

CONFIDENTIAL

**BBC** DESIGNS DEPARTMENT

# REPORT FOR 1971



THE BRITISH BROADCASTING CORPORATION ENGINEERING DIVISION

# PART ONE

## FOREWORD

The principal role of Designs Department is to offer an equipment design service to the operational departments of the BBC. This service, backed by production in Equipment Department, provides BBC customers with an alternative to manufacturers' catalogued equipment.

As design costs must be accounted for, this alternative source of equipment must offer much more than a wider choice of product. If no commercial product is available at all and the BBC's need justifies the cost, then the case for a new design project is clear. It is more difficult to be sure that we should design a new product if an available commercial item would do the job, but a BBC design could do it better or more cheaply. Nevertheless many successful designs mentioned in this year's Report have been done for these latter reasons.

The decision to design or not to design must be the result of close discussions between the customer, who can specify the need, and the Design Section which would do the work. For this reason engineers in Designs Department, particularly Heads of Sections, try to maintain close contact with their opposite numbers in User Departments. Informal contacts are often surprisingly effective but the formal channels of such committees as S.E.C.(Tel.) and the new S.E.C.(Sound) must be the most consistent and reliable means of correlating users' requirements.

As a new member of Designs Department I can say with some objectivity that the Department is respected for its expertise both inside and outside the BBC and is resilient enough to grow in confidence and enthusiasm despite McKinsey, integrated circuits and digital techniques. An instance of the accelerating pace of life is that three Heads of Designs Department sufficed for the first twenty years of its existence but I am the third H.D.D. since 1968!



E.R. ROUT

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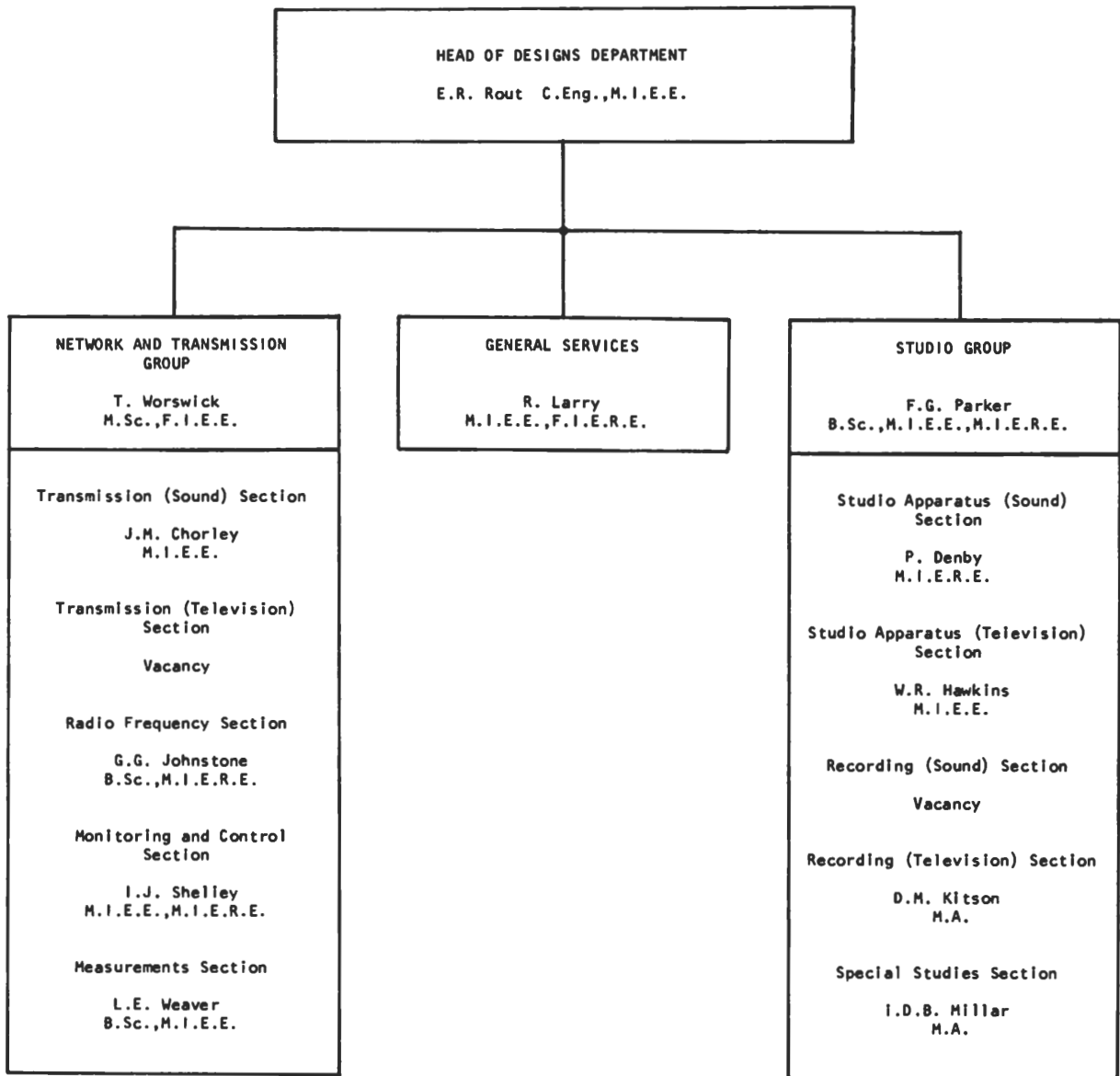
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Designs Department Senior Staff  
1971

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# NETWORK & TRANSMISSION GROUP

The pattern of the year's work in the Network and Transmission Group has been similar to that of previous years. Some new projects have arisen, some older ones have been completed. There has also been the usual passage of smaller jobs from inception to completion during the year.

There has been a steady trend towards greater use of digital techniques, particularly in the application of logic circuits and digital memories.

First the more important new jobs started and completed during the year were:-

## AUTOMATIC MONITOR FOR PARALLEL TELEVISION TRANSMITTERS

In twelve of the BBC's major UHF transmitting stations the transmitters are installed in pairs, operating in parallel. If one transmitter fails the other continues to maintain the service. This poses interesting problems in monitoring and controlling the transmitters automatically.

The two transmitters have a common input (the signal from the P.O. circuit or rebroadcast-link feed), and a common output, the aerial. The automatic monitor has to be able to identify which transmitter is faulty and then to initiate the appropriate action. It should be able to do the fault location without switching transmitters on and off so as to cause the minimum disturbance to the broadcast signal.

The radio-frequency output signal from each transmitter is brought out separately prior to the combining network and a third signal is made available from the output of the combining network. Radio-frequency demodulators derive from each of these three signals video-frequency signals which are representative of the signal from each of the two transmitters and the combined output. The automatic monitoring apparatus has therefore five signals to examine:-

- (a) The input signal from the main P.O. circuit
- (b) Input signal from the reserve circuit
- (c) Combined output signal from the two transmitters
- (d) The output signal from No. 1 transmitter
- (e) The output signal from No. 2 transmitter

The automatic monitor can make measurements of the quality of each video signal by measuring the parameters of its insertion test signal. This technique has been described in previous Designs Department Annual Reports. From the measurements made on the five signals the monitor can, by logical deduction, identify where the fault or degradation is occurring and initiate the appropriate corrective action.

The first of these monitors will be put into service at Dover in January 1972.

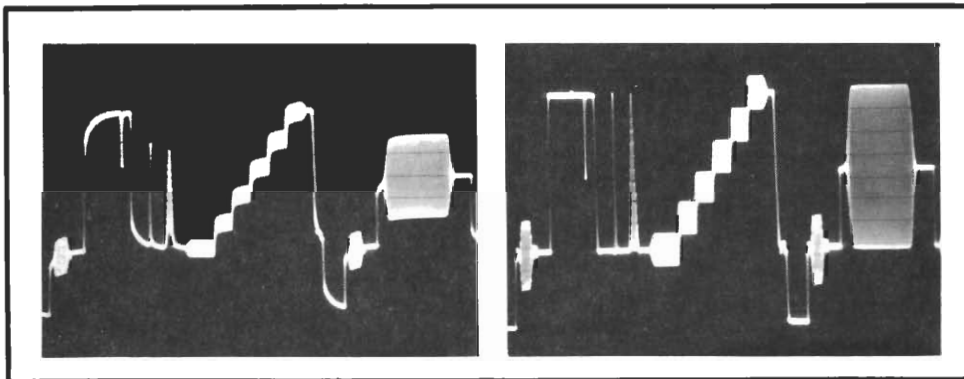
#### AUTOMATIC MONITOR FOR P.O. CIRCUITS

At some unattended BBC television stations the television signal is supplied by a P.O. circuit. It is desirable, therefore, to be able to supply the P.O. engineers with information about the state of the circuit without the need to send a BBC engineer to the site. One such example of this situation is Caldbeck where the nearest BBC manned station is Sandale.

At Caldbeck an automatic circuit monitor has been installed. If the performance of the circuit is degraded beyond acceptable limits, an alarm is given and information about the degradation made available at Sandale. The BBC engineer at Sandale can now discuss with the P.O. engineer (who is at Carlisle) the nature of the degradation and, in many cases, the remedy can be applied without anyone going to site. For example, the most-usual degradation is a change in the magnitude of the signal, and the P.O. engineer at Carlisle can remedy this as the signal passes through his station.

#### A NEW AUTOMATIC EQUALISER FOR 625-LINE COLOUR TELEVISION SIGNALS

In the 1968 Designs Department Annual Report mention was



AUTOMATIC VIDEO EQUALISER. Illustrated above are input and output waveforms for the new automatic video equaliser. The input waveform (left) exhibits a frequency characteristic that would produce a picture with severe streaking, loss of fine picture detail and de-saturated colour. These defects have been corrected in the output waveform (right).



made of an automatic regulating amplifier which was installed at the input of the main UHF colour-television transmitters. From information derived from the insertion test signal, this amplifier corrected both the absolute level and the level of the colouring signal, applied to the transmitter input.

Experience since its introduction has shown the need for a more versatile regulating amplifier which can correct more forms of signal distortion.

During the year, a study was made of various ways in which the problem could be tackled. The outcome is a new automatic regulating amplifier which is basically very simple and inexpensive but which can correct for,

- (a) variations in signal level
- (b) middle frequency distortions (bar tilt)
- (c) 2T pulse-to-bar ratio (shape of high contrast edges)
- (d) chrominance/luminance gain inequality
- (e) chrominance/luminance delay inequality

The whole apparatus, including the associated digital control system, is arranged to "fail safe" so that failures in the apparatus itself do not make the signals worse.

This instrument promises to be a very powerful tool in maintaining high-quality signals over both the distribution and contribution networks.

#### PROBLEMS OF SETTING PERFORMANCE LIMITS

As the BBC-1 and BBC-2 625-line television distribution networks expand, more attention is having to be paid to the limits of technical performance which should be expected and assigned. On the one hand one could wish for immaculate results for 100% of the time but to maintain a high standard of quality for a very high proportion of the time costs a great deal of money; on the other hand the quality must not be allowed to slip to the point that viewers will complain frequently.

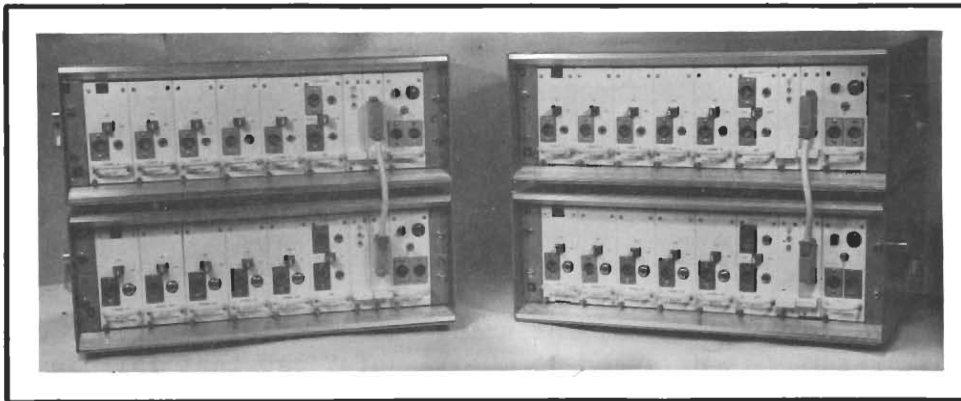
For what percentage of the time and at what time of day the signal quality can be allowed to be degraded, and by how much, are not easy questions to answer but they are important questions because they affect the whole planning and cost of the distribution system, together with its reserves and monitoring apparatus.

