Euston with relatively easy access was an area of 27 acres lying between the electric lines at Stonebridge Park station and the Sudbury marshalling yard. This site had been used as a spoil dump during the construction of the electric lines and ground level was approximately 29 ft. above the main line and 33 ft. above the electric lines. It was necessary to remove approximately 305,000 cubic yards of spoil to make the site suitable and build a concrete retaining wall 3,000 ft. long, approximately 10 ft. high alongside the electric lines, to obtain sufficient width for the shed and marshalling sidings. The spoil was transported by rail to Ripple Lane on the Tilbury line where it was used to provide the formation for a new marshalling yard which was being constructed at the same time.



The site, bounded on two sides by the electric lines and Sudbury marshalling yard, was cut off from Euston by the North Circular Road which crossed the end of the site at a much lower level. Access could be obtained from Wembley but as this would require a longer occupation of the main line and a back shunt, it was decided to make a direct connection from Euston at the S.W. end by constructing approximately one mile of double track from Harlesden with a 3-span bridge over the North Circular Road ; a connection is also provided at the Wembley end.

The double tracks diverge immediately after crossing the North Circular Road. The down carriage line parallels the electric tracks, with the shed on the main line side. Before reaching the shed, trains pass over a concreted section of the track 480 ft. long which is drained so that lavatories of coaches can be flushed before the train enters the shed. The machine for applying cleaning solution to the coaches is at the north of the paved area, while the carriage washing plant is 500 yds. north of this. At the Wembley end of the down carriage line there is a shunting neck which permits the trains to draw clear and be set back on any of the four shed roads. These four roads are gathered together again at the entrance to the yard and trains can proceed direct to Euston or be set back into any of the 15 marshalling sidings, or into one of the 7 stabling sidings which are dead ended. An up carriage line is provided on the main line side of the shed to enable engines which have disposed of their trains to be released and for the through passage of empty stock trains. The total length of the marshalling and stabling sidings, excluding running loops and roads through the shed, is 8,680 yards, or approximately 5 miles, providing accommodation for 434 coaches.

Direct road access was not possible, and it was at first proposed to construct a footbridge over the electric lines to enable the staff to get direct to the shed from Stonebridge Park goods yard. When the scheme was reviewed after the war it was decided to provide a ramp in the goods yard with a subway underneath the electric lines and a further ramp alongside the shed, which enables cars, light vans and other road vehicles to go direct to the shed. Staff use the same ramp and subway but can obtain direct access to the shed by means of a stairway at the end of the subway, which leads direct to the booking-on point. The time recording clocks are positioned immediately at the top of this entrance stairway. To the left-hand side of the stairway is the male amenities block consisting of toilet and lavatory rooms, locker room, etc. ; the female accommodation is on the right-hand side. The office block is also adjacent to the main stairway, and drying and ambulance rooms for the male and female staff are also provided. Adequate workshop and stores accommodation is located in close proximity to where the work is carried out and stores needed. To facilitate working in the pits underground stores served from the subway are included.

The amenities for the staff at the new shed are in accordance with the standards laid down by The Railway Executive and adequate toilet and lavatory facilities are provided at different parts of the shed.

## METHOD OF WORKING IN SHED

The train proceeds along the down carriage line into the shunting neck, from which point it is propelled into one of the four lines leading into the carriage shed, each holding 16 coaches under cover. The work in the carriage shed is planned in four main stages :—

1. Examination. Interior, exterior and underneath. Initial interior cleaning.
2. Exterior cleaning and inside maintenance.
3. Interior cleaning and outside maintenance.
4. Equipping of sleeping cars with linen and final inspection.

The train is moved from stage to stage by mechanical winches operating endless ropes and the coaches stand in each stage for a predetermined period according to the output required. After passing through the shed to sidings outside, the coaches are worked away by engines into the marshalling sidings for making up into outgoing trains.



INTERIOR OF SHED

The conditions obtained under this progress working are :—

- (a) Stock is passed through the shed for cleaning and maintenance before being marshalled. This ensures adequate time in which to perform the work and considerably reduces, if not eliminates, the large volume of such work previously carried out in the marshalling and stabling sidings. Most of the staff will be working under cover.
- (b) The concentration of the work inside the shed reduces to a minimum the movement of staff and stores. In addition, supervision of the staff, initial examination of trains and the passing out of the finished work is facilitated.
- (c) In an ordinary carriage shed the Operating department deliver, take away and shunt vehicles as necessary, and in the interests of safety all work must be stopped and the men kept clear whilst these movements are being made. In the progressive shed no engine power is utilised for moving the coaches after their delivery into the first stage ; all subsequent movements in the shed being by mechanical means controlled by a special signalling device operated by an appointed member of the shed staff. This affords greater safety to the staff as all movements are made at predetermined times.

To facilitate work concrete platforms at footboard level are provided at two stages and each of the four roads have pits over the length where examination and maintenance is carried out.

## WORKS AND BUILDINGS

The shed is 1,120 ft. long by 77 ft. 8 in. wide, excluding the stores, offices and amenities, which are arranged along the sides. There are four roads which have normal depth pits for 860 ft. and shallow pits in the remainder. All pits are of mass concrete construction and are provided with fluorescent lighting and drainage. The shed floors are concrete at rail level, except where mechanical haulage mule decks and cleaning platforms are provided.

