

specially built towers on the sides of the forestage just in front of the stage proper. With four bass bins and four horns on either side this constitutes a high power system with essentially the same performance characteristics as the central array.

### 3. Stereo Reinforcement System

For a totally natural sound with a very controlled coverage of the auditorium BOZAK three-way 'concert' columns (having six bass, nine mid range and eight high frequency drivers) are used. Three per side are mounted in the towers along with the bass bins and horns already mentioned. The centre of the beam of sound from the loudspeaker is directed at the rear of the auditorium; thus the maximum amount of energy is focused where it is most needed and amplification decreases progressively as you move nearer to the front.

Two columns are sited for optimum coverage of the Balcony and two for the main area of the Stalls. A triangle of seats in the front near the stage is catered for by the remaining pair.

### 4. Rear Enhancement System

Because the auditorium is so large it is very difficult to obtain a natural level of sound at the rear without it being obviously amplified towards the front, and vice versa. So we decided to set the overall sound level so that it is comfortable throughout the main part of the auditorium and then add an 'enhancement' system to provide an extra boost at the rear. This consists of twin rows of loudspeakers set flush into the

ceilings above the rear Balcony and Stalls seating areas. Each of these four rows of 8" cone loudspeakers (some 55 in all) is fed via a digital delay line set so that the sound from the main system arrives momentarily *in advance* of the sound from the ceiling speakers. The resultant effect is therefore an unobtrusive enhancement of the natural ceiling reflections.

Apart from the general increase in level of some 2-3 dB there is also a restoration of some of the higher frequencies which have been absorbed en route from the stage. Thus the articulation factor is greatly improved.

Although designed primarily for Speech Reinforcement it has been found that even with performers using a close microphone technique the Enhancement system appears to improve the acoustics in these relatively low ceiling areas.

### Amplification

All the main loudspeakers, including outlets for portable stage monitors and effects speakers, are driven by H/H S-500D power amplifiers; some eighteen in all. The enhancement system is driven by four H/H TPA 50-D power amplifiers operating into a 70 volt line.

Each amplifier is fed via a screwdriver preset gain control on a separate panel, and run with its front panel gain control fully open. Thus, in the event of failure, amplifiers may be interchanged without upsetting the critical overall balance.

Graphic equalizers were incorporated in

the amplifier chains to the central array and enhancement systems following tests with pink noise and an IVIE spectrum analyser (confirmed by ears).

### Mixing Console

The original intention was for the mixing console to be installed in the centre of the auditorium where the operator could properly balance a stereo mix, but the economics of the permanent loss of ten prime seats proved a powerful argument for an alternative position at the rear of the Orchestra. However, all the wiring is run via a junction box in a room below the centre of the seating slab for a possible future move. The mixer, designed by Theatre Projects for Rank Strand Sound, has twenty-four mic/line input channels (with full equalization and three auxiliary sends) selectable in mono or stereo as appropriate to eight group output channels. The mono outputs are normalised via a patch field to amplifiers associated with the Central Array and the Enhancement, and the stereo outputs are normalised to the stereo music and reinforcement systems. The two remaining outputs are each fitted with four rotary gain controls for selection to any combination of four power amplifiers which connect to socket outlets on stage for portable effects loudspeakers.

An unusual feature on the mixer is the flexible sub-grouping arrangement. By depressing an internally-lit push button on the groups, any of Groups A-F may be connected to become a Sub Group Master contributing to Groups G and H. Thus Group G and H become the main stereo output and may be suitably patched to one of the loudspeaker systems. A pan control associated with each sub grouping push button assigns the sub group to left or right. The mixer can become 24 into 6 into 2. Or, perhaps more typically, 24 into 4 into 2 with the Central Array and Enhancement remaining as separate output groups.

In addition to the twenty four main input channels there is a 40 channel sub mixer comprising 10 triple input microphone modules with level controls only and 10 single mic/line input modules with treble/mid/bass tone adjustment. Routing of any combination of submix channels to the main mixer is via a pin matrix. The console therefore has a total input capacity of 63 channels (assuming the submixer is all patched to only one channel of the main mixer).

The 530 way mini jack patch panel has been designed with as much 'normalling' as possible so that it is possible to plug up 40 microphones on stage such that they will appear on the mixer without the necessity for any patch cords in the jackfield. Another 20 circuits in the orchestra pit are also 'normalised' to the mixer. Insertion points for the main inputs and group outputs also appear on the patchfield which can be used for external signal processing equipment.

An additional feature of the patching is that the entire jackfield is connected in sections by multiway plugs and sockets to the installed wiring and the console. This



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