M. DAVIS
C/O E2/M16

POST OFFICE

telecommunications

JOURNAL

ONE SHILLING
AND
SIXPENCE

SUMMER 1968

THE HEART THAT MAKES THE TOWER TICK

By K. E. WARD

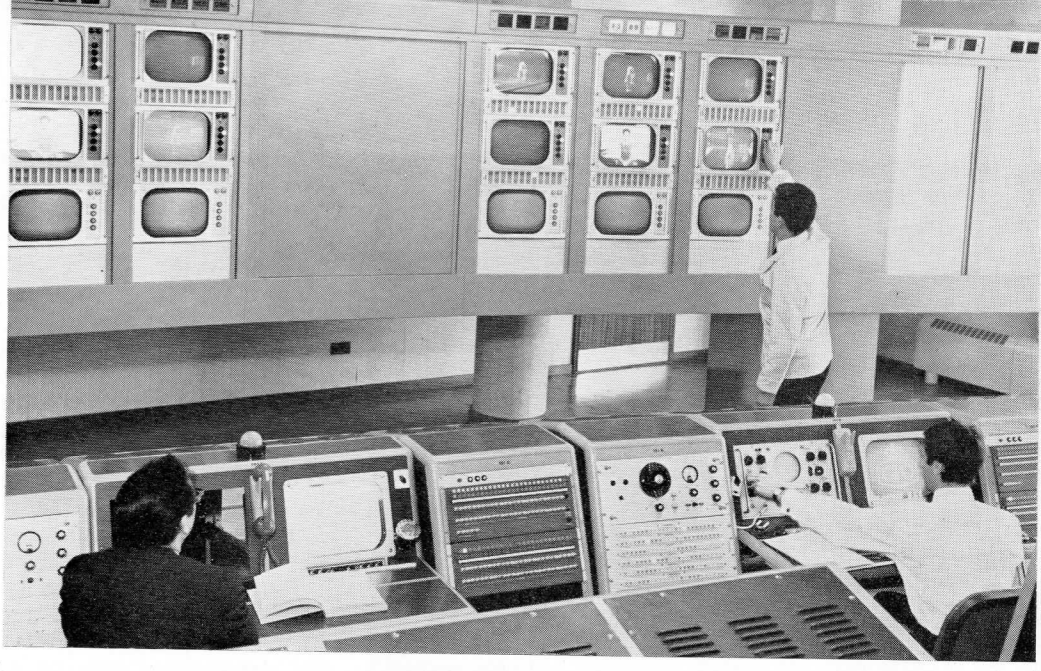
Worm's eye-view of the Post Office Tower rising above the building which houses two trunk exchanges, a tandem exchange and a TV switching centre, together occupying 2½ acres of floor space.

THE Post Office Tower, symbol of 20th century technological progress, has received a great deal of publicity as the hub of Britain's expanding microwave communications network. But little has been said of the large building at its base which contains the heart of the complex and without which the Tower would be incomplete.

Apart from being the largest single building project ever undertaken by the Post Office, it contains a unique and comprehensive collection of modern communications equipment installed on some two miles of racks. Future plans include the installation of Pulse Code Modulation transmission systems and multi-frequency signalling equipment.

During its planning and design some interesting and unusual problems, such as the power arrangements and ventilation, had to be overcome, providing valuable experience for the large multi-unit buildings planned for the future.

The accommodation, which comprises some two-and-a-half acres of floor space, houses two major trunk exchanges—Mercury and Tower—the Museum tandem exchange and the London



Inside the London Television switching centre control room. About 5,000 switchings are made each month.

Television Switching Centre, together with the supporting repeater, power and ventilation equipment.

Mercury switches traffic into London and Tower switches traffic out of London. Museum tandem exchange routes traffic between London director exchanges.

Welfare arrangements include a large staff dining-room and lounge and, to cater for visitors as distinct from sightseers to the Tower, there is a 36-seat cinema and reception lounge.

The building is served from two main distribution frames. Junction cables are terminated on a 200 vertical MDF while trunk cables appear on another consisting of 100 verticals. Much of the frame wiring uses the new solderless wire wrapping technique.

Mercury trunk exchange, which switches trunk traffic into the London Director Area, has a capacity for 7,000 incoming trunk terminations. The trunk circuits terminate on signalling relay sets which convert the line signals into direct current pulses required to route the call through the exchange and to provide the necessary supervisory conditions.

Associated with each signalling relay set is a first selector and a register access relay set with a register hunter to provide access to the common register translators.

Switching is carried out on 4,000-type two-motion selectors, a considerable saving in junction

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Technical Officer D. Hooker checks a unit in an electronic common equipment cabinet in *Mercury* exchange. Each cabinet pair has an ultimate capacity for handling 194 simultaneous calls.

These are the two main distribution frames which serve the building. They extend to 300 verticals and are among the biggest of their kind in Britain.

line plant being achieved by sharing most of the 11,000 outgoing junctions with the Museum Tandem Exchange, although 35 of the larger Director Exchanges have exclusive routes from second selector levels.