The regular measurements which are made on the transmission network provide much useful evidence on which to base a realistic assessment of what it is possible and economic to do. This is a continuing job as the network expands.

Several other developments were brought to completion during the year:-

#### MULTIPLEX EQUIPMENT FOR TELEVISION OB USE

On many television outside broadcasts of a major nature, such as the Boat Race, Horse Racing, Naval Reviews, etc., there is always a complicated communication system required to give the various control, speech and talkback facilities for the production and engineering staff. These are frequently set up using radio links as the bearer circuits. To economise in the number of radio links used, a multiplex apparatus has



TELEVISION SOUND MULTIPLEX EQUIPMENT. This equipment provides 5 narrow-band (3.4kHz) control circuits. Each control circuit may be used in either a 2- or 4-wire mode and when switched to the 2-wire mode, telephone through-ringing facilities are provided. Also, 2 or 3 control channels can be combined to provide a 6.8 or 10.5kHz commentary/effects channel.

been designed so that on one music-quality radio link a number of communication channels, up to a total of five, can be carried simultaneously. The apparatus is flexible so that the number of channels can be varied, e.g. up to five speech channels or three speech channels and one music channel, and so on. Signalling facilities are supplied on the speech channels so that operators can ring one another in the conventional way.

A prototype of the equipment has been built and used in field-trials on several outside broadcasts. Six complete sets will be supplied during 1972.

#### PULSE CODE MODULATION DEVELOPMENT

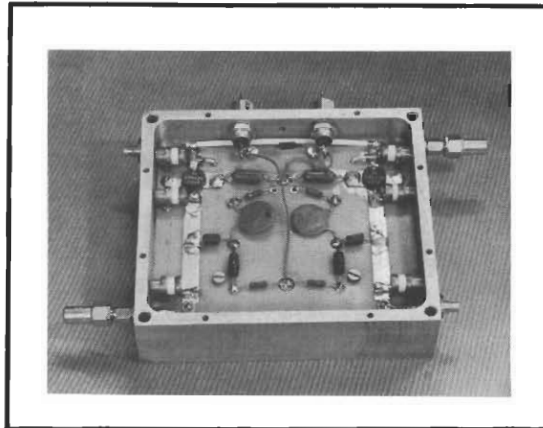
The new PCM apparatus to be used to supply up to 13 high-quality bearer channels for radio broadcasting on the London, Sutton Coldfield, Holme Moss route is now being actively designed. The principles and basic parameters of the system were established by Research Department and now the hardware

for service use will be produced by Designs Department and Equipment Department as a joint effort. The first equipment is due in service between London and Wrotham in July and the remainder will be completed by the Autumn 1972.

### UHF DEVELOPMENTS

The development of techniques for obtaining more power at UHF from solid-state devices has continued.

On the frequency-modulated television outside-broadcast link apparatus mentioned in last year's Annual Report, a power output of 20 watts has been achieved in the laboratory. The devices used to produce this power are expensive and electrically fragile and so a considerable part of the problem is the design of reliable protective circuitry so that the devices are not damaged or destroyed in day-to-day use. Apparatus for service use is now being produced.



UHF AMPLIFIER. This new design of module forms part of UHF Active Deflectors and Translators. The amplifier is mounted in a cast chassis, an inexpensive form of construction.

In the realm of UHF television broadcasting there is still the need for a small solid-state transmitter with a power output of 10 watts. Recent developments in semiconductor devices are bringing this nearer. A power output of 5 watts has now been achieved in the laboratory. It is hoped that 10 watts will soon be realised.

### VHF DEVELOPMENTS

In the VHF band, television outside broadcasts have a need for high-quality music links. They will often be used in connection with the multiplex equipment mentioned above. A prototype transmitter and receiver have been on field-trial and now apparatus for service use is being produced.

Also in the VHF band, a new radio microphone is



VHF RADIO MICROPHONE. This new, compact device has an output power of 250mW in the range 45-65MHz. An FET RF power output stage is used for stability under all load conditions. The case is moulded from Darvic thermoplastic material in the Department's Model Shop.

being developed for television outside broadcast use. It has an output power of 250 milliwatts which will give a working range of about 1,000 yards.

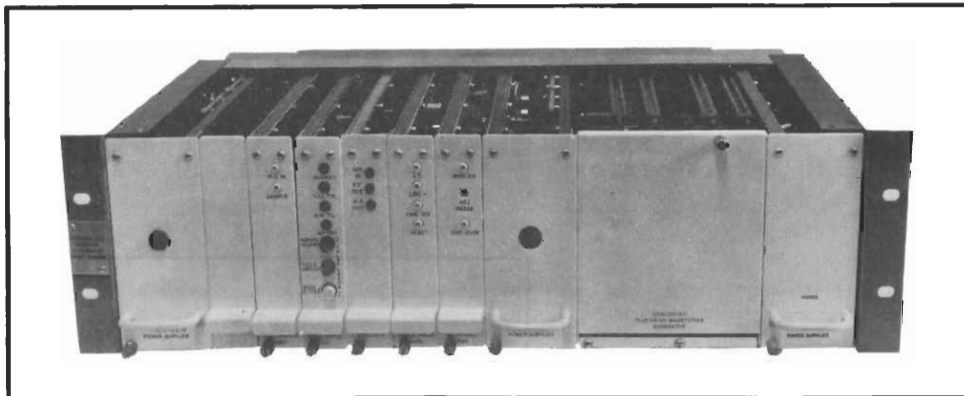
### TELEVISION WAVEFORM ACCURACY

In the development of the television distribution network, more and more automatic apparatus is being introduced to economise on manpower. Much of the apparatus depends for its satisfactory operation on the presence in the television signal of the basic synchronising signals of a reasonable standard of accuracy.

It has been found that some mis-operation of automatic apparatus in the field has occurred because the basic synchronising waveform was in error at the source, i.e. the television studio centre. The errors were often of such a nature that the studio engineers were not embarrassed by it, and perhaps not even aware of it, whereas elsewhere in the networks apparatus was declaring the signal faulty and trying to take appropriate corrective action, or, in one or two cases, closing down transmitters.

It was apparent that, to permit the satisfactory expansion of the use of automatic apparatus, a greater vigilance over the basic waveform at source was required.

To assist in this vigilance Designs Department have developed a "Synchronising-signal Gauge". This device makes a



**AUTOMATIC SYNC MONITOR (SYNC GAUGE).** Verifies that the synchronising component of a video signal is within tolerances that, while wider than the specification, are matched to the failure-point of dependent systems. It uses a Television Waveforms Generator as a reference for comparison purposes. It can be used (with other apparatus) for a cyclic check on a number of video sources.

continual check of all the parameters of the synchronising signal. When it detects an error it signals an alarm and also indicates the precise nature of the error.

The Sync Gauge will be applied in two ways. First, there

will be one permanently connected to the output of the Television Centre of both BBC-1 and BBC-2. This will give a continual check that all is well. Second, a further sync gauge will be arranged to examine all the programme sources at Television Centre (whether on rehearsal or transmission) about once every two minutes, so that faults will be detected long before the source concerned goes on transmission.

A prototype synchronising-signal gauge has been built and put into service at Television Centre. At first many faults were detected, but very soon the incidence of faults and errors reduced as they were found and understood.

It is expected that, with the introduction of a total of four Sync Gauges early in 1972, this aspect of television service operation will settle down to a generally good standard.

#### MONITORING AND CONTROL

Mention was made in last year's Annual Report of the use of Insertion Communication Equipment (ICE) for such purposes as programme identification, remote switching operations, transmission of data, etc.

A prolonged field-trial has been in operation since April 1971. The scope of the field-trial has been widened and experiments have now been tried using the apparatus for:-

- (a) Programme identification
- (b) Transmission of data signals of various types
- (c) Using ICE as the channel for remote control of Natlock operations between the main regional centres and London
- (d) Using ICE as the channel for remote control of Natlock operations between a television outside broadcast and the studio centre

In the field of automatic monitoring and the general control of the distribution network it is becoming more clear that there will be the need to transmit data such as performance parameters from place to place, or from the transmitter to some monitoring station. This, again, is a function for the ICE equipment.

From the evidence of the field-trial, and taking a very forward look at the application of ICE-type signals, it has been concluded that the information capacity of the system could, and should, be increased to about twice the present figure. Further, it is desirable that certain features of the system should line-up with ITA practice so that a common approach can be made in dealings with the Post Office who may

well wish to make use of the signal, at least for programme identification.

Parameters for a revised ICE system have therefore been proposed and laboratory experiments are being carried out to confirm their suitability and practicability.

### STREAKING

One particular form of television-signal distortion has been the subject of special attention in the course of the year. If the amplitude and phase response of the apparatus carrying the television signal is not uniform in the middle frequency range, 50kHz - 500kHz, there ensues an edge effect on sharp transitions in the picture. Distortion in one direction sharpens the edges whereas in the other it makes them rather blurred. For equal amounts of distortion (as measured) the blurring effect is much the more disturbing of the two, particularly with some high contrast scenes.

It has been suggested that the performance tolerances of these parameters, which were established many years ago on black and white pictures, may need some re-examination and perhaps revision.

Methods of measuring this distortion with greater precision have therefore been devised as part of a programme of work on the whole question of streaking on television pictures.

### DEMONSTRATIONS

During the year there were the usual number of demonstrations of apparatus to other departments but, in addition, there were two major occasions.

The first was the visit of the EBU Heads of Research and Development. They were shown automatic monitoring, the new television carrier system, new measuring apparatus and also parts of the new PCM system for 13 high quality music channels for LO-SC-HM.

The second was the visit of some 30 engineers from ORTF who were studying automation in television over a wide field. They were given an extensive demonstration of automatic monitoring and control, and also the automatic fault reporting equipment.

A considerable effort was needed for the preparation of these demonstrations.

## STUDIO GROUP

In June 1971 John Bliss, Head of Special Studies Section, retired after 42 years in the Corporation, much of which was in Designs Department. He was succeeded by Mr. I.D.B. Millar.

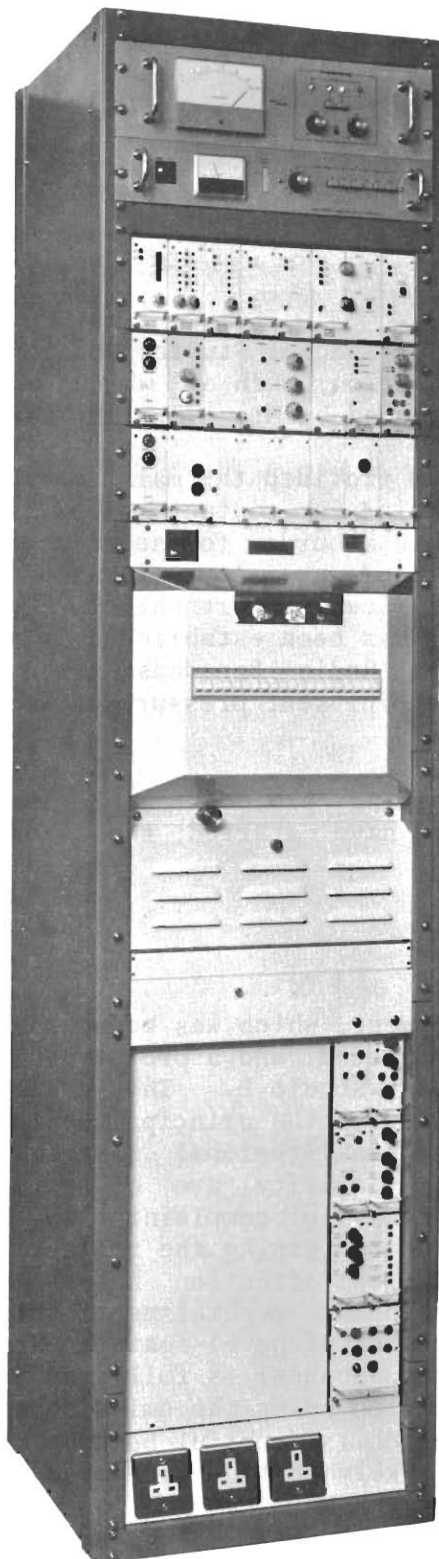
As last year, the Studio Group provided the main contingent of the Field Engineers who maintain contact with the Television Service. Although this is a burden for sections to bear since the services of an engineer are lost for three months, it is thought that the sacrifice is worthwhile. Now that the value of field engineering has been established it is hoped to extend this activity into Radio Broadcasting and Communications Departments when the present pressure of work permits.