The shed structure is a single span welded steel rigid frame, 76 ft. 8 in. centres of hinges with a height of 27 ft. 4 in. from rail to ridge. The frames are at 20 ft. centres, carried on mass concrete footings and support 7 in. by 2½ in. channel purlins which carry the roof covering of Vee Beam Robertson's Protected Metal. There are two continuous stretches of patent glazing on each side of the ridge and similar stretches between the eaves and top of the concrete units which close the lower part of the side.

An upper floor is provided over the whole width of the shed for a length of 160 ft. which contains the laundry and linen storage rooms. Here a centre row of columns is provided to carry the floor, the columns being spaced at 10-ft. centres. The roof of this upper floor is carried by rigid frames similar to those of the main shed.

Special Tee-shaped decks 3 ft. 8 in. high are provided between each pair of tracks in two places in the shed. These decks provide supports for the rails on which the mules

ONE OF THE CONTROL CABINS



operate and also enable the staff to gain access to the inside of the coaches. In addition, platforms are provided between the outside tracks and the walls, and in the centre space opposite the Wembley end mule decks.

Five subways with stairways leading to pits, floor or decks are provided in the length of the shed so that staff can move about freely when trains are in motion. Two of these subways are also provided with ramps outside the shed so that tractors with trailers can carry stores to any point required.

The offices, stores and main amenities are arranged in one block along the electric line side of the shed. These are constructed with pre-cast concrete units which enable easy connections to be made with the side wall cladding of the main shed. One portion of this block has an upper floor of the same construction, which accommodates the canteen and kitchen where seating is provided for 150 people.

A number of small isolated buildings (sub-stations, special stores and workshops) of the same type of construction are provided on the other side of the shed.

The winches which operate the mules are installed in basements, that at the Euston end being outside the shed. The other, at the north end, adjoins one of the subways.

Floors of offices and buildings other than those used as workshops or stores are generally of Indasco. The laundry floor is of granolithic laid to falls to permit of easy cleaning, while that of the linen storage room is laid with wood blocks, the kitchen floor of the canteen being tiled.

Mechanical ventilation is provided over the calenders in the laundry and also in the kitchen. All buildings used as offices, workshops, stores or staff amenities, including the laundry and linen store, are steam-heated by Vectaire and unit heaters thermostatically controlled. Hot water is supplied from a number of calorifiers located in the lavatories.

Covered accommodation for cycles is provided adjacent to the main entrance to the access subway.

## LIGHTING

The lighting installation in the shed was designed to give the same working facilities by night as by day. The depot at present works two shifts so that artificial light plays an important function, and due to the long hours of lighting, fluorescent hot cathode tubes were selected for most of the interior installation but filament lamps are used for all exterior lighting.

## THE SHED

The problem here is to provide an adequate vertical illumination on both sides of the coaches, in addition to the roof and underside, to facilitate inspection and maintenance. The lamps on one side of each coach are mounted so as to give some illumination inside the compartments. Staff work at four levels, viz., pits, rail level, platform level and roof level, so that it is important that none of the lighting fittings shall cause undue glare.

Twin tube fluorescent fittings are mounted on the side walls at 20-ft. centres at eaves height, single tube fittings being used between roads 1 and 2, and 3 and 4, spaced at 10-ft. centres—all these have instant start gear. The centre row of fittings are mounted at 40 centres and 23 ft. high, but to avoid having to use a multiplicity of fluorescent tubes

and yet obtain reasonably the same colour of light as the "daylight" fluorescent tubes used elsewhere, these fittings comprise one 500 watt and one 250 watt H.P.M.V. and two 80 watt fluorescent tubes. The two former lamps are deeply shaded so as to give a light cut off well below the eyes of the men working on the walkways at carriage roof level. These combined blended lighting units can be lowered to rail level for maintenance by means of a winch operated from the walkways.

The pits are lighted by water-tight robust cast iron and steel fittings, spaced at 9-ft. centres in staggered formation, glazed with toughened plate-glass and equipped with instant start gear. Plugs for hand lamps are provided at 36-ft. centres.

The shed is divided into sections switched by means of contactors to suit the working and there is a pilot circuit to provide economical lighting when full lighting is not required.

Fluorescent lighting is provided in the laundry using vapour-proof fittings, and in offices, etc., but filament lamps have been used in those parts which will be occupied irregularly or subject to frequent switching.

## THE YARD

The yard lighting installation follows normal layout using cast aluminium reflectors with visor glass to facilitate cleaning, but special attention has had to be given to the stabling sidings as these are used for servicing trains when necessary, so that a higher standard of lighting than is usual was called for in this case. Clearance for posts could only be provided in every fifth road so it was decided to erect gantries to carry the semi-floodlights

THE YARD





which are used to light the "six-foot way" between the rows of coaches. These gantries are at about 180-ft. centres.

The gantry installation is controlled from the middle ground frame by the Ripple system which obviates the necessity for a multiplicity of cables between the signal box and the shed and thereby considerably reduced the cost.

