INTERNATIONAL BROADCAST ENGINEER

No 12
September 1965
3/6

RCA NEW LOOK

Compact TV Tape Recorder

This budget-priced, quadruplex Recorder accepts high band, color, and electronic splicing accessories

This total performance compact does just about everything the deluxe model does. Complete in a 33 by 22 by 66 inch cabinet, the transistorized TR-4 is the answer for installations where low initial cost and broadcast quality pictures are indicated. A complete recording and playback package, it has suitable monitoring facilities, built-in picture and waveform monitors, and other provisions to meter key circuits for proper setup.

Like other RCA transistorized TV tape equipment, new circuit techniques, needed for high band, are accommodated by the TR-4. With such circuits, (available as optional extras) high band can be selected as a second mode of operation, with all its benefits, including color and monochrome tapes of particularly high quality, and multiple generation video dubs.

Features now standard on the TR-4, as on all RCA TV tape equipment, include air-lubricated tape guides, magnetic tone wheel, solid state control system, built-in switchlock and two-speed operation. Accessories available include Pixlock, automatic timing control, cue record and playback, electronic splicing and drop-out compensator. The TR-4 is the only recorder of its kind that's adaptable to color operation. And standardized modules in this and other RCA TV Tape Recorders assure high quality, easy maintenance, and simplicity in adding accessories.

For full particulars, write to Radio Corporation of America, Bureau de Controle, 118 Rue du Rhone, Geneva, Switzerland; or RCA International Division, Dept. 200A, Central and Terminal Avenues, Clark, New Jersey, U.S.A.

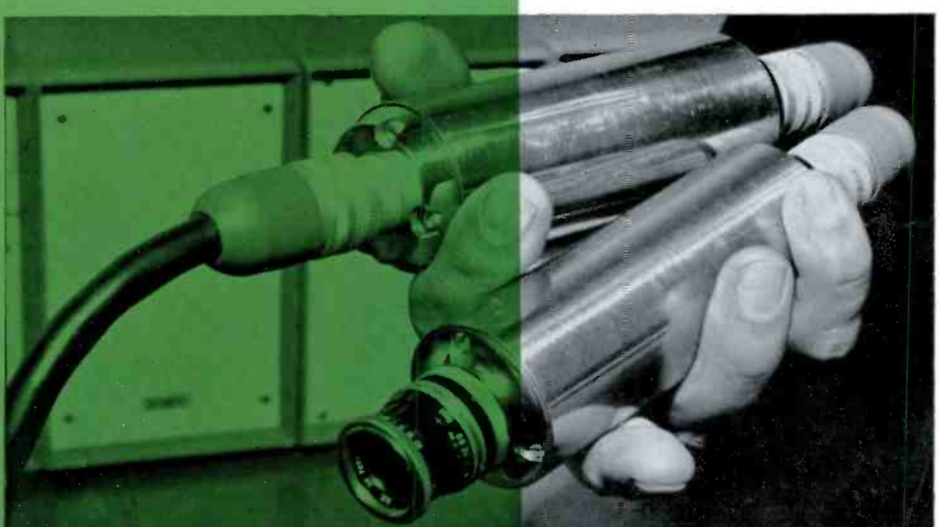
RCA

The Most Trusted Name in Television

PROGRESS IS COMMUNICATION

International Broadcast Engineer

contents



The half-inch vidicon, detailed at the London Symposium by Mr. A. C. Dawe, BSc (Eng) ACGI, makes it possible to produce an ultra-miniature camera such as this, which is only 4½ inches in length, weighs well under 2 lbs., and can be switched from 405 to 525 or 625 by pressing a button!.
See page 606.

advertisers

Incorporating International TV Technical Review and International Sound Engineer, this magazine is published and circulated in nearly 200 countries by Television Mail Ltd, 31 St George Street, Hanover Square, London, W1, Great Britain. Telephone: HYD 3931; Cables: Inteevee, London. Printed by Thames Valley Printing Co Ltd, 28 High Street, Hampton, Middlesex.

Spectacular Electronics at Navex '65

by **KENNETH ULLYETT FRSA**
Television Editor
International Broadcast Engineer

MINISTER of State for Education and Science, Mr R. E. Prentice, MP, in opening the biggest National Audio-Visual Aids Conference and Navex 65 technical exhibition at London's Whitelands College found himself faced with a sort of United Nations dilema. . . .

Among the hundred or so exhibitors in the TV, tape, radio and technical show—in itself the largest exhibition of technical audio-visual aids in education ever staged in Britain—were several from overseas, including the spectacular Tele-Beam, America's latest in large-screen TV projection.

In this 1965 Annual National Conference, organised by the National Committee and Education Foundation, was an amazing display of educational-TV equipment by groups ranging from Granada Installations Ltd to Pye HDT Ltd, from Mullard to Rank CCTV, and from Telequipment to Ampex. Over all, in the huge Movement Hall of Whitelands College a separate display of educational electronic facilities was staged jointly by Rediffusion and Marconi, this 2,000-sq-ft exhibition of a complete school TV studio and control room being the most comprehensive ever staged in Britain.

Dominating interest in the electronics contributions from overseas groups was the Tele-Beam large-screen TV projector demonstrated by Systems Engineering Services Ltd, of Ealing, UK representatives for the Telebeam division of the Waltham Precision Instrument Co Inc, of Brookfield, Conn.

In a studio in Whitelands College's New Teaching Block we saw the Tele-Beam projecting really large pictures—up to 12 ft by 16 ft—with both front and rear projection. This same big-screen equipment is in use in the United States in Federal, State and commercial services, in New York night-clubs for displaying National League play-offs to large audiences, at station and bus terminals, and of course in many universities and the Student Center Auditorium. A 40-kV regulated HT supply is given, and a specially-cooled cathode-ray tube displays a picture which may range from 4½ by 6-ft up to 12 ft by 16 ft. Power consumption from AC mains is 550 watts, and the unit includes its own TV receiver for big-screen display of on-air programme material. Any standard aerial with 300-ohm twin feeder (or 75-ohms alternative) will suit, and the receiver's tuner includes a Standard 12-channel VHF unit with UHF strips available. Video bandwidth is 3.5 Mc/s. For display of locally-generated signals, the external video input is 0.2 to 3.0-volt composite video signal at 75-ohms impedance; there is a simple switch-over arrangement for broadcast or local CCTV. Other controls on the unit include channel selector, fine tuning, picture focus, contrast, plugs for various local CCTV inputs, and the usual on/off volume control .

Circuit details I noted included dual video input, anode-voltage safety discharge, CRT protection against sweep loss, regulated anode and focus voltage; there is a precision optical system which displays the CRT picture at a video output of 4—6 foot-candles highlight illumination on a screen 6 ft by 8 ft. The audio output is at full professional standard, being approximately 8.0 watts at 8 ohms impedance, with 4 and 16-ohm taps available. A very novel feature we saw demonstrated at Whitelands College is that the projector head can be operated remotely at up to 400 feet from the control unit. At better than 4 foot candles illumination, it is not really necessary, as we saw in the demonstration, to have a darkened room, and students can easily take notes while the big-screen TV is on.

In a very large display in C2, Pye HDT Limited showed many electronic facilities for ETV. These include the latest HDT low-cost 'package-deal' dual-purpose CCTV, the Pye Sentinel camera CCTV chain, the HDT Teltalk System by which students and teachers can talk back on a CCTV audio circuit, the HDT group teaching machine, and a range of ETV facilities of the sort which have culminated in the huge concept of an ETV service to Glasgow's 300 schools—a plan initiated jointly in January 1963 by the Glasgow branch of the Scottish Educational Film Association and Pye's associate group High Definition Television Ltd, and Pye Telecommunications.

'The Sentinel is a high-definition camera chain for closed-circuit industrial television,' I was told. 'The basic equipment comprises three units, a camera head with attachment, camera control unit and control panel. Any type of viewing monitor is included to complete the CCTV link. . . .' Technical specifications is as follows: Re-scanning standards, there are separate models available for 625-line 50 fields interlaced (this is Industrial TV Preferred Standard), or 525-lines 60 fields interlaced, and BBC-1 standard 405 lines 50 fields interlaced. Picture resolution exceeds 800 picture points at the centre of the picture, to full 625-line transmission standards. As precision is necessary for many educational displays, I feel it is important that as for picture geometry on the Pye Sentinel, no part of the picture departs by more than ± 2 per cent from a rectangle averaged over the picture; and scanning linearity is such that there is less than ± 2 per cent departure from the ideal.

At Whitelands they were demonstrating this CCTV chain on a variety of light levels. Normal working is designed for 50 foot/candles (500 lux) and upwards which is met with in normal industrial and laboratory settings; but with the lens iris opened to f/1.9 I saw it was possible to get quite good results at only 10-15 foot/candles. Power consumption on a 47-63 cps supply (85-135 or 170-250 volts) is 190 watts. The pickup tube is a Pye Staticon (similar to vidicon specification), the spectral response of which is similar to that of panchromatic film.