During 1971 a number of interesting projects have been brought to completion and a number have started; these are detailed below.

### TRANSPARENCY SCANNER

The transparency scanner development, which was begun some 18 months ago, has now been completed and a prototype is undergoing a field-trial in Lime Grove Studio E. This transparency scanner has been developed with the principal object of producing a device suitable for small regional installations where low cost and high reliability are of prime importance. In view of the vast number of complaints which originate from the Television Service concerning the reliability of slide-changing mechanisms, great attention has been paid to the design of the slide-changing mechanisms of this new transparency scanner, and a number of novel features are embodied. The performance of the scanner is fully up to broadcast standards, the only exception being the omission of electronic masking, the value of which is doubtful because of the wide variety of slide material likely to be encountered in its usage.

The scanner is in a single standard bay to make for simple installation. The flying-spot cathode-ray tube is mounted vertically at the bottom of the bay together with those sub-units required for scanning and focussing. Directly above the scanning mechanism is the slide changer. This is a disc which holds 20 slides around its circumference and which is rotated



COLOUR TRANSPARENCY SCANNER. All the sub-units for the scanner are contained in one bay, making for simple installation. Access for servicing is from the front; the flying-spot CRT and the slide-changing mechanism sliding forward when required. Tube-changing is straightforward and can be accomplished in a few minutes.

by a motor, forming part of a servo-system. Slides can be selected in random order with never more than one second from one slide to any other.

The light from the cathode-ray tube, having been focussed by a lens onto the slide (which is horizontal), then passes into a cast metal box containing a set of dichroic mirrors where the light is split into its constituent components of red, green and blue. To the side of this metal box are fixed the photomultipliers which convert the light into electrical signals for processing in sub-units mounted higher in the bay.

A number of techniques, such as plastic injection-moulding, alloy casting and chemical milling, have been used in the design of this scanner in order to keep the cost down as well as to produce a very much more consistent product. Particular attention has also been paid to the ease of alignment of the scanner as well as to maintenance, when this is necessary.

#### AC TEST SET

This is another piece of equipment which is now approaching the completion of its development. The testing of audio-frequency equipment and lines still depends considerably on sine-wave testing; the current equipment, the AC Test Set Bay Type AC/55, was



designed a considerable number of years ago and is becoming increasingly obsolete both in performance and, in particular, in appearance.

In 1969, as a result of discussions with the users, it was concluded that there was a need for the AC Test Equipment to be re-designed as a portable piece of equipment, and a specification was outlined and accepted for an AC Test Set providing in one instrument the facilities of tone source, amplifier detector, test programme meter and noise meter, as well as including switchable filters for noise and harmonic measurements. The new specification also called for an extended range of higher performance.

The design of this AC Test Set is now substantially complete and, as can be seen from the illustration, below, of the prototype, has been constructed as a 19in bay-mounting unit



AC TEST SET. Within the one housing are contained a tone source, amplifier detector, test-programme meter and noise meter. As shown, the test set is for mounting on 19-inch bay; for portable operation, a carrying-case incorporating a battery-pack is used.

5½in high. The large, centrally-mounted meter carries a standard peak-programme meter scale together with a subsidiary scale, with the same, central line-up position but covering  $\pm 0.5\text{dB}$  for mean and noise readings. The oscillator section (on the left) provides tuning from 5Hz to 50kHz in four decade ranges, has an output attenuator range of 100 decibels, in 2 decibel steps; the output circuit can be selected to be 75 $\Omega$  unbalanced, 75 $\Omega$  balanced, or 600 $\Omega$  balanced. The small meter provides for continuous monitoring of the output level, but the output can also be switched to the main meter for more-accurate checking.

The mode of operation of the measuring section (on the right) is determined by the seven push-buttons which select the calibrate, mean-reading (either directly or through 150Hz or 1.5kHz high-pass filters), weighted or unweighted peak-reading and, in the final position, noise-measurement positions. Noise measurement is in accordance with methods

proposed by Research Department in Report No. EL-17. Coarse and fine attenuator controls are located above the mode selection.

The Test Set incorporates its own mains supplier but, for portable use, can be mounted in a carrying case which contains a battery compartment to provide an alternative supply. The new design will represent a significant saving of size, weight and cost over the four existing designs which it replaces.

### STEREOPHONIC EQUIPMENT

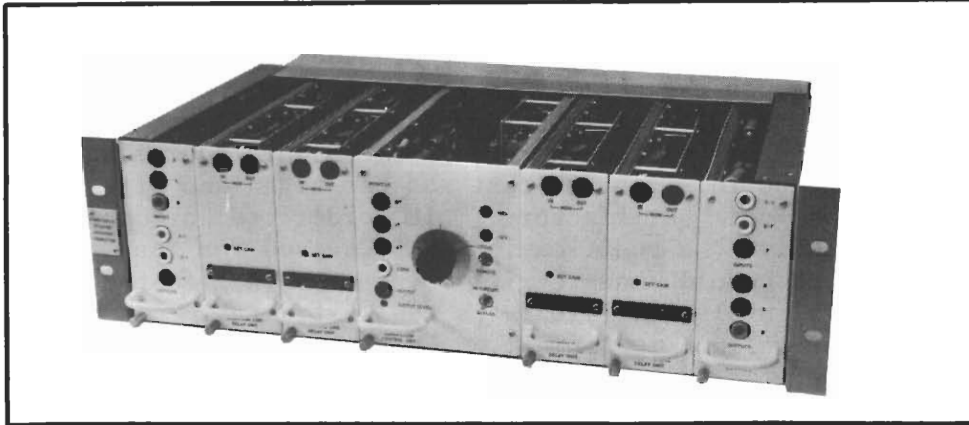
With the completion of a range of Type-D stereophonic programme modules for use in sound studios and continuities, the emphasis has now shifted to the provision of ancillary amplifiers and other special-effects devices. Units recently completed have included a stereophonic effects unit and a remotely-controlled cross-fader. Work is progressing on the development of a stereophonic limiter and of a wide-range width control.

The stereophonic effects unit is used to de-localise a single source when fed to the left and right channels of a stereophonic system. In an original version developed by Research Department, an unprocessed signal and the same signal after passage through all-pass phase-shift networks were added and subtracted to give two complementary outputs. From an input signal having a broad frequency spectrum this method divided the frequency components between the two channels to give an impression of stereophonic width. In the production version, a similar effect has been achieved by the use of electronic phase-shift networks. As a result the size and cost of the device has been appreciably reduced.

In a stereophonic limiter it is necessary for the gain variations of the two control elements (one in each path) to track accurately with control voltage variations. As a preliminary to the design of a new stereophonic limiter, investigations have been carried out and a report issued on methods of achieving this. The problem of remotely controlling and fading a stereophonic signal is a more severe version of the same problem and a solution is possible along similar lines. A simple stereophonic cross-fader suitable for remote-control applications has been developed for use in local-radio stations. By making or breaking an external loop the unit cross-fades from one stereophonic pair of inputs to another at a fixed rate, taking about three seconds. Within these limitations the performance is satisfactory, though a more complex solution would be necessary for a true fader/gain control for stereophony.

### APERTURE CORRECTION FOR TELECINE

Following the successful field-trials mentioned in last year's Annual Report, production units have now been designed



TELECINE APERTURE CORRECTOR. Used with 16-mm telecine machines, this equipment produces pictures of a quality comparable to that obtained from 35-mm telecine machines. Its use should result in savings in film-stock and, on new installations, capital expenditure.

and installed to provide vertical aperture correction for 16mm telecine machines. The equipment is shown in the photograph.

#### DIGITAL TELEVISION

Work has begun on the design of a digital line-store standards converter. Although the standards converter is the specific end-product of this development, it will also provide certain functional blocks necessary for developments in the application of digital video techniques over a much wider field. In addition, certain blocks for use in digital signal processing and timing will become available. These blocks include analogue-to-digital and digital-to-analogue converters, delay and storage units as well as arithmetic and memory units.

The main object of this development is to replace the present analogue line-store standards converters with digital converters having a very much higher reliability. In order to achieve this reliability much attention has to be paid to very mundane details such as the choice of manufacturing techniques, choice of interconnections between units and boards, the environmental conditions to which the equipment will be subjected in service, as well as devising methods of maintaining the equipment, should it become faulty. Although the equipment will be basically digital, it will, inevitably, still have a large number of analogue devices, such as power supplies, and these must be so devised that their reliability is high, particularly in view of the fact that the final units will be installed at unattended transmitting stations.

#### FAST NATLOCK/GENLOCK

The development of the colour television facilities of the

network and area centres requires the continued use of the fast-Genlock function which is now available for monochrome use. This gives the ability to lock the local pulses to any incoming source (for example, during regional opt-outs) in under one minute. Although commercial colour equipment was available to do this job its cost was too high and its performance was not satisfactory. In order to produce the facility required, a modification was devised for the Natlock system which would enable it to be used in a fast-Genlock mode. This involved developing a new extra-fast correction rate for the Natlock equipment. Such a rate required a new timing comparator as well as a new variable-divider unit. The final equipment has a lock-up time of only 18 seconds and in this development work a computer programme was used in order to obtain the data so that the locking-up process produced the minimum of disturbance while it is occurring.

### RUBIDIUM STANDARDS

During the year further work undertaken using rubidium standards has shown the advantages to be gained by the use of such standards for the control of colour synchronising-waveforms generation. The two orders of stability greater than that achievable by quartz oscillators give opportunity for simplification and reduction of the cost of the synchronising process.

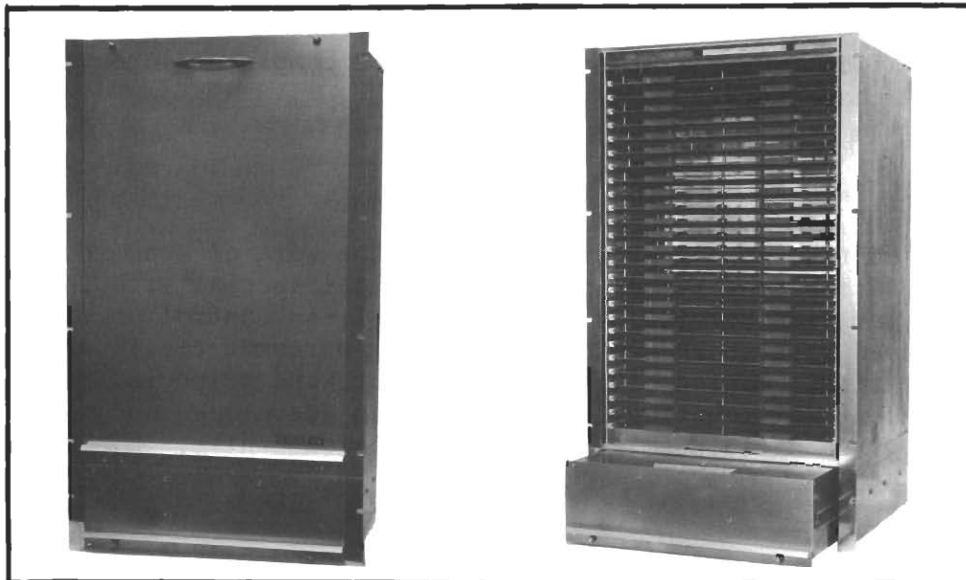
Using rubidium standards at the Television Centre and in Birmingham, Pebble Mill, tests have been carried out to try to convey the control information between these centres using the ICE data channel.

### VISION MIXING EQUIPMENT

During the year, work has continued on the design of the automatic mixer for use in the Network Control areas of Television Centre. Some modification to the original concept has been found desirable and, in particular, the control panel has been replaced by one having edge-wheel type of switches.

Throughout the year, work has continued on the current range of mixing equipment in order to add facilities which have now become an operational requirement. In particular, a programme of work was carried out in collaboration with SCPD and Tel.O.&M. which enabled colour-separation overlay to be installed on the Studio, OB and News mixers.

