



BRITISH
RAILWAYS
ELECTRIFICATION
CONFERENCE

Exhibition
at Battersea



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1960

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1

LOCOMOTIVE E5020

1



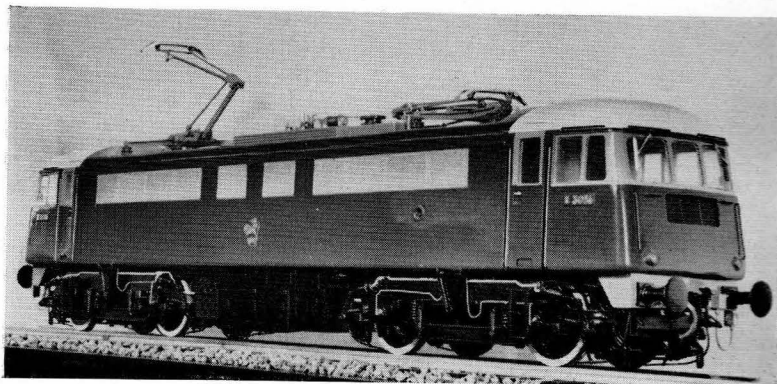
System	— 675 volts, DC, 3rd rail
Wheel arrangement	— Bo-Bo
Weight	— 77 tons
Length	— 50 ft 7 in over buffers
Continuous rated power	— 2,380 hp
Maximum Speed	— 90 mph

Locomotives of this class are used on the Southern Region for the haulage of trunk freight trains of up to 1,000 tons as well as of such passenger trains as do not lend themselves to multiple unit working, for instance the Night Ferry and Golden Arrow and summer relief trains to the Kent Coast resorts. They have 4 frame mounted traction motors controlled by a continuously running motor-generator set whose generator excitation is varied by the driver to assist or oppose the passage of current from the line through the traction motors. Train heating is supplied electrically by jumper connections and either a vacuum-braked or an air-braked train can be hauled.

2

LOCOMOTIVE E3056

2



System	— 25 kV AC 50 cycles
Wheel arrangement	— Bo-Bo
Weight	— 79 tons
Length	— 56 ft 6 in over buffers
Continuous rated power	— 3,200 hp
Maximum speed	— 100 mph

This locomotive is one of a series of 40 being built at British Railways Workshops at Doncaster and Crewe.

3

LOCOMOTIVE E3008

3



System	— 25 kV AC 50 cycles
Wheel arrangement	— Bo-Bo
Weight	— 80 tons
Length	— 56 ft 6 in over buffers
Continuous rated power	— 3,200 hp
Maximum speed	— 100 mph

This locomotive is one of a series of 25 being built by AEI (Rugby) and Birmingham Railway Carriage and Wagon Company Limited.

4

LOCOMOTIVE E3029

4



System	— 25 kV AC 50 cycles
Wheel arrangement	— Bo-Bo
Weight	— 73 tons
Length	— 52 ft 6 in over buffers
Continuous rated power	— 3,000 hp
Maximum speed	— 100 mph

This locomotive is one of a series of 10 being built by the English Electric Company Limited at Newton-le-Willows.

5

LOCOMOTIVE E3051

5



System	— 25 kV AC 50 cycles
Wheel arrangement	— Bo-Bo
Weight	— 78½ tons
Length	— 56 ft over buffers
Continuous rated power	— 3,310 hp
Maximum speed	— 100 mph

This locomotive is one of a series of 10 being built by AEI (Manchester) and Beyer Peacock & Company Limited.

6

LOCOMOTIVE E3042

6



System	— 25 kV AC 50 cycles
Wheel arrangement	— Bo-Bo
Weight	— 77 tons
Length	— 53 ft 6 in over buffers
Continuous rated power	— 3,100 hp
Maximum speed	— 100 mph

This locomotive is one of a series of 10 being built by the General Electric Company and the North British Locomotive Company, Glasgow.

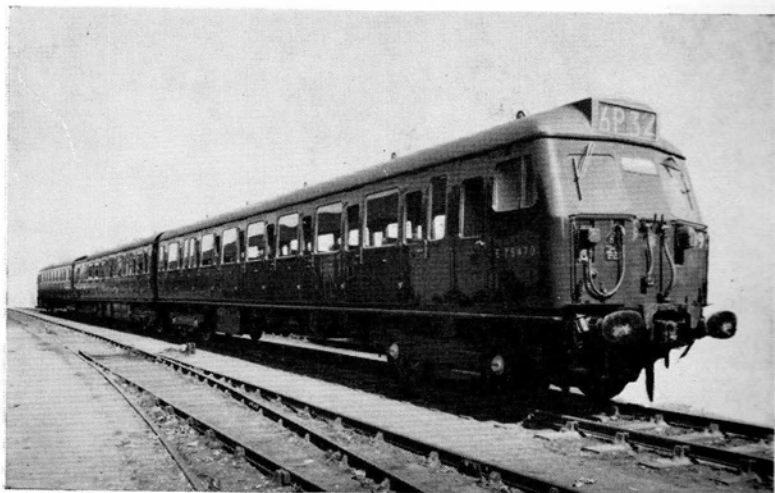
7 MULTIPLE-UNIT MOTOR COACH 7



System	— 25 kV AC 50 cycles
Weight	— 55.6 tons
Length	— 63 ft 6 in over body
Continuous rated power	— 830 hp
Maximum speed	— 75 mph

This coach is the power vehicle for a 3-coach multiple-unit train on the Glasgow suburban electric service. It is one of a group of 91 3-coach units built by the Pressed Steel Company Limited with electrical equipment supplied by AEI (Manchester), fitted with mercury arc single anode rectifiers.

8 MULTIPLE-UNIT MOTOR COACH 8



System	— 25 kV AC 50 cycles
Weight	— 54.2 tons
Length	— 63 ft 6 in over body
Continuous rated power	— 800 hp
Maximum speed	— 75 mph

This coach is the power unit for a 3 or 4 coach multiple-unit train on the suburban lines of the Eastern Region of British Railways. It is one of a group of 71 similar units built at British Railways Works at York and Doncaster with electrical equipment supplied by the General Electric Company Limited, fitted with silicon rectifiers supplied by Westinghouse Brake & Signal Co Ltd.

9 AC LOCOMOTIVE BOGIES 9

The bogies shown as exhibits Nos 9a-9e are those used for the AC locomotives shown as exhibits Nos 2-6 and are built by the builders of the locomotives.

10 MULTIPLE-UNIT BOGIES 10

MULTIPLE-UNIT BOGIE—EXHIBIT No 10a

This bogie is made by the British Railways Works at Wolverton and is similar to that used on Exhibit No 7 but it is for use on the Manchester/Crewe Electrification system.

MULTIPLE-UNIT BOGIE—EXHIBIT No 10b

This bogie is made by the British Railways Works at York and is similar to that used on Exhibit No 8.

The outdoor display includes two lengths of overhead equipment. That on the nearest track is of compound catenary, weight-tensioned construction, as used on high speed lines and was designed by the British Insulated Callender's Construction Co Ltd in conjunction with the Chief Electrical Engineer, British Transport Commission. The equipment on the furthest track is of simple catenary, weight-tensioned construction, similar to that supplied by Messrs Pirelli-General Cable Works Ltd for use on a trial section in the Glasgow Suburban Area, where speeds will not be high.

The display shows a typical selection of fittings and insulators, the fittings on the "live" side at structures Nos BAT 1-3 being of non-ferrous material, as used in areas where atmospheric pollution is severe, while those at structures Nos BAT 4-8 are of galvanized steel and malleable cast-iron, as used in relatively clean areas. Other items of particular interest are as follows:

Structures

Apart from the broad flange beams most frequently used for single supporting or anchoring masts, single tube anchor masts are shown at structures Nos BAT 1A and BAT 1B, while structure No BAT 5 is a tapered double channel mast designed by Messrs Pirelli-General Cable Works Ltd. Structure No BAT 2 is a two-track fixed cantilever having continuous rod bracings welded to the main angles. This type of fabrication is also used for portal structures up to 75 ft span and has a counterpart employing tubular main members instead of angles.

Insulators

The tension insulators are, generally, Polytetrafluorethylene-covered, glass-fibre rods, while those in bending or compression are of porcelain. Short creepage path porcelain insulators, as used in clean areas experimentally on a small scale, are shown at structures Nos BAT 5 and BAT 7.

A section insulator, as developed for running at speeds of up to 100 mph, is installed in the compound catenary equipment adjacent to structure No BAT 2.

Switches

A typical overhead line isolating switch is mounted on structure No BAT 2. These switches are normally operated by hand, but in certain special circumstances, are operated by a remotely controlled motor mechanism.

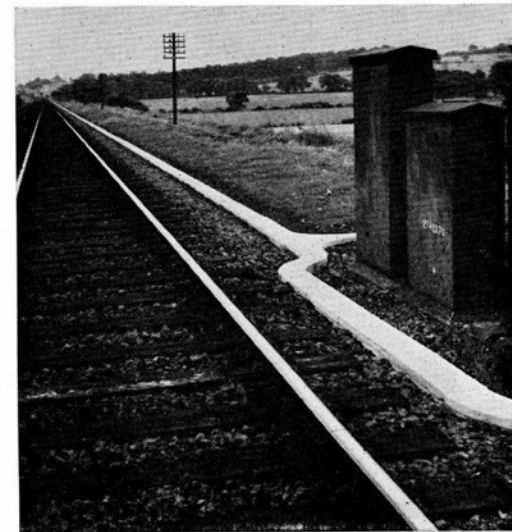
For demonstration purposes, the switch at structure No BAT 2 has been provided with a motor operating mechanism, as supplied by Messrs Switchgear & Equipment Ltd, with local push-button control.

The Company since its inception has in the main been concerned with the supply of clayware and precast concrete goods to a variety of users but generally to those with a connection in the Electrical Industry.

Since the advent of new Railway Signalling techniques, which have usually gone hand in hand with the Electrification of British Railways we have specialised in the manufacture of Precast Concrete Cable Troughing and Fittings and over the last ten years have supplied several hundred miles of troughing in various shapes and sizes.

Our exhibit shows a representative selection of cable troughs, standard fittings and special purpose units together with a small layout illustrating their application in practice. Technical data on the manufacturing processes and on the products themselves is also provided.

In addition we are exhibiting our well known Clay Cable Protection Covers which have also been widely used in this field.



BALDWIN HOUSE, 132 ARKWRIGHT STREET,
NOTTINGHAM

Copper and Copper-base Alloys

HC copper and "Combarloy" (silver-copper) commutator bars and segments.

HC copper strip for alternator and transformer windings, etc.

Copper and cadmium copper contact wire.

HC copper busbars.

Steam Locomotives

Thomas Bolton & Sons Limited were manufacturing copper and brass before the advent of steam locomotives; as suppliers of copper fire-box plates to British Railways and locomotive manufacturers at Home and Overseas, they played an important part in the development of steam locomotives.

Electric and Diesel-electric Locomotives

Today our high conductivity copper products are used extensively by the manufacturers of electric and diesel-electric locomotives for use in field coils and armature coils, for commutator bars of traction motors, generators and auxiliary machines, and also for components of control equipment and for pantograph wearing strips.

BTC 25 kV 50-cycle Electrification Scheme

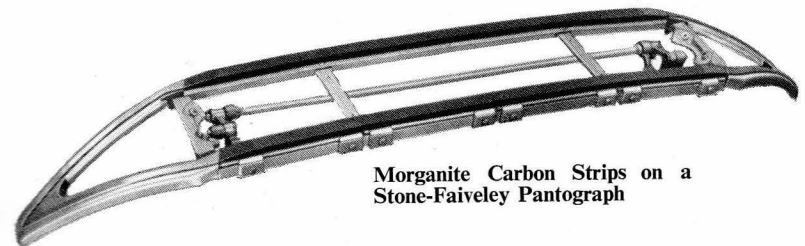
Bolton's hc copper is used in the commutators of the motors of ac electric locomotives, and in the control gear, and in traction motors of ac multiple-unit trains.

Head Office: Mersey Copper Works, Widnes, Lancashire

London Office: 168 Regent Street, London W1

Froghall Works: Froghall, Stoke-on-Trent, Staffordshire

With nearly fifty years of crucible making already behind us by the turn of the century, the invention of the carbon brush gave us another outlet for our specialized knowledge of carbon and graphite. Through continuous research these substances – in one form or another – now provide the solution to a host of Engineering, Electrical and Industrial problems.



Morganite Carbon Strips on a Stone-Faiveley Pantograph

Among the products manufactured by the Morgan Crucible Group of Companies which are making their contribution to Railway Electrification, examples of the following can be seen on our stand:

MORGANITE

Carbon Brushes, Brush Holders and Pantograph Strips for Traction Equipment.

Metal, Metal/Carbon and Carbon Contacts.

Carbon Resistance Rings and Flange Lubricators.

RESERVOIL

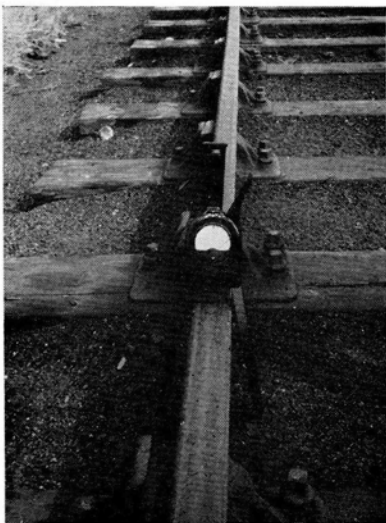
Oil-retaining Sintered Bearings.

