

THE  
DROITWICH  
TRANSMITTING  
STATION

THE BRITISH BROADCASTING  
CORPORATION

1934

PRICE SIXPENCE



Hm #8  
229

# THE DROITWICH TRANSMITTING STATION

---

The general design and lay-out of the Droitwich dual-programme transmitting Station differs widely from that of the four medium wave Regional Stations built during the past five years at Brookmans Park, Moorside Edge, Westerglen and Washford Cross. Changes in design have been made necessary for the following reasons.

The new long-wave transmitter was designed for a power of 150 kW to its aerial, that is at least three times the power of any station previously built by the B.B.C. Furthermore, a number of special precautions have to be taken in the design of a long-wave transmitter and its aerial circuits if reproduction is to be comparable with that obtainable on medium wavelengths.

The Droitwich Station has been designed as a dual-programme transmitting station, and in addition to the long-wave transmitter it will house the new Midland Regional transmitter. Installation of the Midland Regional transmitter is to begin immediately in the open space in the gallery facing the National transmitter units. All the auxiliary equipment for the Midland Regional transmitter is already installed, such as motor-generators and switch-gear. The transmitter itself will be similar to those at Washford Cross.

The main points of difference in the design of the Droitwich Station as compared with the four Regional Stations are:—

(1) The Power House generates alternating current instead of direct current.

(2) Series modulation has been employed for the long-wave transmitter.

(3) The high-tension supply for the 150 kW long-wave transmitter is normally obtained from mercury-arc steel-tank rectifiers and not from motor-generators.

(4) The switch-gear controlling the various power supplies to both transmitters can be operated automatically from the control table in the Transmitter Hall.

(5) The physical height of the 150 kW transmitter units has made it convenient for the Transmitter Hall to be built with a gallery. The units are built through the floor of the gallery.

(6) An important unit has been introduced between the output of the transmitter and the feeder lines to overcome the difficulty in obtaining a good response at the high audible frequencies on the long wavelength.

(7) The masts are 700 feet in height, the highest previously used by the B.B.C. being 500 feet.

Fuel-oil storage is provided by two tanks at the rear of the building, each having a capacity of 150 tons. This is sufficient to enable the Station to radiate two programmes on full power during normal times for a period of three months. Outside the building, also at the back, are situated the



THE B.B.C. TRANSMITTING STATION AT DROITWICH



cooler for the Diesel engine circulating water and the silencer pit. As in previous stations, the main heating for the building is provided by an exhaust-gas boiler, with a separate oil-fired boiler for heating the Station when the engines are not running.

Entering the Station at the Power House end of the building, the following are the principal items of interest.

### THE POWER HOUSE

The equipment of the Power House comprises four 750 b.h.p. six-cylinder Diesel generator sets, each set being directly coupled to a 470 kW three-phase alternator. The Diesel sets run at 375 r.p.m. and the output voltage is 415. The Power House is designed for a maximum capacity of 1,880 kW, but the normal load when both transmitters are working on full power will be about 1,000 kW. This represents the running of three Diesel sets on three-quarter full load.

As in previous stations, any vibration set up by the Diesel engines is isolated from the building by the mounting of all four engines on a 900 ton reinforced concrete block floating on cork. The switchboard in the Power House controls the output of all four generating sets and follows standard practice so far as circuit breakers, synchronising equipment and metering are concerned. In addition to the Diesel engine auxiliaries (fuel pumps, water circulating pumps, air compressors, etc.) the Power House also contains two A.C. to D.C. motor-generators for charging the Station storage-battery.

Proceeding from the Power House towards the front of the building we come to the Battery Room. In this is installed a 1,500 ampere-hour 220 volt battery, the function of which is to provide station lighting, and power for auxiliaries which

have to be used when the Station is not radiating a programme and the engines are not running.

Situated also between the Power House and Battery Room are the usual workshops, transmitter and engine stores, and a garage.

### HIGH-TENSION MACHINE ROOM

The design of the Droitwich Station was somewhat complicated by the fact that the 150 kW long-wave transmitter requires a high-tension supply of about 30 amps at 20,000 volts, while the high-tension supply for the Midland Regional transmitter is 15 amps at 11,000 volts. Two mercury-arc rectifiers have been installed, one acting as a standby to the other. The high-tension transformer, pumps and auxiliary equipment for each rectifier are installed in the respective rectifier enclosures.

Two high-tension motor-generators (maximum voltage 12,000) have been installed for the Midland Regional transmitter, one as a standby to the other. The switch-gear for these machines is so arranged that the two generators can be run in series for the supply of high-tension (20,000 volts) to the long-wave transmitter, if required. The machine room also contains part of the smoothing circuit for both the motor-generator and the rectifier high-tension supplies and, at gallery level, switch-gear controlling the input to the high-tension machines and rectifiers.

### TRANSMITTER HALL

#### *Ground Floor*

The Transmitter Hall is quite unlike that of any other B.B.C. station, as at ground level it houses all the motor-generators for the two transmitters, excluding the two high-tension machines previously described. On the long-wave side of the Transmitter Hall is situated solely the