Turning to the low-cost 'package deal' CCTV unit, I found this is based on the latest Pye Lynx transistorised camera. The 'package deal' includes the camera and a 27-in dual-standard schools TV receiver CC monitor, or a 17-in video monitor, with everything ready to work.

'This system will enable schools to receive 405 or 625-line broadcast programmes. With a simple switch the same receiver can display pictures from the camera on 625 lines. This is an ideal set-up as the substitute for the now-outmoded episcope, or for lesson-relay applications, with bright and clear pictures on a 27-in screen. It means that every child in the class has a front-row view. Technical specification of the apparatus in the link is as follows:

Scanning standard: 625 lines 50 fields using random interlace, adjustable to 525/60 and 405/50. **Aspect ratio** 4:3 or any other rectilinear scan by adjustment; **pickup tube** Staticon C938; **spectral response** similar to panchromatic film, and suitable for operation in daylight or artificial light; **picture resolution,** horizontal of not less than 450 lines can be obtained; **picture geometry**, no part of the edge of the picture will depart by more than ± 2 per cent from a rectangle averaged over the picture; **scanning linearity**, less than 2 per cent departure from the ideal; **sensitivity,** good quality pictures are obtained with scene illumination levels of 50-70 ft/lamberts. **Operating temperature** must not exceed 45-deg C inside the camera, which means a maximum ambient temperature of 35-deg C allowing for a 10-deg C rise inside the unit. **Video output** to the monitors is 1.4 volts p-p composite video signal (peak white positive) on 75 ohms. The **RF output** is better than 200 mV p-p on 75 ohms negative modulation, although this is switched to positive on a 405 line system. When used with domestic receivers as monitors it should be noted that the frequency range of the camera is 47-63 Mc/s, so any channels 2, 3, 4 in Band 1, CCIR can be switched.

As for the camera itself, this weighs only 9 lbs, and is supplied with a 1-in (25-mm) f/1.9 lens on standard C-mounting so that any other 16-mm cine lenses can be used, including zooms. Power consumption of the unit is 13 watts at 200-250 volts 50-60 cycles.

The Teltalk system I found to be arousing enormous interest at Whitelands College, as it opens up a new horizon for CCTV systems in schools. As we all know, one of the great economic advantages of ETV is that it allows different classes in different places to participate in the same lesson at the same time. But to make fullest participation possible it is important to solve the problem of 'question feedback.' There has to be a means by which any of the pupils in any of the lecture-rooms involved is able to ask questions, so that both the teacher at the TV studio point and all the other pupils can hear. Pupils must be able to hear the teacher's answers, too. With Teltalk you have a master console with a microphone in one studio, and one slave unit plus microphone in each receiving lecture room.

'Master console' is perhaps a grand expression for the neat little Teletalk unit, with its sloping desk carrying pressbuttons, flashing 'Classess Calling' and 'Origin of Call' lamps. At the slave units there are easily-seen 'Speak Now' indicator lamps. On checking how the system is wired in a typical CCTV network, I particulary liked the following features: Each of the classes watching TV can signal its **wish** to speak a question without interrupting the video. Then the teacher is able to select the question to be answered. Questions, answers and all subsequent discussion can be heard by all the linked classes. A lesson 'Go Ahead' signal is provided for each class, and 'Further Question' signals can be made to the teacher. I found quite a number of interesting points about the Teltalk on the technical aspects; for example, power supplies are not only transistorised but fully stabilised, all amplifiers (transistorised, of course) are of the plug-in type for easy servicing; and the circuit (which does not require microphones to be passed around, nor trailing wiring) eliminates audio 'howl-round' and instability.

The HDT Group Teaching machine was, I found, something quite new to Whitelands College. It includes a Reflectograph tape deck, a Kodak Carousel projector and a number of other ancillary items, and is transistorised throughout and completely automatic. This sort of audio visual machine will be a boon for group teaching of languages and many subjects in general education or industrial training. The Reflectograph 'Taper' recorder is specially designed by Pye HDT for use in language laboratories, and various integrated AV teaching machines. The projector cassette capacity is 80 35-mm slides in standard mounts, and the lamp used is a 150-watt tungsten iodine type. Remote operational control is by means of a hand-held switch, and sentences, phrases or even separate words can be selected by the teacher for repetition by pupils. There is a built-in speaker below the tape-deck.

In Exhibition Hall D2 Radio Rentals (Rentaset Wired Services Division) were showing what they are doing throughout Britain in connection with ETV. This was a group effort of the factories producing Baird TV receivers, Telerection aerials, Goodmans high-fidelity speakers and amplifiers, and also TV and radio relay equipment from Radio Relay who already run the largest coaxial TV relay system in Europe. I particularly liked the Baird 23- and 27-in TV receivers for schools, built to Ministry of Education recommended specifications. The Goodmans PA 100 public-address speaker (column type) was used for schools systems being demonstrated. Closed-circuit TV systems were seen installed from central studio rooms throughout school buildings, an by coaxial cable between different schools. We also saw specimens of classrooms wired with communal aerial systems, separately from and also in addition to CCTV; a further Radio Rentals facility is that schools can be wired from central radio or radio-relay input with speaker points in all classrooms, with provision additionaaly for tape, microphone or record inputs locally.

Many of the ETV companies with TV monitors in action were, I noticed, displaying as subjects technical composition by the revolutionary new Chemform technique, introduced by Spottiswoode Ballantyne & Co Ltd, a member of the McCorquodale international printing group. Scientific and technical 'copy' in all languages using the Roman, Greek and Cyrillic alphabets can be reproduced by Chemform, using letterpress or lithography. For CCTV projected on to large monitors and big screens it is essento have accurate and well-defined subjects

NAVEX '65—continued

for display, and I was greatly impressed with the printed results of the Chemform process for dealing with planar and non-planar graphic formulae, as well as for stereo-chemistry.

Turning to the recording of the educational spoken word on magnetic tape, I was gratified to find at Whitelands that the Clarke & Smith Mfg Co Ltd, of Wallington have been appointed distributors to education authorities for the new Scotch magnetic tape with super-life coating, I saw tests conducted showing that one can expect an increased life up to 15 times normal for this new process, elimination of undue wear of recording heads, and elimination of rub-off of magnetic-oxide particles. I was also able to try one of the new self-threading reels which will be in general supply early in 1966. All one has to do is lay the tape through the reel, and it threads up automatically without hooks, slots or attachments. Scotch tape, of course, comes from Minnesota Mining and Manufacturing Co Ltd, and 3-M's technical manager Mr P. T. Hobson gave Navex 65 an instructive lecture on the care and maintenance of language-laboratory tape decks. He particulary stressed the need for removing oxide dirt from the tape guides, heads and capstans, urged a regular weekly 'good housekeeping' of all tape-paths, and the keeping of records by educational authorities to check on tape-machine maintenance.

Granada Installations Ltd of Manchester had an imposing exhibit in D4, the chief electronic features of which have been Granada's own 23-in and 27-in schools TV sets, rentals of which are from £29 per annum only. These are fitted with isolating transformers, and comply fully with the requirements laid down in the Report on Schools Television Broadcasting 1956/61, and with the British Standards Safety Regulations BSS 415. Each set is also ready for 625-line working. As a service, Granada tell me they give not only free insurance but free maintenance and replacement of parts, and 10 per cent discount on all orders for five or more school receivers. On technical details I particularly noted lockable front door, rear panel and control door, retractable hood to minimise reflection, forward-facing speaker on large baffle, and CRT covered by implosion guard.

Among many educational electronic devices available from Philips, I single out two tape machines. First is the big EL3549, a four-speed hi-fi recorder specially suitable for schools. 'It is more expensive than a blackboard,' a Philips educationalist remarked to me, 'but there is so much more it can do for teacher and student. The excellent sound quality is essential for studying languages and music. . . .' I am also extremely keen on the EL 3586 battery portable tape recorder, which records and plays back anywhere, even while being carried, and is a wonderful laboratory aid. As Philips also stressed to me, recent copyright revisions now permit tape recordings to be made of BBC Schools broadcasts, and of radio-vision educational programmes, thus allowing schools to fit these broadcasts into their curricula, and not vice versa.

In the Rank Audio-Visual Division exhibit, in Hall E1, I single out the Kershaw Daylight 111 slide and filmstrip projector which can be used in any classroom or lecture hall without having to darken the room. This is a boon if the class has to take notes or make copies of illustrations projected.