The gantries supporting the lights are constructed of pre-cast pre-stressed concrete of 'U' section. These gantries have spans varying from 60 ft. to 80 ft. and were assembled on site from standard concrete units approximately 6 ft. long, which were stressed together with Freyssinet type cables and lifted into position on pre-cast concrete posts. The 'U' section was adopted to enable maintenance men to get easy access to any fitting.

## PLANT AND EQUIPMENT

### CLEANING OF CARRIAGES

The majority of stock to be dealt with at this new shed is that used to form trains working from London to principal northern cities and to Scotland. The empty stock of trains arriving at Euston from these places is worked away from Euston station to Willesden, leaving the down slow main line at Willesden No. 6 signal box and proceeding along a new independent down carriage line where the trains are brought to a stop near the south end of the new shed.

The machine installed for applying cleaning solution to the exterior of the body of the vehicles is on the down carriage line at the south-east end of the shed, and trains pass through it at a speed of approximately 3 m.p.h.

A rigid steel framework spans the track supporting sixteen trailing arms, each arm having, at its outer end, an adjustable steel hood which in turn supports a freely rotating drum adapted to carry ten standard brush heads forming a rotating brush. Each trailing arm is mounted in ball bearings carried in drip proof housings attached to the main structure and spaced so that the width of the brushes overlap when presented to the coach side.

The solution must be applied as evenly as possible over the surface of the coaches with the absolute minimum of wastage and contamination of the frame members, running gear, etc.

Each of the sixteen arms is actuated by compressed air at a pressure of 25 lb. per square inch acting on a motor car piston  $2\frac{1}{2}$  inches in diameter working in an open ended cylinder, the arm being returned to the open position by a counter balance weight on release of the air pressure from the cylinder.

A supply of compressed air is provided by a motor driven air cooled compressor having a free air capacity of 20 cu. ft. per minute arranged to deliver air at 50 lb. per square inch to a receiver of 9 cu. ft. capacity.

The air pressure is reduced to 25 lb. per square inch before entering the control valve mounted in the operator's cabin. This valve, by the operation of a single lever, applies compressed air to the trailing arm cylinders simultaneously, or by movement of the lever in the opposite direction, to exhaust.

The chemical cleaning solution is contained in a sump of approximately 1,000 gallons capacity formed in acid-proof brickwork between the rails. The solution is pumped from the underground sump to the machine by means of a "Mono" type pump of 5 gallons per minute capacity, the pump and motor being duplicated for standby and maintenance purposes.



CARRIAGE WASHING PLANT IN ACTION

Each brush head is fed from its own small feed tank, the height between the tank outlet and the jets feeding the brushes being the same in all cases. The two upper tanks on each side of the machine are directly fed with solution from the pump, and the overflow from these tanks being fed into the tanks below in cascade until the remaining overflow from the lowest tank discharges into the spill-way leading to the underground sump for re-circulation.

Air operated valves open the feed to the brushes when these are in contact with the coach sides.

Fresh water pre-rinsing sprays are provided some distance in front of the solutioning machine, taking a supply of water from an adjacent main. The sprays are under the control of the operator from his cabin, and are primarily intended to damp and cool the coach sides in hot weather and to seal small cracks, etc., in the paint work with water and so prevent the ingress of cleaning solution.

After the solution has been applied, ten minutes elapse before the train is passed through the washing machine at about 3 m.p.h. to remove all the cleaning solution and dirt.

These washing machines, two of which are provided in tandem, are similar in principle to those already in operation on the London Midland Region but so many modifications have been introduced in detail that the machines in effect represent a completely new design.

Primarily each machine consists of an independent robustly constructed steel framework mounted on each side of the running road, each structure being designed to support four vertical flail rotors. The rotors are each driven independently by 3 h.p. motors through worm reduction gear boxes and flexible couplings mounted on platforms on the top of each structure. The flail rotors are geared to rotate at 50 r.p.m.

A special feature of the rotor assembly is the method by which groups of three flails can be removed from the machine by the simple action of lifting a pin. By this means worn or damaged flails can be replaced quickly and easily by the machine attendant.

A centrally disposed pump and operating attendant's house is provided between the two machines and contains the following equipment :—

- (a) Two re-circulating water pumps, each of 350 gallons per minute capacity, driven by 17.5 h.p. motors.
- (b) Two fresh water pumps, each of 150 gallons per minute capacity, driven by motors of 6 h.p.
- (c) One " Mono " type sump drainage pump of 50 gallons per minute capacity driven by a motor of 3 h.p. capacity.

By simple switching the operator can arrange for either one or both machines to be brought into operation, or he can arrange for four or eight rotors to be brought into operation on either or both machines at any one time. In addition provision is made for isolating the motor of any rotor without interference to the others.

Normally only one machine will be operated at a time.

Water draining from the coaches as they pass through the machines is collected in channels and gravitated to one or other of two below-ground sumps each of 300 cu. ft. filtered water capacity, each sump being fitted with a large upward flow coke filter bed 2 ft. deep, the filtered water being used for re-circulation.

## HAULAGE EQUIPMENT

The movement of trains through the shed in stages conforming to the maintenance and cleaning requirements of each stage is made by under deck mule equipment, each line through the shed being served by two independent mules, i.e., a total of eight.

