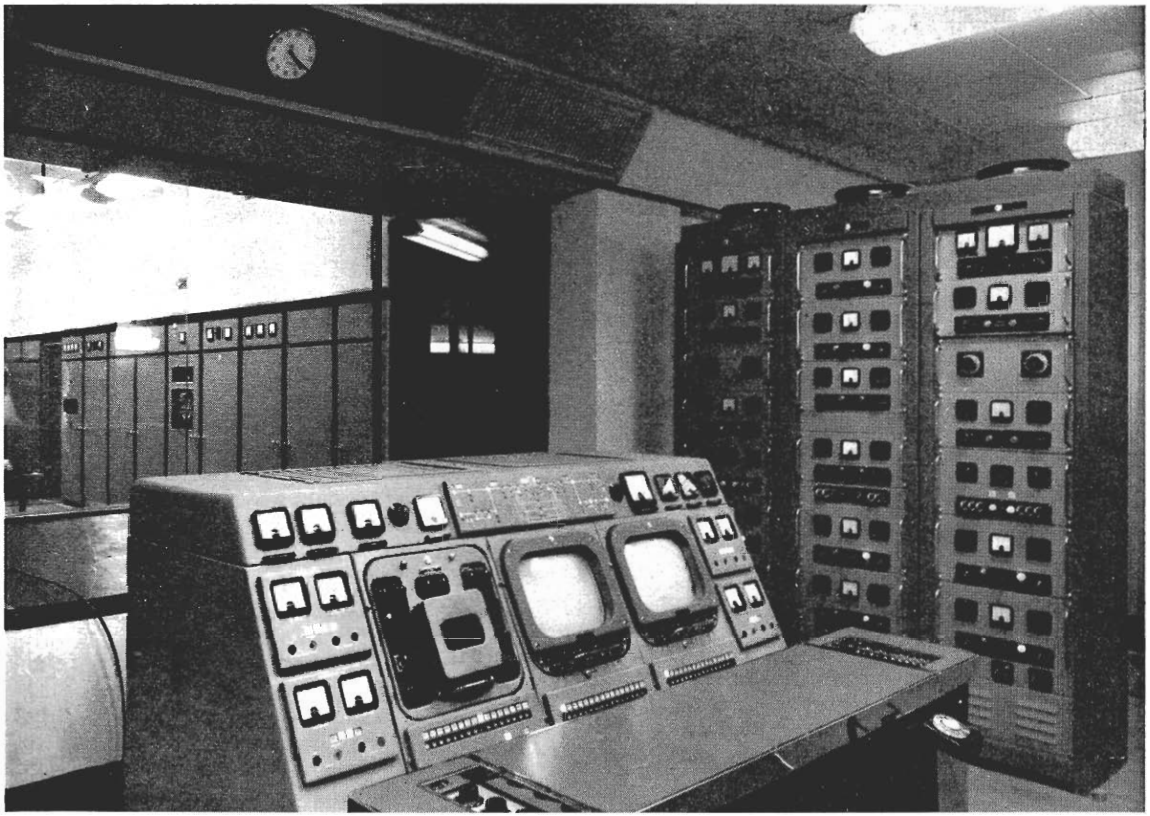

THE NEW B.B.C. TELEVISION STATION AT THE CRYSTAL PALACE

An official account issued by the B.B.C.

General

On 28th March the B.B.C.'s new London Television Station at the Crystal Palace took over the service from the Alexandra Palace station which started the world's first high-definition television service in November 1936. The new station uses the same frequencies as Alexandra Palace (vision 45 Mc/s and sound 41.5 Mc/s), but a vestigial upper sideband characteristic will be adopted for the vision transmissions as at all post-war B.B.C. television stations.

When the original television service for the London area was being planned in 1935 one of the possible sites investigated for the transmitter was the Crystal Palace. At that time, however, little was known about the range which could be achieved with the frequencies on which the television service was to be operated or of the requirements for satisfactory reception of television signals and the Alexandra Palace site was chosen because it placed the transmitter nearer to the centre of the densely populated areas of Greater London and the Home Counties.

Experience has shown that a considerably greater service area can now be achieved and it was apparent when considering the replacement of the Alexandra Palace station that, given a suitable site further south, it would be possible to extend the service in Kent, Surrey and Sussex without introducing a corresponding loss in the North and

North-east. At the same time the service area of the London station could be made to join up with the service areas of the adjoining stations at Sutton Coldfield and Rowridge, and later, Norwich.

An exhaustive field-strength survey showed that, by moving the London station to Crystal Palace, and by increasing the height of the aerial and the effective radiated power, it would be possible to bring more than a million additional people within the acceptable service area and to provide a stronger, and therefore more interference-free, signal for a great many more.