ITM (International Tutor Machines Ltd) of Ashford, Middlesex, in Hall F1, showed us several electronic innovations, of which I select three as outstanding. First, there is the ingenious little 'audio notebook' which is a miniature totally-enclosed battery-operated recorder using 1-in tape. On this 22 master recording tracks can be selected by a switch, each track giving 15 minutes' continuous recording. ITM's language laboratory differs from many others in that it uses a magnetic storage drum ('computer techniques,' they hastened to point out) instead of tape, and allows the student to select any phrase without delay and to pace himself through a lesson. Continuous purchase of magnetic tape is of course unnecessary. The third outstanding item in the ITM display was the Transtutor, a unit system language laboratory for use with up to 16 students, without need for permanent wiring or cumbersome student booths. This Transtutor uses standard $\frac{1}{4}$-in tape.

Much ETV and CCTV equipment demands precision testing and display, and for education in the fields of radar and electronics precision measuring oscilloscopes are needed. In Exhibition Hall R2, Telequipment Ltd, of Southgate, showed a wide range of their 'scope, including—I noted—the D55A double-beam laboratory instrument, with a 5-in double gun PDA tube and, by contrast, the Serviscope S51E. This latter is a special education version of the Telequipment S51A, and incorporates all the recommendations of the Science Masters' Association for simplified controls. It seems to me that with a 5-in flat-faced tube, fine trace, simple and accurate controls and rock-steady sync, this instrument is well suited to lecture theatre and classroom use. Like the S51A, it weighs only about 16 lbs, is low-priced and perfectly safe for use by students and non-technical personnel.

In Display area C1, Scrivener-SLT Ltd of Bristol gave us a wonderful exhibition of the Monitor language laboratory and electronic teaching aids. These are already in use in over 70 major educational centres ranging from the South Devon Technical College to Fettes, Edinburgh. A conventional tape desk is used in this system, and Monitor offer complete 'electronic classrooms' with master consoles (twin tape decks, consolets (with push-button controls), student recorders (a patented dual-channel recorder allowing a student to perform normal listen/record exercises, while the master tape channel is non-erasible by the student), and a number of other facilities including the Type 11 student unit (for listening to recorded material from the master console, and for communication with the instructor), and bulk tape erasers.

In addition to the Clarke & Smith Mfg Co tape previously mentioned, there was a wide display of TV receivers (most notable, in my opinion, the Type 645 with a wide-angle 27-in tube), and the TR 634/5 transistorised tape recorders. The first uses a Wright and Wearie Mk V tape deck with special C & S facilities, while the TR 635 is based on the Truvox D82 Mk 11, both covering $7\frac{1}{2}$ and $3\frac{3}{4}$ speeds. C & S are distributors of the fine AEI overhead projector, earlier models of which we had previously noted at EFVA exhibitions, and which is now available as standard with a 500-watt lamp giving an overhead projection illumination of some 2,000 lumens.

Under the general banner of Elstone Electronics Ltd, in Exhibition Hall A2, there was a most comprehensive display of ETV facilities including the Tandberg series of recorders from Oslo, distributed in the UK by Elstone, and a range of loudspeakers and educational radios. The Tandberg Series 6 is available 4-track or 2-track; this is a stereo-mono recorder with cathode-follower output and 'sound-on-sound' facilities. There is a novel Huldra radio suitable for educational radio reception and tape recording, and this is available with stereo amplifiers for Series 6 recording.

Cybernetic Developments Ltd of Byfleet (a subsidiary company of APT Electronic Industries) showed their student booths and teacher's console as designed for language laboratories, the electronic features of these being most comprehensive in my opinion. Student booths are constructed on the recommendations of BS 3030, and the main console has group selector switching, group intercom switching, class intercom and intercom volume controls, and recording is on high-fidelity half-track.

Largest exhibition in Navex 65 is that jointly organised by Rediffusion and Marconi, details of which are given on page 598 in this edition.

INTERNATIONAL NEWS

Elected

■ THE FOLLOWING COMMITTEE, elected by the UK and Eire Section of the Institute of Electrical and Electronics Engineers to take office on October 1, was announced at the first Annual General Meeting on June 29:—

Chairman: Dr R. C. G. Williams, Chief Engineer—Philips Electronic and Associated Industries Ltd. **Vice-Chairmen**: Sir Harold Bishop, Consultant—British Insulated Callenders Cables Ltd; Sir John Hacking, Consultant—Merz & McLellan. **Treasurer**: Dr R. L. Smith-Rose, Secretary General—Inter-Union Committee on Frequency Allocations. **Secretary**: R. C. Winton, Executive Engineer—Mullard Ltd. **Assistant Secretary/Treasurer**: F. S. Barton, Director — Hewlett Packard Ltd. **Committee Members**: R. W. Addie, Joint Managing Director—Painton Ltd; S. L. M. Barlow, Director—Barlow & Young Ltd; Dr G. S. Brayshaw, Reader in Electrical Engineering — Northampton College of Advanced Technology; Dr G. S. Brosan, Principal—Enfield College of Techonology; Dr R. C. Cuffe, Divisional Engineer—Electricity Supply Board of Ireland; A. A. Dyson, Managing Director—Erie Resistor Ltd; C. J. O. Garrard, Director—London Region, GEC (Engineering) Ltd; F. J. Lane, Partner—Preece, Cardew & Rider; Commander C. G. Mayer, Managing Director — G-U Overseas Ltd; C. T. W. Sutton, Chief Engineer—Enfield-Standard Power Cables Ltd.

Among the aims of the Section is close co-operation with the Institution of Electrical Engineers, the Institution of Electronic and Radio Engineers and other professional societies, in the organisation of conferences, with the special function of providing a two-way link with the USA and other countries. During the last two years the IEEE has co-operated in this way in the organisation of four international conferences.

All members of the IEEE with addresses within the geographical boundaries of the Section automatically become members of the Section. Present membership stands at over 1,000, and under arrangements agreed with the IEE and IERE, IEEE members may attend their meetings in London in the provincial centres.

Apart from any Section activities IEEE members have the advantage of a direct link with developments in electrical and electronic engineering in America through the IEEE publication 'Spectrum' mailed monthly to all members. They have also the opportunity of subscribing to the 'Proceedings' at a lower rate and of joining any of the 32 IEEE Professional Technical Groups and receiving their Transactions.

New station

■ MAR DEL PLATA, the principal seaside resort and one of the largest cities in Argentina, will soon have one of the most modern television broadcasting stations in the country. Fully equipped with Marconi television studio and transmitting equipment, this station will be opened towards the end of the year. It will be run by Mar del Plata Television SA and will provide television services for the 300,000 population of the town and neighbouring countryside, together with over $1\frac{1}{2}$ million visitors during the summer season which lasts from November to April.

This order follows a similar contract announced by the Company in April, to equip another new Argentinian television station at Santa Fe. The total value of these two orders exceeds £200,000.

The station will have two studios, one for normal programme work and the other for news, announcements and interviews. These will use two Marconi Mk IV, $4\frac{1}{2}$ inch image orthicon cameras and a Marconi broadcast vidicon camera respectively. Telecine facilities will consist of two 16 mm film projectors and a slide projector, coupled to a Mark IV vidicon camera. A full range of Marconi sound equipment will also be provided, together with synchronising and test signal generators, and control mixing and switching equipment.

The transmitting station will have a single Marconi five kilowatt Band III vision transmitter and a Marconi one kilowatt frequency modulated sound transmitter.

Conference

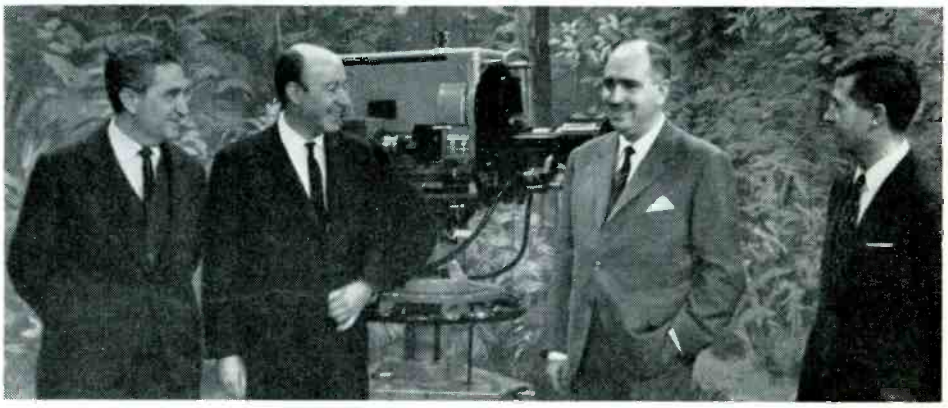
■ NEW CONCEPTS in television engineering techniques, and an important display of new TV equipment, will bring TV engineers from all parts of the world to the 98th SMPTE Technical Conference and Equipment Exhibit at the Queen Elizabeth Hotel, Montreal, October 31 to November 5. International discussion of some of the critical problems confronting the TV industry will be a major feature.