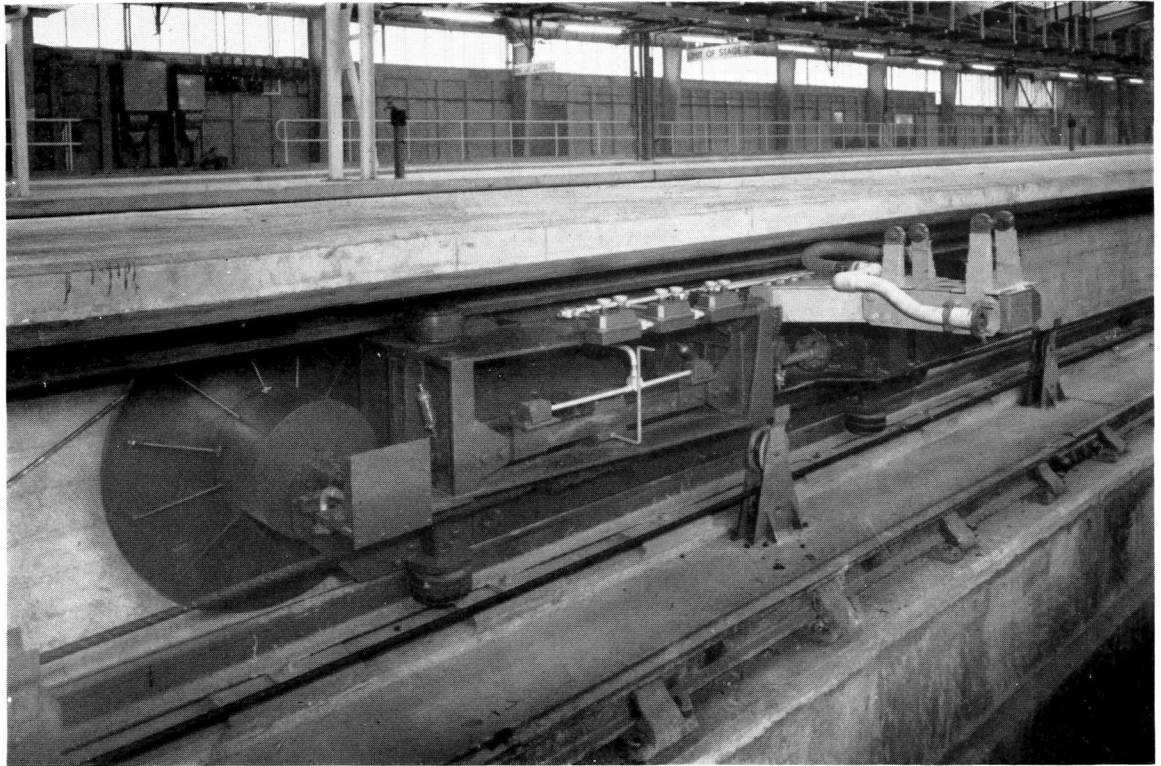
The mules at the Wembley end of the shed have a total travel of 340 ft., while those at the Euston end have a total travel of 260 ft.

Mechanically the mules are entirely independent, but the electrical protection system ensures that a movement cannot take place by either mule on any one road without the operating and maintenance staffs being in a position of safety.

The following is a description of one mule and its associated equipment, all four being the same :—

The mule consists of a robustly constructed carriage mounted on rollers running on vertically disposed flat bottom rails and is winch-hauled by ropes which are adequately supported by ball-bearing idlers throughout the length of the track, an adjustable tensioning pulley being provided at the outer end.





VIEW OF MULE WITH ARM RAISED

The weight of the mule is carried by two rollers on the lower rail and any tendency to lift is restricted by similar rollers arranged to contact the upper inverted rail. Any sideways movement of the mule is prevented by horizontal rotating rollers arranged to engage the sides of the rail heads of both the upper and lower rails. All the rollers are mounted on ball bearings and means of adjustment is provided to take up the wear on the treads.

The mule incorporates a hinged arm which is raised or lowered by a 1 h.p. motor through a train of gearing, limit switches being provided to stop the movement at the limit of travel in each direction. The outer end of the arm incorporates a series of four cantilever springs of plate construction arranged to embrace the buffer heads between two coaches on the mule side.

The haulage rope is not attached directly to the mule carriage but to a bridle mounted in guides and which can be moved a total of 3 ft. in relation to the mule carriage by means of a screw driven by a motor of 1 h.p. through a train of gearing. This enables local adjustment of the mule arm to be made by the mule attendant to facilitate engagement with the buffers.

In addition a rotary exhaustor driven by a motor of 5 h.p. can be connected to the train vacuum by flexible hose and "Tee" connector.

Power for the mule motors is conveyed from a central position in the mule runway through a flexible cable coiled on a spring-loaded sheave mounted on the mule frame.

The control of the various motors on the mule is by means of a multi-motor control panel complete with interlocked isolator and push buttons arranged in the form of cups which can be depressed by the operator by means of a rod which he carries for this purpose.

The arm raising and positioning controls are of the "hold to run" pattern. The exhaustor motor is arranged to run continuously after depression of the start button until stopped by depression of the stop button.

The winch is of particular interest, incorporating a form of drive which has been little used, and it is unique so far as the movement of trains is concerned.