FOLIAC

Switch Plate and Overhead Conductor Lubricants.

Conference Delegates will be very welcome to visit our Head Office, Factory and Research Department, at

BATTERSEA CHURCH ROAD, LONDON SW11



A Ferranti Railway Type 'R' Clip-on Ammeter

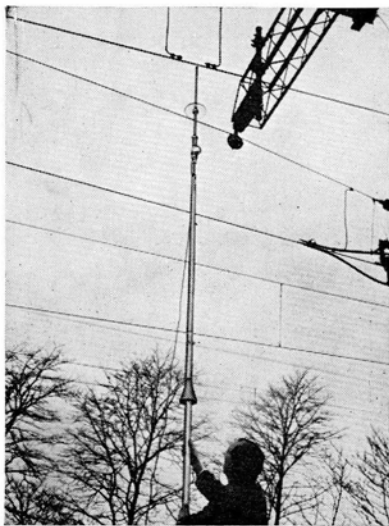
Railway Type "R" Clip-on Ammeter

The Ferranti Railway Type "R" Clip-on Ammeter has been specially designed for measuring ac current in steel rails of the 95 lb Bull Head and 113 lb Flat Bottom types, as used on British Railways.

The main body of the instrument is housed in a black bakelite case with thumb - operated selector switch but the limbs of the current transformer core are uninsulated.

Ferranti High Voltage Indicator

At the request of British Railways, Ferranti Limited has developed a high-voltage indicator, in order that measurement of voltages on railway 25kV ac overhead line can be carried out quickly, efficiently and safely. The indicator can distinguish between dc static, ordinary ac and induced voltages. Of the electrostatic type, the indicator has two ranges, 0-15kV and 0-30kV, the accuracy being approximately $\pm 5\%$ of full scale. The complete equipment, ie testing rod, 2½ in dial electrostatic voltmeter and flexible earthing lead, can be easily dismantled and packed in a lightweight carrying case.



A Ferranti Railway High Voltage Indicator

HOLLINWOOD, LANCASHIRE

London Office: KERN HOUSE, 36 KINGSWAY, WC2

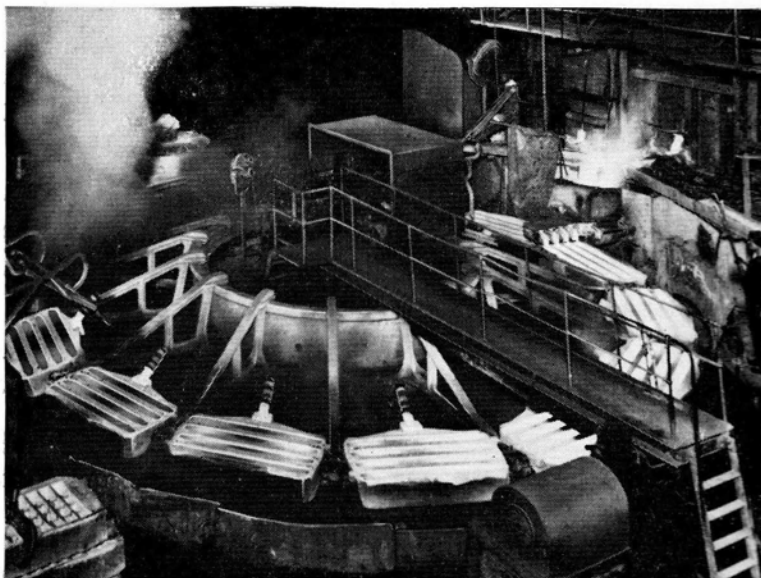
For nearly half a century the BICC Group has played an important part in the electrification of railways in five continents of the world. They have designed equipment for direct current and high voltage alternating current systems to operate in extreme climates varying from tropical to sub-arctic.

In addition to providing overhead equipment for railway electrification the Group manufactures and installs power cables and overhead transmission lines, telecommunication cables and signalling cables.

The resources of the Group include a copper refinery and wire rolling mill, factories which produce all types of cables under carefully controlled conditions and a wide range of accessories and other equipment. In addition the construction organization has unrivalled world-wide experience of railway electrification work and the Group's research facilities are second to none.



Signboard near Crewe



Casting copper wire bars on 4-bar casting wheel

The BICC Group is at present undertaking work for British Railways, as part of the 15-year Modernization Plan published by the British Transport Commission in 1955, based on the electrification of main lines and suburban systems using overhead equipment at 25,000 volts and a frequency of 50 cycles per second. Some years earlier an experimental installation had been set up between Lancaster, Morecambe and Heysham, and about the same time a site for testing various types of overhead equipment was established at the BICC Prescot Works.

Recent work includes the survey of routes, preparation of plans and designs; the manufacture and supply of stranded and solid wires, ferrous and non-ferrous accessories and steelwork. Other contracts are held for the manufacture, supply and installation of

specially screened telephone cables, floodlighting towers and bulk supplies of railway signalling cables.

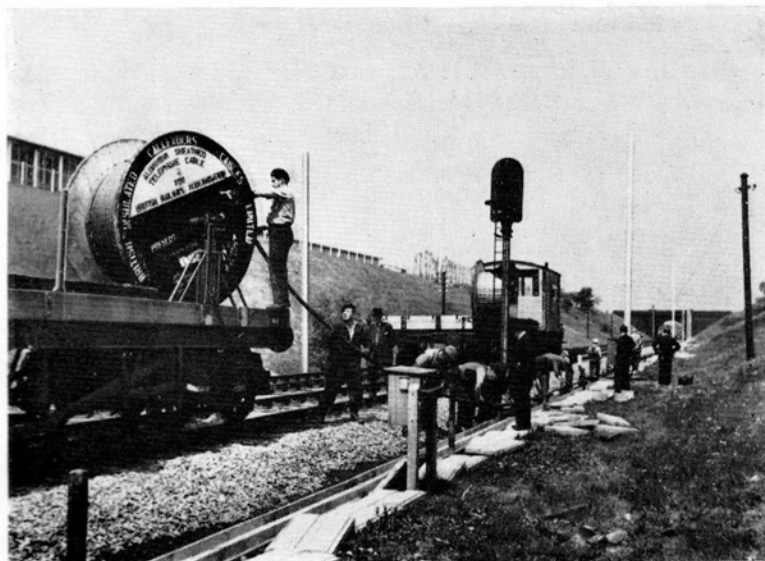
On Stand No 15 the following exhibits are featured.

Overhead Equipment

The display is complementary to overhead equipment which can be seen during visits to the London Midland and Eastern Regions of British Railways and in particular during the inspection of equipment and construction plant at the Crewe Depot. Items displayed will comprise all types of registration and supporting fittings, cantilevers, insulators and examples of the latest types of insulation. Other accessories include different types of section insulators, turnbuckles and line fittings with rail bonds and miscellaneous items.

Telephone Cables

Samples of the specially screened aluminium sheathed telephone cables, as installed on the Manchester/Crewe and Liverpool/Crewe electrification schemes, are available for inspection. An interesting



Cable laying in progress



View of BICC drawing office at Kirkby, Lancs., where work is carried out on railway electrification

demonstration illustrates the protection afforded by cable screening against the effects of interference from the traction system. Sections of cable troughing, trackside cabinets, joints and other cable accessories may also be seen.

Power Cables

A length of the most recent concentric 25kV oil-filled corrugated aluminium sheathed track feeder cable is on display with a fully sectioned sealing end. Other displays include 25kV twin concentric gas filled cable and its straight through joint; aluminium and lead sheathed cables; rubber and plastic insulated and lead sheathed cables; rubber and plastic insulated and sheathed supply cables; train jumper cables and a complete assembly of a 25kV pantograph cable with end bushing.

Signalling Cables

Miniature PVC insulated and sheathed multicore cables; Gloucester straight joint for multicore signalling cable; glass fibre dome type inspection joint; signal cabin wiring cables, together with all the relevant accessories.

PO BOX No 5, 21 BLOOMSBURY STREET, LONDON WC1

PANTOGRAPH TYPE AM

Manufactured under licence from Etablissements L. Faiveley

This pantograph is a development of that adopted by the French Railways for high speed duties after successful tests by the International Union of Railways (U.I.C.). It is suitable for operation at track speeds up to 100 mile/h in both directions of travel and complies with the exacting requirements of lightweight catenary systems.

The collector and articulated system have been designed aerodynamically and have been fully tested in wind tunnels at speeds of 100 mile/h and above. The major proportion of the total upward force holding the collector against the contact wire is applied by the pantograph working springs: this force is constant for all operational heights of the contact wire. The remainder of the upward force is applied aerodynamically: it varies with speed, and rises to about 4 lb at 100 mile/h in both directions of travel.

A distinctive feature of the pantograph is its sensitivity: it responds in service to a pressure differential measured in ounces. Its articulated members have low inertia, particularly the collector head. This is resiliently mounted and maintains contact under the most adverse conditions, for example when crossing stagger points and section isolators. The resilient mounting substantially reduces the effect of the hammering caused by these hard spots.

The base of the pantograph is a welded steel frame which can be supplied in various forms to suit the customer's fixing arrangements. The articulated members are of alloy steel tubing for strength, rigidity and light weight.

The operating air motor linkage has been so designed that once the pantograph is raised, the moving system is disconnected from the motor unit and is not affected by its friction. The flow of air to and from the compressed air operating motor is restricted by a throttle valve to ensure suitable speeds of rise and fall. If the air supply should fail, the pantograph is withdrawn automatically from the line and is therefore safe.

The pantograph has been designed for systems operating up to 25 kV but, with modified collector heads, is equally suitable for lower ac and dc voltages.



ARKLOW ROAD, LONDON SE14

Cable samples of all types applicable to Railway electrification.

Sealing bell termination and copper sleeve straight-through joint for 25 kV track feeder cables.

Cast iron line-side cabinet mounted on cast iron plinth, complete with terminal strips and links and with telecommunication cables terminated and connected.

Railbonds.

Moulded rubber plugs, sockets, glands and terminations for:

Coach interconnector cables.

Oil immersion heater leads.

Direction indicator cables, etc.

Grid suspension wiring system as applicable to Railway Stations, locomotive sheds and marshalling yards.

Potheads for terminating dry core paper insulated telecommunication cables.

Unyte Wiring System for temporary lighting during tunnel maintenance, bridge building, etc.

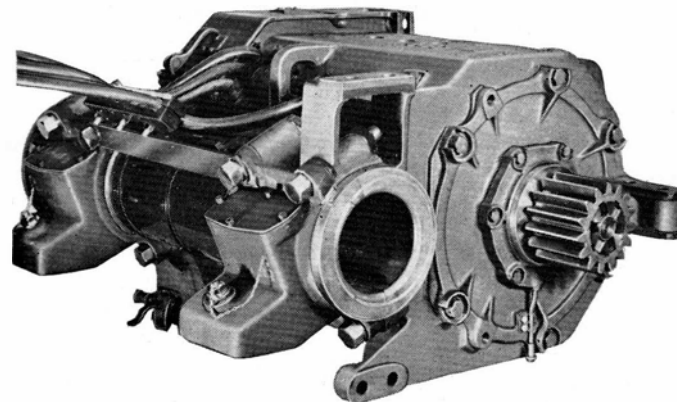
Display panels showing construction work in progress on various Railway electrification contracts.

BRIMSDOWN, ENFIELD, MIDDLESEX

SELF-VENTILATED 1,500 V. DC AXLE-SUSPENDED TRACTION MOTOR

This motor, designated type C.152, is specially designed in dismantled form to facilitate examination. It is suitable for operation on rectified single-phase ac supply at industrial frequency. Commutation is extremely satisfactory even with up to 30 per cent ripple, this desirable feature being achieved by skilful detail design and care in manufacture.

The motor conforms with BS.173 in every respect. Class "B" insulation is employed throughout, the armature and field coils being fully bakelised. Field weakening is obtained by means of a tapped field. The insulation to earth is designed for a working voltage of 1,500 V. dc so that the motor would be suitable for use on rectifier vehicles in dual operation on single-phase 50 c/s ac systems, as well as on 1,500 V. dc systems.



*Ratings at 57.5% Full Field on
Rectified Single-Phase 50 c/s ac*

Output, hp	205	175
Amperes	225	190
Volts	750	750
Speed, rpm	1,500	1,620

One Hour

Continuous

Maximum Service Speed - 2,580 rpm

Weight complete with pinion and gearcase - 4,214 lb.

Similar motors can be supplied either with larger outputs for forced ventilation - as required for main line locomotives - in conjunction with suitable flexible transmission, or having special high speed construction and lower outputs for use with a cardan shaft drive to high-ratio, right-angle drive gearboxes.

CROMPTON HOUSE, ALDWYCH, LONDON WC2

Reyrolle are showing a 25 kV single-phase air-blast circuit-breaker suitable for controlling the incoming supply to electric locomotives. It is of unit construction and is designed to be accommodated in the roof-structure of the locomotive. It is composed of two principal parts, namely the circuit-breaker with its associated isolator which protrude above roof-level, and an air-receiver which together with the circuit-breaker operating-mechanism is housed in the roof void. The underside of the air-receiver is thermally insulated and is mounted so that the temperature of the operating air in the circuit-breaker and in the receiver remains equable.