Work has now been started on a new range of studio mixing equipment. The mixer framework has been designed and a careful investigation carried-out into the cooling problems that are associated with the tight packing of electronic equipment. During this development work attention is being paid to the needs of production and maintenance testing by providing an adequate range of test-jigs as well as the production of novel



NEW MIXER FRAMEWORK. Shown above are views of a laboratory model of the suggested new mixer framework. The electronics modules are mounted horizontally and plug into a large "mother-board" at the rear. The assembly is enclosed by a front cover and is cooled by air circulated by a fan in the drawer-assembly at the base.

supporting documentation which will allow the equipment to be maintained easily.

#### COLOUR PICTURE MONITORS

The colour picture monitors which were acquired from industry to start the colour service have proved highly unreliable and, as a result of an urgent request from Tel.O.&M., a programme of investigation and design was carried out in order to make the Pye 19in colour monitors more suitable for service use. As a result of this work a significant improvement in the important grey scale stability was achieved. Although the necessary modifications were quite extensive, the amount of work to each monitor has been kept to a minimum by the addition of small printed circuit cards to the existing units. These cards were produced in collaboration with the original manufacturers, Pye, and a programme of work has started by Tel.O.&M. to install them. The results of this work already justify the effort which was spent on investigating the instabilities and other failures associated with these monitors and will produce a very valuable by-product in the form of knowledge which can be used in the evaluation of other commercial monitors as they appear.

#### DISK DATA STORE

The Magnetic Sound Delay mentioned in last year's Report has now been converted into a data store for use in such

applications as driving the ANCHOR Character Generator. The device has been so arranged that it will store 100,000 bits of information, sufficient to give about 80 complete screens of ANCHOR characters.

#### OPTICAL SPECIAL EFFECTS

A continuing and growing part of the work of one section of the Group consists of producing optical special effects for the Television Service. The Remote Iris Control which was developed last year has now been taken up commercially by one of the firms making lighting equipment, and a special camera attachment for mounting lenses has been developed and is now being given a field-trial at the Television Centre.

# GENERAL SERVICES

## DRAWING OFFICE

During the past year a number of projects have been drawn in the metric mode, examples being the transparency scanner bay, the main framework for the new mixer and an unsupported printed-card system. Each project handled by the Drawing Office is now subjected to a scrutiny to determine whether it should be drawn metric.

The co-ordinatograph came into more use during the year. Among the main tasks for which it was used were the generation of printed-board master surrounds to replace the existing surrounds when imperial references were changed to metric, an extension of the range of masters to include surrounds for new chassis and the laying-out of the originals for the increased range of pin configurations used on printed-circuit board layouts.

Early in the year it was agreed that Equipment Department would hold the Specifications of units and equipment in addition to the manufacturing and testing information which they already retained. All Specifications held by Design Department Drawing Office have now been passed to Equipment Department. Although this change eased the demand on the Drawing Office Registry for the supply of Specifications, there was no significant change in the number of prints produced compared with the previous year. The number of new Specifications issued was about 10% up on 1970.

## PRODUCTION UNIT

### Model Shop

The number of individual jobs completed in 1971 increased by 12% from 740 in 1970 to 830. To some extent the increase was due to the completion of several long-term projects such as the transparency scanner and the VHF transmitter for Radio Brighton. Both of these projects made extensive use of Production Unit services.

New facilities made available include a prototype and small-batch production winding service enabling all coils for

Designs-Department manufactured equipment to be made 'in house'. A new winding machine has been purchased and will come into use in 1972. A purpose-built drilling machine for printed-circuit boards, the Excellon Uni-drill, which drills very high-quality burr-free holes was installed in the latter part of the year. High accuracy of hole placing is achieved by means of a projection head which displays a 10-times full-size picture of the board being drilled.

Progress towards metrication continued and a number of measuring instruments were purchased just before a general price increase came into force. Every member of the Model Shop now has a comprehensive set of metric instruments available to him as well as the metric machinery bought and converted earlier. Conversion charts from Imperial measurements now occupy the walls of the Workshop and Machine Shop in order to simplify metric working during the interim change-over period, thereby reducing the chances of error.

Plastics are playing an ever-growing part in the production field, both injection-moulded parts using powder as the raw material and items formed from sheet using pressure and heat. A recent example of the former was the fuseholder blank used for conversion to single-pole fusing, two thousand of which were made from ICI Alkathene in a double-impression mould. Another injection moulding still undergoing tests is the printed-circuit board handle for applications where high extraction forces prevail. This handle, which is moulded from nylon, enables two or three fingers to be inserted into a loop thus providing the user with ample grip. The sheet forming technique was used to make a case in ICI Darvic p.v.c. sheet to contain the new radio-microphone transmitter. The design combines strength, pleasing appearance and economy.

Internal printed-circuit board production rose by about 18% to 2,600 boards, but the quantity made by outside contractors fell drastically to only 650, making a grand total of 3,250 boards for the year. Experiments with through-hole plated printed-circuit board production took place in order to identify any problems and to evaluate proprietary systems. These tests are continuing.

Conducted tours of the Workshops and demonstrations of equipment were organised for the Department's engineers during the last quarter of the year to acquaint engineers with the facilities available so that even more effective use could be made of them.

#### Outside-contracts Manufacture

There was a substantial reduction in the value of sub-contracted work which, at £7,200, was less than one-third the figure for 1970.

#### Stores

The new Stores catalogue and pricing-arrangements became



effective in May and the process of updating the catalogue and the Stores stock is continuous. Metric screws are now standard stock items.

The quantity of orders placed by the Department as a whole showed a slight increase on last year and a new and very convenient system of ordering from Valve Stores by telephone has been used extensively, saving 150 paper requisitions, which was about half of last year's total.

#### GENERAL SERVICES LABORATORY

Judged solely on the basis of the number of units passing through the Laboratory there has been an apparent decrease in the work load this year. This is due in part to two relatively large jobs which were scheduled for late 1971 being put back to early 1972. However, some units have more than made up for the lack of numbers by the complexity of work required.

As a result of the lower number of units being tested, the Laboratory has been able to undertake an increased amount of special investigation and development work for, or in conjunction with, other Sections in Designs Department and other Departments. This has included investigations into the discrimination of fuses, and of the parameters of new thick-film amplifiers, a feasibility study to consider the possibility of producing a data reader for use in conjunction with CEMAST and the re-design of a number of units including: the Flying Spot Equaliser Master Amplifier AM1/561; the Flying Spot Equaliser Slave Amplifier AM1/562; the Matrix Colour Signal Coder and Decoder MA1/501 and /502, and the Tie-line Equalisers EQ5/526A & B.

#### LIAISON UNIT

The Research/Designs Agreement with the ITA was terminated in the Autumn of 1971. The Agreement had not resulted in a great amount of work for the Liaison Unit and more time can now be devoted to activities aimed at improving communications with other Departments, an area where there is scope for improvement.

During 1971, sheets in the series 'ENGINEERING DESIGN INFORMATION' were issued at a rate of about one per week. The circulation has increased, both internal and external to the BBC.

The Unit produced descriptive booklets containing notes on the Department and the demonstrations being presented for the visits to the Department that form part of some Television Centre Seminars.

The Unit has continued to deal with enquiries from

industry on the availability of designs for BBC equipment. A number of sales of information have been made and several potential sales are 'in the pipeline'. This contact with industry gives an interesting insight into some of the problems peculiar to industry.

Responsibility for the production of the 'Registered Designs and Coded Equipment' passed to Designs Department at the end of 1971. To enable the necessary work to be carried out without an increase in staff, an automatic writing/editing machine is being purchased. This machine should also simplify the production of a number of lists and schedules used in the Department as well as contributing to the data-processing activities. At the time of writing (February) it has not been possible to start work on the list as the machine, as originally delivered, was found to be defective and returned to the manufacturers. However, it is hoped that the time being lost will be made up by the Autumn.

#### GENERAL OFFICE

The General Office has continued to administer the Management Information System. This involves the collection and collation of detailed information on current work from the Design Sections and the production of a monthly Progress Report. Quarterly Returns are also compiled and issued.

The General Office also maintains the records for all leave in the Department.

#### FINANCE UNIT

The change to decimal currency in February placed an increased burden on the Finance Unit with the conversion of all the Department's accounts. This was carried-out with the minimum of interruption to the normal work of the Unit.

SOME OF THE PRINCIPAL PUBLICATIONS BY DESIGNS DEPARTMENT 1971

<u>Technical Memoranda</u>		8.301(71)	Proposals for a New Design of Studio Mixer.
1.73(71)	Iris Control Unit UN3/29.		
		8.305(71)	Considerations in the Development of the Automatic Mixer EP5/509.
1.75(71)	Proposed 16mm SERDUMAG System Head Measurements.		
		10.40(71)	A Computer Program: DEPR for Printed Circuit Layouts.
3.111(71)	Continuity Interchange for Broadcasting House, London.		
		10.41(71)	A Fast Natlock Genlock.
3.112(71)	An Investigation into the Use of Integrated Circuits as Voltage-controlled Audio Gain-elements.		
		11.64(71)	Feasibility Study: A Revised Form of Colour-signal Stabilising Equipment.
3.113(71)	Metrication of Laminations for Transformers and Chokes.		
		11.69(71)	Automatic Monitoring of Unattended Television Transmitters.
3.117(71)	Measurements of Earth Leakage Currents.		
		11.72(71)	Insertion Communication Signals: Applications and System Development.
5.71(71)	VHF Transmitters BA13/15 and BA13/16: Provisional Handbook.		
		<u>Film '71</u>	
7.173(71)	Time Codes for 16mm Camera Films.		The Choice of Codes for Film Editing and Telecine Pre-programming - (D.M. Kitson).
7.175(71)	Operation of 'ANCHOR' Equipment.		

Nordisk Symposium on  
Sound Control Techniques

PCM for High-quality Programme Sound - (J. O'Clarey).

Television Video Transmission Measurements,  
L.E. Weaver, Marconi  
Instruments Limited.

JSMPTTE

Automatic Measurement and  
Control of Unattended  
Television Transmitters -  
(I.J. Shelley and D.L. Smart).

Lectures

Digital Circuits in  
Television, M.E. Whatton,  
Plymouth College of  
Technology.

Sound-in-Syncs, J.M. Astle  
and C.J. Dalton, Plymouth  
College of Technology.

Radio and Electronic  
Engineer - October 1971

Gaussian Filters for Pulse  
Shaping - (L.E. Weaver  
and D.C. Broughton).

Vision Mixing Equipment,  
W.R. Hawkins, Royal Tele-  
vision Society, April 1971.

PAL Coder Design, G.D. Roe,  
South-western Branch of  
Royal Television Society,  
October 1971.

Books

Television Measurement  
Techniques - L.E. Weaver,  
IEE Monograph Series No.9.

CONFIDENTIAL

**BBC** DESIGNS DEPARTMENT

REPORT FOR 1971



THE BRITISH BROADCASTING CORPORATION ENGINEERING DIVISION

**PART TWO**



## NETWORK AND TRANSMISSION GROUP

### TRANSMISSION (SOUND) SECTION

7 Engineers  
6 Laboratory Technicians

#### CIRCUITS FOR THE TRANSMISSION OF SOUND PROGRAMMES

Sound-in-Synchs Pulse Code Modulation System Continuing

Further field-trials have been carried out using the pre-production models, first between London (Switching Centre) and Rowridge on BBC-2, and secondly between Television Centre and Crystal Palace on BBC-1. These latter tests included comprehensive monitoring, both at Television Centre and at Crystal Palace. The equipment has been used for several outside broadcasts - in particular for the Glen Coe Climb and for "At Sea with the Royal Navy" - and it was in great demand during the Postal strike.

One set of equipment is on loan to the ITA and another is at Equipment Department where it is being used to assist with the testing of the first production models.

A prototype model of Pye TVT's Sound-in-Synchs equipment has been tested.

Quality Checks on Rebroadcast Links forming Part of the Simultaneous-broadcast System Continuing

A VHF check-receiver has been re-aligned, first for checks on Wrotham at Broadcasting House, and secondly for receiving-tests on Wenvoe at Bristol.

Multi-channel PCM System Continuing

Prototype units have been designed for the 13-channel pulse-code modulation system which will distribute high-quality sound (both mono and stereo) to Wrotham, Sutton Coldfield, and Holme Moss. Close co-operation is being maintained with Equipment Department

who will be manufacturing and testing a large part of the production equipment.