It will be appreciated that the main factors underlying the design of the winch required that it should be capable of accelerating a total weight of approximately 500 tons smoothly and without shock and with strictly limited effort to the required maximum speed while retaining complete control of the movement and bringing this mass to rest with precision and without shock to the train or equipment.

These requirements have been met by the provision of two scoop tube fluid couplings driven from each end of the motor shaft which is extended accordingly. One coupling drives through a train of totally enclosed gearing to the drum, giving a rotation in one direction. The other coupling drives through an independent set of gearing which incorporates in addition a pinion which reverses the direction of rotation of the drum. The motor is 120 h.p. squirrel cage uni-directional in rotation and continuously running.

The motor starts "light" under the control of a Star Delta panel operated by push button in the driver's cabin. Engagement of one coupling, therefore, produces rotation of the drum or alternatively produces a braking effort consistent with the amount of oil in the coupling.

Both scoop tubes are coupled through linkage to a single control lever in the driver's cabin. Movement of this lever in the forward direction produces forward movement of the mule, and backward movement of the lever produces a reverse movement of the mule, or if a train is connected to the mule the required braking effort.

In addition, an electro-mechanical brake is fitted which is held off while the motor is running but comes into action automatically in case of current failure or emergency. This brake acts on a sheave keyed to the final drive shaft.

Each winch comprises two drums, one drum serving the mule on one road the other serving the corresponding mule on the adjacent road.

The motor, scoop tube couplings, reduction gearing and drum pinion shaft are common to both, a pair of claw clutches on the drum pinion shaft allowing one or other of the drums to be engaged with the driving gear but not both at the same time. Selection of the mule to be used is made by the driver by the movement of a clutch lever in his cabin.

Each drum, however, is mechanically connected to a dial indicator which shows the position of the mule in relation to the terminal points.

The same instrument incorporates a governor and cam mechanism so arranged that should the driver not keep the train within the allowable speed, consistent with the distance of the mule from the terminal, the governor will open a switch and trip the main motor, thereby applying the mechanical brake.

## SERVICING EQUIPMENT

In the marshalling sidings cold water and oil gas servicing points are provided at convenient distances and on the eight roads nearest the shed low voltage battery charging points are installed for charging 24 v. train electric light batteries with a further series of charging points for dealing with 110 v. batteries as used on anthracite/electric kitchen cars.

To keep the interiors of stock warm and dry during the winter months, the whole of the sidings are equipped with steam supply points for pre-heating trains prior to departure to Euston.

## SIGNALLING AND TELECOMMUNICATIONS

The Signal and Telecommunication Engineer's department has been involved in the provision of three new signal boxes and telecommunication facilities inside the shed.

The three new signal boxes are Willesden Carriage Shed North, Willesden Carriage Shed South and Willesden Carriage Sidings Middle.

The North signal box houses a 1943 pattern  $4\frac{1}{2}$  in. centre frame of 40 levers and controls the entrance to the up loop, up carriage line, through stabling sidings, marshalling sidings and the four shed roads. Electrical control is also exercised over the six lever ground frame which has been provided at the north end of the marshalling sidings. The signal box is of composite construction, i.e., brick up to operating floor level with timber top.

The South signal box, which is of timber construction on a brick foundation, houses a  $4\frac{1}{2}$  in. centre R.E.C. type frame of 30 levers and controls the exit from the four shed roads which converge into a common connection with the up carriage line. Access to this line is also given from the stabling sidings and marshalling sidings. A down carriage line from which access is given to the four shed roads is also controlled from this box.

Permissive block applies on the up carriage line between north and south signal boxes, and communication between south signal box and the controllers at the ends of the shed platforms is by electrical indicators operated by plunger at the platform ends and in the signal box.

The Middle signal box is of low elevation and of all timber construction, and houses a 20-lever  $4\frac{1}{2}$  in. centre R.E.C. type frame. The function of this box is the control of the points to the stabling sidings and marshalling sidings.

Apart from the four signals on the four shed roads at the entrance to the shed at the north end all fixed signals are of the semaphore type. These four signals are of the colour light type and exhibit permanent red aspects. Subsidiary signals are fixed below each which are controlled by switches in the winch control cabins. Repeaters for these signals in the form of stencil indicators are provided on a gantry structure spanning the four shed roads 230 yards from the shed entrance.

Two-way loudspeaker communication for operating purposes has been provided between the north frame and the shunters working at the north end of the shed and also between the middle frame and the marshalling area. Similar facilities were provided under an earlier stage of the scheme between Sudbury Junction signal box and Sudbury Middle Sidings foreman.

Inside the shed loudspeaker equipment has been provided to facilitate working and to warn the staff of impending traffic movements.

Each of the two control cabins on roads 1 and 2 can speak to each other or to staff working on roads 1 and 2. The staff on the mule platforms can speak directly to the control cabins from microphones mounted at strategic points on the platforms.

Identical facilities are provided for the staff associated with roads 3 and 4.

The carriage shed foreman may speak directly to the staff working on either or both of the mule platforms.

A 25-line automatic telephone exchange has been installed to provide full inter-communication between all staff involved in the working of the shed and external telephone facilities have been made available to certain offices by means of lines to Willesden station telephone exchange, or connections to local omnibus telephone circuits.