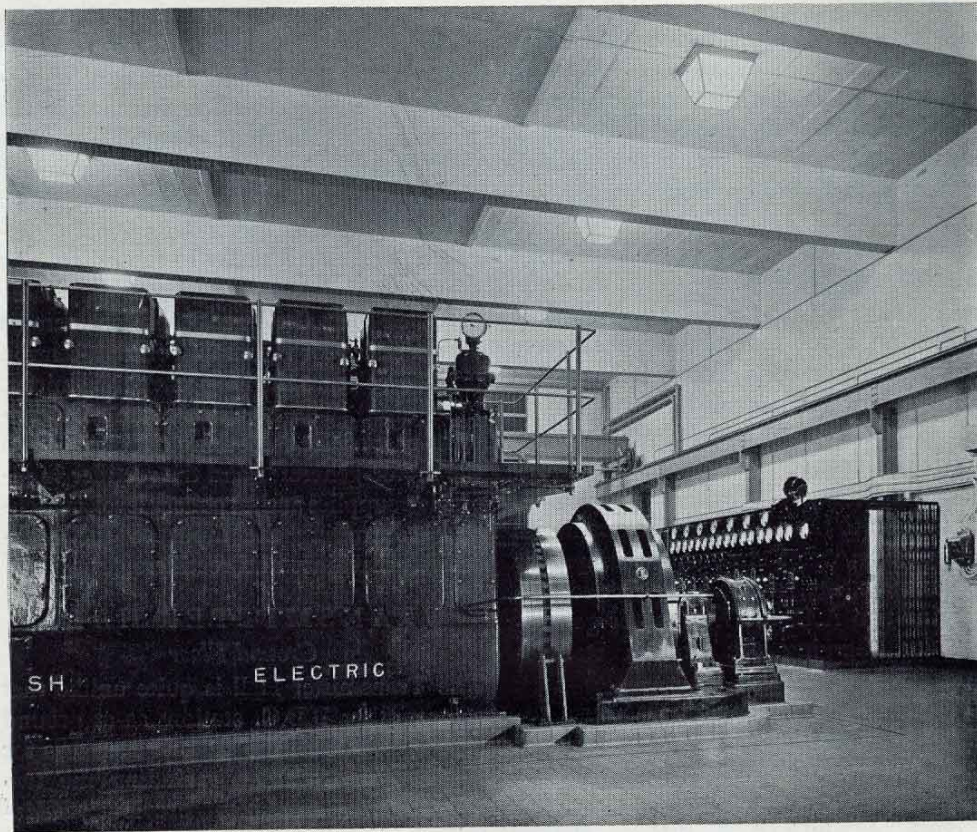


filament-current machines for the long-wave transmitter. Each of these machines is mounted immediately adjacent to the particular unit or valve which it is supplying.

A point of particular interest is the two machines, one as a standby to the other, which supply filament current for the "B" unit of the long-wave transmitter. It will be noticed that these two machines are installed in a safety enclosure and are entirely insulated from earth. This is because the filaments of the valves which they supply are 10,000 volts above earth, rising to as much as 20,000 volts during full modulation. The induction motors

driving these machines are at earth potential and power is transmitted through porcelain couplings. The various controls, such as field current regulators, are similarly insulated.

Amongst the machines on the ground floor is a unit which has been called a "transducer." This unit, which is situated in the circuit between the output of the transmitter and the feeder lines to the aerial-transformer house, contains high-frequency circuits, the main function of which is to reduce attenuation of the higher audio frequency side-bands, thus enabling the long-wave transmitter to have a straight