### CARRIER SYSTEMS

Carrier Multiplex System for Television Outside Broadcasts Continuing

The prototype equipment, which has the capability of up to five telephony channels and/or one programme channel, has been constructed and field tested. As a result, modifications have been incorporated and the manufacturing drawings are being revised. Six sets of this equipment will be made for Television OB's.

### REMOTE CONTROL

A Universal Switching System Continuing

A remote control switching system has been designed and built to enable some of the switching functions of the Wrotham VHF transmitters to be controlled from Broadcasting House. It is hoped that this work will lead to a system having a universal application, and consideration is being given to its use between Television Centre and Broadcasting House for remote vision and sound switching.

A 40Hz Switching System Continuing

A prototype 40Hz oscillator and detector has been constructed for field-trials of a low-level, low-frequency switching system from Droitwich. This is a possible method of remotely switching between the Radio 1 and Radio 2 networks at unattended sites which can receive Droitwich, on occasions when it is required that Radio 2 VHF transmitters shall radiate Radio 1, whilst the Radio 1 medium-frequency transmitters continue to radiate R1, and the R2 medium- and low-frequency transmitters continue to radiate R2.

### STEREOPHONY

Polarity Checker Completed

The field-trial has been completed and the Specification and Technical Memorandum have been issued.



**Stereo Encoder****Continuing**

Completion of this unit - which will be required for the extension of stereo - has been delayed pending agreement on network levels for stereo and mono. This has now been obtained and the necessary modifications are being carried out.

**NEW TEST METHODS AND TEST EQUIPMENT****New Programme-weighting Network****Continuing**

Some small modifications have been carried out and the Specification has been issued. Agreement is being sought with the Post Office on new acceptance figures using this unit.

**Tests for Non-linearity on Sound Programme Circuits****Continuing**

The use of random-noise has been proposed for the measurement of non-linearity. Equipment has been built which has given some interesting results, particularly using a PPM as the measuring instrument. Some subjective tests have been made and the results are being assessed.

**MONITORING****Improvements to the Automatic Fault-reporter****Continuing**

Modifications to the original Automatic Fault-reporters are being carried out. The Specifications and Technical Memoranda have been written.

**Alternative Version of the Automatic Fault-reporter****Continuing**

This equipment, which uses the 23kHz carrier radiated from transmitters, has been designed and a prototype has been constructed which is on a field trial at Oxford.

**MISCELLANEOUS****New Filter for Audio Bandwidth Restriction of LF and MF Transmitters****Continuing**

A prototype filter with a closely-controlled

cut-off characteristic has been constructed and is now on field trial. It is considered that this filter will optimise the performance of a.m. broadcast transmitters whilst reducing the adjacent-channel interference.

**Pre-emphasised PPM's for Sibilance Tests**

**Completed**

Two pre-emphasised PPM's have been constructed for use by Television Sound as part of an investigation into the causes of excessive sibilance, S-blasting and gain ducking which has been experienced from certain UHF transmitters.

**Voice-frequency Ringing Unit for Outside Broadcast Telephones**

**Continuing**

The Post Office have indicated that LF ringing may not always be possible on Outside Broadcast telephone lines. Modifications are therefore being carried out on the existing VF ringing units to see whether they may be adapted for this purpose.

**Inductor Design**

**Continuing**

Over the last 12 months about 150 inductors were designed as a service for the whole of Designs Department for use in prototype equipment.

## NETWORK AND TRANSMISSION GROUP

### TRANSMISSION (TELEVISION) SECTION

5 Engineers  
6 Laboratory Technicians

#### TELEVISION LINKS

##### Measurements on Distribution Chains

Continuing

Insertion Test Signals added to the BBC-1 and BBC-2 outputs at Television Centre enable the in-service performance of both distribution systems to be checked right through to the output of the terminal transmitters.

Maintenance limits for each performance parameter at every video point in these chains have been up-dated as new links and transmitters have been brought into service. These calculated limits serve as a guide to operational staff on manned stations and also form a basis for the setting of limit-units in the automatic monitors which are being installed on un-manned stations.

##### Performance of Distribution Chains

Continuing

The results of daily Insertion Test Signal measurements from some 35 points on the distribution chains have been collated and prepared for analysis by specially-developed computer programs. This information provides statistics on the long-term performance of the distribution system which are valuable in the design of new equipment and which enable trends to be identified and corrective action to be suggested.

The use of a BBC automatic monitor and a data logger enabled a more vigorous investigation to be carried out into the hour-by-hour variation of selected performance parameters measured at Crystal Palace and at Mendip.

##### New Links Provided by the Post Office

Continuing

Acceptance tests have been carried out in

co-operation with Communications Department on the following links:-

BBC-1

London - Birmingham  
 Carlisle - Belfast  
 Bristol - Plymouth  
 Plymouth - Caradon Hill  
 Birmingham - Peterborough - Tacolneston

EBU

Tolsford Hill - Lille - Tolsford Hill

Western House Video Links Completed

The four coaxial circuits between Broadcasting House and Western House were re-equipped with modern apparatus, all four being made reversible from the Western House end.

Outside Broadcasts Continuing

Assistance in respect of staff and equipment was provided for the following:-

The University Boat Race on the Thames  
 "At Sea with the Navy"  
 Interference tests on the Solent

TELEVISION LINK EQUIPMENT

UHF Transmitter Demodulator Continuing

An improved version of the UHF Transmitter Demodulator employing a synchronous-demodulation techniques has been developed. Three pre-production models have been prepared for TCPD, and three existing models are to be updated.

Depth of Modulation Indicator Completed

A unit has been developed which enables the depth of modulation of a UHF transmission to be read directly from an oscilloscope-display of the video output of a BBC-designed rebroadcast receiver.

UHF Rebroadcast Receiver Completed

Four pre-production models of the new UHF

rebroadcast receiver, which embodies a synchronous detector, were produced for TCPD. One of these replaced the original prototype at Heathfield which had completed fifteen months of fault-free service.

#### Mains Failure Protection Unit

Completed

An add-on unit for the synchronous rebroadcast link receiver has been developed. This unit eliminates the possibility of an incorrect demodulator lock occurring when the receiver is re-powered after a mains failure.

Five pre-production units have been supplied.

#### Synchronous Demodulator

Continuing

A start has been made on the design of a synchronous demodulator unit which will form an integral part of the comprehensive RF Test Equipment which is being developed for use by Transmitter Maintenance Teams.

#### Watertight Box

Continuing

A housing for receiver mast-head amplifiers, etc., which have to be mounted in exposed positions is under development.

#### UHF OB-link Equipment

Continuing

This BBC-designed equipment employs frequency modulation and operates in UHF Band V. The use of this band offers advantages over the more commonly used SHF band when a link has to be set up over a non-optical path, or when the transmitter is required to be mobile, e.g. for the Boat Race (which this year involved the first use in the UK of a helicopter-mounted colour camera). A disadvantage of operating in Band V however is the absence of exclusive r.f. channels. To lessen this disadvantage, a frequency synthesiser is being developed to enable rapid changes of operating frequency to be made.

Development of a 20-watt output amplifier

for use with the transmitters of this link equipment is nearing completion and it is envisaged that about ten of these will be required.

#### Television Carrier Equipment

Continuing

Design of a carrier equipment, which will enable a second television channel to be derived on many of the unrepeated coaxial cables which are currently operated at video frequencies only, is nearing completion. Two pre-production sets, including monitoring and test equipments, are to be produced in the Department. It is envisaged that a further eighteen sets will be required subsequently.

Further development of this technique to derive a third channel under certain circumstances is to be investigated. A possible application in outside broadcasts is also under consideration.

#### Adjustable IF Delay Corrector for OB's

Completed

A variable delay equaliser has been developed for insertion in the IF path of OB SHF links. This corrector is used to improve the colour transmission performance of existing link equipment.

#### Double Diversity Switch

Completed

A unit has been designed to select automatically the better of two rebroadcast or micro-wave link receiver outputs. It is programmed firstly to determine whether both outputs contain synchronising pulses and if not to select the one which does. If both outputs do contain synchronising pulses it then decides which is the stronger of the r.f. signals and selects that signal.

#### Modification to Stabilising Amplifiers

Continuing

Existing stabilising amplifiers will not handle a video signal containing Sound-in-Syncs pulses. A plug-in replacement sampling pulse generator unit is therefore being developed to overcome this difficulty.

**Sound Subcarrier Detector****Continuing**

A detector is being developed for use with BBC fixed micro-wave links. The object is to raise an alarm, or take executive action, when the sound subcarrier accompanying a vision signal drops below a pre-determined level.

**INVESTIGATIONS****Streaking****Continuing**

Transmission aspects of the problem of streaking or smearing distortion on television pictures are being investigated. A start has been made with the design of equalisers for short cable-runs inside a studio centre.

**Output of Television Centre****Continuing**

An automatic monitor and chart recorder have been connected to the BBC-1 and BBC-2 cable feeds to Western House. These have shown occasional anomalies which require further investigation. One positive outcome has been the installation of blankers at Television Centre to clean-up the lines in the field-blanking interval, upon which noise is measured, before they leave CAR.

**VHF Rebroadcast Receiver****Completed**

The performance of an ITA-designed receiver which has been purchased by the BBC was checked before installation.

**Noise Meters****Continuing**

Measurements of the absolute and relative performance of different types of instrument for the measurement of random noise on television circuits was carried out, and as a result the design of an instrument under development in the Department was modified.

## NETWORK AND TRANSMISSION GROUP

## MONITORING AND CONTROL SECTION

7 Engineers  
6 Laboratory Technicians

TELEVISION MONITORING

## Automatic Monitors

Continuing

These units operate on the Insertion Test Signal and have a measurement capability which has been extended to cover all the required parameters, with the exception of differential phase and gain, for which various measuring techniques are still being investigated. A new and improved technique for the automatic 'K' rating of the lobes of the 2T pulse has been developed. Some 34 sets of the basic equipment and associated automatic control systems are now in operation at unattended UHF 77 transmitters and the performance is being analysed as part of a more detailed investigation into automatic monitoring.

An automatic control unit for use on Post Office circuits has been developed and two pre-production models have been installed for field-trial at Caldbeck.

An executive control unit for parallel transmitters has been designed and will shortly be undergoing a field-trial. A batch of nine units is being manufactured to meet urgent operational requirements.

## Sync Gauge

Continuing

Sound-in-Sync, automatic monitoring and other automation projects now under consideration are all to some extent dependent upon the accuracy of the television waveform. As continuous manual monitoring of the sync waveform is virtually impossible, an automatic Sync 'Gauge' has been developed and a prototype unit is on field-trial at the Television Centre on the BBC-1 network output. When an out-of-tolerance waveform is detected an alarm and



an indication of the nature of the fault are given. In the final arrangement, in addition to the Gauge monitoring the output of the networks, an additional Gauge will sequentially sample each position on the CAR matrix thus ensuring that any non-standard waveforms are detected at the earliest possible moment.

#### Line and Field Sync Monitors

Completed

During the year a number of problems have arisen in connection with the detection of line and field synchronising pulses and modifications and extensions to existing units have been devised.

#### Insertion Test Signals

Completed

The insertion and extraction of insertion test signals requires accurate identification of the correct lines in the field-blanking interval. A multi-purpose trigger-pulse generator has been designed.

### DATA TRANSMISSION

#### System Investigations

Continuing

With the continuing increase in the number of unattended transmitting stations and other automatic devices the transmission of data becomes extremely important. The technical and economic advantages of various transmission systems are being studied.

#### Insertion Communication Equipment

Continuing

This equipment inserts data in the form of digitally-coded pulses on one or more lines in the field-blanking interval of a television waveform. The signals may be transmitted with the video waveform and decoded at any distant point thus providing an economic and multi-purpose communication system.

Two sets of prototype equipment are at present on evaluation trials for network ident, Natlock and general data-

transmission purposes.

The results of these trials will be used as the basic for the design of an operational system which should be completed by mid 1972.

#### AUTOMATIC CORRECTION

Continuing

At the present time most UHF transmitters are equipped with automatic video-signal stabilisers which correct for luminance level and chrominance-luminance gain inequality. An analysis of the performance of the network has shown that automatic correction of 10 $\mu$ s-bar slope, 2T pulse-to-bar ratio and chrominance-luminance delay-inequality would considerably improve the quality of the radiated signals.

A new corrector capable of dealing with all these impairments is being developed with the additional constraints that it should have an improved performance and reliability when compared with the existing equipment and it should be half the cost and size. An experimental model should be available for field-trial early in 1972.