The Crystal Palace station was brought into operation initially with an aerial on a temporary 250-ft. mast and an effective radiated power of 60 kW—about twice the power of the Alexandra Palace station. About July of this year the e.r.p. will be increased to 120 kW when a temporary aerial on the permanent tower will be brought into service. It is expected that the permanent aerial system on the completed tower will be ready by the end of 1957 and the e.r.p. will then be further increased to 200 kW.

Station Buildings

The building is of reinforced concrete with brick partition walls. The offices, mess room, kitchen and common room are on the front of the building overlooking the Lower Terrace, thus having the advantages of natural light and ventilation. The remainder of the building, including the transmitter hall, relies on artificial light and mechanical ventilation. All the engineering equipment, with the exception of the ventilating plant and feeder switching equipment on the upper floor, is on a single level.

The buildings have been so planned that, if necessary in the future, they can be extended without causing interruption to the service.

Transmitter Hall

The main transmitter hall contains two vision and two sound transmitters. Viewed from the control room end the sound transmitters are on the right and the vision transmitters are on the left. (*See cover picture.*)

Each vision transmitter has a peak white output power of 15 kW and is grid modulated in the final stage in which the use of a pair of high-power type C.R.192 tetrodes is noteworthy. The high gain of these valves allows the use of receiving type valves in the modulator and also reduces the number of r.f. amplifying stages required. Another interesting feature of the final stage is the triple tuned output circuit. Metal rectifiers are used for the 6 kV anode supply.

Black level feedback ensures that the black level in the radiated vision signal will remain constant to within 2% of the correct value. The centre frequency of the band-pass characteristic of the transmitter output circuit is offset from 45 Mc/s to 44 Mc/s to take advantage of the narrower bandwidth and hence the higher output power permitted by the vestigial sideband characteristic of the transmission. The transmitter tuned circuits are not relied on for any of the shaping of the unwanted upper sideband, as this is done by the two vestigial upper sideband filters into which the outputs of the two vision transmitters are fed. These filters are installed in cabinets in line with the vision transmitters.

The sound transmitters are Class B modulated in the final stage and are rated at $4\frac{1}{2}$ kW carrier output, but will operate at $3\frac{3}{4}$ kW to preserve the standard ratio of 4 to 1 between peak white vision and sound carrier power. The design is straightforward, but the use of 20 db of negative feedback over the a.f. chain keeps the distortion at less than 1% at 95% modulation, which is well up to modern transmitter standards.

The sound transmitters are contained in a single line of cabinets whilst the vision transmitters have additional cabinets containing power supply equipment mounted behind them.

Water-cooled test loads are provided for each transmitter. Thus any transmitter may be tested whilst the remaining transmitters are still carrying programme.

The phases of the pairs of vision and sound transmitters are compared at similar points near the inputs to the combining filters and monitored and adjusted to the correct values by the r.f. phasing equipment in the control room. It is found that very little phase drift occurs after the first ten minutes after switching on. The combining filters and aerial feeders are assumed to have a constant phase shift and check measurements made over a period have proved this to be a correct assumption. Video phasing, once set for the two transmitters, is unlikely to change.

Transmitter Control Room

The transmitter control room is situated at the end of the transmitter hall which can be viewed through sliding glass windows (*see picture, p. 35*). From here the engineer on duty can see all the transmitters under his control. The control room contains, in addition to the main transmitter control desk, the duplicate drive and phasing equipment for the transmitters, the vision and sound programme input equipment, together with

distribution amplifiers and a transparency scanner for the local generation of captions and test cards. Magnetic tape sound reproducers are also installed to provide locally generated announcements in case of emergency.

The four transmitters can be started from cold and shut down from the control desk. Two picture monitors and a waveform monitor are mounted on the sloping front of the desk. These normally display the input and output pictures and the output waveform but they can be switched, by push-button operated relays, to other points in the transmitter chain.

At the top of the control desk is an illuminated mimic diagram showing the arrangement of the transmitter and aerial feeder coaxial switches. For normal use all the lamps on this diagram should be white, abnormal conditions being indicated by lamps of various colours.

A key switch panel is provided for selecting the input to be fed to the sound and vision transmitters; this may be the television programme, one of a variety of test patterns, or the output of the local caption scanner.

A peak programme meter and two percentage modulation meters are provided to enable the sound signal to be checked.

The transmitter control room is acoustically treated to facilitate aural monitoring of the sound part of the transmission but adjacent to it there is in addition an acoustically treated quality-checking room equipped with vision and sound apparatus of high quality to enable critical sound monitoring to be carried out.

Transmitter Combining Filters and Feeder Switching

The outputs of the four transmitters are combined in the following way: The output from one sound transmitter is combined with the output of one vision transmitter. The outputs of the other sound and vision transmitters are also combined. The two combining filters are located in cabinets which are set in line with the sound transmitters.

The feeders from the combining units are routed to the base of the aerial tower via a feeder switching room on an upper floor in which eight coaxial switches are provided to enable the transmitters and feeders to be interchanged in all possible combinations in the event of faults developing in the transmitters, feeders or aerial system. Under normal conditions the output of each combining unit is connected to one half of the aerial system. A mimic diagram mounted on the wall indicates the position of the various switches which are colour-coded in the same way as the diagram to facilitate quick and accurate operation.