In the transmission field, reports will be presented on colour TV in Europe before and since the recent CCIR Conference in Vienna, new UHF transmitter design, and on cable distribution of UHF signals. Recent research work by the Institut fur Rundfunktechnik, Munich, on quadrature distortion correction will be described, showing how NTSC colour transmission can be improved. A panel discusion on network problems is also planned.

A special session on the relatively new art of vertical interval testing and monitoring will bring together contributors from Canada, Australia and Germany. Engineers from the Canadian Broadcasting Corp will discuss automatic video switching and some of CBC's quality control procedures. CFCF-TV will describe their operational experience with multiple fixed Marconi 321 vidicon cameras, and other equipment papers from six countries will include new cameras, electron beam recorders, monitors, colour slide scanners, up to complete mobile units and new studio designs.

Gemini Film Recording System

The first European installation of the Gemini television film recording system was recently completed by Rank Studio Equipment in the Madrid studios of Rediffusion y Television Espanola. Photograph shows Dr Octtaivs Rocci, Presidente de Neotecnica, Madrid, (second from right) with studio officials following completion of the installation. Gemini is a system for recording television programme material on 16 mm film simultaneously with transmission and/or video tape recording. It can be attached to any studio television camera fitted with a Rank Taylor Hobson Varatol V zoom lens and, by means of a beam-splitting device, records on 16 mm film the same image received by the television tube. Developed by MGM, Gemini is marketed by Rank Studio Equipment (The Rank Organisation) in all countries except the Americas and Japan.



5th International Congress on Acoustics

THE Fifth International Congress on Acoustics will be held in Liege, Belgium, from September 7 to 14, under the auspices of the International Commission on Acoustics and of the International Union of Pure and Applied Physics, under UNESCO.

The International Commission has entrusted the Presidency and the organisation of this Congress to one of its members, Joachim Frenkiel, Professor in the Faculty of Applied Sciences of the State University of Liege.

The International Commission on Acoustics (ICA) was created at the General Assembly of the International Union of Pure and Applied Physics, held in Copenhagen, 1951. IUPAP is part of the International Council of Scientific Unions, sponsored and subsidised by the UNESCO.

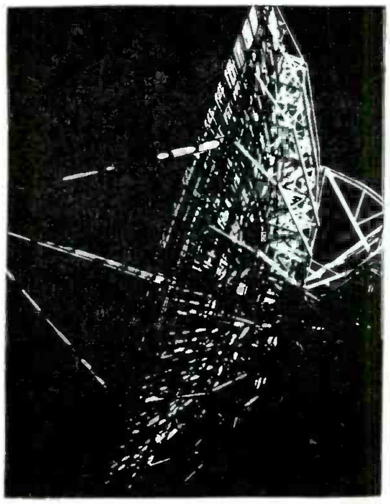
The essential scope of the ICA is to create and sponsor international co-operation within the field of pure and applied acoustics. In view of this the ICA has decided to stimulate and sponsor major international conferences on acoustics, which are held every third year. The Congress in Liege is the 5th of the series. Previous congresses were held in Delft (Netherlands) in 1953, in Boston (USA) in 1956, in Stuttgart (Germany) in 1959, and in Copenhagen (Denmark) in 1962.

Some 450 papers will be presented in total, in such sections as: A. Speech Synthesis and Analysis; B. Physiological and Psychological Acoustics; C. Molecular Acoustics; D. Ultrasonics; E. Underwater Sound; F. Noise Control; G. Architectural Acoustics; H. Room Acoustics; J. Electroacoustics; K. Physical Acoustics; L. Mechanical Vibration and Aeroustics; and M. Musical Acoustics. The opening lecture on the morning of September 7 will be by Professor P. Brien, Member of the Royal Academy of Belgium. His title is: The Acoustical Organ and Animal Evolution. The papers will be read in various rooms in the Palais des Congres, Esplanade de l'Europe, Liege.

A full programme of technical visits, as well as a special ladies' programme, is being arranged. During the Congress an exhibition of acoustical material by principal manufacturers will be organised.

Several British speakers from BBC, NPL, STC, and University of Southampton will participate. A full report of the major sessions will be appearing later in IBE. Until September 4, the Secretariat of the Congress can be reached at 33 rue Saint-Gilles, Liege, Belgium. Telephone: 32 31 67.

OUTLOOK



Trend to the weather 'hot line'

SAYS Patty Cavin in Electronic Age: 'The young meteorologist in the noisy communications room on the third floor of the US Weather Bureau's National Weather Satellite Centre in Suitland, Maryland, squinted nervously at the clock above the compact bank of electronic machines. It was two minutes after 10 am. The shiny red 'phone in his hand emitted a high-pitched squeak. Behind him lights flashed above a row of sombre black telephones, direct lines to Cape Kennedy, Fairbanks, Alaska, The National Hurricane Centre in Miami, and NASA Headquarters in Washington, DC. Around him a serious group of men checked the electronic scanner machines steadily rolling off weather maps, while facsimile specialists scanned the keys of their machines, preparing for action. Suddenly it came. *'Hello Washington. . . . Hello Washington. This is Moscow. Professor Bugaev is here. . . .'*

Patty Cavin gave us much more along these dramatic lines, as though for a television script.

'As the crackling tones of a Russian interpreter 5,000 miles away in the Central Forecasting Institute in Moscow faded through the speaker, the US Weather Bureau's sandy-haired Arthur W. Johnson . . . .' etc, etc, etc. Nobody presumably knows if Professor Bugaev was sandy-haired, so maybe he was wearing his fur cap. However, there is one journalistic adjective in this fascinating account which you may have missed. I mean 'the shiny red 'phone in his hand,' which emitted the high-pitched squeak. A *red* 'phone. A hot-line 'phone. And to tell the truth, this is precisely what it is.

While the whole world is aware of the Pentagon-White House hot line to Moscow, designed in dire emergency to keep the US President in rapid touch with the Soviet Premier, few realise that broadcast communication is one jump ahead of politicians, statesmen and military leaders. There has been a weather hot line between Moscow and Washington ever since October 1964, when RCA Communications Inc (the prime contractor in establishing the circuit) first turned it over in working condition for the US Weather Bureau.

This is a vitally important international trend which must be noted. While various nations may not agree on military status, social or religious philosophies, it behoves technicians such as ourselves to keep hot lines open wherever possible.

Sadly there has not been complete exchange of information on colour television, nor on satellite links. It might be thought that military needs of security transcend the human needs to exchange such information, but were this so then the weather would almost certainly be on the Top Secret list, as it always is when a fighting war begins. In the case of the existing international weather line, it is a great credit to all technicians responsible that information has been steadily flowing over the line since October 1964. It is, states Cavin, transmitted by four different modes—voice, facsimile, photograph and telegraph. Thus, the most technical cloud-cap data and maps, charted by courtesy of the American family of TIROS weather satellites, can be speedily flashed to Russia within minutes of their reception at the Suitland Satellite Centre. Cavin also expresses the view that top credit for negotiations belongs to the distinguished American scientist Dr Hugh L. Dryden, deputy administrator of the National Aeronautics and Space Administration, whose continued persuasiveness as technical adviser to the US representative on the UN's broadly-based 28-nation Outer Space Committee finally convinced Russia's shrewd academician Professor Anatoli Blagonravov that the Soviet Union should hook up to the weather line.

When trends mature, things have to be paid for, and it is understood that the most difficult part of these particular negotiations was reaching agreement for the payment of the weather hot line. Well, now both countries share equally the expenses that are approximately £9,000 a month. . . .

Cavin, detailing the chain of events along this trend, says that these ideas have piqued the imaginations of and spurred into action not only Soviet diplomats but also three American Presidents—Eisenhower, Kennedy, and Johnson. Speaking to the United Nations, late in his term of office, President Eisenhower proposed that '. . . we press forward with a programme of international co-operation for constructive use of outer space under the United Nations. Better weather forecasts, improved world-wide communications . . . these are but a few of the benefits of such co-operation.' As President-Elect, John F. Kennedy in November 1960 included in his State of Union message his personal enthusiasm for the first two TIROS satellites then orbiting the earth, and sending back helpful photographic data. *'I now invite all nations, including the Soviet Union, to join with us in developing a weather prediction programme. . . .'* His high hopes began a positive plan eleven months later, in December 1961, when the UN General Assembly unanimously approved Resolution 1721, embodying a Kennedy-proposed four-point programme of space co-operation.

When technicians first set up the hot line, Moscow and Suitland were the only two transmitting points on the first link. High-speed facsimile communication became possible, thanks to RCA and other techniques, and photos are received and transmitted at twice the speed usually possible on international circuits. Other countries can come in on a receive-only basis, if they agree to pay a proportional share of the cost.

And where will the next step in this globe-spanning link be? Our Washington correspondent has given a strong hint, and that is why this month I raise the weather hot line as a 'trend' and not simply as a technical *fait accompli*. The truth is that by 1968 the third step will be to Australia. Then the British Commonwealth will start to play a vital part in this trend.