#### SOUND MONITORING

Sound Automatic Monitor Major

Continuing

Various problems associated with the introduction of these monitors have been dealt with satisfactorily.

General

Continuing

Throughout the year numerous requests for improved or changed operational facilities have been received and the resulting design work has been almost continuous.

#### TRANSCODING

Continuing

Equipment for PAL to SECAM transcoding has been constructed and supplied to Television Operations. Advice and assistance has been given on numerous problems associated with various aspects of PAL - SECAM - PAL transcoding.

## NETWORK AND TRANSMISSION GROUP

## RADIO FREQUENCY SECTION

5 Engineers  
4 Laboratory Technicians

TELEVISIONUHF Translators and Active Deflectors Continuing

The first active deflector was introduced into service at Bethesda in May 1971. The basic modules for this device (which also form the basic modules for the "one-step" translator) have been re-designed to incorporate the most-recently available transistors. Additionally a synthesiser for use with the translator is being developed. Production of a number of translators of the "one-step" type is scheduled for early 1972.

UHF Off-air Receiver Completed

A version of this receiver incorporating a "pseudo-synchronous" detector has now been produced. This receiver is designed primarily for use by mobile maintenance teams to provide second-grade measuring facilities, but it is expected that it will also have wide general use.

Commentator's Colour Monitor Completed

A Sony Trinitron Receiver was modified to work as an "off-air" unit or to accept line video feed.

TMT Test Equipment Continuing

Work has continued on the production of the range of video test equipment in light-weight housing particularly suited to the requirements of mobile maintenance teams. All these units are now in production with the exception of the gain/delay and noise-measuring test equipment which should

be available by mid-1972.

#### UHF Power Amplifiers

Continuing

Work is in hand on the development of a 10-watt output stage which can be driven by the standard translator. Such amplifiers are particularly required for use in type-C relay stations.

#### Comprehensive RF Test Set

Continuing

Work is in hand on the development of a test set for use by mobile maintenance teams. This test set will provide a range of facilities to enable comprehensive measurements to be made at relay stations. It will provide a modulated RF signal on any UHF channel and a synchronous demodulator for examining the output from the unit under test. It will also provide facilities for performing sideband analysis, intermodulation distortion measurement and swept-frequency measurement.

#### Microwave Link Deviation Calibrator

Completed

This unit provides test signals at IF to check the setting up of microwave links. It is battery operated and small enough to be carried in a pocket.

### SOUND

#### Band II Sound Equipment

Continuing

The design of a two-channel diversity receiver has been completed and the first receiver has been installed at Rowridge to provide the stereo feed for Radio 3. It is expected that a number of these receivers will be installed as part of the stereo coverage system.

#### Stereo Driver and Transmitters

Completed

A design has been completed of a range of solid-state VHF FM transmitters with output powers of up to 400 watts. Three

of these transmitters have been installed at the local radio stations of Brighton, Leicester, and Nottingham.

#### Radio Microphones

Continuing

A new version of the VHF radio microphone for use by Tel. OB's is being designed to replace the existing unit.

#### VHF Link Equipment

Continuing

Development is in hand of a range of solid state VHF FM transmitters and receivers covering a range of frequencies between 47 and 141MHz. These will provide a high-quality speech channel for OB use with the option of multiplex or stereo input.

#### VHF Receiver

Continuing

A design is in hand of a simple VHF receiver primarily for checking VHF transmitter performance.

## NETWORK AND TRANSMISSION GROUP

## MEASUREMENTS SECTION

3 Engineers  
5 Laboratory Technicians

INSTRUMENTS

Field Interval Noise Measuring Set Completed

This instrument, which measures signal-noise ratio in the presence of a television signal, has been found extremely useful in operational service both by the BBC and the Post Office.

Pulse Duration Meter Continuing

By the use of this meter, the durations of components of the synchronising waveform can be measured with high accuracy under operational conditions from a digital display. A prototype has undergone extended field-trials at Television Centre and has been found to meet the needs of the Television Service very adequately.

Gated Noise Measuring Set Completed

This is more suitable than the Field Interval Noise Measuring Set for purposes such as the measurement of signal-to-noise ratios of cameras, etc. A number of models will shortly be in service.

Gain and Delay Tester Continuing

A more comprehensive and multi-standard replacement for the TE1/503 Gain and Delay Tester is under development. A new feature is the measurement of the various quantities directly from a meter.

Differential Gain Unit Continuing

At the request of users this has now been

modified to operate individually, as well as in conjunction with the Waveform Sampling Unit, to enable differential gain to be measured with high precision. The prototype is about to undergo field-trials.

#### Coaxial Cable Tester

Completed

This tester provides an immediate indication of faults on prepared cable lengths before installation. It has successfully completed extended field-trials; minor modifications were introduced as a consequence.

#### LF Interference Measuring Unit

Completed

This is a small, battery-operated device for the measurement of low-frequency parasitics on transmitters; it was designed at the request of Transmitter Department.

#### SECAM Signal Analyser

Continuing

Designed at the request of the Television Service for the measurement of the basic parameters of a SECAM signal, this Analyser will be considerably less expensive than the commercially-available unit.

#### Audio Line-up Generator

Continuing

A precision unit for the accurate checking of sound circuits and PPM's, this Generator is being designed at the request of the Sound Service.

#### ITS Eraser

Continuing

This Eraser will replace the existing unit, taken over from available studio equipment, which has not proved adequate under service conditions for use with the ITS Generator and Inserter. A novel principle is employed which ensures long-term stability and simultaneously provides means for inserting and extracting test signals in the field-blanking interval.

<b>EBU ITS Generators</b>	<b>Completed</b>
A number of ITS Generators and Inserters were modified to EBU standards on behalf of the Television Service.	
<b>Voltage Calibration</b>	<b>Continuing</b>
An investigation into the absolute accuracy of level measurement equipment in BBC use is in progress.	
<b>Differential Phase Distortion Measurement</b>	<b>Continuing</b>
A new and very interesting proposal has been made recently in Germany for the measurement of differential phase without the transmission of a separate sub-carrier reference. This has been the object of a preliminary study, and will be given full laboratory trial in due course.	
<b>ITS Sync Separator</b>	<b>Continuing</b>
A new unit is under design for use with ITS Generators and Inserters which will operate reliably in the presence of Sound-in-Sync signals.	
<b>Measurement of Streaking</b>	<b>Continuing</b>
At the request of SCPD and operational departments, experimental equipment is under design for the objective measurement of small amounts of picture streaking. It is hoped that this will eventually lead to a standardised method of measurement.	
<b>Satellite Circuit Testing</b>	<b>Continuing</b>
Assistance has been given to H.E. Tel. Network and the EBU in the preparation of standard measurements on international circuits using the insertion test signal.	
<b><u>WAVEFORM MONITORS</u></b>	
<b>Calibration Unit</b>	<b>Completed</b>
At the request of the Television Service	



a precision calibration unit has been designed for internal addition to Tektronix type 529 waveform monitors. Modification of the monitors at Television Centre is now under way.

#### New Graticule

Completed

With the aid of the SEC (Tel.) Subcommittee on Video Test Techniques and Equipment, a revised sine-squared pulse and bar graticule has been designed for general use.

#### Oscilloscope Equalisers

Completed

A further range of miniaturised equalisers has been designed to enable the chrominance and luminance gains of a waveform monitor to be set precisely to equality in any given case.

#### Appraisal of Waveform Monitors

Continuing

New waveform monitors which appeared potentially useful to the BBC have been tested and appraised. Advice has been given both to users and to manufacturers.

### NETWORKS

#### Laguerre Filters

Completed

A new and improved approach to the design of Gaussian filters for television pulse shaping has been investigated with the assistance of Computer Application Engineer. An article on this subject appeared in the October issue of "Radio and Electronic Engineer".

#### Delay Networks for Studio Timing

Continuing

Assistance and advice has been given to a manufacturer on the design and production of very-high-quality encapsulated video delay networks for studio use.

**Subcarrier Notch Filter****Continuing**

In co-operation with an outside manufacturer a specification has been drawn up for a crystal band-rejection filter for measuring equipment. An experimental model is being constructed by the manufacturer.

**General Assistance****Continuing**

Advice and assistance on the design of filters and other networks has been given to engineers of Designs and other departments.

**MISCELLANEOUS****Appraisal of Instruments****Continuing**

A number of test and measuring instruments have been critically examined and appraised with respect to their use to the BBC. Where appropriate, demonstrations have been arranged.

**General Problems****Continuing**

Advice and assistance has been given to engineers of Designs and other departments in measurement and instrumentation problems. In some instances experimental equipment has been made and tests carried out.

## STUDIO GROUP

## STUDIO APPARATUS (SOUND) SECTION

7 Engineers  
6 Laboratory Technicians

STUDIO EQUIPMENT

Type-D Modulator Sound Studio Control Equipment                      Continuing

With a comprehensive range of Type-D modules now available, an investigation is being made into the feasibility of devising a modular desk construction and wiring system. This aims to facilitate the off-site assembly, wiring and testing, and so minimise the installation time of Type-D sound control desks.

SWITCHING EQUIPMENT

Reed Relay Programme-switching Equipment                                      Continuing

Work continues to develop a programme-switching module employing reed relays together with its associated control unit and racking system.

TEST EQUIPMENT

AC Test Set    Continuing

The design is substantially complete of an AC Test Set to provide sine-wave generating and measuring equipment in a single, compact unit. A fuller description is contained in Part 1 of this Report.

Sequential Tone Switcher    Completed

This unit is to replace the relay switching unit in the Sequential Tone Oscillator, OS1/1. A ring of thyristors controls reed relays which select the tone applied to the output; the dwell time is individually determined by a

simple adjustment at time of installation.

#### Switched-frequency Oscillator

Continuing

The design of a new Switched-frequency Oscillator has been started. This version provides for selection of any one of eight audio frequencies and can be used for checking the gain or frequency response of lines and apparatus. It is intended to replace the existing design but can also be adapted for use in CMCR's.

#### OTHER APPARATUS

#### Earth Fault Tester

Continuing

The design of this unit has been considerably modified as a result of experience in the field but the design is now finalised. A pre-production batch of 6 units is being made to meet urgent television requirements.

#### Loudspeakers

Continuing

The manufacturing information for the LS3/5 was produced from information supplied by Research Department and passed to Equipment Department for manufacture of 17 loudspeakers. The position concerning the supply of BBC Monitoring Loudspeakers was reviewed in a report submitted to DCC. As a result, production efforts have been concentrated on the LS5/5 and LS3/4 loudspeaker assemblies and a number of manufacturing, production, testing and user problems have been dealt with.

#### Loudspeaker Amplifier

Completed

After tests carried out in co-operation with Radio Broadcasting Engineering, a version of a 25W loudspeaker amplifier manufactured by H.H. Electronics has been agreed with the manufacturer for BBC use. This version has been coded and the necessary information issued.

#### Automatic Cross-fader

Continuing

Following a satisfactory field-trial at

Radio London, the design has been completed of this device which enables automatic cross-fades to be made from one stereo input to another when the control circuit is opened or closed. This design also meets a particular application at the Far Eastern Relay Station and five pre-production units are being made to meet their urgent operational requirements.

#### Automatic Prehear Switch

Completed

This unit comprises a variable-gain amplifier, detector, threshold and logic output. It was developed to detect the presence of a prehear signal and connect it automatically to the loudspeaker, but the unit is likely to have more general applications of a similar nature.

#### Stereophonic Effects Unit

Completed

This unit processes a single audio input so as to distribute its frequency components between two outputs which can be used as left and right stereophonic signals but which can still be recombined to give a satisfactory sum signal. It therefore de-localises a source and is particularly useful in spreading monophonic effects across the stereophonic stage.

#### Stereophonic Limiter

Continuing

The design has been commenced of a programme-limiting amplifier. The existing device incorporates a delay network and uses f.e.t's as gain control elements. The new limiter is intended to have similar facilities and performance but employ more straightforward circuit techniques so as to improve reliability and facilitate the ganging of two limiters for stereophonic working.

#### Peak Level Indicator

Completed

In some self-operated studio installations, control of the programme volume is carried out automatically by the use

of a limiter or compressor, and the speaker needs a simple indication that his speaking level is within the range of control. A circuit has been designed which can be used in place of the meter on the output of a peak-programme meter amplifier and indicates low, normal or high volume on three appropriately coloured lamps.