An electric impulse clock system has been installed with 24 secondary clocks distributed throughout the shed and the offices.

The whole of the signalling work has been carried out by Signal and Telecommunications Engineer's department staff and this applies also to the telecommunications work with the exception of certain wiring routes which were provided by contractors.

## SAFETY SYSTEM

As the trains are moved from stage to stage in the shed by mechanical means, it is necessary to take special precautionary measures for the safety of the staff. The normal practice at carriage sheds is for the staff to protect themselves by means of a red flag by day and a red lamp at night which they fix on the ends of the train on which they are working and remove after the job has been completed. With the new carriage shed this practice would entail a considerable amount of walking time as in certain circumstances it would be possible for 35 to 45 coaches to be on one road and this would necessitate the staff protecting themselves over a distance of approximately half a mile.

It was realised that some new method of protection would be necessary and an electrically-operated colour light system was devised.

The system is so devised that only the man who sets the danger signal can release this to the clear signal.

With this system colour signals give indication by RED or GREEN lights to those working at or above floor level and by means of illuminated word signs in the subways. Red indicates that it is safe to work on or under vehicles, and Green that vehicles are about to be moved.

Each of the four roads in the shed is separately protected by an independent system.

Protection is obtained by operating switches in control panels located at points throughout the shed.

To operate a switch, staff are issued with a “common key” which will fit all lock switches on left-hand side of panels throughout the protection system covering each road.

This key is inserted in any vacant lock switch on the nearest control panel to where work is to be done and turned in a clockwise direction. When this has been done a key on the right-hand side of the control panel should also be turned in a clockwise direction and this will change the signal indication from “Green” to “Red,” thereby indicating to all concerned that someone is about to be, or is, working on a vehicle on the particular road. The subway signs also change giving indication that it is safe to enter.

The key from the right-hand side of the panel is then removed from the lock and retained until the job is completed.

When work on the vehicles is completed, the reverse procedure to the above is carried out, inserting and turning the protection key in an anti-clockwise direction, thus releasing the original “common key” which should also be turned in an anti-clockwise direction, and afterwards removed and retained until next required.

The keys in the right-hand side of the control panels, which are removed and retained when the red signal is required, can only be used on the lock from which taken and must always be used on the same lock to release the personal “common key”.

Control panels are located at the following points in the shed :—

- (a) Floor or platform level for staff working at side or inside of vehicles.
- (b) On walkways for staff working at roof level.
- (c) In subways for staff working in pits underneath vehicles.

In the event of a control panel being inoperative, the nearest available panel on the same road is used.

Each man or leader of a gang is issued with a “common key” for which he is responsible.

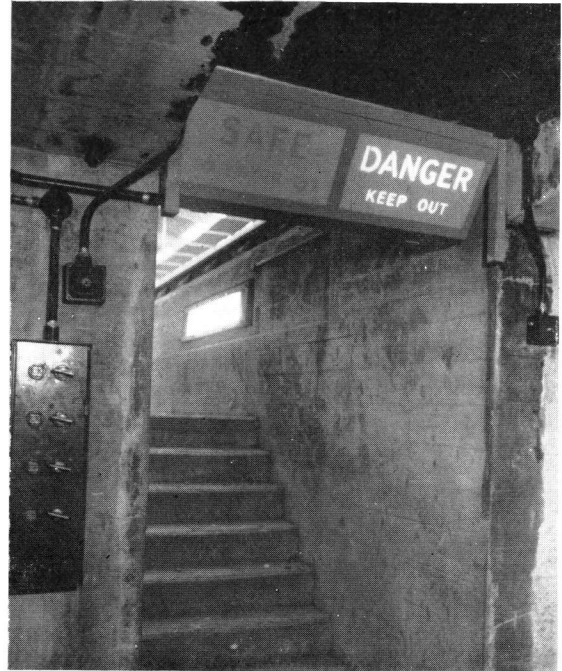
Before commencing work on vehicles it is essential that individuals should protect themselves and where gangs are concerned the approved leader is responsible for such protection.

Care has to be taken to see that the system protecting the particular road is used.

In conjunction with the protection arrangements the loudspeaker announcement system is used to broadcast instructions as may be necessary.

The indications of the colour signals and signs are as follows :—

**Green light inside shed** Indicates no staff are working in coaches throughout the road and movement of vehicles by mule or engine can be made.



ENTRANCE TO PIT SHOWING PROTECTION INDICATORS

**“ Danger ” in subways**

Indicates no staff are working underneath coaches throughout the road and movement of vehicles by mule or engine can be made. It is dangerous to enter a pit when this sign is showing as movement of vehicles is likely to take place.

**Red lights in shed**

Staff working on, in, or underneath vehicles and all movement of trains on road concerned is prohibited.

**“ Safe ” in subways**

Staff working on, in, or underneath vehicles and all movement of trains on road concerned is prohibited.

In addition to the signs mentioned above there is a colour light indication in each of the driver's cabins and the system is interlocked in such a manner that the winches cannot operate the haulage mules when the danger signal is showing. Further protection is given by electrical communications between the North signal box and the north control cabins. A section of the line at the entrance of the shed is also track circuited so that if occupied another train is prevented from approaching the shed on that line.