John Dickson Ph.D.

IBE's EDITED TAPE SERIES (1)

+ First in a revealing new series of Edited Tapes actually recorded in person-to-person interviews by INTERNATIONAL BROADCAST ENGINEER REPORTERS. The following text is taken direct from our edited interview account. We open this month with a discussion with four world experts in colour-TV.

FOUR KINGS OF COLOUR

FOUR kings of colour television were group on the platform at the 19th Broadcast Engineering Conference.

They were R. T. CAVANAGH, general manager of studio equipment, North American Philips Company (a man in the public eye because of the introduction of the Plumbicon for colour-TV), H. N. KOZANOWSKI, manager TV Advance Development, Radio Corporation of America; ALBERT W. MALANG, chief engineer of Whittaker Corporation, and R. E. PUTNAM, manager Audio/Video Development Engineering, GEC of America. Chairman of the panel is FRANK L. MARX, president ABC Engineers, American Broadcasting Company.

These men are held in highest esteem in the United States, where there is already the world's biggest colour television public service operating. We were privileged to have our tape recorder on this session at the National Association of Broadcasters' engineering conference. The following is an edited account. It will be followed next month with a transcript of a second tape reel giving frank answers by the four experts to questions raised before our microphone by American, British, Japanese and other broadcast engineers at the meeting.

FRANK MARX: Well, we certainly hope that out of this panel will come some solution to the colour-TV Tower of Babel, particularly as it relates to colour cameras. I am going to put a hat in front of our four panellists and ask them to draw numbers for the order in which they will then present their particular philosophy! **(Philip's Bob Cavanagh drew No 1, Al Malang No 2, GEC's R. E. Putnam No 3, and RCA's Dr Kozanowski last.)**

BOB CAVANAGH: To begin with, I'll only speak about two hours! The problem is when I get talking about Plumbicon tubes and cameras, I get carried away. This particular tube is not just an infant. It is a tube that started in research and development approximately ten years ago. If we think of the tube and where it stands now with regard to colour-TV, right now, future improvements can be expected in areas of sensitivity, resolution, spectral characteristics . . . all within the existing configuration. Of course the existing configuration is very interesting . . . it is a one-and-a-quarter-inch diameter tube, and it's eight inches long. So in operating advantages we can think in terms of size. We can also think in terms of very low dark-current . . . and by that I mean the order of a few nanoamperes.

There is no shading coming out of this tube. There is no shading compensation anywhere in the colour-camera system. It is a linear transfer characteristic, or as close to linear as we can hold it. It is of the order of a gamma 0.9.

Yes, the lag was held down. It is extremely short. It bears no relationship to the past knowledge of lag in a vidicon tube. Sensitivity? We think in terms of an average around 400 microamperes per lumen as the sensitivity. In terms of resolution of the tube, our production tubes are yielding 40 per cent depth of modulation at 400 lines or 5 Mc/s. . . .

Now if we think of this and ask: 'Well, what does it mean for colour cameras?' the most significant thing is that the gamma is a **fixed** gamma, and holds independently of light level. Well, as it is of the order of 0.9 in the tube, this means the camera must be compensated with an additional gamma exponent of approximately 0.5.

If we talk of a typical operation for an RGB colour camera, we think in terms of operating at 150 foot-candles and scene illumination of f/4.0. The depth of the field associated with f/4.0—because the image format is roughly one-half the diagonal of an image-orthicon image format—means that for comparison you must relate this to f/8 for an IO comparison. The wide channel in the camera you set for a 40 dB signal-noise ratio out of the encoder. The cameras themselves we set for 80 per cent depth of modulation at 400 lines in the centre of the image—again, wide-channel.

(Question to Cavanagh: What is your policy about colour cameras? Are Philips going ahead with an RGB camera, or the YRGB?)

CAVANAGH: Because of the size (which is, let's say, fortuitous and very good for a three-tube colour camera, and with colour-fidelity advantages) the Philips plumbicon RGB colour camera will be continued in production—certainly in Holland and the USA. As the Philips' research and development of the **four**-tube camera progresses (this is the YRGB camera) future availability will be determined.

Based on our present knowledge—not just ourselves but broadly in the industry, any four-tube Plumbicon camera obviously must be larger, heavier. And it will require linear matrix correction for the luminance errors related to chromaticity errors in the reproduction of the NTSC system. The linear 'taking' characteristics of the Plumbicon, however,

NORELCO's latest colour camera, complete with shot-box for remotely-controlled lens. In this exclusive tape interview, four leading colour experts talk of the future of systems using tubes as in the Norelco.

allow very easy and clean-cut solutions to the luminance errors which exist.

FRANK L. MARX: Thank you, Bob. Al (Malang), I believe you are No 2.

ALBERT W. MALANG: Recent experience has convinced us at least and I believe most of the trade, that a separate luminance channel is a very desirable feature for a film camera, particularly as so many broadcasters have to deal with a hybrid operation—partial colour, partial monochrome.

I think we are fairly well convinced that probably the best pickup tube for a colour film chain is the vidicon . . . although I must confess to you that the conviction is not **absolute** yet. There are a family of new pickup devices starting to be available, chief among them being our old friend from years back, the dissector. It could conceivably turn out in the very near future that the dissector may take over a part of TV colour film work, the obvious problem being that you need transports of a more continuous light-application nature. All the same, continuous-motion transports are available, and of course the projected slide does not give us this problem. But, for the main, it would appear in today's state of the art that the four-V chain is the principal workhorse, and the best choice under any given set of circumstances for film use in a colour station. But the situation's not so clear-cut when we come to studio colour.

We have convinced ourselves that the four-tube camera is the desirable approach. Well, it eases the problem of going from monochrome to colour, and back. The question is: **which four-tube combination?**

At the present moment there hasn't been enough work done in the lighting techniques to be able to choose among the many tubes available for the chromo channel. One can talk in terms of vidicons and small image-othicons. The choice is varied. Plumbicons, obviously. For the luminance channel I think our opinion is beginning to settle on an IO. But for the chromo channel we just cannot make up our mind. The state of the art—in terms of efficient and effective colour-splitting dichroics (the elements that have to split the light entering the camera into the three necessary channels)—is inadequate so far as lighting goes.

So we intend to spend a great deal more time surveying the situation to determine what is the most desirable combination of characteristics . . . or, if one approaches this with absolute honesty, what is the least burdensome set of compromises necessary to do an effective job in a live colour studio.

It is difficult to envisage live colour production continuing and growing in a situation where dimming and mood-lighting is as difficult as it is today. Maintaining colour balance from a tungsten incandescent-type fixture can turn a person grey very quickly! The four-tube camera of course does offer a slight advantage in that respect. As the colour temperature of the incident light changes there is fond hope that the presence of the three chromo channels will permit a kind of colour masking. But it would certainly be a great deal more desirable to be able to eliminate the problem in the first place and to establish as completely stable camera operation as possible.

To sum it up, we don't know how to, yet. But we intend to find out. . . .

(The discussion opened up re colour-camera stability. And as a Philips RGB camera was being used in the demonstrations accompanying the 19th Broadcast Engineering Conference, the previous speaker intervened).

CAVANAGH: Let me digress for a couple of moments and give you the operating characteristics of the set we have here. What we call the indoor scene is illuminated at 200 foot/candle incident illumination. The so-called outdoor scene we have is set for 140 foot/candles. The colour temperature was set at about 3,000-deg Kelvin. The cameras are set for a contrast ratio of approximately 100/1.

Just for the sport of it, we have done experiments by swinging the camera down into the area illuminated by fluorescent lighting. The colour temperature is very different, obviously. The area is lit at a level of some 11 to 13 foot/candles only. So we open the lens iris to f/2 and adjust the master Black level, and we have what we feel is a very fine picture even under that reduced scene illumination. We could have touched up the skin tones, but we purposely leave it as it is, just so that you can see what this means. What it shows is something we feel is very significant. It is a tolerance to colour-temperature changes that begins to approximate what the human eye does!

Again, just for your information, the cameras we have here are registered around 8.30 in the morning and we purposely do not re-register them throughout the day. It is all related, really, to the fact that the gamma characteristics in these tubes are purposely controlled in the fundamentals of the surface, and they hold constant independent of illumination level. This gives a capability of colour fidelity that is very difficult to get in any other way. . . .

R. E. PUTNAM (GEC): We have lived with colour cameras since the middle 1950's, and I think we are all familiar with the three-IO camera. But we are at the point of changing to a camera technique where we have some operational ease and maybe some more simplicity. So I believe that cameras in the future are going to have a separate luminance channel. Now you can take your own choice as to how you want to take care of the chrominance channel. This probably is the biggest bag of worms there is today!