#### Type-D Power Supplier

Completed

To provide the large currents needed in Type-D studio installations, a suitable commercial power supply unit has been chosen, tested and incorporated into a BBC-designed bay-mounting panel in co-operation with SCPD.

#### OTHER WORK

##### Commercial Equipment

Continuing

During the year tests have been carried out and reports issued on the Elcom Microphone Amplifier, the CTH four-channel mixer and the Sendor Loudspeaker Type BC1A.

##### Transformers

Following the investigation of, and recommendations on, sizes of metric wires to be used in the BBC for wound components, a complementary investigation into metric laminations was carried out. From this it was concluded that it was not possible at this time to standardise on metric laminations for BBC use and a report in these negative terms has been issued.

The Section has continued to provide a transformer design service to the BBC. Among the many transformers designed have been several toroidal transformers that fit over studio earth leads and enable fault currents to be detected or measured.

##### Audio Integrated Circuits

Completed

The use of several integrated-circuit devices as voltage-controlled variable-gain elements has been investigated and a report published.

**Other Components****Continuing**

During the year tests have been carried out and reports published on a reed-input thyristor-output a.c. relay, several reed push-button switches and on Morganite voltage-dependent resistors for use as relay suppressors.

## STUDIO GROUP

## STUDIO APPARATUS (TELEVISION) SECTION

7 Engineers  
8 Laboratory Technicians

MIXING AND SWITCHING

## Automatic Mixer

Continuing

Work has continued on this project throughout 1971, culminating in a demonstration of the equipment in its elementary form. This project has acted as a focus for the discussion of automation implications in Networking Areas. It has increased in scope and size as the true benefits of automation have been revealed and much useful experience has been gained in the development of mixer-control, multiplexing, storage and logging. However, it may be some time yet before its full potential is sufficiently well-known to permit the design to be completed.

## Matrix Mixing Facilities

Completed

The last of a range of amplifiers has now been developed. Within this system it is now possible to offer amplifiers with the d.c. component maintained during switching operations, a form of control compatible with digital integrated circuits, and destination amplifiers which have two outputs for convenient monitoring and measurement. In particular, a cutting-and-fading crosspoint has been incorporated on one amplifier system and this could be used on some of the specialised mixing systems of the future.

In collaboration with SCPD, logic control panels have been designed and produced so that the individual requirements in regional centres can be satisfied without the continuing need to provide fresh designs.

## New Mixing Techniques

Completed

The field-trial of soft-edge split-screen



effects at the Television Theatre, and of similar equipment in Lime Grove were completed. They demonstrated the usefulness of the technique by materially improving the reliability of colour-separation overlay.

However, the provision of a non-additive-mixing field-trial aroused very little interest and as a result, this facility is not being incorporated in the new range of vision mixers. This is contrary to experience outside the BBC, but it could easily be explained by considering the unpredictability of the non-additive mixing effects. Effects, to be of real value, must be designed into the programme at the earliest stage, but non-additive mixing can only be appraised by demonstration during a rehearsal. The programme director is in difficulty if at the last moment the effect does not work reliably.

#### Studio Vision Mixing

Continuing

The Studio Engineering Committee (Television) accepted the proposal of its sub-committee on Vision Mixing that work be started immediately on two designs of vision mixer; one for studio use, the other for outside broadcasts. The range of work required by this project is very wide and includes, for example, the electronic design of stabilising amplifiers, mixing amplifiers, special-effects amplifiers etc.; consideration of the ergonomics of the control panels and their interconnection to the associated electronics with the minimum of wiring is also necessary.

By careful collaboration with SCPD, Tel. O.&M, Equipment Department and Training Department, this mixer will not only fit in well with the studio equipment of the future but, from the outset, documentation is being provided to make it easy to understand, easy to test and easy to maintain. For example, a novel form of technical presentation in the operating handbooks is being investigated.

A careful consideration of the

implications of running a large piece of electronic apparatus from a common power supply is being investigated. Problems such as the maintenance of service under fault conditions and the avoidance of large quantities of heat in wasteful regulators are being investigated.

A derivative of the studio mixer which is cheaper and more suitable for regional use is being provided in area studios. A development commitment to provide outside-broadcast mixers has also been accepted and much of the work carried out for the studio mixer is being made directly applicable. Common techniques and mechanical construction together with interchangeability of sub-units should ease the training problem and facilitate the movement of personnel from one environment to another.

#### NEW TECHNIQUES

##### A Command Multiplexer

Continuing

Work has continued on this system for multiplexing 72 command circuits to one audio circuit. Preliminary demonstrations have been given and the indications are that the system is extremely robust. Construction work continues and a formal field-trial is expected soon.

#### SPECIAL EFFECTS

##### Colour-separation Overlay in Studios

Completed

Work is now in hand by SCPD on the implementation of bank-overlay in the television studios in West London. This system is described in Design Department Technical Memorandum No. 8.292(70) "The Control of Overlay Facilities on Studio Mixers", and it has been developed to provide a wide variety of overlay effects without placing an undue burden on the vision-mixer operator. Similar systems have been applied to the new installations in Birmingham and Glasgow.

Within the limits imposed by the space considerations of outside broadcast vehicles, overlay facilities have been fitted to CMCR11 in order to provide the

advantages of overlay on outside broad casts. As a result of the successful field-trial, Designs Department Technical Memorandum No. 8.298(71) "The Modification of CMCR Type 2 for Colour Separation Overlay" was produced. In conformity with this memorandum a programme of modification is now underway, and five vehicles throughout the country have been equipped already. It seems likely that the programme will continue throughout 1972 until the whole fleet has been equipped.

The continued use of overlay in News Studios has demonstrated the consistent performance that can be achieved. As a result, it has been decided to extend this facility so that cutting between two overlay pictures can be used on transmission. The convenience of "button-matching" control of overlay on immediate broadcasting such as News, is now well established and the new overlay facilities will continue to use this technique. By a re-allocation of existing controls, Tel. O.&M. have devised a method of adding this extra facility. The electronic equipment required has been designed by Designs Department and subsequently manufactured by Tel. O.&M. after consultation with SCPD. In this way, a local and special requirement has been provided with the minimum of specialist effort and yet a rigorous testing programme has been maintained so that performance does not suffer. In addition, this kind of collaboration with the operating departments ensures that their needs and difficulties are fully appreciated.

#### NEW DESIGNS

##### PAL Coder

Continuing

The development of this unit is almost complete and will be available in good time for the re-equipment of colour studios.

##### PAL Decoder

Continuing

This development is almost complete and the new decoder will be available in the coming year. It is likely that an important use of the new coder and decoder and their derivatives will be in standards-conversion applications. To

this end, care is being taken to ensure the low-distortion performance of these units by testing them in cascade. Significant reductions in size and improvement in operational stability will be provided by these designs.

#### Picture Monitor Line-up Generator

Completed

This unit has been completed and the drawings made available to Equipment Department. A pre-production model has been incorporated in a new 2-camera MCR for Tel. O.&M. News and preliminary reports are very favourable. Provisions have been made for a number of possible options on this instrument such that it can be driven from a video signal, rather than station pulses, and its multi-output could be converted to single-output by the substitution of its output card by a switching card.

#### Video Tie-line Equaliser

Continuing

The techniques used on an equaliser for use with cables 400-600ft in length were so successful that an existing equaliser was re-designed using the same principles. This is part of a continuing programme of work, designed to simplify studio equipment installation. It includes equalisers that are quickly set up on-site, switchable video delay units, amplifier connectors and the like. The availability of such components means that the circuits are more-easily installed and also give a higher final performance. The circuits can therefore deteriorate to a greater extent before accurate re-adjustment is necessary.

#### Unit Switch Matrix

Completed

This unit is basically a 6 x 1 switcher, but because of its convenient mechanical construction it can be extended to provide a 24 x 1 capability. It includes the facilities of d.c. restoration and integrated-circuit compatibility of control, and could be used as an on-air interfield cut unit. A number have been

made in Designs Department to confirm the design and these have been delivered for use in the re-equipment of CAR. In addition to the basic switching system, a back-connector has been designed which maintains the isolation performance and simplifies installation.

#### The Up-dating of Pye 19in Colour Monitors

Continuing

The sources of reported performance drift on this picture monitor were investigated and suitable circuitry, using modern components not available to the original designers, was designed. Some three-hundred kits were manufactured by Messrs. Pye and a large-scale modification programme is in progress. In spite of the effort involved in this work, the work is going well and is providing to be very effective in stabilising the colour performance over the wide-ranging temperature conditions experienced on outside broadcasts.

## STUDIO GROUP

## RECORDING (SOUND) SECTION

3 Engineers  
4 Laboratory Technicians

MAGNETIC RECORDING

Measurement and Standardisation of Magnetic Recording Characteristics Continuing

Tests made in 1970 for the EBU to confirm the advantages of a new 16mm SEPDMAG recording-standard making compatible CCIR and US standards regarding tack position were continued this year using professionally-made heads for the new standard. The Technical Memorandum No. 1.75(71) describes the success of this system and an Appendix to this Memorandum describes a use of the system for simple telecine dubbing which would offer the BBC a significant financial saving.

Test Tapes and Films Continuing

25 working masters for VTR audio alignment tapes have been made. 6 working masters for  $\frac{1}{2}$  in magnetic tapes for speeds of 15 and  $7\frac{1}{2}$  ins/sec are being made.

6 working masters for 100 $\mu$ s Commag Test Films have been made. At the same time 6 stepped azimuth test films were also made.

Commercial Tape Recorders Completed

A number of magnetic tape recorders were tested this year and a noticeable feature was the rapid emergence of the cartridge and cassette types for broadcast use. The following large professional tape recorders were tested and reported on:-

The Ampex AVR-1 Recorder (Sound Section), the Philips PRO 72 8-track, the Studer B62, Leavers-Rich Mk 6 and the Philips PRO 36. Among the smaller types were the Gates Cartridge Criterion 80, the Cuemaster 753,

the Spotmaster Cartridge, the Philips Model 2505 Cassette and the Nagra SN midget tape recorder.

**Modification of BTR/2 Recorders (RDA/4) Continuing**

A number of these machines have been modified by Tech. S. (Radio) and 20 more are to be modified by an outside manufacturer. Our co-operation has been maintained.

**Co-operation with Manufacturers Continuing**

Assistance has been given to outside manufacturers on problems associated with magnetic tape recorders.

**Magnetic Delay Continuing**

The RD4/7 magnetic sound delay unit prototype using a stretched membrane of ordinary magnetic tape was sent to the Television Centre for a field-trial.

A prototype using the above principle for data storage, coded the RD4/8, is nearing completion and should be available for field-trials in the New Year.

**Camera Magnetic Sound Equipment Continuing**

The AM15/502P equipment used with Commag cameras for Television News was designed in 1957. It has proved to be very popular with operators and Television News Division asked for a re-design on similar lines. The new equipment, designated AM15/503P, should have a prototype ready by the end of this year and 3 models with full manufacturing information ready by the end of March 1972.

**Investigation into 3½ ins/sec Magnetic Tape Recording Continuing**

At the request of CEXB a preliminary investigation of the problems of magnetic

tape recording at a speed of  $3\frac{3}{4}$  ins/sec is being made. In the first instance the equipment used at Bush House for their original  $3\frac{3}{4}$  ins/sec tests (i.e. the modified Leever-Rich Model Mk 5 modified for  $3\frac{3}{4}$  ins/sec working) and similar makes of magnetic tapes have been used for our tests. An interim report indicates that the serious high frequency variations complained of is a function of the type of tape and of the machine tape-path design.

### DISK REPRODUCTION

#### RP2/6 Disk-reproducing Desk

Completed

This desk is being introduced in significant numbers in studios and control cubicles for radio broadcasting. A number of minor weaknesses have become apparent when working under these quiet (studios) and busy (control cubicle) conditions but have been cured fairly easily.

#### Tannoy Pickups

Completed

A Designs Department Technical Memorandum No. 1.74(71) was issued describing the use of the Tannoy Pickup on RP2/1 Reproducing Desks for replaying fine-groove disks ( $33\frac{1}{3}$  and 45 r.p.m.) and coarse-groove disks (78 r.p.m.) both at a playing weight of  $3\frac{1}{2}$  grams.

### OPTICAL FACILITIES IN TELEVISION

#### Optical Bench

Continuing

The prototype optical bench developed and assessed last year has been re-designed offering more effective movements of the optical bench. It is being given a field-trial at the Television Centre.