The acceptance of trains into the shed is made by the winch driver when he is satisfied that the road is clear ; the instructions for taking away trains at the outgoing end is also given by the winch driver at that end to the traffic inspector by means of a plunger signal to give indication.



## SERVICES

A large number of services are required in the working part of the shed and some are also required in the marshalling and stabling sidings. The arrangement of these so as to make them easily accessible to staff using them, and for maintenance purposes, was a major problem. This was solved in the shed by carrying all services overhead with droppers to the various platforms and operating points. Two overhead galleries, suspended from the roof, to which access is gained from the floor and decks of the shed at a number of points, extend from the laundry to the Wembley end of the shed. These galleries have a walkway on each side to enable staff to get on to the roofs of coaches, the space between walkways being used to carry the pipes for steam testing, vacuum testing, vacuum cleaning, gas, hot and cold water, electrical services and communications. The smaller number of services required from the laundry to the Euston end are also carried overhead but the walkways are not provided.

The following services are provided on all roads :—

- (a) Vacuum cleaning.
- (b) Cold water.
- (c) Hot water.
- (d) Oil gas.

These are arranged at floor level, whilst in the pits steam and vacuum testing points are installed.

## ELECTRIC POWER SUPPLY AND DISTRIBUTION

To deal with the electrical load two sub-stations have been provided, these being necessary to distribute the load owing to the extreme length of the shed.

The ultimate maximum demand for electric power in and adjacent to the shed will be 1,000 k.v.a. at 0.9 P.F. Owing to the importance of maintaining supply continuously the layout of the supply system has been designed to ensure the minimum of interruption in the event of a fault occurring on any part of the H.T. system.

The two sub-stations are built on to the south side of the shed, one towards each end. The supply is brought from different sections of the H.T. switchgear in Stonebridge Park power station at 11 k.v. by a 0.1 sq. in. 3-core PILAS cable to each sub-station, where it is stepped down to 415 volts in a 1,000 k.v.a. transformer. The high tension feeders are controlled through oil switches operated from the control room at Stonebridge Park and protected with high rupturing capacity fuses, so arranged that in the event of one fuse blowing the switch is opened. High tension oil-immersed hand operated isolators are provided at each sub-station.

The L.T. switchgear in each sub-station consists of an incoming 1,500 amp. triple pole air circuit breaker connected through busbars to combined fuse switchgear controlling the outgoing circuits. Discrimination is provided between the L.T. fuses and the H.T. fuses in the power station. An L.T. interconnector, consisting of two 0.4 sq. in. PILAS cables in parallel joins the two sub-stations. The end of this interconnector in one sub-station is controlled by a 1,000 amp. triple pole air circuit breaker, and the other end by a 1,000 amp. isolator.

All three L.T. air circuit breakers are remote-controlled from the control room in Stonebridge Park power station and are electrically interlocked so that only any two can be closed at one time. This interlocking is necessary to prevent the different sections

of high tension switchgear at Stonebridge Park being inadvertently paralleled through the L.T. sub-station equipment. Power for operation of the air circuit breakers is obtained from 100 volt batteries erected in a battery room in each sub-station. A pilot cable, 32 core, plus a telephone pair laid between Stonebridge Park power station and the sub-stations, is used for the remote operation and back indication of the breakers, and for the electrical interlocking.

The normal method of operation is that each sub-station is fed independently, with the isolator on the L.T. inter-connector closed, but the circuit breaker at its other end open. If required, however, the whole load can be transferred to one transformer almost instantaneously by operation of the air circuit breakers from the control room in the power station.

Underground cables are run from the sub-stations to main power and lighting distribution boards, installed at central positions in the shed, which in turn feed smaller sub-distribution boards fixed at various points in the shed and outbuildings.

## WATER AND STEAM SUPPLY

For the testing and pre-heating of coaches, provision of hot water for the amenities and for the laundry, steam is generated by heat exchangers which operate on superheated steam at 375 p.s.i. supplied by Stonebridge Park power station.

The water requirements for a depot of this size, particularly as a laundry is involved, are fairly heavy, and two sources of supply have been made available, one from British Railways' wells at Watford and the other from the Colne Valley Water Company. To ensure continuity of supply in case of a failure from either of these sources, two storage tanks, each of 30,000 gallons capacity, have been erected. A base exchange water softening plant is installed.

## AUXILIARY EQUIPMENT.

The vacuum testing and cleaning plant is housed in a room located near the centre of the shed, there being one rotary exhaustor for the cleaning system and two reciprocating pumps for brake testing.

As part of the layout a road is allocated for dealing with coaches which require repairs of a heavy nature and such that cannot be dealt with when passing through the shed. This road is equipped with a pit, full services for steam and vacuum testing, battery charging, etc. A 10-ton electrically operated gantry hoist is available to enable bogies and wheels to be changed.

In connection with the working of the shed a petrol tractor and trailer services are provided. Special trailers for carrying cells, enclosed box trailers for refuse removed from coaches and general flat trailers for ironwork, etc., will be provided and a 15 cwt. mobile petrol operated crane will be available for unloading stores of a bulky nature.

The oil gas supplies to the depot will be by means of a main from British Railways' oil gas works at Kentish Town and reservoirs with a booster compressor are being provided.