In NHK the Japanese in their colour network have standardised on a **two**-tube camera. They use two image-orthicons, and derive the colour information from a striped filter. That's probably about as simple as you can get. I think we have all thrown out thoughts of a **single** striped tube of the sort many of us played about with in the early '50's, but it is always an interesting question. In those days separate luminance was then unknown. As a matter of fact it was a laboratory novelty, and it took six or seven years before anything was done on it. There are pro's and con's. I'd like to cover some of both.

Starting off on the negative side, the argument FOR separate luminance is that there is in fact, a colour error. I don't suppose anyone will deny this. But I will state that you can run AB tests and still find it hard to get any group of people to agree that one pattern is better than another. Experts have proposed to use separate luminance and then put in a correction signal back into the luminance so that you get it absolutely correct. I think the main problem with the 'correction' is how you derive this correction signal.

Naturally a four-tube camera is more complex than a three. It has more in it. But with present-day technology this is not a problem. From an engineering standpoint, there were days when if anybody whispered 'transistors' to me I

Four Kings of colour—continued

▶

wished I'd never heard the word. Yes, I had gone through all the rigmarole that transistors are 'reliable' and 'the thing of the future.' But from a design standpoint there were other matters also in those early days. Transistors cost too much. And they took too much time. Now transistorised equipment has proved to be very reliable; and, more important to users of colour-TV equipment, it is extremely stable.

The other point is the signal-noise ratio. Now noise in the chromo channel is not a problem. But it is a major problem in the luminance channel. I believe this to be one of the keys to the colour camera of the future. You can use the argument that you would like a three-tube colour camera to pick up about 4 dB advantage in signal-noise. . . . Noise is a function of the tube used in the luminance channel, so there is little you can do about it.

On the positive side, an advantage of the separate luminance system is basically that absolute registration is not going to affect either resolution or signal-noise. However, we will probably end up with a slightly better black-and-white picture, if we look at the situation over all. So far as the pro's of the three-tube camera are concerned, when correctly set up it puts out a beautiful picture, and it is then difficult to tell the result from that with a four-tube. In general the three-tube is less sensitive to knob-twisters . . . and we have a little of that in all of us!

DR H. N. KOZANOWSKI (TV Advance Development, RCA): Well, I agree that the four-tube approach with a separate luminance channel gives you high resolution and good signal-noise, with the restrictions that Mr Putnam has mentioned.

You have a picture which is completely independent of registry. For some TV chains it is your 'bread and butter' while you are getting warmed-up on colour. When you come into the chromo picture, however, I would try to exclude image orthicons from the chromo channel because in a sense they are a little too complex for the job. Of course if the day comes when we get an 'image-orth' which looks like a vidicon (in size) I will be very interested! In any case the essential requirements are: **Flat field,** because this is the basis of making good chromo pictures: **Low dark current,** since you do not want to have to fool around with problems of that general nature; **Good colour sensitivity,** adequate for a sound basis of colorimetry: **High sensitivity,** because this determines where the threshold will be ultimately for the camera use. And, finally, adequately-controlled **lag.**

In a luminance channel you can tolerate a great deal of what might appear to be lag in the fundamental chromo channel, yet never miss a trick in the luminance. In this respect Nature is awfully kind!

Dick has referred to this, and so has Al Malang. Colour registry should be as good as possible, but the practical tolerances are such that you do not suffer if matters become slightly upset so far as the luminance picture is concerned. The human eye on a few channels needs, after all, something of the order of 120 lines resolution or less, to perform its proper function. So it is with a great deal of engineering satisfaction that one gets something out to 5 Mc/s and whop it off! I must say my own personal prejudices on the choice of a tube for the separate luminance are very definitely in the direction of the image-orth. This is not only because we at RCA have used it for so many years, but because it has a very conveniently built-in knee for taking care of highlights and glint. Things like these aren't important to the technical man, and he doesn't see why they have to be in the picture, but the production people will always argue the point with him. So long as we can solve our tube difficulties here with a built-in characteristic, I am happy.

The other point mentioned is with regard to tolerance in technical operation. It is exciting to design a camera for use under ideal conditions, but what matters in service is how much tolerance you can build into it . . . especially tolerance for everything going wrong, and still come out with a good picture. The separate luminance camera to my mind has a built-in cushion when things go wrong, yet not really bleeding from the effect. This is important on a long-haul basis and particularly so in the warm-up period when the colour is starting to roll. Then there's the problem of the old outdoor pickup, when you are competing with Nature. Outdoor broadcasts have a habit of fooling you, especially with the actual sky up there being very, very bright, and the colour information on the monitor down below almost vanishing. All the engineer can do is put that signal on the system and say: 'Well, there **is** colour there; you just have to have faith!'

My own approach to this is that one can stand a great deal of gamma correction and 'squash' the blue sky down to where it is of reasonable value in the picture. This point was made first by Bill Wintringham, of Bell Laboratories, a great many years ago—I think in the 1950's. His viewpoint, given in a paper for the IRE, stressed that if you are running an entertainment service as opposed to a colormetric measurement exercise, all that matters is you make pleasing pictures. What is important is the result to the viewer at home who will either like or dislike it. If you have freedom of choice between luminance and chrominance components you can distort, if you wish, or compress the white highlights and raise the chromo. And the general effects will be better than the present general rule.

FRANK L. MARX: I noticed that while the experts were speaking, others were taking notes. Would any one like to comment on points raised by others

CAVANAGH: There seems to be one point not emphasised. For those of us who for many years have been working with colour systems there is a difficult problem associated with trying to match transfer characteristics. Now if you take the view that colour fidelity is not important (as Dr Kozanowski has done). this shakes it up easily! However, if you take the view that colour broadcasting will become more and more important as time goes on, then it demands more caution in reviewing the whole system and in the choice of transfer characteristics in the pickup tubes. On the one hand you can form any kind of colour picture. ('There are a lot of knobs there, you can push them any way you like.') On the other hand, for proper colour fidelity it is much simpler if the transfer characteristics of either the three or four tubes **match.**

If we go into registration, the comments—if I interpret them correctly—are valid and related to our present situation where there are not too many colour receivers and where it is also important to keep in mind the reception on the much greater number of monochrome receivers. Based on our own (Philips) and other evaluations, I must say that the registration requirement for a four-tube camera is not significantly different from that for a three-tube. In the long run my feeling is that we must strive for the very best colour fidelity we can achieve, and also the best monochrome fidelity. But neither one should be downgraded in favour of the other. Lag is no problem for monochrome reception (when you have lag in the chrominance channels) but excessive lag is very serious for colour reception in that case.

DR KOZANOWSKI: May I speak as an individual, not for any corporation. If I were allowed to write the ticket for an ideal tube for colour television, I would be very tempted to detail the specification for a tube which has zero dark current, zero lag, and gamma of 0.5, so that it would not be necessary to tamper with it. The unfortunate thing is that Nature is cautious! Both the Plumbicon and the Selenicon, to get the characteristics they have, unfortunately come out with a gamma of 9/10 or thereabouts. I would like to warp it into shape, but unfortunately it doesn't warp. Therefore I agree in principle that you have to correct because a gamma of 9/10 gives one a very harsh picture. But I do not think this is a vital requirement. It is simply the best anyone knows how to do right now. . . .

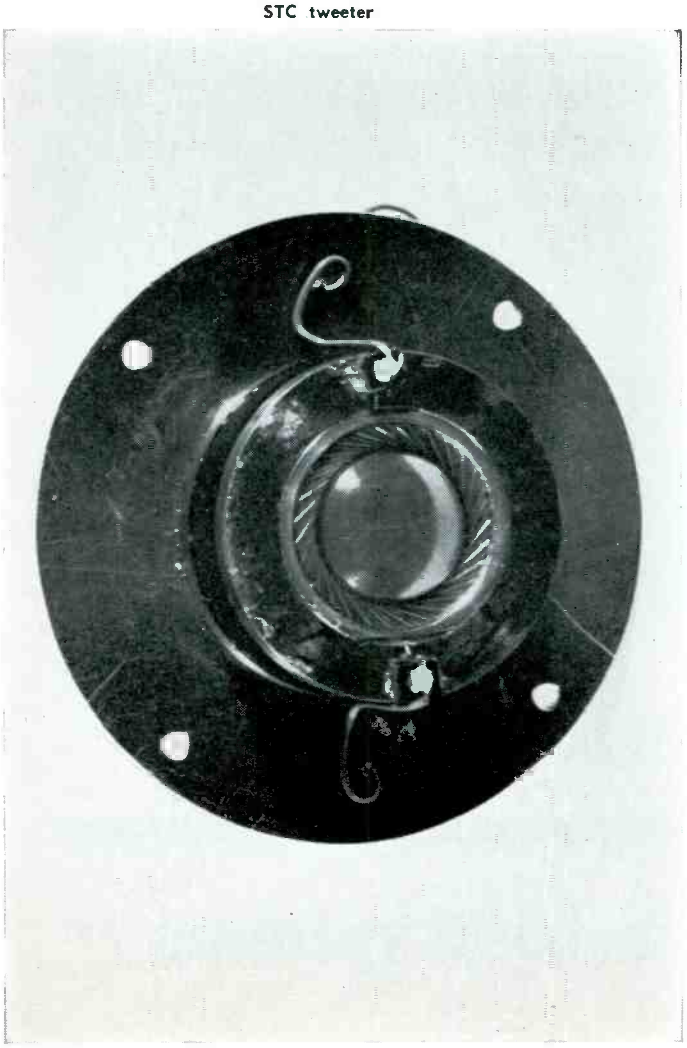
(The four experts then dealt with questions from other listeners while these remarks were recorded. Questions raised include comparative operating costs of colour systems, on multiplexers, the disadvantages of the Plumbicon, on the striped filters used by Japan's NHK colour network, and the new four-tube camera built for NVT, the independent Japanese colour station. A transcript of these edited questions and answers will be given in the next issue).