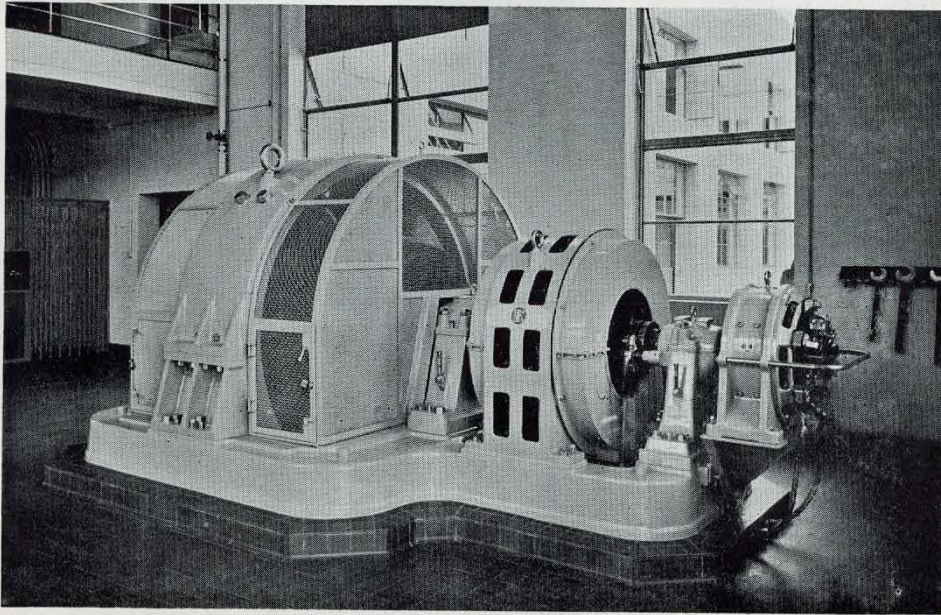


ONE OF THE FOUR 470 kW DIESEL-GENERATOR SETS AND PART OF THE POWER SWITCHBOARD, TAKEN AT NIGHT



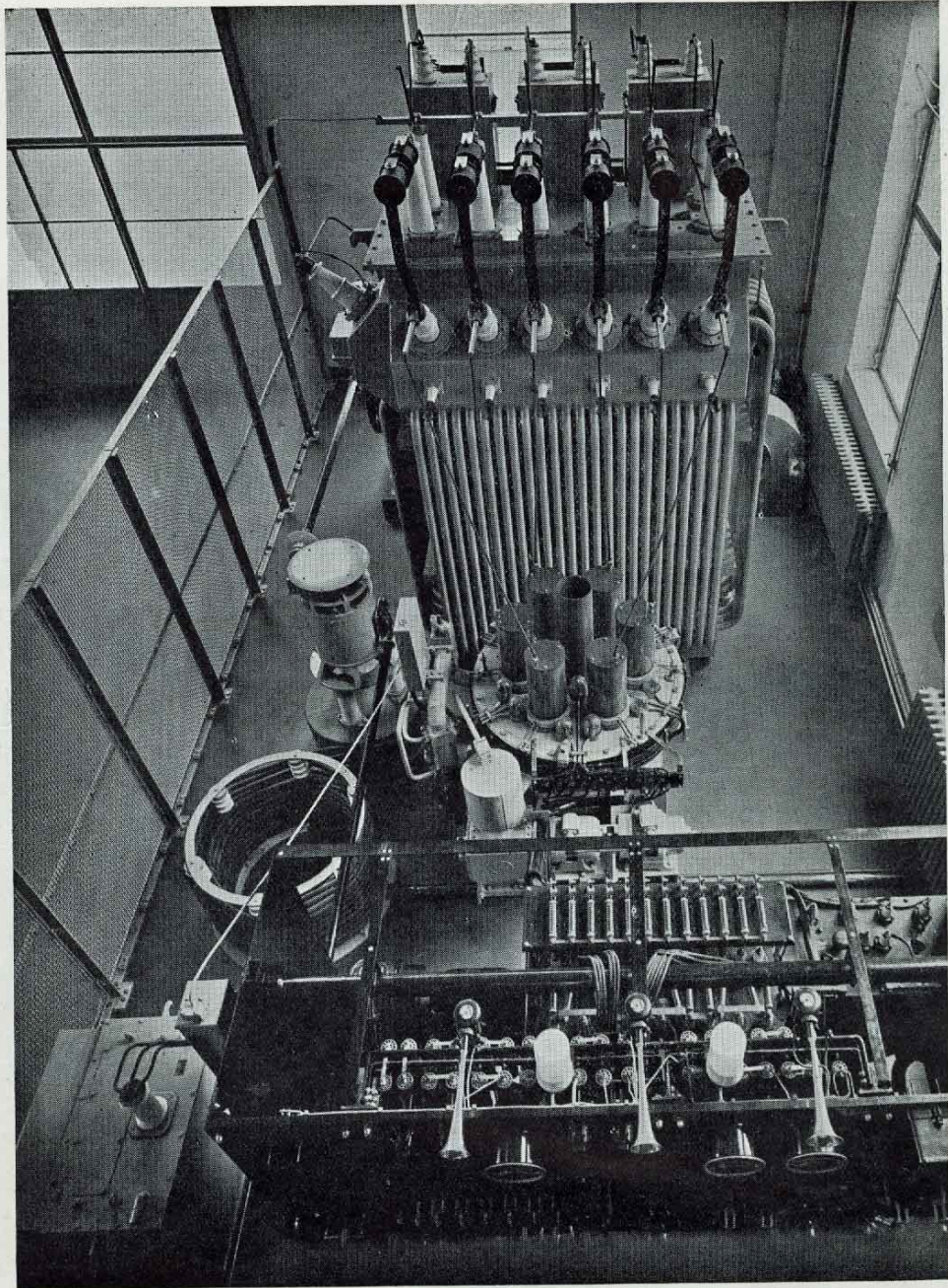


THE HIGH-TENSION MACHINE ROOM, TAKEN AT NIGHT, SHOWING THE A.C. INPUT SWITCH-BOARD, SMOOTHING ENCLOSURE, AND THE TWO MERCURY-ARC-RECTIFIER ENCLOSURES



ONE OF THE 12,000 VOLT D.C. MOTOR-GENERATORS FOR THE SUPPLY OF HIGH-TENSION CURRENT TO THE MIDLAND REGIONAL TRANSMITTER





ONE OF THE MERCURY-ARC-RECTIFIER ENCLOSURES AS SEEN FROM THE MACHINE ROOM GALLERY



line frequency response up to approximately 9,000 cycles per second.

On the other side of the Transmitter Hall are situated the filament-current generators, grid-bias generators, and H.T. generators for the early stages of the Midland Regional transmitter, the units of which will be installed immediately above them. The grid-bias machines and H.T. generators for the earlier stages of the long-wave transmitter are also on this side of the Transmitter Hall.

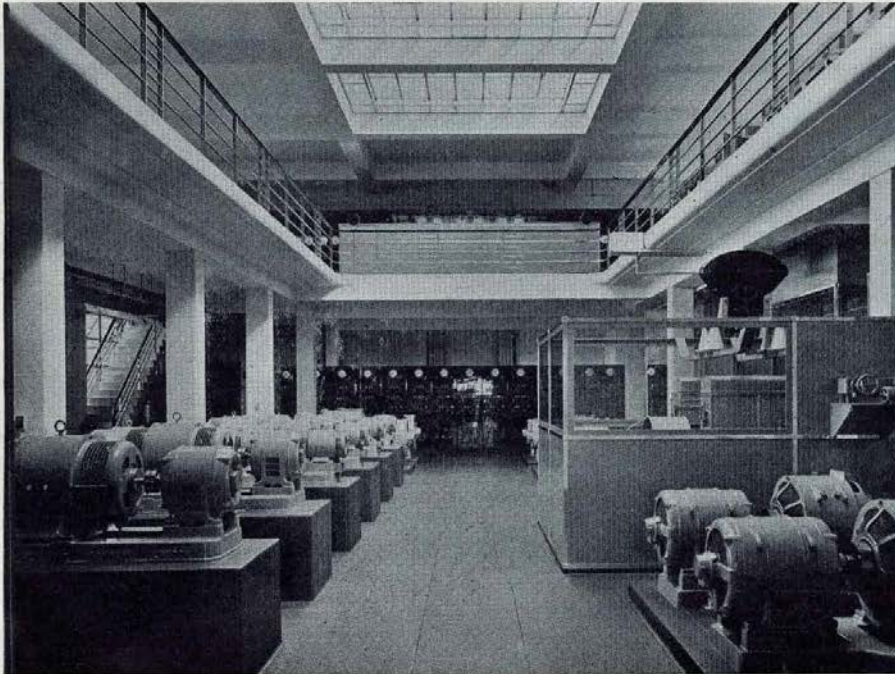
All motors driving the various generators in the Transmitter Hall are of the induction type, but the larger motors driving the high-tension generators are self-starting synchronous motors. The principle of

grouping all the smaller motor-generators on ground level in the Transmitter Hall enables them to be conveniently watched by the engineers on duty at the transmitter control table. At one end of the Transmitter Hall, also at ground level, is a large switchboard on which are mounted the contactors of the automatic switch-gear for the control of the motor-generators.