The circuit-breaker has a making and breaking capacity rating of 250 MVA at 25 kV, and a normal-current rating of 400 amperes.

The blast-head of the circuit-breaker which contains normally-closed contacts lies parallel to the locomotive roof and is supported on a vertical porcelain insulator which is also the blast-pipe between the air-receiver and the circuit-breaker contacts. A porcelain-enclosed resistor is connected across the break and a vertically-mounted sequential isolator, rotating through an angle of 70 degrees, is provided. The main contacts are readily accessible and are fitted with elkonite tips to minimise burning. Contacts for earthing both the circuit-breaker and the isolator are also provided.

The mechanism is actuated by a 100-volt dc holding-coil which controls the operation of the blast-valve. In the event of power failure the circuit-breaker automatically opens and isolates.

The welded-steel air-receiver has a capacity of 1½ cu ft (sufficient for two operations of the circuit-breaker); it has a design-pressure of 130 p.s.i., but normal working-pressure is 100 p.s.i. The air-supply to the receiver is drawn from the locomotive's main compressed-air system.

Reyrolle are also displaying a 1,200-ampere 25 kV 250 MVA single-phase small-oil-volume circuit-breaker for use in track-side sub-stations controlling the supply to the overhead catenaries. The circuit-breaker can be regarded as being built up of two parts, a supporting compartment and a circuit-breaking compartment. The lower supporting compartment consists of a steel base-chamber on which stands a porcelain insulator surmounted by a steel centre-chamber. This portion houses the driving linkage to the moving contact, and when filled with oil constitutes the main insulation to earth. The circuit-breaking compartment is mounted above the steel centre-chamber and consists of an inner bakelized paper tank surrounded by an outer porcelain insulator, above which is mounted a steel top-chamber which supports the fixed contact and its turbulator arc-control device. The oil within the bakelized paper tank is entirely separate from that in the lower compartment which is consequently kept free of carbon deposits. This feature also reduces the amount of carbonized oil needing replacement.

Operation of the moving contact is by means of a simple bell-crank linkage driven from a rotating shaft coupled to a mechanism cubicle mounted alongside the circuit-breaker. The power-unit for closing the breaker is a motor-wound compression-spring, and opening is controlled by a kick-off spring charged when the breaker closes.

HEBBURN, COUNTY DURHAM

Signalling Transformer for auxiliary stand-by signalling and auxiliary equipment:

The transformer would be switched on to the CEGB grid in the event of an emergency, ie failure of railway supply.

Booster Transformers:

These are connected between the overhead line and the running rail to limit the electro-magnetic induction disturbances to neighbouring telecommunication circuits.

Current and Voltage Transformers:

For 25 kV and 6 kV circuits and High Accuracy Current Transformer for Laboratory use.

High Voltage Oil Test Equipment:

For testing transformer and switchgear oil.

High Voltage Test Equipment:

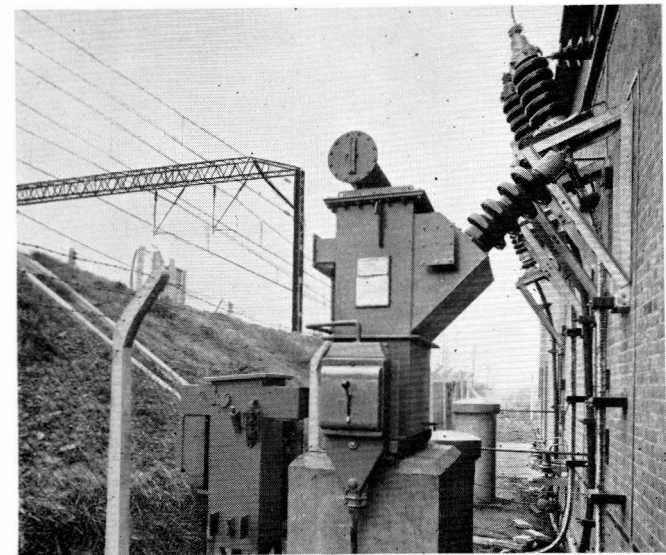
For applying high voltage tests to electrical equipment.

2,000 ampere Current Injection Test Equipment:

For testing overload circuit breaker coils, etc.

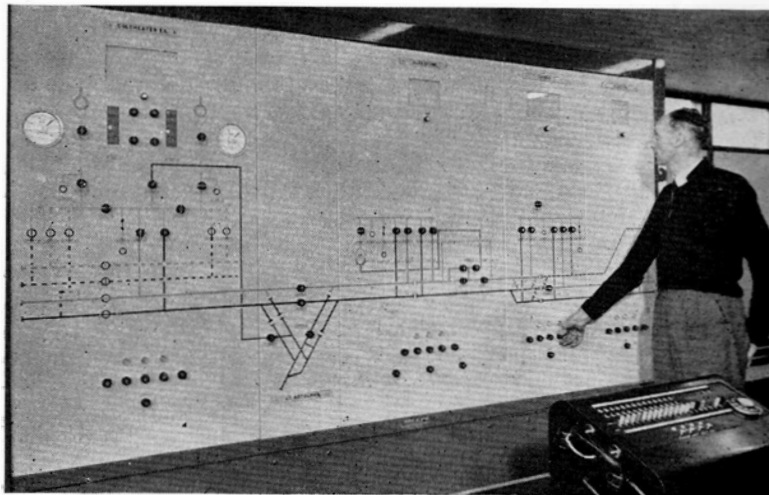
5 kVA Electronic Constant Voltage Transformer:

Resin Cast Portable Tool and Lighting Transformer:



Feeder station under construction at Colchester

SOUTH WIMBLEDON, LONDON SW19



A typical STC remote control diagram

Standard Telephones and Cables Limited are engaged in almost every aspect of railway telecommunications and are particularly active in the current British Railways electrification schemes.

The contribution made by STC in the communication field can be classified under the following headings:

Remote Control

A very comprehensive STC remote control system is at present being installed on the Liverpool Street-Enfield-Bishops Stortford-Clacton-Southend ac electrification schemes, for which the control room is at Romford; a similar system for the Fenchurch Street-Tilbury-Shoeburyness route is now in production. Both of these schemes involve equipment which is typical of STC remote control practice.

A mosaic diagram of the type exhibited, but 42 ft. long, will be incorporated in the Romford control room. Circuit breakers and other switches are controlled from, and their condition shown on, this mimic diagram.

Control and indication of transformer taps, supply voltage, maximum demand and line faults are all effected from the central STC control desk. The supervisor's desk has full telephone facilities which are duplicated for each of the control engineers.

A model of the STC type of mosaic diagram is exhibited along with a typical outstation cubicle which houses transistorized voice-frequency telegraph equipment used for the transmission of coded signals between control station and outstations.

Railway Signalling Equipment

The STC exhibit shows a modern signalling control desk incorporating Train Describers. The control panel is constructed of unit mosaic tiles and shows a



An STC train describer at St. Pancras

typical track layout for a comparatively small interlocking area, with all the controls and indications following a geographic pattern.

In a system of this type the signalman selects the desired route by operating push buttons at the entrance and exit of the route.

The description of all trains is shown in the appropriate place on the track diagram by means of miniature Cathode Ray Tubes which in this case display a 4-digit Train Number. By virtue of this integration of the train describer and the signal control panel the signalman sees at a glance the position and identity of the trains.

Indications on the diagram show Point Setting, Route Locking, Signal Clearance and Track Occupation together with Train Description.

The exhibit also shows typical units of the Signal Post Telephone System by means of which a train crew can call from any signal post to the signal cabin and thus provide a means of keeping traffic moving in emergency conditions.

STC has supplied, and is supplying, the Train Describers for the Crewe to Manchester; Crewe to Liverpool; London, Tilbury and Southend; and the Glasgow Suburban schemes, all of which are closely associated with the electrification programme of the British Transport Commission. These schemes also include Signal Post Telephones and Traffic Control Telephones.

Strad - An Electronic Re-transmission System

There is a world-wide demand for efficient telegraph systems and in particular for the best relaying facilities possible.

To meet this demand, STC have designed and developed the STRAD automatic electronic telegraph relay system. STRAD systems have been installed and are being manufactured for large administrations in the U.K. and abroad. For example, a large fully automatic system is at present being manufactured for the London Midland Region of the British Railways for installation at Crewe.

Within the STRAD equipment, messages are handled at 83,000 words per minute. This high "cross-office" or handling speed is achieved by using electronic circuits throughout. STRAD receives telegraph messages from a number of incoming circuits, temporarily stores them in a magnetic drum central message store, sorts all messages according to destination and then retransmits them to

the appropriate outgoing circuits in order of priority and time of arrival.

Telecommunication Cables

Pioneers in the telecommunication cable field, STC are supplying a wide range of cables to many regions of British Railways.

In the modernization of the Glasgow suburban railway and some of the Eastern Region lines, ac electrification using a catenary wire at 25 kV and 6.25 kV 50 c/s has prohibited the use of conventional telecommunication cables because of the high voltages induced into them by the traction currents.

STC have designed telecommunication supervisory cables which are specially screened to reduce the expected induced voltages.

These cables, together with loading equipment to reduce the losses in the cables, provide the large number of telephone supervisory circuits and other control facilities necessary with a modern railway system.

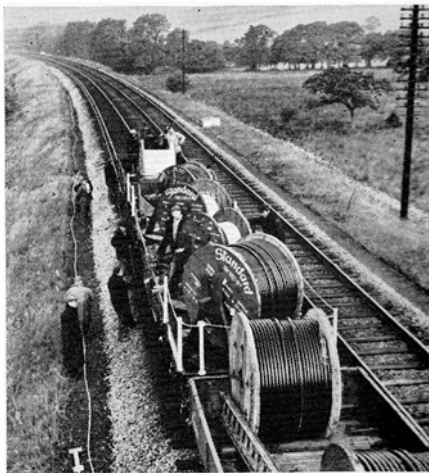
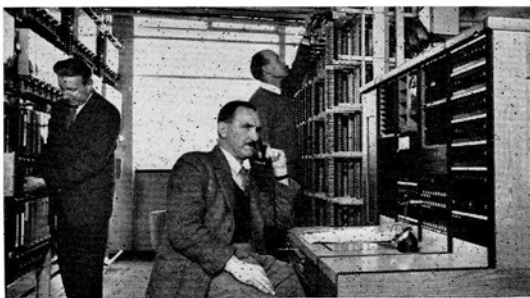
A new composite aluminium sheathed cable is now made by STC; 300 miles of this cable has been ordered by British Railways for installation on the London-Tilbury-Southend line of Eastern Region.

Telephone Systems

STC supply complete automatic exchanges and telephone equipment for railway signalling and telecommunications. The STC range includes intercommunication systems,

complete PAX's, PABX's, telephone apparatus such as selectors, uni-selectors, relays, junction boxes, telephone instruments, headsets and switches. STC has had over three-quarters of a century of experience in the telecommunication field to back the high quality of these products.

600-line PABX for British Transport Docks at Southampton



Laying STC telecommunication cables



Installing STC 300-circuit trunk telephone system in Sardinia

Transmission Systems

STC are manufacturing and installing small-diameter coaxial cable telephone systems for British Railways. A repeater for this system is exhibited, the system being designed to provide up to 300 two-way telephone circuits over each pair of coaxial tubes in the cable.

The exclusive use of transistors in the repeater enables it to be housed in a buried case instead of requiring a building. Spaced 4,000 yds. apart along the route, these repeaters are fed with power along the cable itself.

STC 12-circuit transistorized telephone systems are also being supplied to British Railways for use on multi-conductor type cables.

STC microwave equipment for multi-circuit telephony is exhibited. Using

radio channels in the 5,925 to 7,725 Mc/s band, this system provides 4 radio channels on a single route, each radio channel carrying up to 240 speech circuits. Circuits for switching the traffic baseband to a reserve radio channel and an engineer's speaker circuit are provided.

The exhibits include a demonstration of the STC all-transistor telegraph regenerative repeater. This equipment uses transistors, germanium diodes, printed wiring and the latest type of STC relay, all of which contribute to the compact design. Up to 36 repeaters of the type shown can be accommodated on a single 9 ft high rack.

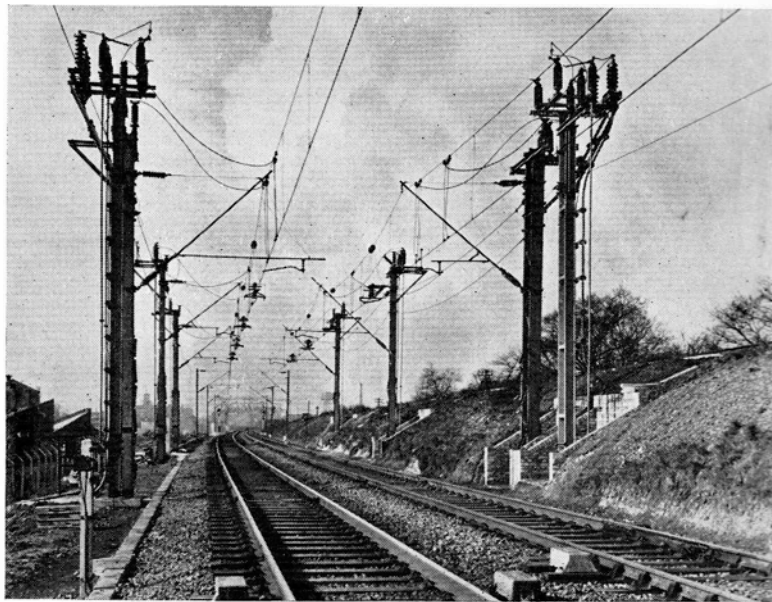
Sound Reproduction

A typical STC rack framework, incorporating two pre-stage and two power amplifiers along with a change-over panel, is exhibited.