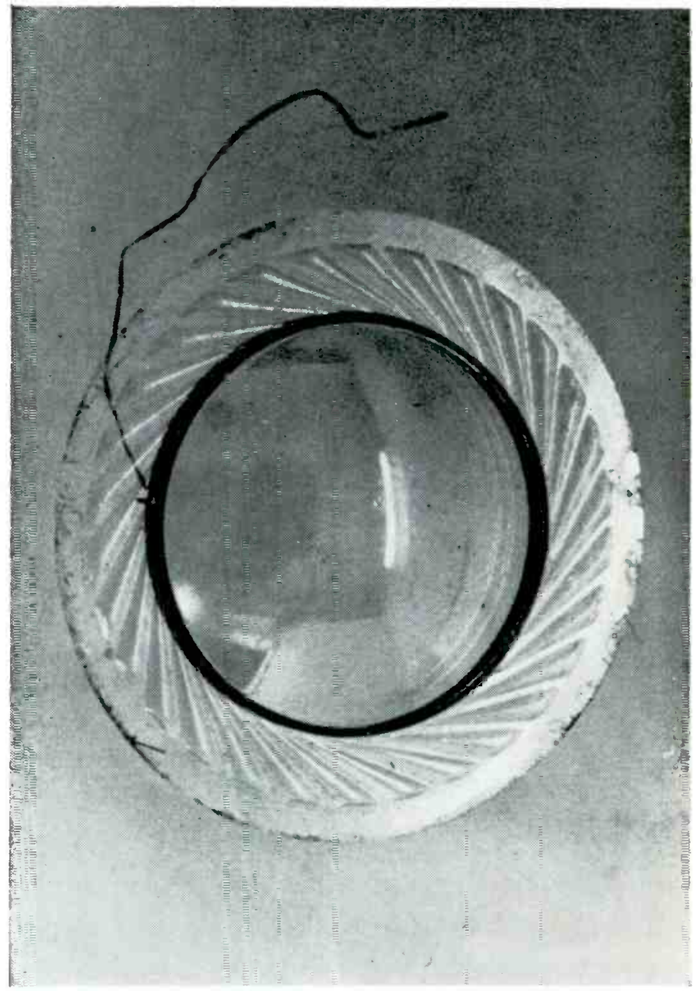
New S.T.C. high frequency (tweeter) unit

M. L. Gayford and colleagues at Standard Telephones & Cables Ltd., Electro-Mechanical Division at Harlow, Essex, have designed a small direct-radiator moving-coil tweeter based on moving-coil microphone technique. It will be marketed in UK shortly, but no details of availability or price are yet available.

by Donald Aldous (audio editor)

STC tweeter





Melinex 1 mil diaphragm and coil unit of new STC tweeter.

THE LOUDSPEAKER is a small omni-directional unit which is precision made and individually assembled and calibrated in the same way as the STC braodcast quality microphones. A light robust polyester diaphragm with tangential corrugations carries an aluminium tape-wound self-supporting speech coil. The system is acoustically damped and has an excellent transient response. The use of a high coercivity ceramic ring magnet enables the unit to be made in the form of a flat cylinder which is easily mounted in a hole in the front of a normal good quality loudspeaker cabinet. A plate is provided to close off the opening and prevent acoustical leakage from the interior. Thus the diaphragm of the tweeter is placed just behind any overall front cabinet protecting front covering gauze, etc and the usual resonant cavity effects encountered in the cabinet mounting of tweeters are completely avoided.

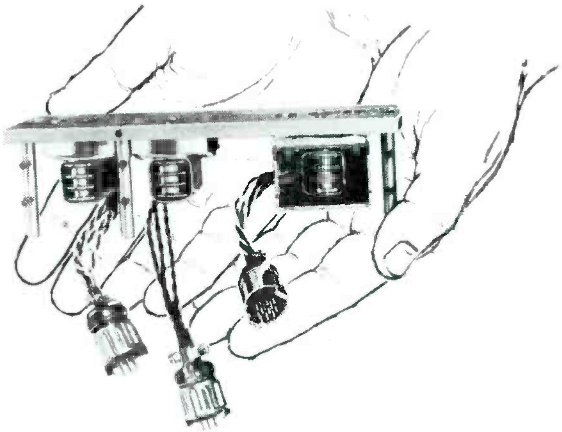
The STC tweeter covers the frequency range from approximately 6 kc/s to almost 20 kc/s very effectively, when it is shunted across the speech coil of any high quality bass or mid-range dynamic loudspeaker with a lmfd series capacitor.

Dimensions: $2\frac{1}{2}$ in diameter overall by $\frac{5}{8}$ in depth approx. **Weight:** 250 grams approx. **Impedance:** 25 ohms. **Polar Response:** Substantially omni-directional. **Frequency Response:** Substantially flat from 5 kc/s to 17 kc/s within $\pm$ 2 db. **Magnet gap flux density:** 10,000 gauss. **Efficiency:** Suitable to match good quality 15 or 3 ohm loudspeakers. **Power handling capacity:** 3 watts peak in 5 kc/s – 20 kc/s range.

IN JUST MINUTES . . . YOU CAN SWITCH FROM 4-TRACK TO 3-TRACK RECORDING (and back again!)

with the SCULLY 282-4 recorder/reproducer. . .

and interchangeable plug-in three track heads



HERE'S THE STORY: Buy the SCULLY 282-4 for 4-track, ½" recording and you get the finest solid-state instrument available . . . built to the exacting standards of craftsmanship and performance for which the SCULLY name is so well known. Expect sound performance unequalled . . . dependability in the most critical and demanding applications.

NOW add this 3-channel head assembly which plugs in and converts the SCULLY 282-4 to a 3-track unit. Gives you just the flexibility you're looking for, doesn't it?

TECHNICAL DATA

FREQUENCY RESPONSE: ±2 db 30 to 18,000 cps @ 15 ips; ±2 db 50 to 15,000 cps @ 7½ ips; ±2 db 50 to 7500 cps @ 3¾ ips

SIGNAL TO NOISE RATIO: Peak record to unweighted noise (50 to 15,000 cps band) using 3M 201 or equivalent tape
7½ and 15 ips full track —65 db
7½ and 15 ips stereo —60 db
3¾ ips full track —55 db

FLUTTER AND WOW:
15 ips: Better than 0.08% RMS
7½ ips: Better than 0.1% RMS
3¾ ips: Better than 0.2% RMS

SCRAPE:
15 ips: Better than 0.12%
7½ ips: Better than 0.15%
(All components 300 to 5,000 cps)

JUST A WORD MORE about SCULLY all-transistor recording equipment. It has an outstanding operational record . . . insuring minimum down-time during sessions. When servicing is required, its plug-in construction makes for fast, easy repair. Relays, modular sub-assemblies, electronic chassis, solid-state amplifiers **all plug in** . . . no complicated wiring disconnects or de-soldering.

SCULLY RECORDING INSTRUMENTS CORP.
FOR EXPORT:
ROCKE INTERNATIONAL CORPORATION
13 EAST 40TH STREET, NEW YORK, NEW YORK, U.S.A., 10016. CABLES: ARLAB

SOUND and VISION for schools

by Jonathan Chambers

HUGE Movement Hall at Whitelands College has been devoted, during the run of Navex/65, to a school TV studio and control room with telecine facilities, managed jointly by Rediffusion and Marconi.

Rediffusion's James Van den Bergh and Marconi's R. Dan Boyle explained to me how this powerful association began gradually some years ago, as the two groups are experts in their own particular fields.

'Marconi,' they said, 'manufacture a complete range of television equipment, and have planned, installed and maintained television installations from the most complex national broadcasting networks to basic CCTV for education and industry. And Rediffusion has more experience of planning, installing and maintaining wired television distribution systems than any company in the world. The company also manufacturers equipment including a range of simple TV receivers for use on its wired systems, which have great scope in education. . . .'