## TRANSMITTER HALL

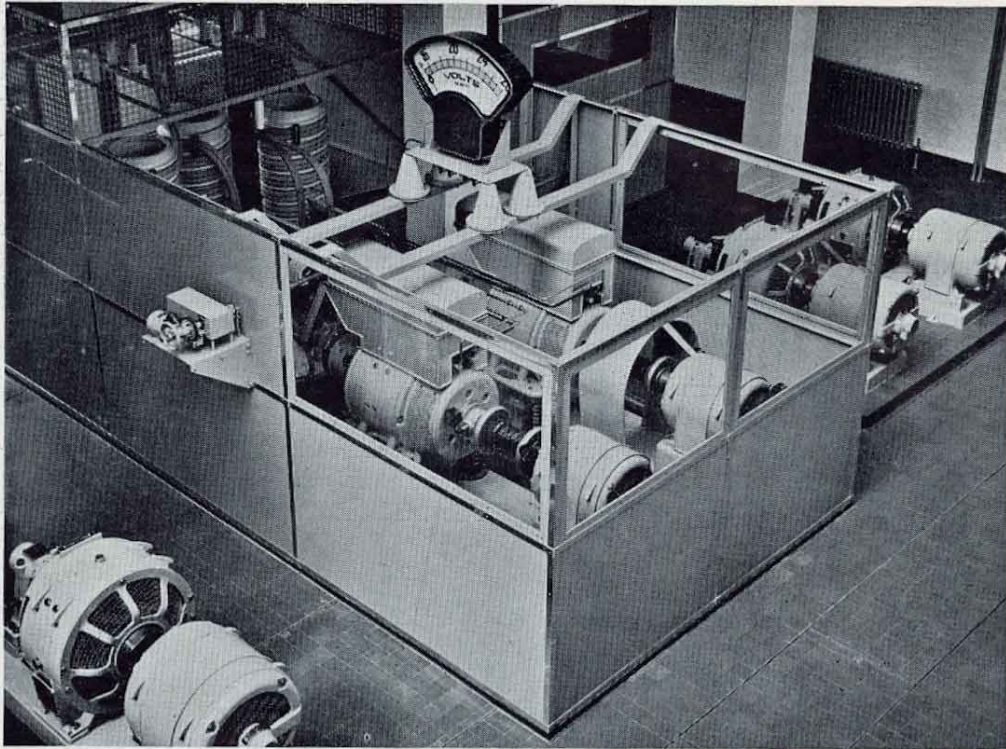
### *Gallery*

The gallery of the Transmitter Hall will, as explained earlier, contain the two transmitters on opposite sides, facing each other. The Midland Regional transmitter is de-



THE GROUND FLOOR OF THE TRANSMITTER HALL. ON THE LEFT ARE THE REGIONAL TRANSMITTER FILAMENT-CURRENT MACHINES AND GRID-BIAS MACHINES ; ON THE RIGHT, THE NATIONAL TRANSMITTER FILAMENT-CURRENT MACHINES





THE SAFETY ENCLOSURE CONTAINING THE MOTOR-GENERATORS WHICH SUPPLY FILAMENT-CURRENT TO THE OUTPUT VALVES OF UNIT 'B'. THE GENERATORS WORK AT 10-20,000 VOLTS ABOVE EARTH POTENTIAL.

(One of the shields has been removed to show the porcelain coupling between the generator and earthed motor.)

signed for an output of 50 kW and is similar to those at Washford Cross. It will not, therefore, be described in these remarks.

The long-wave transmitter consists of 5 units, as follows:—

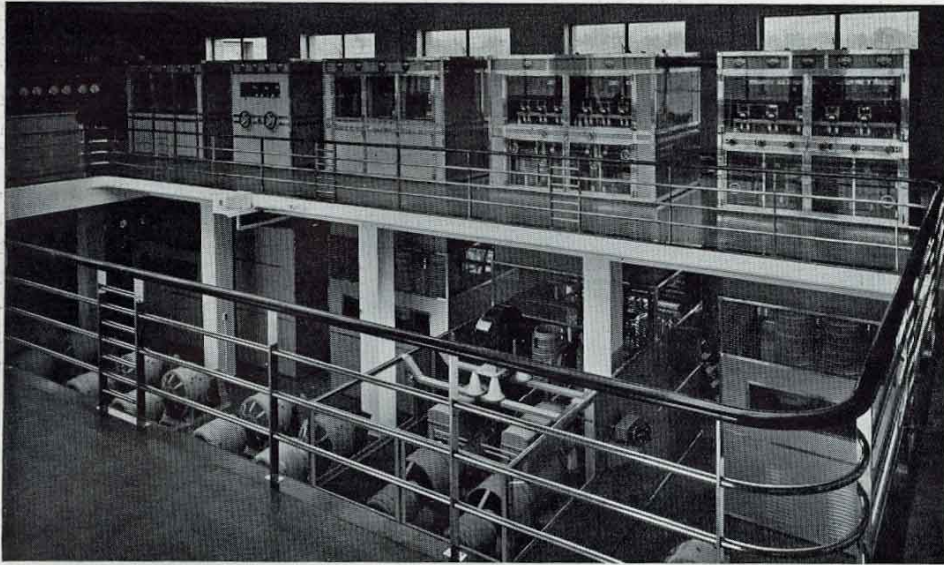
*Unit A.* This is purely a three-stage low-frequency power amplifier, or modulation unit. The final stage of this unit consists of four 10 kW water-cooled valves connected in parallel and working on 10,000 volts high-tension. Standby valves for each stage are provided, and can be brought into circuit immediately by the operation of their respective change-over switches.

*Unit B.* The second unit is a <sup>LWO</sup> three-stage high-frequency power amplifier, driven by a constant-frequency drive situated elsewhere in the building. The final stage of Unit B consists of four 15 kW water-cooled power transmitting valves also running with 10,000 volts on their anodes. The usual arrangements are provided for switching in spare valves without the necessity of handling the valves themselves.