A desk mounted output control panel contains the necessary keys for switching in or out of circuit different groups of loudspeakers, which may be dispersed throughout marshalling yards or railway station platforms.

A wide range of STC high-quality microphones is shown, along with new curved column loudspeaker, and other types for outside use.

One of the largest telecommunication concerns in the Commonwealth, Standard Telephones and Cables Limited can supply, within its own organization, complete systems for supervisory control and telecommunications in the railway industry.



Hackbridge and Hewittic type RSB 25 kV on-off-earth rotating type isolators installed on the Colchester-Clacton-Walton Lines (British Railways Eastern Region)

The main exhibit on the Hackbridge and Hewittic stand is a 6.25 kV railway isolator consisting of two single pole units, one of which is actuated by a motor operated mechanism, and the other by hand.

The motor mechanism employs a series of springs to operate the isolator, and these are charged by means of a single phase 230 volt driving motor. All three positions of the isolator are motorized. In addition, the isolators can be hand operated by means of a simple device which disconnects the motor and allows the springs to be charged by a cranked lever.

A large number of these isolators are in service on British Railways, and a typical installation is illustrated above.

HERSHAM, WALTON-ON-THAMES, SURREY



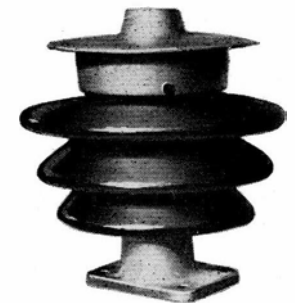
25 kV Cantilever Strut Insulator with nickel gun-metal clamp

Since the beginning of this Century, when the House of Doulton first supplied its patented Pedestal Rail Insulators for use in the London Underground, it has been associated with the manufacture of various types of ac and dc traction insulators for use in all parts of the world, and is continuing the association by supplying 25 kV and 6.25 kV Insulators for the British Railways Electrification Scheme.

These High Voltage insulators have been developed in conjunction with Engineers of the British Railways and the British Insulated Cables Construction Company, and tests conducted on a special test gantry have proved their efficiency under conditions of severe pollution.

The range of exhibits displayed on the Doulton Stand comprise insulators of 8,000 lb, 15,000 lb and 30,000 lb mechanical rating for both 25 kV and 6.25 kV duty, together with insulators for Pantograph support and track switches.

The material used for all these insulators is a fully vitrified high grade siliceous porcelain, developed by Doulton for all high voltage applications.



25 kV Post Insulator for pantograph frame support

WILNECOTE, TAMWORTH, STAFFS

A selection of cubicle and industrial switchboards together with busbar trunking of all amperages and types are exhibited, also oil circuit breakers and fuse switches.

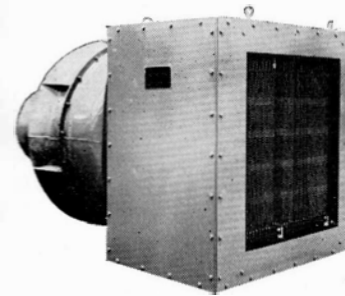
Cubicle Switchboard incorporates 60 amp to 600 amp fuse switches from our range of 35 MVA type tested switches, back of board mounting oil circuit breakers, fuse distribution boards, contactors and motor starter, also usual instrumentation.

Industrial Switchboards comprise incoming oil circuit breaker and outgoing fuse switches mounted above and below busbar chamber and illustrate ease of extension.

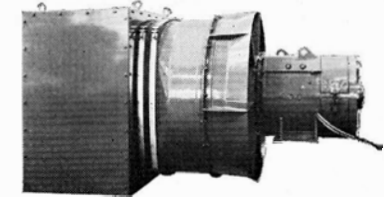
A unit from each frame size of oil circuit breakers 100 amp to 1200 amps with examples of drawout and non-drawout patterns are mounted on one display unit for close inspection, such units being available for wall, floor or switchboard mounting. Selected units from our range of industrial and streamline fuse switches suitable for either wall or switchboard mounting are also displayed.

Comprehensive Display of Busbar Trunking 100 amps to 600 amps from our well known range, also all accessories such as tapping boxes, cable units and bends, etc. This equipment is particularly suitable for workshops, machine shops, carriage washing sheds, etc.

Cable Trunking, underfloor ducting, also special multiple service trunking incorporating a combination of 100 amp Busbar Trunking and Cable channels suitable for laboratories and test stations, etc.



An Expanded Metal forced ventilated rheostatic braking resistor for locomotive service. These equipments which are normally supplied complete with fan and motor, can be designed for horizontal or vertical mounting. The typical unit shown has a continuous rating of 1,000kW.



The Expanded Metal Company (Electrical Division) which incorporates The Cressall Manufacturing Company specializes in the supply of resistors, rheostats and allied equipment.

Heavy current equipment is supplied which can incorporate resistor elements of either expanded metal or folded metal strip or edge wound metal strip.

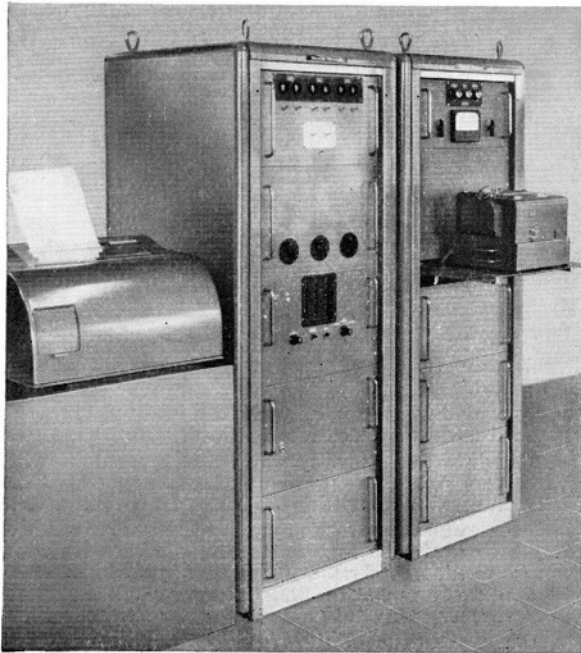
Lighter resistors down to the smallest wire wound types are all available from the same source thus simplifying problems of ordering composite equipment and ensuring an unbiased judgement on the best types of resistor to use.

Resistors of wire-wound construction are available on a variety of formers, from mica cards to steel tube formers and included are vitreous enamelled porcelain wound resistors. Asbestos woven nets and grids are among the division's standard products and rheostats incorporating them, as well as wire wound types of vitreous enamelled or open wound construction, are all listed.

Obviously, the applications of these many basic products are extremely diverse throughout the railways, but a few of their uses in the electrification programme are shown.

Expanded Metal Company Limited Exhibits manufactured at West Hartlepool.

- 1 A 25 ohm track feed current limiting Expanded Metal resistor for use in railway signalling circuits as supplied to the Westinghouse Brake & Signal Co.
 - 2 A set of Expanded Metal tapping resistors for ac locomotives as supplied for the English Electric 25kV ac locomotives.
 - 3 A set of motor field permanent divert Expanded Metal resistors as supplied to the GEC for the conversion of existing dc Shenfield motor coach stock to ac operation.
 - 4 One frame of a 3 frame Expanded Metal main starting resistor which is being used in the conversion of existing dc motor coach stock to ac operation.
 - 5 A display of Expamet Expanded Metal Resistor Elements.
- Exhibits made by The Cressall Manufacturing Co Ltd at Birmingham.
- 6 Cressall wire wound rheostats, vitreous enamelled and open wound, used for instrument panel dimming.
 - 7 Cressall vitreous enamelled wire wound porcelain track feed resistors as supplied for Westinghouse 50 c/s signalling equipment.
 - 8 A Cressall band-type anode heater for Rectifier pre-heating.
 - 9 Railway Cab Heaters of 3 and 4 element types as supplied for 25kV locomotives.



THE MICROCELL ELECTRONIC SUPERVISOR

This datalogger can be arranged to have upper and lower pre-settable controls available on every channel, and no output is effected by tape or printer until any one of the quantities being monitored wanders outside the prescribed set limits. Should all the readings return inside limits, then the machine will automatically note the time and cease recording. Prediction that an event is about to occur is possible because limits can be set closer than the process under control demands.

Specification: Number of channels type A 12-12, type A 24-24, type A 48-48, type A 96-96. Sampling rate-160 milliseconds per channel. Maximum decimal digit output rate-25 per second. Output code-International Teleprinter, or to order. Analogue to digital overall accuracy-better than $\pm 0.1\%$. Input resistance-1 megohm. Power Requirements: Normal 240V. A.C. single phase 50 cycles at 1.5 kW. Alternative 110V. D.C. (converter extra). Alternative 24V. D.C. (converter extra).

9 KINGSWAY, LONDON WC2

Exhibit 1. Three-position Track-Sectioning Isolators for overhead mounting.

2. Power and hand operating mechanisms for Track Sectioning Isolators.

The SE track-sectioning isolator type TS as supplied to the British Transport Commission for British Railways is shown in 6.25 kV and 25 kV forms.

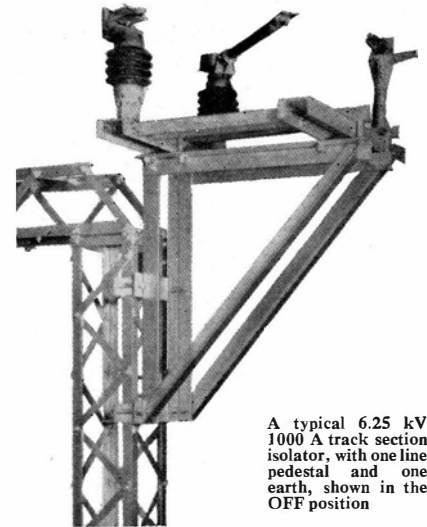
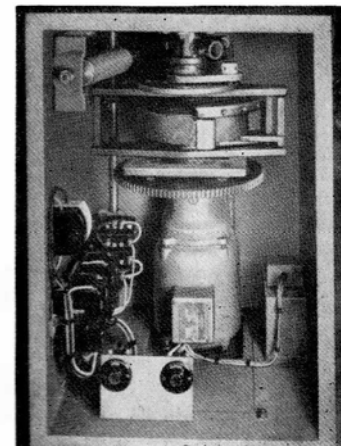
Specification

	Rated Voltage	Rated Current	Short-time Current
6.25 kV	1800 A	24 KA for 1 sec.	
6.25 kV	1000 A	24 KA for 1 sec.	
25 kV	600 A	18 KA for 3 sec.	

The TS Isolator is available as a single unit as illustrated, or with two isolators on a single base. The standard *type E* fixed-contact and moving contact blade, as used elsewhere in the SE range of outdoor overhead line isolators, are used on the TS Isolator.

The flexible contact at the hinge pedestal is designed to give ample freedom allowing for the 90 degree blade movement.

The Hand Operating Mechanism is arranged for padlocking and key-interlocking, and has a positive mid-way stop to prevent the isolator being moved from one extreme position to the other accidentally.



A typical 6.25 kV 1000 A track section isolator, with one line pedestal and one earth, shown in the OFF position

The Power Operating Mechanism type S3M has a motor-charged hydraulically controlled driving spring which has ample power to operate the isolator in adverse track conditions of snow, ice, and soot deposits, but is controlled by the hydraulic damper to prevent over-speeding in free conditions.

The mechanism is powered by a geared electric motor; the supply can be any standard single-phase ac voltage, or from a battery, as specified. The mechanism incorporates limit switches and can be fitted with interlocking devices as required, and provision is made for emergency hand-operation. The mechanism is enclosed in a galvanized steel case, ventilated and heated.

Interior of the Power Mechanism type S3M for Track Section Isolators, showing the geared motor drive with the helical spring above it, and above that and to the left, the hydraulic damper

BANBURY, OXFORDSHIRE

Connecting the Railway to the National Grid

For the transfer of electric power from the 132 kV National Grid to the British Railway's feeder stations, the AEI Cable Division developed a new type of feeder cable. This is a 25 kV Concentric oil-filled cable which is being used extensively for the 50 cycle single-phase system of traction which has been adopted for future electrification of British Railways. Samples of both the lead sheathed type and corrugated aluminium type of this cable will be on view.

Concurrent with the design of the cable, joints and terminations were successfully developed and examples of sealing ends and straight through joints will be shown.

The Construction (Cables and Lines) Division of the AEI installed the first lengths of 25 kV Concentric oil-filled cable at Stockport and have subsequently installed 10,800 yards for the Glasgow Suburban electrification scheme. They have also installed 24,000 yards of 25kV Solid type cable for the Manchester-Crewe electrification scheme. Illustrations of typical cable-laying operations will be displayed.