Battery charging, which is essential, particularly for boosting the batteries of sleeping car trains, is by means of static rectifiers, and these are built into the west side of the shed at approximately 100 ft. distances apart with plug connection points to the first eight roads in the sidings. Similarly, rectifiers are used for the 110 volt batteries on the electric kitchen cars.

## LAUNDRY

As the new depot will deal with the majority of the London Midland Region sleeping cars, it was considered that laundering facilities should form part of the scheme, thereby reducing the handling of linen, ensuring that it is not contaminated in any way and is kept in first class condition, free from dampness. The laundry is also planned on progressive lines, the soiled linen being received in a room only to be used for this purpose, where it is sorted and then passed to the washing machines, of which there are six. After the washing process the wet linen is partially dried by means of four hydro extractors ; the next move is to the ironing machines, drying tumbler and air drier, according to the type of item concerned. After laundering and folding, the linen is conveyed to a clean linen store where it is placed in racks ready for use, the clean linen store being separated by a corridor from the actual laundry.

When sleeping cars are passing through the shed the soiled linen is collected and placed in canvas bags which are lifted by means of an electric hoist direct into the laundry, and supplies of clean linen are lowered by means of the same hoist on to the shed platform where it is put into sleeping cars which have, in the meantime, been cleaned. The process of making the beds and preparing the berths is carried out in the sidings after the vehicles have left the shed.

The laundry is of sufficient capacity to deal with 80,000 pieces of linen weighing approximately 35,000 lbs. per week. In addition, it is capable of dealing with 4,000 lbs. weight of blankets, mattress covers, etc., per week.

A sewing machine room is provided adjacent to the linen room and repairs are carried out to sleeping car linen, blankets, etc.

Another room to one side of the shed is for the cleaning of sleeping berth carpets carried out first by vacuum cleaning and then by the use of a carpet cleaning machine.

THE LAUNDRY



# CONTRACTORS

## PLANT AND EQUIPMENT

Henry Lees & Co. Ltd.  
John Boyd & Co. (Engineers) Ltd.  
Geo. Cohen, Sons & Co. Ltd.  
Rosser & Russell Ltd.

Worthington Simpson Ltd.  
Sturtevant Engineering Co. Ltd.  
Bells Asbestos Co. Ltd.  
Aiton & Co. Ltd.

Holden & Brooke Ltd.  
Simmons & Hawker Ltd.  
W. Gilmour Smith & Co. Ltd.  
British Insulated & Callenders Cables Ltd.  
English Electric Co. Ltd.

Rashleigh Phipps & Co. Ltd.

Falk Stadelmann & Co. Ltd.  
Metropolitan Vickers Electrical Co. Ltd.  
General Electric Co. Ltd.  
Crompton Parkinson Ltd.  
Bective Electrical Co. Ltd.  
Power Equipment Co.  
Northampton Foundry Co. Ltd.  
The Permutit Co. Ltd.  
Simmonds & Stokes Ltd.  
London Transformer Products Ltd.

Haulage winches, mules and controls.  
10-ton fixed electric Goliath crane.  
Laundry hoists.  
Low pressure steam, vacuum cleaning, vacuum testing, gas, hot and cold water mains in shed and sidings and heating installation.  
Vacuum exhausters (testing) oil gas compressor.  
Vacuum exhauster (cleaning).  
Lagging, low pressure steam and water piping.  
High pressure steam main and condensate return piping.  
Heat exchanger.  
Heat exchanger pipe-work.  
High pressure steam lagging.  
H.T. and L.T. cables.  
Transformers and distribution boards. L.T. switch-gear.  
Wiring for power and lighting and protective system, in shed and buildings.  
Fluorescent lighting fittings.  
Lighting fittings.  
Lighting fittings.  
Lighting fittings (laundry) H.T. isolators.  
Outside wiring for lighting.  
Protective key switches.  
Main and break pressure tanks.  
Water softening plant.  
Watertight plugs and sockets.  
Low voltage transformers.

## CIVIL ENGINEERING AND BUILDING

L.M. Region Direct Labour Organisation  
John Booth & Son, Bolton  
Liverpool Artificial Stone Co.  
Mellowes & Co. Ltd.  
Robertson Thain Ltd.  
Vulcanite Ltd.

General contractor  
Steelwork in shed.  
Precast concrete units.  
Patent glazing.  
Roof coverings.  
Roof coverings.

## LAUNDRY

The machinery in the laundry was supplied by the under-mentioned firms, and the installation of these machines, together with the services, was carried out by Messrs. Thomas Bradford & Co. Ltd.

Messrs. Thomas Bradford & Co. Ltd., Salford  
Washing machines, ironing machines and Zonda drying tumbler.  
Lister Engineering Co., Woolwich  
Air speed drying machine.  
British Laundry Machinery Co. Ltd., Alperton  
Sheet spreader.  
Thomas Broadbent & Sons Ltd., Huddersfield  
Hydro extractors.  
Lunbys, Ltd., Halifax  
Calorifier.  
R. G. Whitaker, Ltd., Kingston-on-Thames  
Shaker tumbler.  
Singer Sewing Machine Co. Ltd.  
Electrically driven sewing machines.