The outstanding feature of the exchange is the electronic register translators, comprising eight pairs of cabinets to convert the three code digits identifying a London Exchange into anything up to eight digits required to route the call through the rest of the Exchange and Director network. Each cabinet pair has an ultimate capacity to handle 194 simultaneous calls on a time-sharing basis, each call being connected to the electronic processing equipment for 80 micro-seconds at recurring intervals of 16-2/3 milli-seconds.

Incoming dialled information is stored on ferrite cores and processed by transistor and core logic circuits.

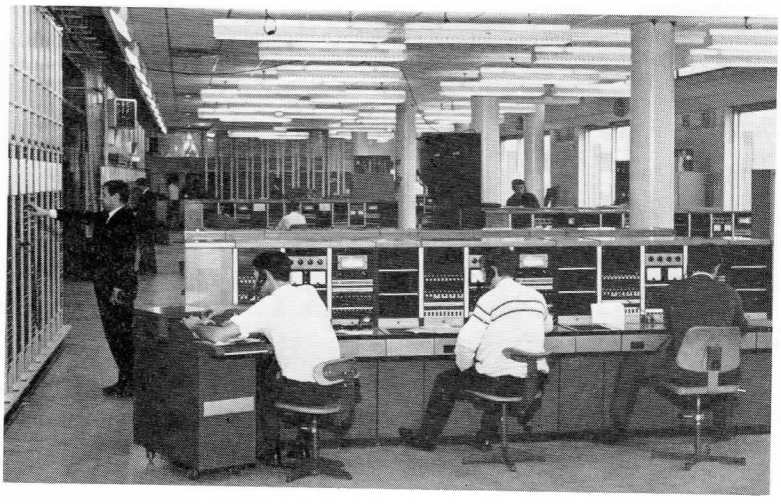
The Tower Trunk Exchange was designed to switch STD calls originated in the London Director Area, although ultimately it will handle only traffic from the Centre Area, for which its capacity of 7,000 incoming terminations will cater until 1975.

The incoming junctions terminate on register access relay sets which provide access to the register translators by way of register hunters and are also connected to the first selectors which are of the 4,000 two-motion type. However, motor uniselector group selectors are used for the final switching stages because their increased availability results in a worthwhile saving of trunk lines. Controlling register translators are provided to convert the national code into routing digits and to determinate the charge rate.

Ultimately, 24 electronic register translators will be installed and these will eventually be modified

A suite of register translators in the Tower Exchange. The RT in the foreground has had a panel removed to show the position of the magnetic drum which is located under the circular cover.

The Test Room—focal point of the building—showing the suite of test jack frames and some of the test desks.



to provide multi-frequency signalling facilities to enable the exchange to route calls over the proposed transit network. Each register translator uses a nine-inch nickle-plated magnetic drum rotating at 2,160 revolutions a minute and sub-divided into a number of magnetised tracks on which the received and translated digits are stored together with translations and charging information. The electronic common equipment uses valves and semi-conductor diodes, information being processed as 9·7 micro-second code pulses.

The third exchange in the building replaced the original Museum Tandem exchange in the adjoining Museum exchange building. Its function is to switch traffic between London Director exchanges. The equipment consists of 4,000 type two-motion selectors with auto-auto relay sets to provide holding and transmission facilities. A number of information final selectors provide access to recorded information services.

The large trunk repeater station on the ground floor contains a variety of equipment to amplify and convert the telephone conversations into a suitable frequency range for transmission over the line systems and microwave radio links connected to the building. In addition, groups of circuits are routed through the repeater station from other London trunk exchanges and repeater stations.

At present, equipment is provided or planned to route 56,000 circuits through the station, although this is by no means the ultimate capacity.

To economise in equipment and provide flexibility of routing, the conversations pass through several stages of modulation before being translated to their final frequency range. Initially, they are assembled into groups of 12 occupying the frequency range 60–108 kHz after which 60-channel (five group) supergroups are formed with a further change of frequency to the range 312–512 kHz and finally a number of supergroups are assembled into a hypergroup to occupy the frequency range for the line or radio equipment.

Testing and commissioning the trunk and junction circuits is carried out in a large test room containing nine suites of test desks comprising 27 positions with comprehensive testing facilities. In addition, three positions house line-routiner remote control panels and cable gas pressurisation alarms with fault locating equipment. Test access to the trunk and junction circuits is obtained by way of a suite of 70 test jack frames with capacity for 33,700 circuits. Incoming junctions are tested from the Main Distribution Frame by way of patching circuits to the test jack frames. Outgoing circuits can also be busied from the test room. Future plans include a Precision Test Centre in the test room for locating cable faults.