A telescoped sample of AEI 25 kV concentric oil-filled cable



Pulling AEI 25 kV concentric oil-filled cable off cable train between Motherwell and Sunnyside for Glasgow Suburban electrification

This Company will be showing a selection of Electrical Measuring Instruments and Circuit Breakers from their wide range and among these exhibits will be the following:

- (a) $3\frac{1}{2}$ in Single and Double Moving Coil Edgewise instruments with illuminated dials for use on either dc supply or (self contained) Rectifier Pattern for use on ac supply.

These instruments are being supplied to the BTC for the new high voltage railway electrification.

- (b) Range of Earth Proving Supply Points. Standard pattern and totally enclosed pattern. Suitable for use on single phase, three phase or dc supplies.

These have been developed to safeguard the operators of portable and transportable electric tools.

A demonstration unit with facilities for the application of all types of faulty earth conditions will be in operation.

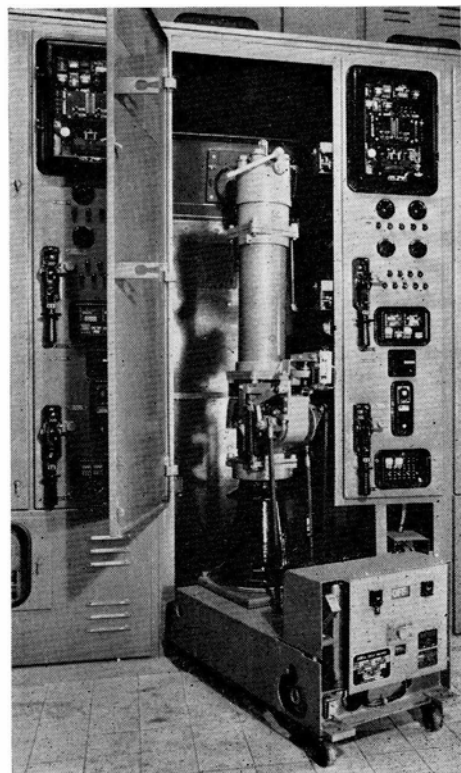
- (c) Relay for connection in 83 $\frac{1}{3}$ cycles per second system to detect 50 cycles per second currents. Moving coil pattern with contact adjustable over scale range.

Supplied for the electrification scheme on British Railways.

These are for use on an 83 $\frac{1}{3}$ cycle track signalling system, where an excess leakage into the circuit of 50 cycles traction current could cause unreliable and spurious signal indications.

Our association with the British Railways dates from 1927 with the installation of transformers and rotary converters on the Southern 700 volt third rail inner suburban system. When their major main coast line electrification schemes were inaugurated from 1930 onwards, we were appointed main contractors for the supply and installation of the 33 kV ac switchgear and relay protection, the 700 volt dc connections and all the associated supervisory control equipment. These electrification schemes were disrupted by the Second World War in 1939, by which date over 100 rectifier sub-stations, an equal number of track paralleling huts and five control rooms were in service. It is noteworthy that all this equipment is still functioning efficiently.

We are at present able to undertake complete power supply installations for both ac and dc electrification. For the British Railways 25 kV 50 cycle ac schemes now coming into service, we are supplying and installing high voltage oil minimum switchgear together with protective relay equipment, main power transformers, booster transformers and lightning arresters. The relay equipment includes distance impedance protection, thermal overcurrent protection and automatic reclosing.



At this Exhibition, we are showing a 25 kV air insulated switchgear unit with oil minimum circuit breaker as supplied to the Eastern Region of British Railways. The circuit breaker is rated at 800 amps and has a breaking capacity of 300 MVA at 25 kV. (See illustration.) Also shown are the core and windings of a 25 kV booster transformer representative of the 25 kV and 6.25 kV booster transformers we are supplying to reduce telecommunications interference from traction return currents.

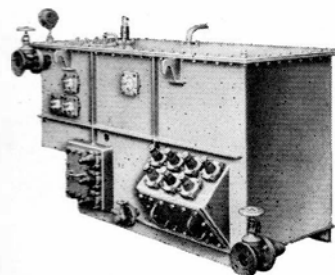
We are sole representatives in the United Kingdom for the well-known ASEA Group of Sweden and maintain full technical liaison with them. ASEA entered the railway electrification field in 1891 and have supplied the major portion of the electrification requirements, including traction equipment, for the Swedish State Railways. In addition, they have supplied equipment to most of the Overseas Railways for electrification projects.

Brush Electrical Engineering Company, Traction Division, show a range of electric traction equipment for 25/6.25 kV 50-cycle, ac multiple-unit trains. Amongst the items of equipment shown will be

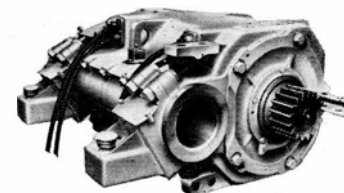
1. 1,010 kVA, 25/6.25 kV, oil cooled rectifier transformer for mounting below motor-coach; high voltage change-over switch mounted in tank. Also Air break on-load tap changer for voltage control of rectifier transformer, and for field weakening of traction motors. Underframe mounting.

2. Silicon Traction Rectifier type 6010, by Messrs. Westinghouse Brake and Signal Co. Limited. Nominal rating 700 volts, 1,000 amperes dc at 22.5 kV, 50-cycle, bridge connection. Forced air cooling by external motor driven fan.

3. 230 b.h.p. traction motor, axle hung, nose suspension, self ventilated, 1 hour rating, suitable for operation on rectified single-phase ac supply. Class B insulation to BS 173/1941.



1,010 kVA, 25/6.25 kV, oil-cooled
Rectifier Transformer

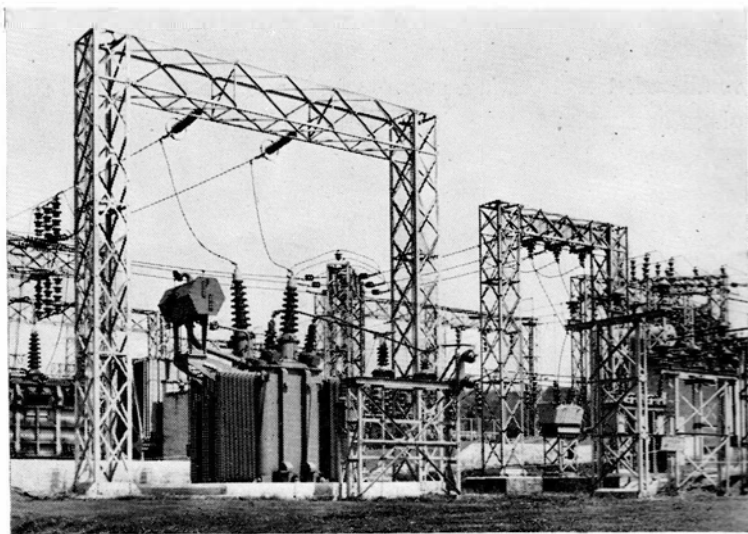


230 bhp Brush Traction Motor

Manufacturers of Heavy Rotating Plant for the generation and conversion of electrical energy; Transformers up to the largest outputs and highest voltages; Rectifiers for large power conversion systems; Motors for every industry; Automatic Control and Electronic equipments.

TRANSFORMERS FOR RAILWAY ELECTRIFICATION SCHEMES

136 MVA of transformers in sizes from 3MVA to 10MVA have been supplied for British Railways' Eastern Region and Glasgow Suburban (Stage 1) electrification schemes for the supply of power to the overhead conductor systems at 25 kV and 6.25 kV.



Strathleven transformer station of the North of Scotland Hydro-Electric Board showing 5 MVA single-phase 132/25 kV transformers for the supply of power to British Railways' electrified lines in the Glasgow Suburban district

EDINBURGH 5, SCOTLAND

BTC Electrification

Manchester — Crewe

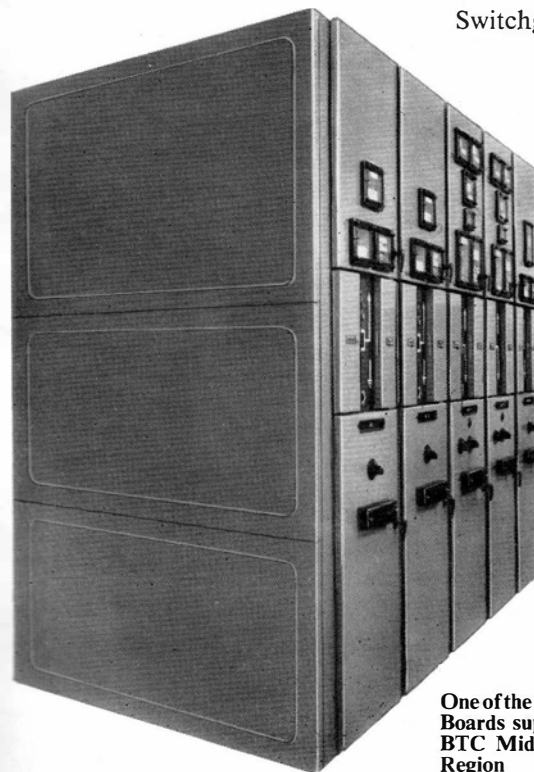
Liverpool — Crewe

Glasgow Suburban

Using Single Phase Switchgear Type K11 330 MVA at 27.5kV
and Type B41 165 MVA at 6.9kV

27.5 kV and 6.9 kV single phase metalclad oil filled Switchgear for the Feeder Station and Track Sectioning Cabin Sub-Stations controlling and protecting the incoming supplies and feeders to the overhead conductors.

The equipments are of unit construction and are readily extendible to form multi-panel switchboards.



One of the K11 Switch-Boards supplied to the BTC Midland Region

Type K.11 Oil Circuit-Breaker 27.5 kV – 330 MVA.
Type B.41 Oil Circuit-Breaker 6.9 kV – 165 MVA.

The K.11 and B.41 units are of similar style being totally enclosed and oil-immersed with fixed oil circuit-breakers, integral double isolation and earthing. Voltage-transformers can be fitted to units thus supplying a voltage reference for the distance measuring feeder protection.

The oil circuit-breaker is electrically closed by means of a solenoid through a trip free linkage. A patented self compensating interrupter is fitted which maintains a consistently low level of arc energy over the interrupting range. High pressure faced contacts are fitted, the whole equipment therefore being suitable for repetitive duty.

Relay panels are fitted to each unit.

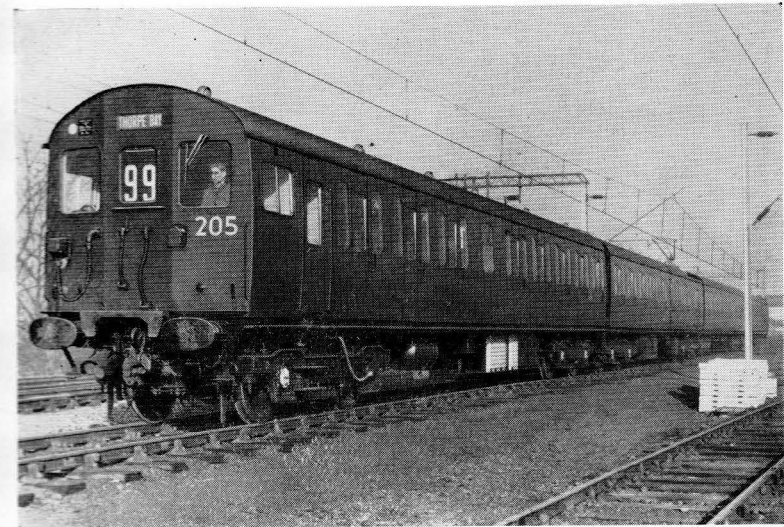
SALIENT FEATURES:

1. Total enclosure in sectionalised earth metal compartments – unaffected by atmospheric conditions.
2. Compact design requiring minimum floor area.
3. Main insulation immersed in oil – ideal for electrical stress control and dielectric stability.
4. Interlocks grouped with a mechanically operated mimic diagram for clarity and simplicity.
5. A simple main circuit with a minimum of moving parts.
6. Integral tank raising and lowering mechanism.

Type K.11 Fuse Unit.
Type B.41 Fuse Unit.

These are of similar style in appearance and construction to the oil circuit-breaker units, but in place of the circuit-breaker is fitted a high breaking-capacity cartridge-fuse. Stress control spheres envelope the fuse clips. These units are used for the control and protection of standby transformers for signalling supply.