#### Remote Iris Control

Completed

A Technical Memorandum No. 1.73(71) was written to summarise the work of last year on this equipment.



MISCELLANEOUS

## Chassis System

Continuing

The Imhof-Bedco CDX chassis system is being considered for use in the BBC to replace the old system based on the PN3/23. Certain modifications have been made to the above system to make it suitable for BBC use and two nest-boxes full of various types of chassis and plug/socket combinations are being produced for evaluation.

## Automatic Reporter Alarm Panel

Completed

The Magnetic Tape Reproducer RP4/3 used with the above alarm equipment was modified to increase its reliability.

## Recording Standards

Continuing

Co-operation in the development of recording standards has continued with the British Standards Institution (BSI), the European Broadcasting Union (EBU), the International Electrotechnical Commission (IEC), the International Standards Organisation (ISO) and the CCIR. These include sound recording on disk, film, sound tape and video tape.

## STUDIO GROUP

## RECORDING (TELEVISION) SECTION

6 Engineers  
6 Laboratory Technicians

VIDEO TAPE RECORDING

Video Tape Recorder Reference Regenerator Completed

There are now eight video tape recorders at Television Centre which are arranged as four pairs, each pair sharing a set of timing-correction equipment. In order to run both recorders in synchronism it was necessary to derive various timing waveforms, such as mixed-synchronising pulses and a 7.8kHz square-wave, from the output of the recorder's demodulator, at which point the timing of the waveforms is unstable. A unit has been developed to carry out the necessary regeneration from this unstable source and all machine pairs at the Television Centre are now equipped with these units.

Video Head Optimisation Continuing

On a video tape recorder, the lack of simultaneous-replay facilities means that adjustment of recording levels can take a considerable time because of the need to rewind and replay before it is possible to tell that a satisfactory recording has been made. A system is being developed that allows a simultaneous replay of one of the four heads at a time. A simple monitoring system will allow adjustments to be made to the recording level on each head so that all four channels are the same.

Video-tape Editing Continuing

The whole question of electronic aids to video-tape editing has been under continuous review. Design work has started on equipment to generate and detect the standard SMPTE video-tape time code which, when recorded on the cue track of the tape, will allow any television frame to be

uniquely identified.

Designs Department Ampex Video Tape Recorder

Continuing

The Ampex VR 2000 recorder in the Department continues to play a vital role in the development of equipment such as the video head optimiser. In addition, it is much in demand as a picture source for demonstrations and for making a permanent record of the results of work in other sections of the Department.

FILM

Colour Transparency Scanner

Continuing

The design of a colour transparency scanner is nearing completion; a field-trial of the prototype started in December 1971 at the Lime Grove Studios. The object of the design has been to produce a reliable good performance equipment at a reasonable cost.

Pre-programming of Telecine Controls

Continuing

Prototype equipment has been developed for the pre-programming of the Tarif colour-correction unit on telecines. The device is inherently capable of being extended to cover other telecine control functions such as cinemascope pan, sub-titles, aperture correction etc.

Crystal-control Film Camera Motor Drive

Continuing

Design work has started on a system for crystal-control motor drive for 16mm film cameras. Used in conjunction with a ½in magnetic tape recorder similarly driven from a crystal, it should be possible to run the film camera and sound recorder in synchronism without any inter-connection between the two.

MISCELLANEOUS

Electronic Character Generation

Continuing

Further developments of the Anchor

character generator have been devised. The standard Anchor unit itself (that is to say a unit which generates all the standard upper case letters and symbols and which is controlled by a keyboard) has been linked to a commercial fast-access magnetic store to provide a very flexible caption-generator system which has been used during the year for such events as the Open Golf Championship and for the Party Conferences. A further development has been a clock suitable for displaying times of sporting events and this has been used successfully for show-jumping outside broadcasts. Development work has just started on generating a full set of lower case letters.

## STUDIO GROUP

## SPECIAL STUDIES SECTION

6 Engineers  
5 Laboratory Technicians

PICTURE SOURCE SYNCHRONISATION

## Fast Natlock Genlock

Continuing

Development of the colour television facilities of the network and area centres requires a continuation of the present fast genlock function now available for monochrome use. This gives the ability to lock the local pulses to any incoming source, for example during regional opt-outs, in under one minute. Commercial colour equipment was available but at a cost outside the budget and the performance was not entirely satisfactory. The centres were to be fully-equipped with full colour Natlock equipment which, in the genlock mode, may take up to five minutes to lock up - the parameters were dictated by the requirements of slavelock operation. It was impossible to modify the existing monochrome equipment and the normal method of "line-dropping" would require modifications to the sync pulse generator - a number of types of which were known to be in use.

The solution which was adopted and which proved successful during a field-trial period at the Current Affairs and Sports studios at Lime Grove involved developing a new extra-fast correction rate. Such a rate required a new timing comparator and a new variable divider unit. Other changes were small modifications to existing Natlock units. The final equipment has a lock up time of 18 seconds. A computer program was used to minimise the disturbances during the locking process.

Sets of units are being manufactured by

the Department for service use.

### Phase Comparison

Continuing

New designs for phase comparison equipment have been completed. These overcame the main disadvantages of the units at present in service by making a direct comparison of the burst from a remote signal with a reference burst, so removing the need for a burst-locked oscillator with its attendant disadvantages. Field-trials are planned for a central area mixer.

### Rubidium Standards

Continuing

Further experience has shown the advantages to be gained by the use of rubidium frequency standards to control the generation of colour synchronising waveforms. The two orders of stability greater than that achievable by quartz oscillators give opportunity for simplification and reduction in cost of the synchronisation process.

Tests have been carried out between studio centres and to an OB site using the ICE data channel to convey the control information from comparator to remote source.

### APERTURE CORRECTION

Continuing

Following the successful field-trials of the prototype aperture equipment mentioned in the last Annual Report, units for production have been designed and installation has taken place. Some problems have arisen during production testing and installation; modifications to units are in hand.

### DIGITAL TELEVISION

Continuing

Re-allocation of work between sections of the Group has led to the development programme for the second generator of line-store standards converters being taken over by Special Studies Section.

Although the end product is specifically

the design of a digital line-store converter, the functional blocks necessary for this development have wider application to a large number of other video projects which involve signal processing and timing and phase correction. These blocks include analogue-to-digital and digital-to-analogue converters, delay and storage units as well as arithmetic and memory units.

Line standards converters as such are not new and indeed digital methods for achieving conversion have already been demonstrated. What is of prime importance in this development is the production of equipment that is easy and consistent to set up and that will be reliable in service at unattended transmitting stations.

### COMPUTER APPLICATIONS

#### Facilities

Continuing

Use of the Honeywell G265 time-sharing system has continued to provide on-line facilities; BBC/ICL 1900 batch processing is used where there is a cost advantage.

#### Training

Continuing

Furthering the idea that engineering staff should where possible use the computing facilities themselves, one course on the time-sharing service and two courses on the table-top computer have been run.

#### Assistance

Continuing

Over 30% of the effort of the Computer Applications Engineer is used to provide assistance to engineers within the Department. Although this is largely for network design problems, problems across the whole field of design activity are treated. For example: work on Natlock divider ratios (as mentioned above), interpolation apertures for digital standards converters, auto and cross-correlation of statistical data, calculation of polynomial coefficients, tabulation of switch settings for various cycle lengths of a pseudo-

random pulse generator, completion of metric wire sizes for transformer designs, and a system for the analysis of UHF amplifiers from the S-parameters of given transistors and coupling networks.

#### Printed Circuit Layout

Completed

The program has been translated for batch process handling on the BBC/ICL 1900 machines. Some modifications have been made but no further major changes are planned. The procedure has been made into a routine. In this the laboratory technicians determines and punches his own input data. Drawing Office staff then take over the detailed work of getting the program run on the ICL machines. When the output tape is available, the draughtsman operates the digital plotter and delivers the layout to the design section. On average, the program is used about once each week.

#### OTHER WORK

##### Character Generation

Continuing

Work has started on an investigation into the use of integrated circuit read-only-memories for television raster scan displays.

There are numerous possible applications both within the Corporation and at a domestic receiver. Research Department are investigating ways in which data can be transmitted to domestic receivers.

##### Clock Systems

Continuing

Oscillators with increasing long-term stability are coming into service as part of television synchronising systems.

Investigations are proceeding into ways of making use of this stability in driving both impulse and mains-type clock systems. A field-trial at Television Centre is planned.



## GENERAL SERVICES LABORATORY

2 Engineers  
7 Laboratory Technicians

TESTING

<u>Quantity</u>	<u>Title</u>	<u>Code</u>
6	Automatic Fault Reporter	PA2M/7A
1	Telegraph Combining Unit	UN1/75
1	VHF/FM Transmitter Bay	BA13/15
5	Receiver, UHF Television Rebroadcast	RC5M/502
1	Equipment, Test, UHF Receiver	EP14M/501
5	Equaliser, Line, Fine Trimming	EQ5/524
1	Return Loss Measuring Set	UN1/524
2	Generator, Test, Bar-and-Sweep	GE4/546
8	Unit, Control, Logic Changeover	UN3/32
14	UHF Receiver	UN1/642
6	Filter, High-pass	FL3/504
9	Power Supplier Stabilised	PS2/109B
9	7.8kHz Regenerator	GE6/522
1	Unit, Tube Blanking and Protection	UN1/647
1	Unit, Focus	UN1/643
1	Generator, Waveform, Field Scan	GE6/521
1	Generator, Waveform, Line Scan	GE6/520
1	Video Delay Unit	UN14/518
1	Test Generator, Studio Line-up	GE4L/543
1	PAL Colour Coder	C02L/503
3	Colour Monitors, Pye	847100
1	Amplifier, Complementary Picture	AM5/515
16	Video Delay Unit	UN14/511
1	Monitor Automatic, Colour Phasing	MN2/519
2	Video Switch Unit	UN9/519
1	Calibration Unit	UN2/508
1	Meter, Noise, Gating	ME1/508
10	Generator, Pulse, Gating	GE2/600

<u>Quantity</u>	<u>Title</u>	<u>Code</u>
2	Unit, Gated Noise Measuring	UN1M/638
4	Oscilloscope Equaliser	EQ1/520A & B
3	Matrix, Colour Signal, Coder	MA1/501
3	Matrix, Colour Signal, Decoder	MA1/502
14	Power Supplier Stabilised	PS2/82A
5	Matrix, Switching, Video	MA2L/504
21	"Colortrack" Portable Greyscale Reference	-
1	Panel, Colour Signal Synthesiser	PA1M/558

#### SPECIAL INVESTIGATIONS AND DEVELOPMENT

1. AM1/561, Flying Spot Equaliser Master and AM1/562 Flying Spot Equaliser Slave Amplifier. Investigation and redesign of these units was undertaken for Recording (Television) and Studio Apparatus (Television) Sections. Completed
2. An investigation of the discrimination of Beswick TDC157 fuses when used in the Mains Distribution Panel (PA9/9) was undertaken for Studio Apparatus (Television) Section and SCPD. A Report was issued. Completed
3. An investigation of the parameters of a large number of new Thick Film Amplifiers (Type ITT 58CPX 002338-BAA) was undertaken for Studio Apparatus (Television) Section. Completed
4. An investigation into the performance of a general-purpose output stage for Video Amplifiers was undertaken for Studio Apparatus (Television) Section. Completed
5. Environmental Tests were undertaken on the MN2M/513 and /518B Automatic Monitors for Monitoring & Control Section. Continuing
6. Arising out of difficulties encountered during the Test and Alignment of the MA1/501 and /502 Matrix Colour Signal Coder and Decoder redesign of these units was undertaken for Special Studies Section. Continuing
7. Design of a Jig for the alignment of IN2/504 for both initial alignment and re-alignment in the field was undertaken for Monitoring & Control Section. Continuing
8. Redesign of the EQ5/526A and B Tie Line Completed

Equaliser was undertaken for Studio Apparatus (Television) Section.

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| 9.  | Development of the GE6/526 Generator, Waveform, Switching was undertaken for Studio Apparatus (Television) Section.  | Completed |
| 10. | Special tests and modifications were undertaken on the UN9/544 RGBY Switch Unit for Studio Apparatus (Television) Section.                                   | Completed |
| 11. | A feasibility study was undertaken for General Services Section to consider the possibility of producing a "Data Reader" for use in conjunction with CEMAST. | Held      |