The London Television Network Switching Centre is on the third floor in special accommoda-

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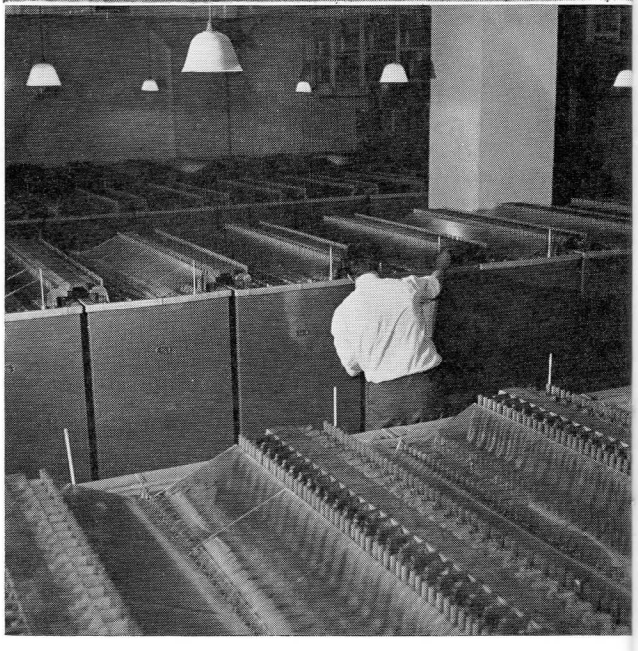
Right (above): the standby diesel engine alternators in the power room. Below: The standby batteries which can supply power to the exchanges if the main's supply fails. They weigh 155 tons.



tion with under-floor cabling, controlled lighting and sound insulation. There is also a visitors' viewing gallery. Facilities are provided for terminating and controlling sound and vision circuits, including colour, rented by the BBC, ITA and various programme companies. The circuits comprise main links to other network centres, links to transmitters and local circuits to various studios.

A permanent outside broadcast network terminates at the Outside Broadcast switching centre (also on the third floor) which is linked to the Network Switching Centre. The BBC have a permanent national network and carry out switching at their own premises but the ITA transmitters are shared by the commercial companies and the links are inter-connected at the Network Switching Centre.

Automatic switching of both vision and sound channels is carried out at the precise scheduled time synchronised with the Speaking Clock. About 5,000 switchings are made each month. Television links, both line and radio, are routed by way of the Television Repeater Station and terminate on video distribution racks which have a capacity for 1,800 channels. The circuits are connected direct or by way of the network switching console.

Testing and maintaining the circuits is carried out on five test consoles with two monitor suites containing 20 picture monitors (with provision for 54) to enable picture quality on any circuit to be checked.

To ensure that mains failure does not interrupt the vital telecommunications and television services there is a large and complex power plant supplying five million watts of AC power. It uses two separate alternative mains supplies, with short break changeover if the one in use fails, backed up by five 743-hp, six-cylinder diesel engine alternators capable of supplying 2·5 million watts of power in the event of complete mains failure. Fuel is supplied from three 16,000 gallon tanks.

Most of the transmission and exchange equipment requires DC supplies which are provided by separate power plants. The largest supplies up to 12,000 amps. at 50 volts to the exchange equipment and consists of six (with provision for seven) 2,000 amp. mechanically-regulated rectifiers and two

Off-duty staff snatch a welcome break in the lounge.

15,000 amp.-hour batteries weighing 155 tons. Distribution to each floor is by way of a riser consisting of a 20-bar aluminium busbar with a cross-section of 80 square inches and weighing five tons —the largest so far installed by the Post Office.

In marked contrast is the 1·08 square inch total cross-sectional area of the 18 mineral-insulated, copper-sheathed cables that supply the AC power to the plant. The plant is unique in that no fuses or circuit breakers are provided at the plant itself, fusing being carried out on the equipment floors. Floor load current is measured remotely, using transductors wound over the busbar feeds at each floor. These convert the magnetic field due to the current into an indication of its magnitude. A separate 30-volt plant supplies the electronic register translators in the Mercury exchange and the Repeater Station DC power is derived from the other plant.

There are also two large ventilation plants to cope with the considerable heat radiated from the equipment. Air is pumped into the equipment floors at the rate of 17,600 cubic feet a minute by way of electrostatic filters which are automatically taken out of service periodically and washed.

In addition, 37 free standing cooling units circulate air, which is cooled by a refrigeration process, to equipment which gives off excessive heat. The water for cooling is supplied from six cooling towers at the rate of 4,000 gallons an hour.

The Tower communications complex has been operational for two years and has already made a significant contribution towards meeting London's trunk traffic demands. The installation was carried out by several contractors and acceptance testing was done by the Centre and Long Distance Areas. Many difficulties were encountered, mainly because of limited access to the site and the need to phase the installation of equipment as the building was erected. But all have been overcome through the magnificent skill and co-operation of all involved in completing a tremendous and well worthwhile task.

THE AUTHOR

Mr. K. E. Ward, *C.Eng AMIERE joined the Post Office in 1948 as a Youth-in-training in the Canterbury Area and was transferred to Long Distance Area in 1957 as an Assistant Executive Engineer, employed initially on Trunk Exchange maintenance duties and eventually as Clerk of Works at the Post Office Tower.*

On promotion to Executive Engineer in 1965, he moved to the LTR Regional Headquarters and is now a member of the Long Term Planning Branch.