MANCHESTER 16

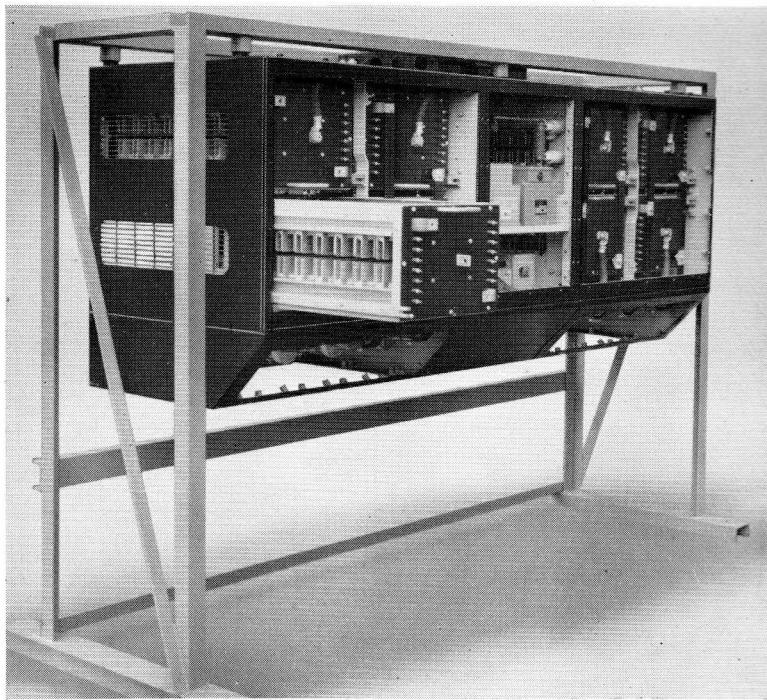


One of the 25 kV ac multiple-unit trains in service on British Railways, Eastern Region. 'ENGLISH ELECTRIC' equipped the first 25 kV ac multiple-unit trains built by British Railways

The English Electric Company has three-quarters of a century's experience in the manufacture of complete locomotives and equipment for electric railways.

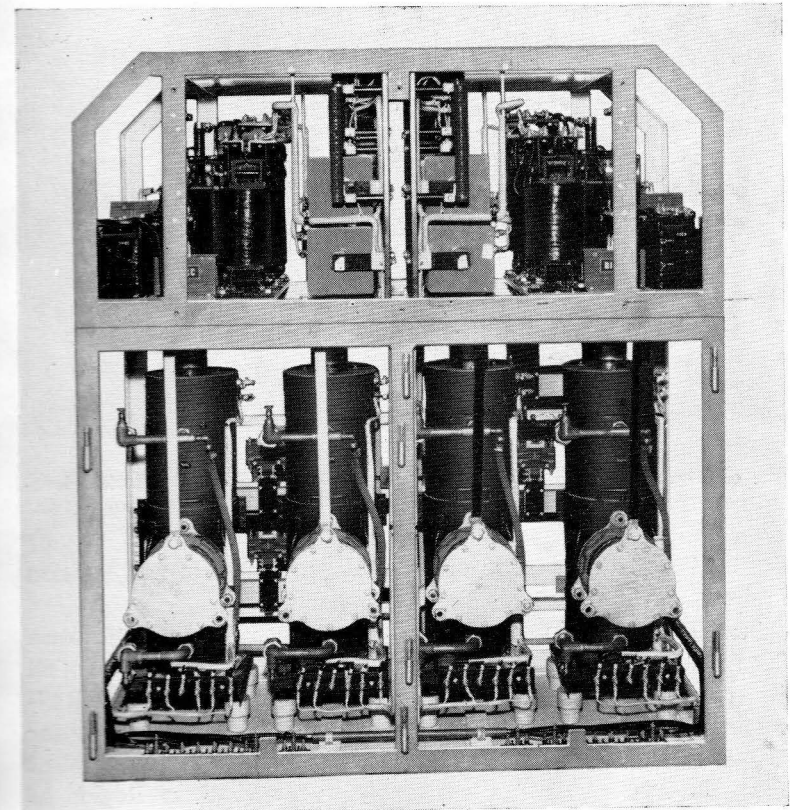
'ENGLISH ELECTRIC' experience of 50 cycle ac traction started as far back as 1952, when the first of three 860 hp 3-coach trains was put into service on the Lancaster, Morecambe and Heysham line of British Railways. An existing dc motor coach was used for this train to which two 'ENGLISH ELECTRIC' multi-anode mercury-arc rectifiers and an oil-immersed transformer were added. The contact wire was energised at 6600 volts.

In 1957, soon after the British Transport Commission announced its intention to proceed with major electrification schemes using the 50 cycle single-phase ac system, 'ENGLISH ELECTRIC' received orders for the electrical drive equipment for 112 motor coaches and 15 complete locomotives.



A silicon rectifier equipment as installed in a four-car multiple-unit train of British Railways

The first 25 kV ac multiple-unit train on British Railways was commissioned in December 1958. This train, together with trains put into service in March 1959 on the Colchester-Clacton line, all include 'ENGLISH ELECTRIC' electrical drive equipment. Each four-car set comprises a driving trailer, motor coach, non-driving trailer and driving trailer. The motor coach carries four traction motors, two pairs of air-cooled single-anode steel-tank mercury-arc rectifiers, a tap-changing transformer, reactors and ac and dc control gear. Automatic connections for either 25 kV or 6.25 kV operation are incorporated. All the electrical equipment is under-floor mounted.



Mercury-arc rectifier assembly as supplied to British Railways for 25 kV ac electrification. Two such units supply power for a 3,000 hp locomotive

The rectifier equipments for the fifteen 'ENGLISH ELECTRIC' 3000 hp electric locomotives differ from the motor-coach equipments in that eight water-cooled ignition type mercury-arc rectifiers are mounted in an above-floor compartment.

Later orders placed with 'ENGLISH ELECTRIC' by the British Transport Commission include electrical drive equipment for a further 42 motor coaches. These equipments include silicon rectifiers, which are very



One of fifteen 'ENGLISH ELECTRIC' 3,000 hp 25 kV 50 cycle electric locomotives being supplied to British Railways

simple due to the absence of pre-heating, excitation and ignition equipment.

In addition to equipment for 50 cycle ac electrified lines, 'ENGLISH ELECTRIC' is also supplying main-line diesel-electric locomotives of all five types - ranging from 1000 to 3300 hp - ordered for British Railways under the modernisation plan. Well over 1,000 power units for 350/400 h.p. diesel-electric shunting locomotives have been supplied since 1933. All electric rolling stock for the Southern Region of British Railways, which operates the most intensive suburban service in the world, has been equipped with 'ENGLISH ELECTRIC' traction motors and control equipment since 1936.

THE ENGLISH ELECTRIC COMPANY LIMITED

in association with

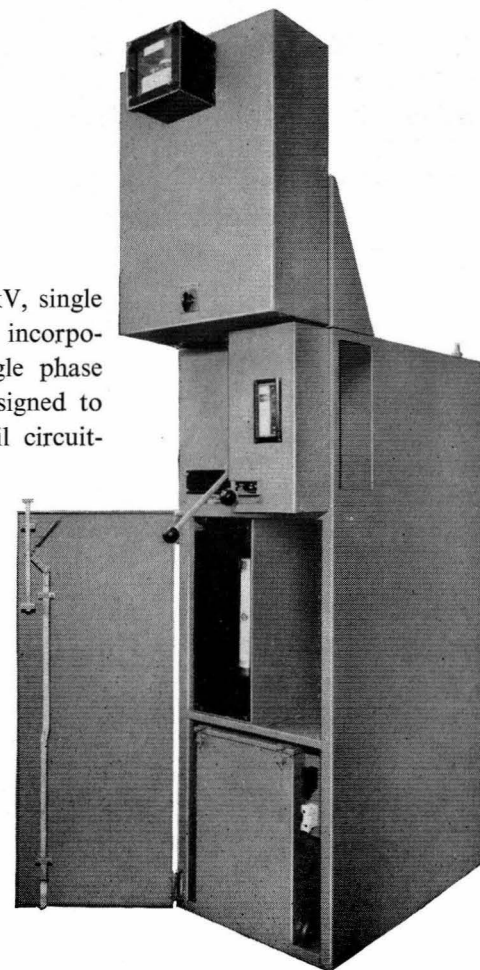
THE VULCAN FOUNDRY LIMITED and
ROBERT STEPHENSON & HAWTHORNS LIMITED

ENGLISH ELECTRIC HOUSE, STRAND, LONDON WC2

South Wales Switchgear Limited are exhibiting a number of equipments developed for and of special interest to those concerned in Railway Electrification.

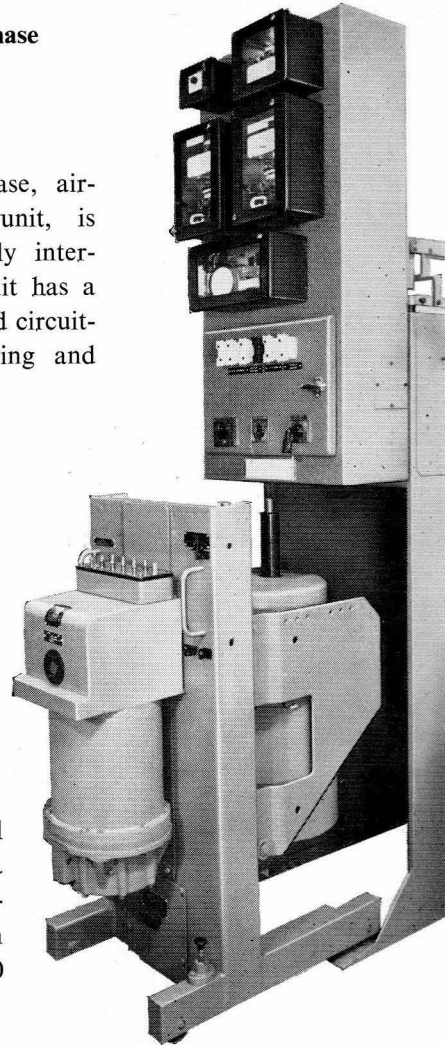
**Type AE/VT 6.25 kV
Single Phase
Fuse-switch Unit**

The type AE/VT, 6.25 kV, single phase, fuse-switch unit, incorporating a 3-position single phase oil switch, has been designed to line up with the SD6 oil circuit-breaker units.



**Type SD6 6.25 kV Single Phase
Air-insulated
Metal-enclosed
Switchgear**

The type SD6, single phase, air-insulated metal-enclosed unit, is vertically isolated and fully interlocked throughout. The unit has a withdrawable truck-mounted circuit-breaker with integral raising and lowering mechanism.



Also to be shown is a 2-panel fuse switch board with a built-in contactor and distribution board for use on 3 phase systems up to 660 volts.

BLACKWOOD, MONMOUTHSHIRE

For upwards of fifty years The General Electric Company Limited has been a major supplier of electrical equipment for railways, and in 1922 supplied the first 6.6 kV, 25 c/s ac equipments for the suburban systems of the former Southern Railway (L.B. and S.C. Section). Nine years later the Company built the equipments for the first 1,500 volt dc passenger trains with overhead supply to operate in this country. Now in connection with British Railways electrification at 25 kV, single-phase, orders have so far been placed to cover the building of ten 3,300 hp locomotives for passenger and freight service, to run at speeds up to 100 miles/h, as well as electrical power equipments for 71 multiple-unit trains. The first of the locomotives are now in service for driver training.

In addition to rolling stock the Company is supplying signalling equipment, train lighting and heating apparatus, and our associated



GEC 25 kV 3,300 hp locomotive

Company, Pirelli-General Cable Works Ltd, is supplying and installing overhead contact line equipment, feeder and communication cables. Some idea of the Company's activities in 25 kV railway electrification is given by the range of exhibits.

Rolling Stock

Power equipment for locomotives and multiple unit stock is being exhibited including traction motors, 'Com-Pak' rectifier equipments, transformers with automatic changeover switches and motor-driven tap-changing switches, master controllers and a motor-generator blower set. The 'Com-Pak' mercury arc rectifier is of considerable interest. It has a particularly high power/weight ratio and is capable of withstanding heavy overloads.

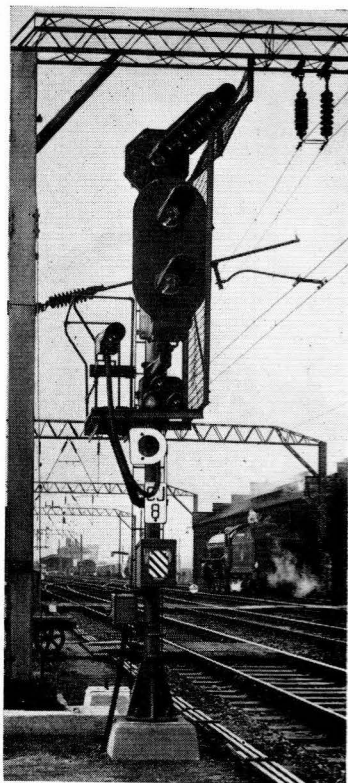
Signalling

Signalling equipment is supplied by The Siemens & General Electric Railway Signal Co Ltd whose exhibits include artificial track circuits covering single rail dc and single and double rail ac; a dc searchlight signal with immunised windings and series protective chokes, and a phase-angle and relay energization indicator for use in setting up ac track circuits.

All the equipment can be demonstrated in operation and controlled amounts of 50-cycle ac can be injected into the track circuits and searchlight signal, a cathode-ray oscilloscope showing the effects at selected points in each circuit.