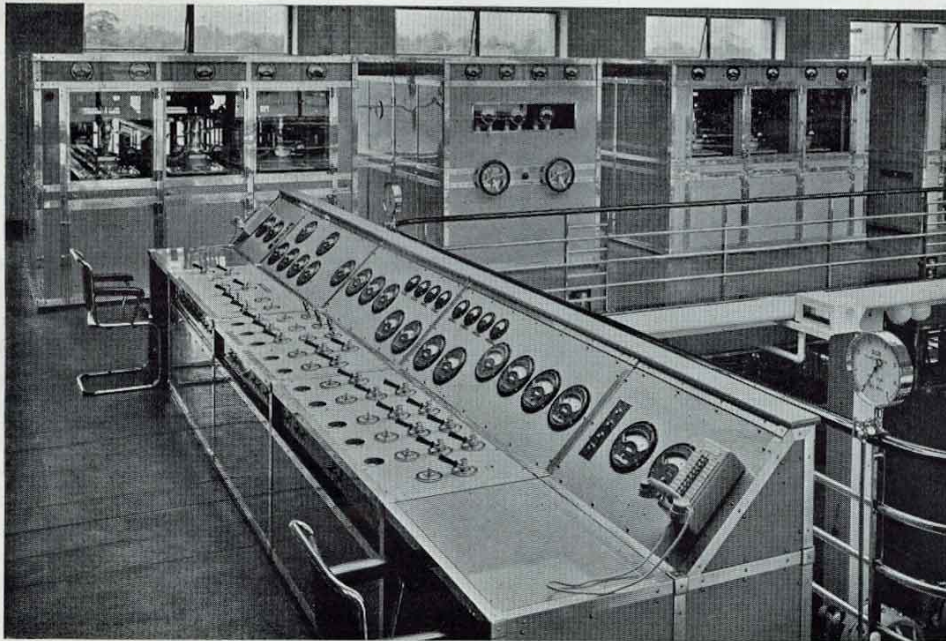
#### MODULATION SYSTEM

The new Marconi system of series modulation has been incorporated in the design of this transmitter. The final stages of Unit A





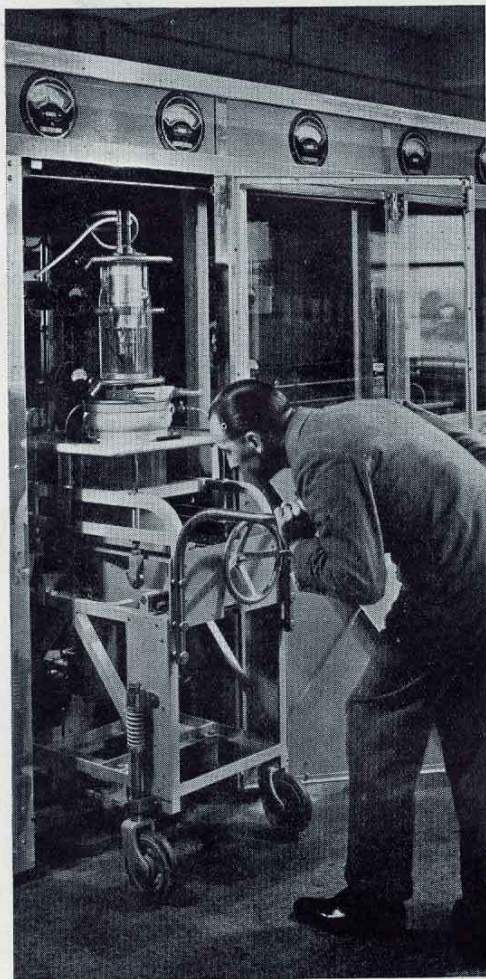
A GENERAL VIEW OF THE TRANSMITTER HALL SHOWING THE NATIONAL-PROGRAMME TRANSMITTER AND THE MOTOR-GENERATORS WHICH SUPPLY IT WITH FILAMENT-CURRENT



THE CONTROL TABLE FROM WHICH THE POWER SUPPLIES TO THE TRANSMITTERS ARE CONTROLLED, AND THE OUTPUT STAGE OF THE NATIONAL TRANSMITTER



and Unit B are connected in series. Thus the final stage of Unit A acts as a speech-controlled resistance in series with the high-tension supply to Unit B, the total voltage across both stages being approximately 20,000. Thus, in the condition of no modulation each will have a potential of approximately 10,000 volts across it. *Units C.1 and C.2.* The third and fifth units of the transmitter are the two halves of the