The feeder switching room also contains switchgear controlling the aircraft warning lights on the tower, the aerial de-icing equipment and the s.h.f. receiving equipment on the tower. Two de-hydrators are also provided, one spare to the other, to feed dry air under pressure to the aerial feeders so as to exclude moisture.

Aerials

The temporary aerial consists of six dipoles mounted in two tiers on the three corners of the 250-ft. triangular stayed mast which is erected on the site of the old reservoir. This system is fed by six H.M.7 helical-membrane semi-flexible cables connected to extensions of the two 5 in. diameter feeders which will feed the final aerial system on the main tower. One group of three cables feeds the upper three dipoles and the other group the lower dipoles. Great care has been taken to keep the lengths of all cables and feeders electrically equal to ensure that the signals from the pairs of phased transmitters arrive in phase at the aerials.

The partly completed permanent tower has at present a height of approximately 440 ft. but in its final form it will be 640 ft. high. Preparations are in hand for erecting a four-stack temporary aerial near the top of the tower as it is at present. This will increase the effective height of the aerial from 200 to about 400 ft. and at the same time enable the effective radiated power to be increased from 60 kW to 120 kW.

Later, in 1957 when the tower is completed, a further four stacks of dipoles will be erected above the 440 ft. level and the e.r.p. will be further increased to 200 kW. Above the Band I aerial there will be space for two high gain Band III transmitting aerials.

Vision and Sound Programme Circuits to Crystal Palace

The vision signals reach Crystal Palace over duplicate 1 in. diameter co-axial cables rented by the B.B.C. from the G.P.O. Normally one of these cables carries the programme from Broadcasting House with the other acting as a reserve. Either cable can, however, be used for sending vision programmes in the reverse direction from Crystal Palace to Broadcasting House. This provision has been included to cater for the feeding of outside broadcast programmes, received at Crystal Palace by radio link, to the other transmitters in the B.B.C.'s national network. The low

attenuation of this type of cable enables the signals to be transmitted in either direction without intermediate repeater equipment which would have inevitably reduced the reliability and increased the running costs of the vision link. A carrier frequency of 15 Mc/s is used. The terminal equipment at each end of the link has been engineered by the Designs Department of the B.B.C. Engineering Division. Provision has been made for additional terminal equipment which will enable each cable to carry more than one programme simultaneously to cater for possible future developments. The associated sound programme reaches Crystal Palace over G.P.O. lines.

Test equipment is installed for carrying out routine performance measurements on the vision circuits to Broadcasting House, and on the vision and sound transmitters and feeder system.

The equipment is installed in the Lines Termination Room from where the vision and sound signals are passed to the Transmitter Control Room.

S.H.F. Receiving Room

The s.h.f. receiving room for receiving vision signals from outside broadcast points, is situated behind the control room. It will contain equipment for handling the signals to and from the s.h.f. paraboloids which are to be mounted at the 430 ft. level on the permanent tower, and also the remote-control mechanism used for turning them. Initially there are four paraboloids although later the number may be increased. These aerials, which are intended for receiving radio link transmissions in the 4,400-4,800 Mc/s band from outside broadcast link transmitters, have a gain of 33 dB and each paraboloid can be set to any desired bearing within an arc of 180° with an accuracy of better than + 1°. The received signal from the aerials is fed by a system of wave-guides and flexible coaxial feeders to receiving equipment mounted on the tower structure. It is then passed, at intermediate frequency, to the receiver room. Means are provided for remotely tuning the receivers which are fitted with automatic voltage regulators and equipment for regulated power supplies. This is convenient because most of the regulated output is required for equipment in the adjacent control room.

Power Supplies

The power supply for the station is obtained from the London Electricity Board over two feeders connected to different networks so as to ensure continuity of supply in the event of a failure of either one. The supply is nominally at 11 kV but since the two networks operate at slightly different voltages it is not at present permissible to parallel the supplies. Should a changeover be necessary, however, it could be effected in a very few minutes. The supply is transformed on site to 415 volts 3 phase 50 c s by duplicate 500-kVA, delta-star connected transformers and space is available for a further pair of similar transformers should future extensions render them necessary.

The supply is distributed round the building from the L.V.A.C. switchroom which contains two boards, one for the transformer secondary switching and distribution to the main loads, and the other for general services, standby supply control, and heating and ventilating plant control.

An adjacent room contains the 25-kVA automatic-starting diesel-alternator set for use in the event of a complete mains failure. This is arranged to feed skeleton lighting throughout the building, the aircraft warning lights on the tower and the outside broadcast link and coaxial cable termination equipment. This ensures that, when an outside broadcast is being received via the Crystal Palace radio link equipment, a failure of the public power supply in the district would not deprive the whole country of the programme.