Overhead Contact Line Equipment and Cabling

Pirelli-General Cable Works Ltd, is showing a wide range of

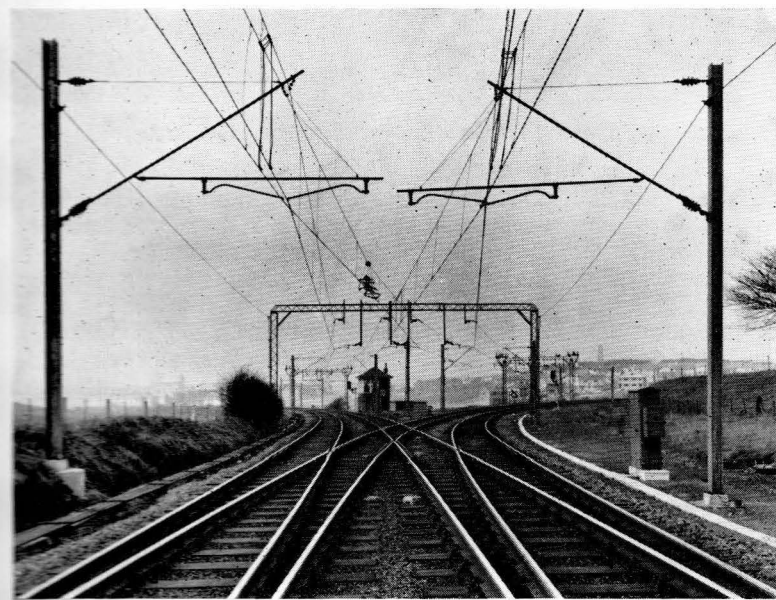


Searchlight signal and direction route indicator with subsidiary signals

power and communication cables including 25 kV concentric oil-filled feeder cables, stainless steel sheathed self-supporting aerial cables, a low loss communication cable spun to a catenary wire by an aerial cable spinning machine and special communication cable designed to prevent excessive induced voltages when used on 25 kV single-phase traction systems. The exhibits also include a double channel mast top complete with cantilever assembly, and photographs of overhead equipment erected by the Company on the Glasgow Suburban Electrification lines, Scottish Region, British Railways.

Heating and Lighting

Various designs of apparatus for carriage heating, water heaters and lighting are included on the stand. Heaters for locomotive-hauled stock are designed for operating on 800 V dc or 1,000 V ac with heating elements of the metal-sheathed, mineral-filled type,



British Transport Commission 25/6.25 kV balance weight equipment erected by Pirelli-General Cables Works Ltd



Fluorescent lighting operated by transistor-inverters from 110 V dc supply

positively sealed against moisture. For the multiple unit stock, heaters for underseat mounting operate at 265 V ac from a supply taken from the tertiary winding of the power transformer.

Fluorescent lighting operating through transistor-inverters from dc supplies is of particular interest. For locomotive hauled stock a 40 watt fluorescent tube inverter unit operates on a 24 V supply. For the 25 kV multiple unit stock, a transistor-inverter has been developed for service on a 110 V supply and feeds four 40 watt fluorescent tubes. The first installation using this form of lighting was supplied by GEC to the Eastern Region of British Railways.

MAGNET HOUSE KINGSWAY LONDON WC2

Signalling Equipment

The Signal Division exhibit is a model railway layout along which runs a model of the new British Railways Type "A" Bo-Bo 25 kV ac locomotive, the passage of which operates 4-aspect colour light signals in their correct sequence. Above the layout is a diagram of the track showing white route lights, red track occupied lights and indications showing the signal aspects.

In front of the layout there are displayed various types of signalling equipment used on ac electrified lines. At the left a relay rack accommodates various ac immune relays in both our miniature and standard size plug-in types. Adjacent to this is a test meter for measuring ac signalling voltages in the presence of 50 c/s voltage from traction sources.

Two sets of track circuits are shown:

1. The single rail Westatic style "R" Track Circuit of the dc type operates from an input of 110v 50 c/s. An ac immune track relay is used and the whole equipment is unaffected by normal levels of 50 c/s voltages from traction sources appearing across the track. If under traction fault conditions there is a very high level of 50 c/s on the track which might cause a serious deterioration in train shunt, then the auxiliary relay associated with the feed set will release, disconnecting the feed equipment from the track and causing a safety side failure.

2. The Westatic 75 c/s equipment for double rail track circuits employs a static frequency converter for changing 110v 50 c/s input into a 75 c/s output. At the relay end of the track circuit there is a frequency discriminator containing a filter and a rectifier. The dc output from the rectifier is used to operate a standard track relay. Two style "R" impedance bonds are shown which have been specially designed for use in 50 c/s traction territories.

On the turntable there is a cut-away section of the ac immunized "D" point valve which is used to control pneumatically-operated point machines.

Brake Equipment

The Brake Division exhibit shows some of the more important components of the electro-pneumatic brake equipment supplied for British Railways ac multiple unit stock and components for the vacuum controlled straight air brake equipment used on ac electric locomotives.

The EP Brake Controller is of the latest self-lapping design. Electrical and pneumatic isolation of the controller in non-operative driving positions is by a self-contained switch and pneumatic isolating valve which are operated when the controller handle is put into a special shut down position, this being controlled by a small removable key.

In view of the constant demand for easing the problem of maintenance and extension of overhaul periods, this controller and the other apparatus shown include rubber seated valves in place of metal valves.

The controller uses a diaphragm in place of the metal piston and the earlier wipe contacts have been replaced by silver alloy butt contacts. Maintenance is made much simpler and is largely a matter of the simple replacement of rubber seats, etc.

The magnet valves on the EP Brake Unit are of the latest design incorporating rubber seats and an integral pneumatic relay to allow the size of the coil to be considerably reduced with consequent saving in weight and bulk.

An improved version of the well known type JS Brake Cylinder with integral slack adjuster is now being supplied. This cylinder, type JSL, shows considerable weight reduction and is simpler than previous types.

The self-lapping straight driver's brake valve of greatly simplified design and the vacuum driver's brake valve with spherical valve and rubber seat are also shown. Both of these valves are supplied for the locomotive brake equipments and the designs are conspicuous by eliminating the metal valves previously employed.

The 'Pilotair' Control Valve is shown – capable of a great diversity of applications, it is used on the ac Multiple Unit stock to control the foot-operated horns.

Compressors – Type E5. A small machine flange mounted on its electric driving motor – used for raising pantographs and charging Air Blast Circuit Breakers before entering service (M.U. Stock).

Type 2.EC.38. Capacity 28 cu. ft. free air/min. – Integral electric motor – Direct drive without reduction gearing. Main compressed air supply for locomotives.

Exhauster – Type 4.V.110.L. Swept Volume 110 cu. ft./min. at 1,000 r.p.m. Flange mounted motor – Direct drive without reduction gearing. Main vacuum source for locomotive.

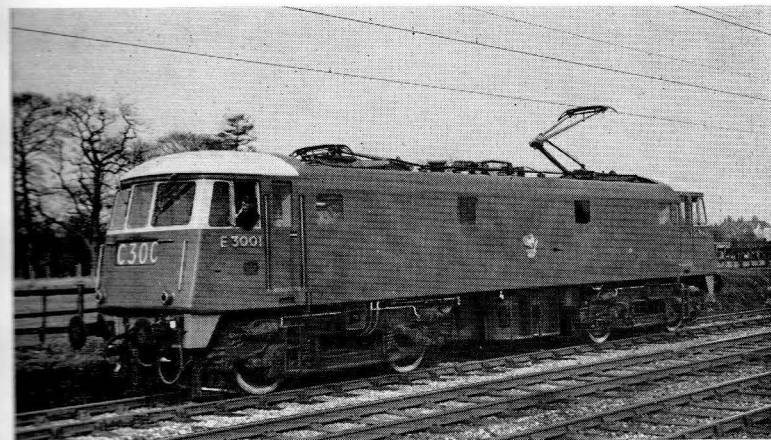
Rectifier Equipment

The Rectifier Division exhibits include a Westalite traction equipment, style 1285, one complete rack of Silicon rectifiers forming part of a main traction rectifier equipment style 6029, and a selection of Selenium and Silicon rectifiers specially intended for traction service.

The type 1285 equipment which is completely static, employs natural cooling and is designed for operation on B.T.C. ac multiple-unit services on London-Tilbury-Southend and Enfield-Chingford-Bishops Stortford lines. The equipment which is under-frame mounted uses a specially developed Selenium rectifier of potted construction in both circuits to meet the adverse environmental conditions. Both circuits are supplied from the tertiary of the main transformer which is nominally 240 volts, 50 cycles, single-phase, with a range of variation from 176 to 315 volts. One circuit is a straightforward bridge rectifier giving 200 volts dc (nominal) for the dc motor of the Westinghouse type CM.38 air brake compressor. The other circuit is a constant potential transductor controlled rectifier providing 8kW at 110 volts dc $\pm 1\%$ despite simultaneous load and supply variations, to float charge a 72 cell 55AHC nife battery, and supply carriage lighting control circuits, etc. Transductor excitation is derived from a Westmag controller which senses any deviation from 110 volts and re-establishes correct operation by means of a magnetic amplifier. A current limiting circuit is included in the controller to prevent overload of the rectifier should a condition occur where full load is applied to this circuit with a completely discharged battery. The type 1285 equipment is of rugged construction, and is completely static, no relays, contactors, etc., being used.

The Silicon rectifier rack which forms part of the main traction rectifier style 6029 is also designed for operation on B.T.C. ac multiple-unit services, the complete equipment being rated for 1,500 volts dc 520 amps. This equipment, which is forced air-cooled, occupies only one bay of the motor-coach underframe. The equipment case includes cooling fan, rectifier diode fuses and associated current transformers for fuse failure indication, rectifier surge suppressor and fan proving device in addition to the rectifier racks. A feature of the design is that all Silicon rectifier diodes and interconnections are accommodated within "clean" parts of the equipment case, only rectifier cooling fins being subjected to "dirty" cooling air. Consequently tracking difficulties are ameliorated.

Silicon rectifier diodes SXAN.125 of normal polarity, and SXBR.125 of reverse polarity, as used in the main traction rectifier, are shown, and in addition Selenium rectifiers type T12A, T13A and T14A to specification U.712 for traction operation, as well as rectifier extrusion type E113B employed on type 1285 equipment.



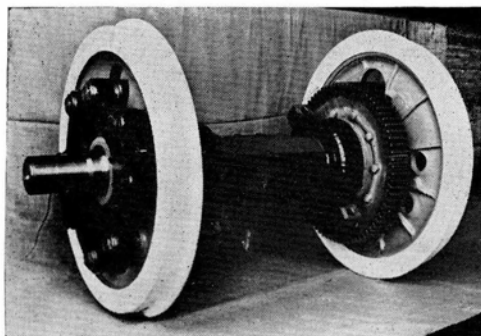
Locomotive E3001

In 1959 the Traction Division of Associated Electrical Industries Limited was formed by the integration of the Traction Departments of British Thomson-Houston Co Ltd and Metropolitan-Vickers Electrical Co Ltd both of which have been manufacturing electric traction equipment since before the turn of the century. It is not surprising therefore, that the AEI Traction Division should be playing a large part in the conversion of the main lines of British Railways to 25kV 50-cycles single-phase electric traction.

Two complete AEI electric locomotives are shown – one of the E3001 type, of which there are twenty-five, designed at the Rugby Works (formerly BTH) with mechanical parts sub-contracted to the Birmingham Railway Carriage and Wagon Co Ltd, and the other of the E3046 type, of which there are ten, designed at the Manchester Works (formerly M-V) with mechanical parts sub-contracted to Beyer Peacock & Co Ltd. The main difference between the two is that the E3001 type employs low tension tap changing, while the E3046 type employs high tension tap changing.

Alongside these locomotives, shown outdoors, there is a 3,300 hp electric locomotive of the E3056 type, one of forty being built by British Railways with electrical equipment by AEI.

A Glasgow suburban multiple-unit electric stock is also on view. A total of 91 complete three car sets were ordered by British Railways for the Glasgow and district 25kV electrification. The mechanical



Locomotive wheel and axle assembly with Alsthom type drive

silicon and germanium rectifiers all being represented.

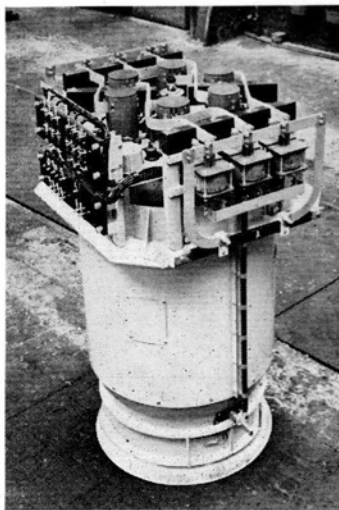
The large six-anode pumpless steel-tank mercury-arc rectifier is of the type used on the AEI 25kV locomotives. Three of these rectifiers are installed on each locomotive to convert the output of the transformer to direct current for the traction motors; they are diametrically connected in parallel so that each tank has three anodes in each half cycle.

The single-anode pumpless mercury-arc rectifier tank, of the continuously excited type, is used on the Glasgow Suburban multiple-unit stock. Four of these rectifiers, specially designed for underframe mounting, are used on each train set. (Similar equipment, commissioned by Metropolitan-Vickers on one of the Morecambe-Heysham trains in 1957, has operated without trouble for over 100,000 miles).

The silicon semi-conductor rectifier tray is of the type being supplied for some of the 25kV ac locomotives built by British Railways and the germanium semi-conductor tray is of the type

parts for these are being built by the Pressed Steel Co Ltd at their Paisley Works, while all electric traction, heating and lighting equipment is being supplied by AEI.