WHEELING ONE OF THE OUTPUT VALVES OF THE NATIONAL TRANSMITTER INTO POSITION

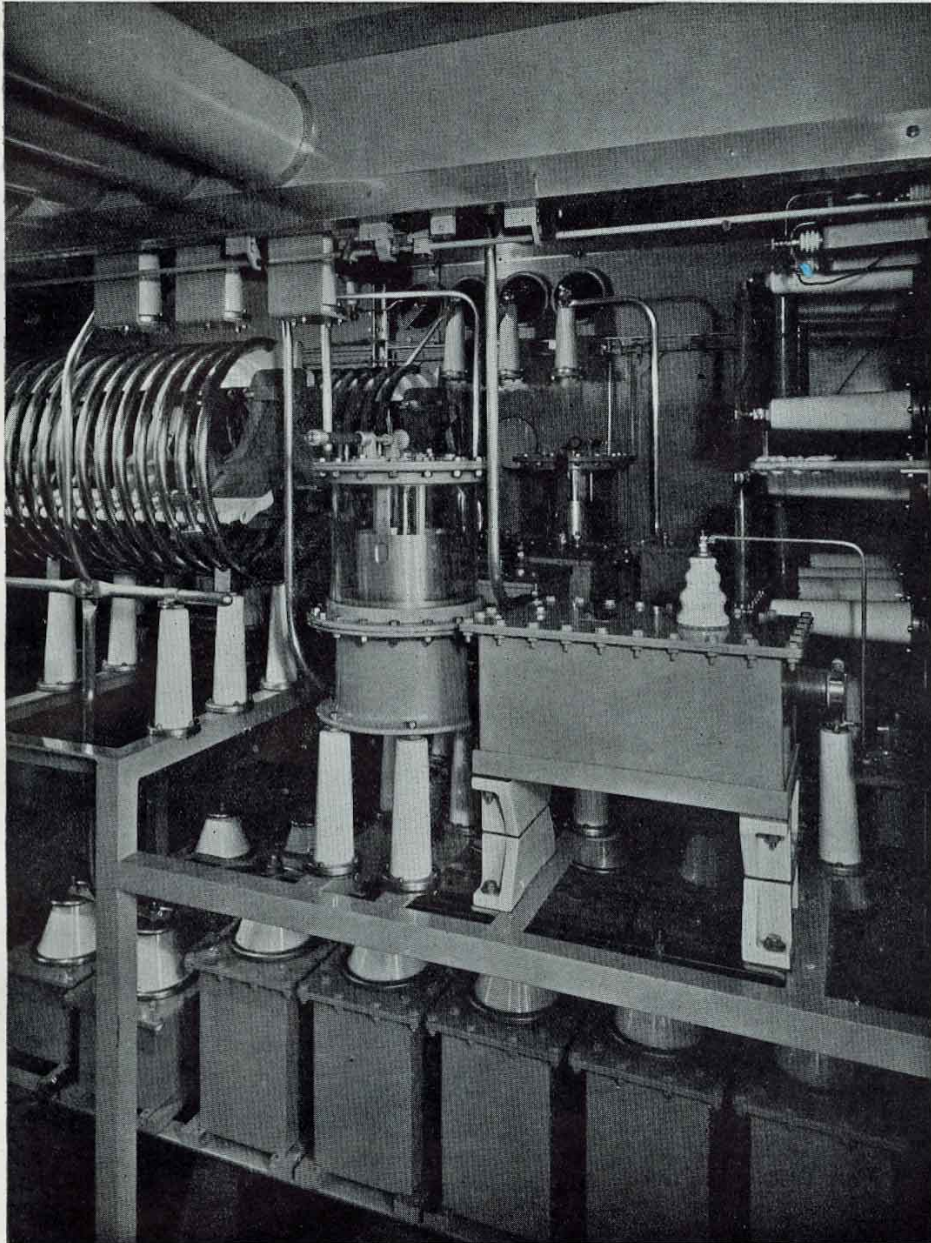
final push-pull modulated-high-frequency stage. Each of these units contains three water-cooled transmitting valves of a new type. These valves are each capable of a maximum output of 50 kW, one valve in each unit acting as a spare. With two 50 kW valves each side of the push-pull circuit, therefore, an output power of 150 kW is obtainable without running the valves at their full load rating. Owing to their weight and physical size a special trolley arrangement has been provided for wheeling the valves into position with a jack to lift them on to their seatings.

*Unit D.* Unit D contains the tuning circuits for Units C.1 and C.2 which are situated symmetrically on either side of it. On this unit are also placed various meters showing peak modulation, power output to the feeder lines, etc. The output of Unit D passes through the "transducer," mentioned earlier, and thence to the transmission lines connecting the main station building to the Aerial-transformer House. To prevent danger to life, the doors of these units cannot be opened until the high voltage supply has been cut off.

#### THE POWER CONTROL TABLE

The power control table is situated at the east end of the Transmitter Hall facing the two transmitters. On this are mounted the essential controls for both transmitters, together with meters reproducing the readings of the most important meters in the transmitter units. Two engineers will sit at this control table, one monitoring the National transmitter and the other the Midland Regional transmitter. The actual control handles regulate the various power supplies through the medium of the automatic switch-gear. Interlock circuits make it impossible accidentally to connect two machines to the same load or to make serious mistakes in switching operations.





THE TUNING CIRCUITS OF THE OUTPUT STAGE OF THE NATIONAL TRANSMITTER, INSIDE UNIT 'D'



Immediately behind the power control table is a switchboard, with meters showing the outputs of the various motor-generators. It is also fitted with manual switch-gear controls which can be hand-operated should any of the automatic switch-gear fail. The small D.C. motors installed to operate the automatic switch-gear, such as field regulators, take their current from the auxiliary D.C. bus-bars.

#### AERIAL-TRANSFORMER HOUSE

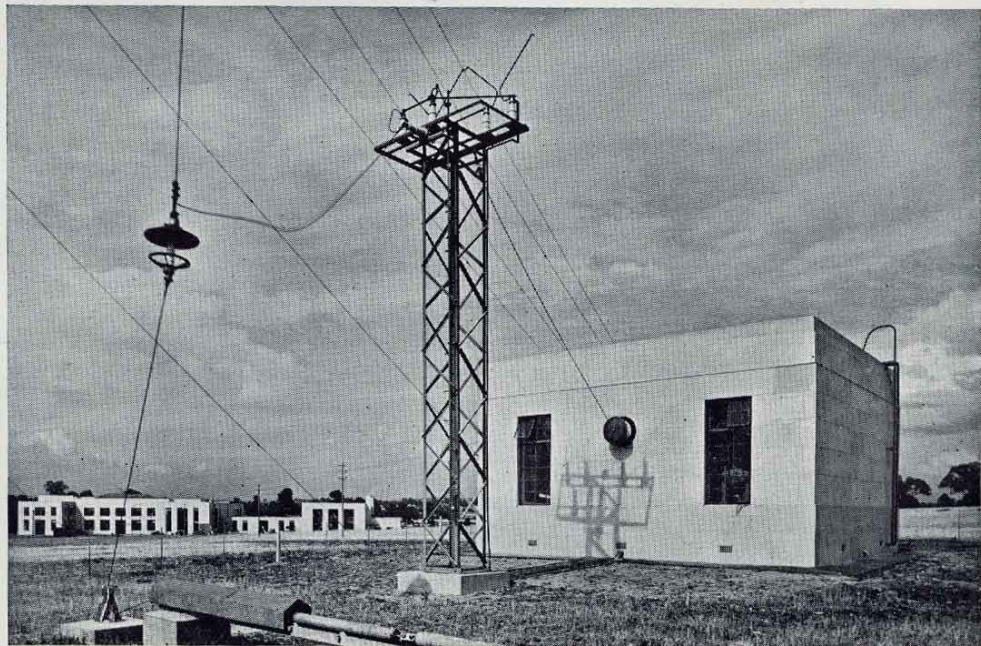
The aerial circuits are situated centrally between the two masts, and of course, at the foot of the vertical down-lead. Two complete sets of aerial tuning circuits have been installed in the Aerial-transformer House, one acting as a standby to the other. This principle has been adopted by the B.B.C. for the first time in this Station

owing to the possibility of damage to this part of the circuit by a lightning flash which may not be cleared by the lightning arresters.

Situated immediately outside the Aerial-transformer House is a steel pylon, on which are the lightning arresters and the termination of the down-lead from the aerial. The aerial for the Midland Regional transmitter will be supported by the north mast, near the foot of which will be built the Regional Aerial-transformer House.

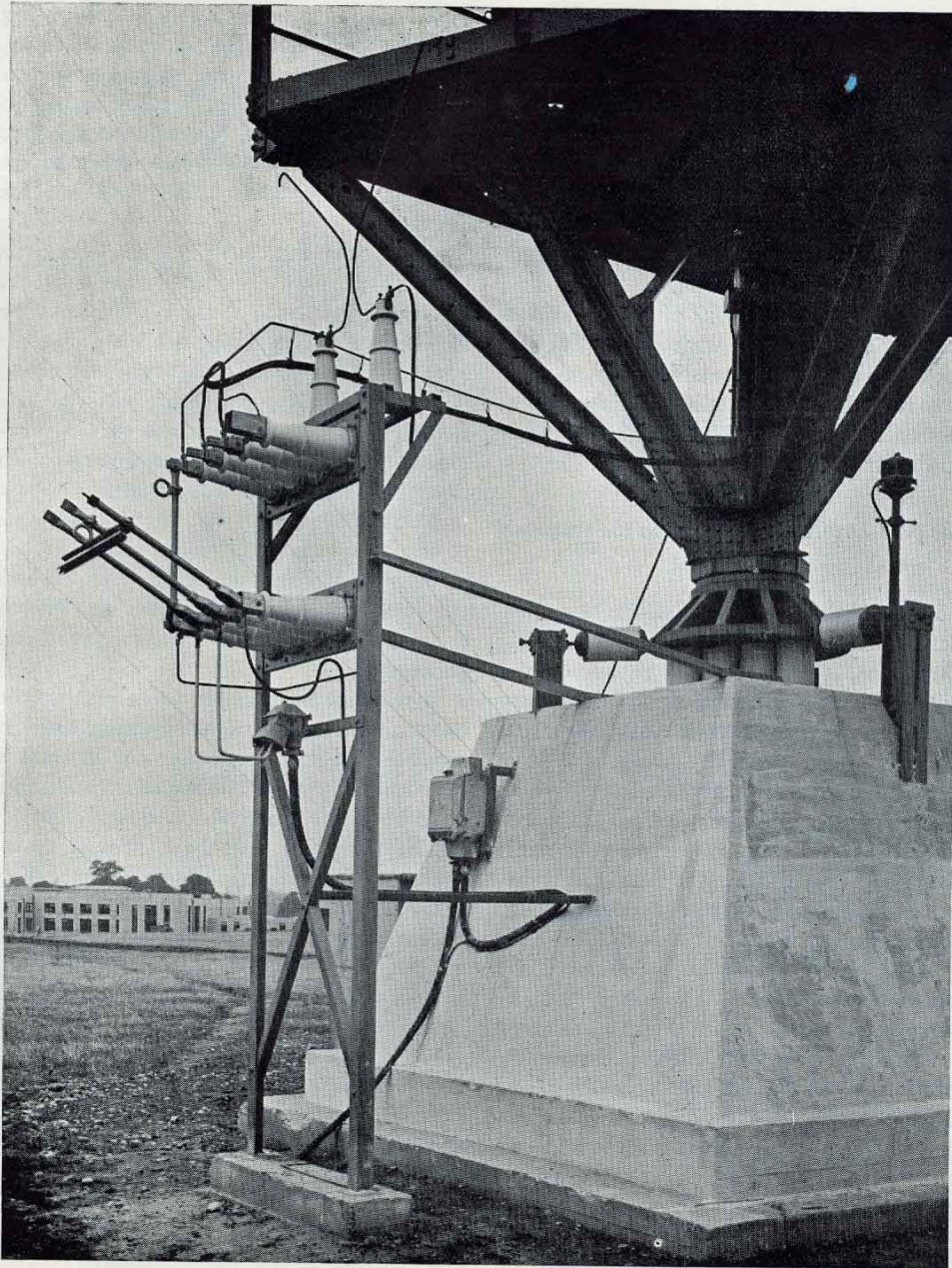
#### CONTROL ROOMS

The Droitwich Station is, of course, connected to the simultaneous broadcasting land-line network by means of buried cables to Birmingham. There are two special input control rooms, one for the National Programme, the other for the



THE NATIONAL AERIAL-TRANSFORMER HOUSE, THE PYLON WHICH CARRIES THE LIGHTNING-ARRESTERS AND THE AERIAL DOWN-LEAD TERMINATION; AND, IN THE FOREGROUND, THE AERIAL TENSIONING DEVICE





THE BASE OF THE MAST. THE SWITCH-GEAR ON THE PYLON IS FOR EARTHING THE MAST, SUPPLYING CURRENT TO THE LIFT MOTOR, AND CONNECTING THE MAST-HEAD TELEPHONE



Regional. These control rooms are situated at gallery-level immediately adjacent to the Transmitter Hall and contain, in addition to the line relay switching circuits, all the necessary line - amplifiers, programme - meters and similar line-monitoring circuits. The amplifiers are mains-driven, the H.T. supply coming from rectifiers, and the L.T. supply from motor-generators, through suitable smoothing circuits.