Indoors on the AEI stand are essential parts of electric locomotive equipment. Prominent among these are the rectifier exhibits; mercury-arc (multi- and single-anode),



Multi-anode steel-tank mercury-arc rectifier

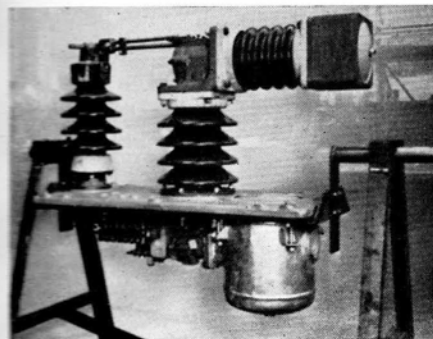
supplied for the conversion of 124 Liverpool St. - South-end trains from 1,500 V dc to 25,000 V ac.

A traction motor for a 3,300 hp locomotive is displayed, complete with a wheel and axle assembly incorporating the Alsthom type flexible drive, which reduces the unsprung weight of the locomotive to a minimum. 300 motors of this type are at present being supplied by AEI. It has the following ratings to BTC Spec. AC3:

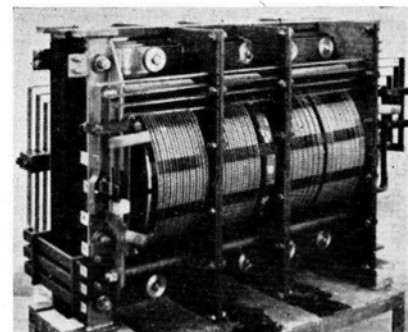
1 hour	975 volt	760 amp	920 shaft hp
Continuous	975 volt	700 amp	847 shaft hp

One of the main transformers as used on the Glasgow suburban multiple units is included among the exhibits. It has been specially designed for underframe mounting, and low tension tap changing is employed because of the difficulty in obtaining adequate clearance for the transition contactors which normally operate in air. This transformer is divided internally into two compartments. The core and windings are in one compartment and the 2-way primary change-over switch is in the other. (The switch is operated by an electrically-controlled air engine, flange mounted on the outside tank wall.)

An air-blast circuit breaker as used on British Railways electric stock is shown working under simulated operating conditions. 145 of these breakers have been ordered by British Railways.



An AEI air-blast circuit breaker as used on British Railways electric stock



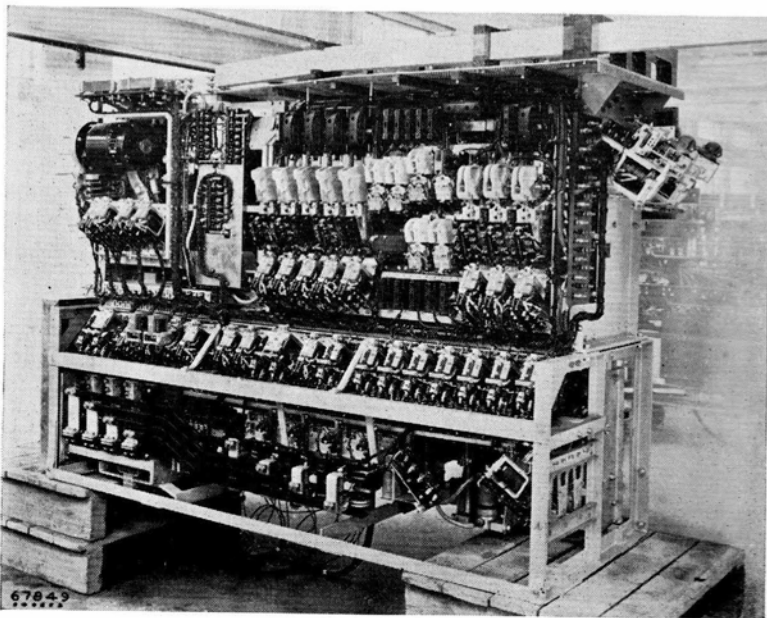
Glasgow suburban multiple-unit-stock transformer

Control gear and tap changing equipment are represented by a complete LT tap changing cam group from one of the Glasgow equipments and an LT locomotive cam-shaft tap changing group with motion gearbox,

driving motor and notching relay.

Other electric rolling stock parts on display include a controller, reverser, overload relay, contactor, potential transformer, relays and automatic power control panel.

Also on the stand are some exhibits of the AEI-GRS Company, and a working display of single-phase distance impedance protective gear for overhead lines, shown by the AEI Instrumentation Division. AEI-GRS is playing a large part in the supply of dc operated railway signalling equipment which has to be specially immunised against the effect of ac traction. Some examples of protected equipment are shown. They include 24-volt dc relays protected against pick-up on 1,000 volts ac, a dc searchlight signal mechanism, the feed and relay ends of a dc track circuit, and a double rail ac track circuit operated at $83\frac{1}{2}$ cycles.



Locomotive LT tap-changer cam group and control unit

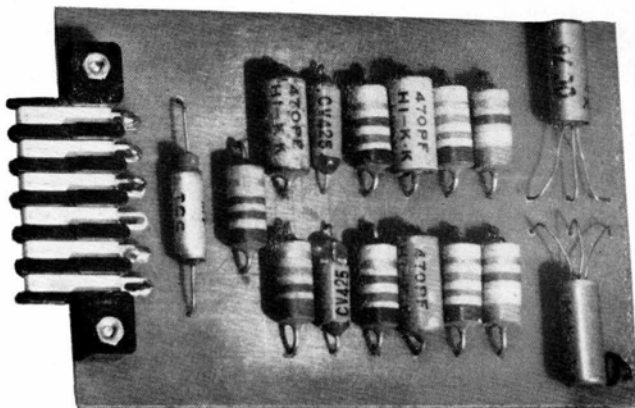
TRACTION DIVISION, TRAFFORD PARK, MANCHESTER 17

We are exhibiting ATE Selective Ringing Party Line Telephones which enable any way-station to be rung individually even with the handset off the rest. These telephones developed specifically to meet the requirements of the railway electrification programme, work on lines sectionalized by transformers. They employ a carrier frequency of 50 c/s which is amplitude modulated at frequencies of 1-14 i.p.s. to actuate the selective ringing device which consists of a galvanometer relay of the type used extensively in this country and abroad for ripple control over electricity distribution networks.

An all-electronic precision pulse source - the ATE Crystal Chronometer - is shown. This has a time interval accuracy of the order of a few seconds per year. This accuracy is not affected by vibration or movement and the Chronometer is therefore particularly suitable for mobile use.



The ATE Crystal Chronometer

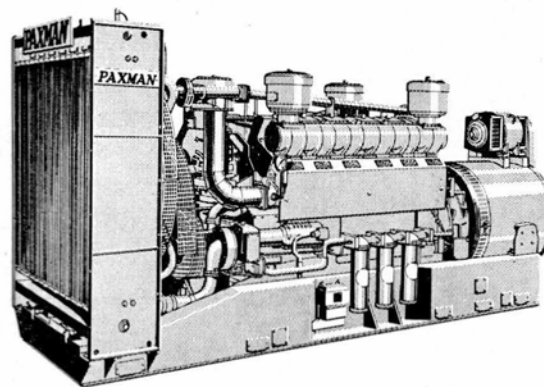


Crystal Chronometer Binary
Divider Circuit Panel

The ATE Crystal Chronometer reduces the wide gap, both in performance and cost, which exists between conventional mechanical or electro-mechanical clocks and the elaborate but extremely precise Caesium atomic clock. It employs a crystal-controlled oscillator to generate a basic frequency which is fed to a series of binary dividers the outputs of which are used to operate pulsing circuits at intervals to meet various requirements including that for an extremely accurate timepiece. In this respect, its margin of error is less than one second per month.

CS Ltd., are also exhibiting a cordless switchboard as used in association with ATE Private Automatic Branch Exchanges. Instead of the jacks, cords and plugs traditionally associated with telephone switchboards, this new switchboard has a neat row of press-buttons and keys for rapid handling of calls and many other time-saving facilities.

STROWGER WORKS, LIVERPOOL 7



Quietly behind the scenes a Paxman 8RPH alternator set (similar to that in the illustration above) is providing power for this exhibition.

The alternator set has been
loaned by
DAVEY, PAXMAN & CO LTD,
STANDARD WORKS,
COLCHESTER

Exhibition Architects

John & Sylvia Reid A/ARIBA, F/FSIA

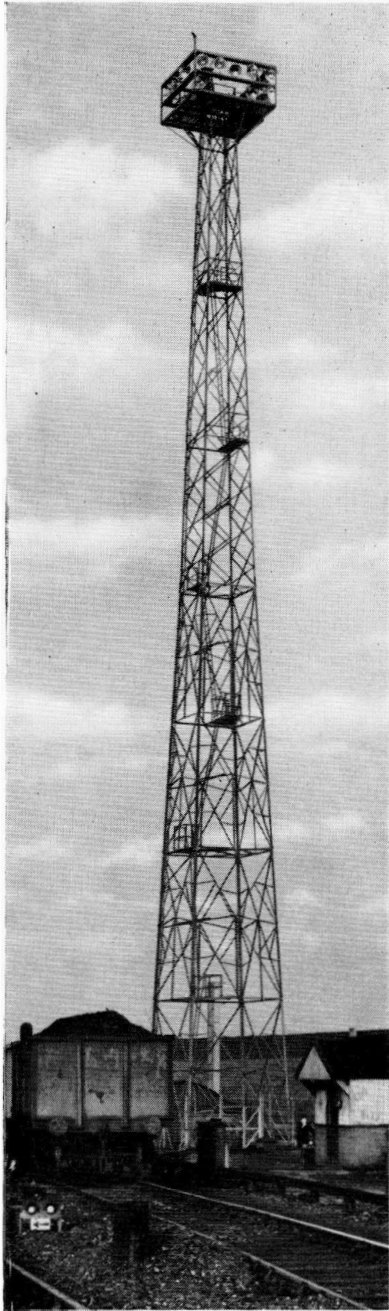
Contractors

Exhibition Construction: EGC Ltd

Shell Scheme: F W Clifford Ltd

Electrical: CP Electrical Ltd

Mechanical Handling: Beck & Pollitzer Transportation Ltd



**BRITISH INSULATED
CALLENDER'S
CONSTRUCTION
COMPANY LIMITED**

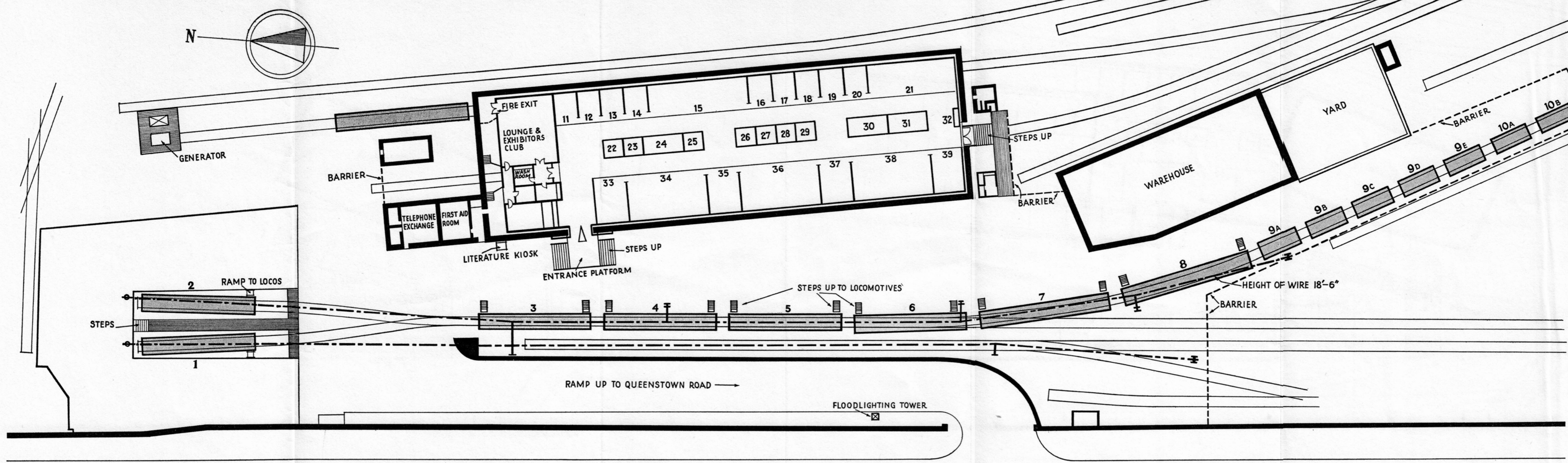
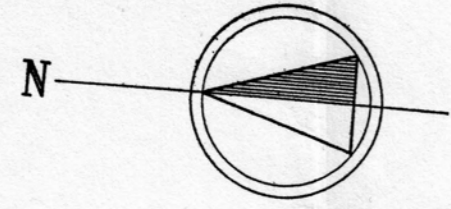
The tower marking the entrance to the Exhibition site at Battersea is of the type designed to meet the BTC's need for low level floodlighting. It is 50 ft (15.2m) high and supports four AEI floodlights 55 ft (16.7m) above ground. It was fabricated and galvanized by Painter Brothers Limited, Hereford.

The illustration is of one of the numerous high level floodlighting towers supplied and erected in the Crewe Marshalling Yards for the London Midland Region. These are 150 ft (45.7m) high and each carries a bank of up to 40 floodlights.

30 Leicester Square,
London WC2



PLAN OF EXHIBITION



BRITISH RAILWAYS ELECTRIFICATION EXHIBITION. BATTERSEA WHARF, OCTOBER 1960

QUEENSTOWN ROAD