Finally, the office block of the Droitwich building is equipped with offices for the Engineer-in-Charge and his Staff, a large mess room, kitchen, quality checking room, an oscillograph room, valve stores and a studio for test and emergency use.

*The part Droitwich will play in the system of Distribution*

It is hoped that Droitwich will give a satisfactory service, under average atmospheric conditions, to nearly the whole of the British Isles. It will certainly provide a very much stronger signal to the outlying areas than has been given by Daventry. It is anticipated that the increased strength of the new long-wave transmitter as compared with Daventry 5XX, will make it possible ultimately to withdraw the National transmitters at Washford Cross, Moorside Edge and Brookmans Park but it is not intended to close down any of these transmitters for some months. It should not be thought, however, that the use of high power and a long wavelength is a complete solution to the problems of fading and night distortion at long distances. The improvement is in the greatly increased distance which can be reached, as compared

with a medium-wave station, before fading becomes noticeable. In outlying districts, where fading has been experienced on Daventry, there will also be some fading on Droitwich. However, by virtue of the fact that Droitwich will provide a very much stronger signal, such fading will be less noticeable.

During the month of August, for three hours every night on six nights a week, Droitwich has been radiating Engineering Test transmissions. This has been done to enable measurements and reception tests to be carried out in different parts of the British Isles, from which the service provided by Droitwich can be compared with that given in the past by Daventry.

Another object of the August tests was to discover any unsuspected faults in the Droitwich equipment before the Station was introduced for public service. Up to the present, no serious troubles have been encountered.

It will not be possible to determine the exact performance of the Station until it has been in regular service for at least a year and all types of atmospheric conditions have been encountered.

The reception tests have proved, however, that the Droitwich signal is more than that of Daventry in all districts except those within a few miles of Daventry, and, of course, the improved quality of reproduction is very marked. It is considered that listeners living near Droitwich, who have equipped themselves with receivers suitable for long-distance reception, will have no difficulty in cutting out the strong Droitwich signal for reception from distant transmitters.



# LIST OF PRINCIPAL CONTRACTORS

## THE TECHNICAL EQUIPMENT

Rectifiers, Switchboards and Mast Lighting Cubicles	Messrs. The British Thomson-Houston Co., Ltd.
High-tension Motor Generators, Diesel Engines, Alternators and Switchboards	„ The English Electric Co., Ltd.
Transmitter and Aerial	„ Marconi's Wireless Telegraph Co., Ltd.
Motor Generators, Switchboards and Light Fittings	„ The General Electric Co., Ltd.
Power Cables and Light Wiring	„ Drake & Gorham, Ltd.
Cables and Condensers	„ British Insulated Cables, Ltd.
Condensers	„ The Telegraph Condenser Co., Ltd.
Resistances	„ The Cressall Manufacturing Co.
Iron Cored Inductances	„ Johnson & Phillips, Ltd.
Storage Batteries	„ The Alton Battery Co., Ltd.
Intercommunicating Telephones	„ The Reliance Telephone Co., Ltd.
Electric Clocks	„ The Magneta Time Co., Ltd.
Lighting Fittings	„ Fredk. Thomas & Co., Ltd.
„ „	„ Troughton & Young, Ltd.
Water Meters	„ Electroflo Meters Co., Ltd.
Aerial Lead-in Pylon and Outdoor Switchgear	„ Standard Switchgear Ltd.
Lighting Protection	„ J. W. Gray & Son, Ltd.
Switchgear	„ Brookhirst Switchgear Ltd.
Fuel Tanks	„ The Whessoe Foundry and Engineering Co., Ltd.
Engine Cooling Plant	„ Ledward & Beckett, Ltd.



## THE BUILDING

General Contractors for the Building	Messrs. Higgs & Hill, Ltd.
Masts	„ The Radio Communication Co., Ltd.
Steelwork	„ Dorman Long & Co., Ltd.
Asphalt	„ The Ragusa Asphalte Paving Co., Ltd.
Stonework	„ The Empire Stone Co., Ltd.
Fire-resisting Floors and Flats	„ The Siegwart Fireproof Flooring Co., Ltd.
Metal Casements	„ The Crittall Manufacturing Co., Ltd.
Sewage Purification Plant	„ Tuke & Bell, Ltd.
Anti-vibration Mats	„ Christie & Grey
Fencing	„ J. B. Corrie & Co., Ltd.
Heating and Valve-cooling Installations	„ Rosser & Russell, Ltd.
Cranes	„ Herbert Morris, Ltd.
Water Heaters	„ Nathan & Allen, Ltd.
Tiling	„ Carter & Co. (London), Ltd.
Valve Lift	„ William Wadsworth & Sons, Ltd.
Waterproofing	„ Rollo Products Ltd.
Sanitary Fittings	„ Leeds Fireclay Co., Ltd.
Steel Water Tanks	„ Braithwaite & Co., Ltd.
Copper Gauze Screening	„ Marshall & Co.
Roller Shutters	„ Haskins
Ironmongery and Metalwork	„ Comyn Ching & Co., Ltd.
Cable Trays	„ G. A. Harvey & Co., Ltd.
Cork Parquetry Flooring	„ The Armstrong Cork Co., Ltd.
Doors	„ The Central Joinery Co. (1927), Ltd.
Lay-out of Grounds	„ P. & F. Smith, Ltd.

---

*Published by the British Broadcasting Corporation, Broadcasting House, London, W.1*  
*Printed by J. J. Keliher & Co., Ltd., London, S.E.1*