On the 2,000 sq ft exhibition hall we were able to see a typical school TV studio and control room with telecine, and were shown how programmes using original material and outside sources, or both, can be transmitted to different classrooms or schools linked together by special high-frequency distribution system.

In a studio area of this type, two studio vidicon cameras type V322B are used. Each is complete with manually-operated four-lens turret and electronic viewfinder, and the tripod has a pan and tilt head as well as being wheeled for mobility. A single multi-core cable from each camera to wall-mounted junction boxes feed video as well as talk-back to the control room, and also connect mains and sync drives to the cameras themselves. There is a headset provided for each camera operator—a detail overlooked in many schools TV units which therefore suffer because the lecturer cannot give rapid instructions to those giving the video demonstration. Just as in full professional broadcast practice, a boom microphone with hand-operated boom and 'pram' is also used in the lecture-room studio area. This, like the cameras, is linked to a multi-input junction box on the wall, into which other microphones can also be plugged if necessary. There is also an audio amplifier and speaker unit installed in the lecture-room studio area to relay the lecturer's instructions during a run-through of the demonstration.

The console used to control the whole TV network looks at first glance like a miniature console suitable for a small TV broadcasting station, and is comprehensive enough for any school, laboratory or industrial-education facility which one could possibly envisage. Along the upper section are four 14-in picture monitors. These display respectively the signals from Camera 1, Camera 2, Preview and Telecine or line (that is, the final selected outgoing picture, again just as in broadcast practice). Video signals from both cameras pass through their respective monitors and then are fed into the vision mixer. This unit, I find, is of a type able to accept up to five different vision signals, and provides full mixing, fading and cutting between pictures. A selector on this vision-mixer control panel allows any picture to be previewed before being cut or mixed. Those familiar with Marconi transistorised equipment no doubt noted at Whitelands College that a sync pulse generator Type V3610 is used in the control console to supply pulses to all cameras in the system.

The vision signal then selected by the teacher, lecturer or producer is then fed (via the 14-in line monitor, which indicates what the pupils are actually seeing) to a modulator. This modulates the vision signal on to an RF carrier. It will be understood (and was demonstrated at Whitelands) that the RF signal is subsequently fed to distribution boxes in the viewing room to which TV receivers are connected. There is a switch provided on the control console to disconnect the studio vision signals from the modulator and to link an 'Off/air' receiver to it, by which means TV receivers can be used to display broadcast programmes from BBC or ITA sources.

ETV experience shows that good sound coverage is just as vital as clear video coverage, and in this joint system an intercom amplifier complete with selector panel is mounted in the console to provide two-way audio communication between the producer, cameramen and telecine operator. A microphone and associated amplifier can be provided in the viewing room for students questions and, when in use, will automatically mute the programme sound being fed to the display receivers.

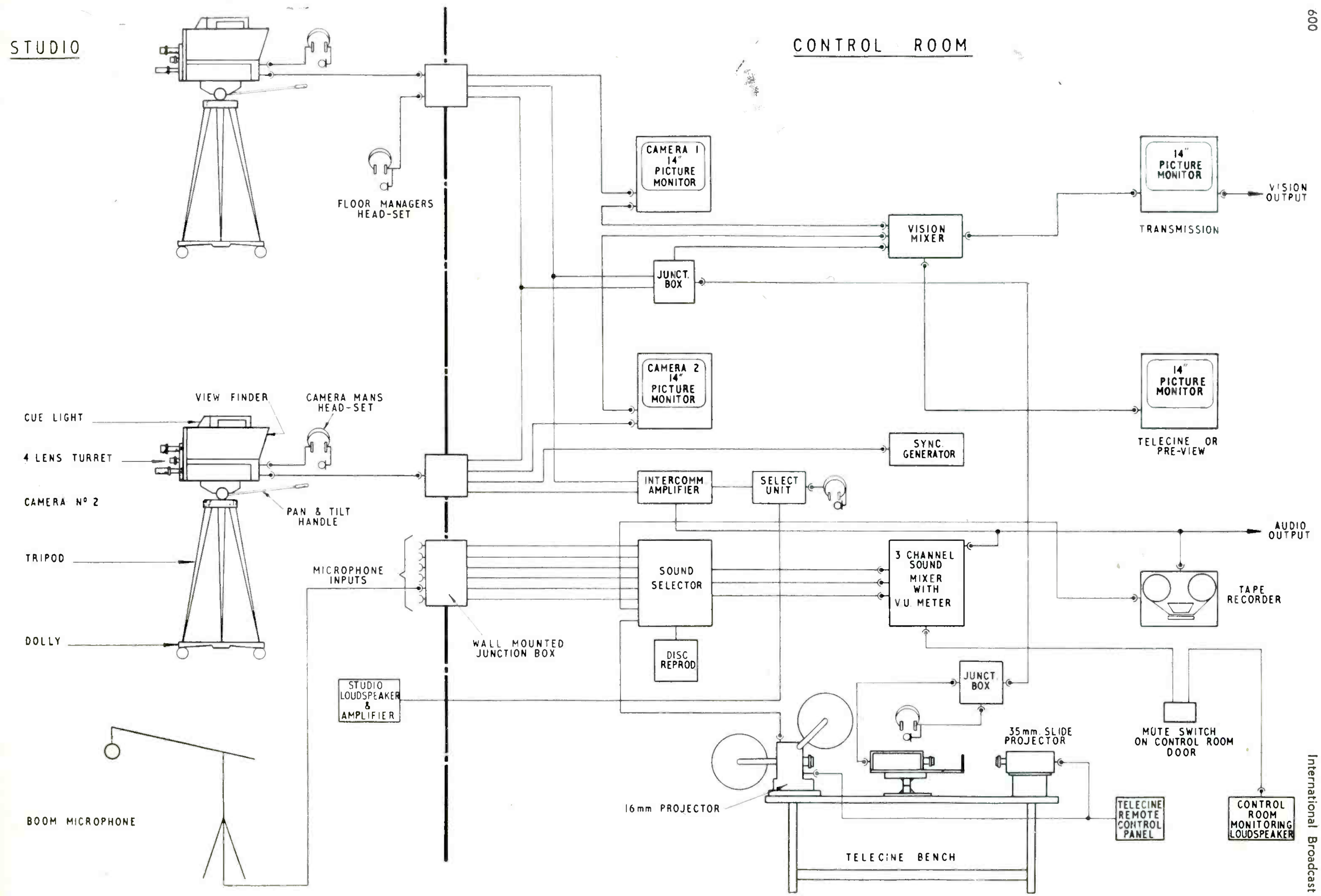
Audio signals from the student's microphone are then fed to the producer or lecturer, are heard on his headset and via his selector can be switched to the studio speaker so that the televised lecturer can hear the question. Normal programme sound will continue as soon as the student's press-to-talk mike switch is released. Programme speech from the studio zone is connected to a sound-selector unit in the control console, and fed subsequently to a three-channel sound mixer which has its own professional type of volume (VU) meter. Programme sound is monitored on a speaker in the control room, and this is automatically muted if the control-room door is opened, so preventing howl-round. The complete typical ETV unit includes a disc reproducer and an audio tape recorder, the output of both being linked to the sound selector. Selected programme sound is fed to an audio amplifier, then subsequently superimposed on the outgoing modulated vision signals to the viewing room, where speakers in the display receivers relay the sound to students.

No ETV system is really complete without its own telecine facility, and in the typical television unit recommended by Rediffusion and Marconi, a telecine layout using a V322A vidicon camera gives facilities for televising 16-mm film and 35-mm slides. The camera is fitted to a rotating index head not only carries the camera but also a field lens assembly on to which the projected film or slides are focussed. Stops are fitted in the index head to ensure correct optical alignment with either projector. A remote control panel fitted into the control room console enables the lecturer or a technician to have remote control of the automatic slide magazine on the projector, and to start/stop the 16-mm projector. Vision signals from the telecine vidicon are fed into the vision mixer on the control console, and displayed on the telecine preview picture monitor. Marconi's can supply a prism unit so that the telecine camera can be used for televising captions and photographs without removing it from the telecine bench.

The heart of the whole ETV system as demonstrated at Whitelands College is the new V322A/B camera which we saw for the first time at the Washington convention of the National Association of Broadcasters in March last year, and which since then has gained a wide public for industrial and ETV work. Full details of this camera were given on page 546 last month, and a data summary is given here. The V322A is the basic camera, and the type B includes the viewfinder with its 7-in screen. Five major training colleges have already started using the camera as

▶ *to page 600*

Exclusive review of the huge Rediffusion and Marconi exhibit at Navex/65.



Facilities diagram of a complete CCTV educational station as demonstrated by Marconi in conjunction with Rediffusion at Navex/65.

Sound and Vision for schools—continued

▶ *from page* 598

the result of Department of Science and Education tests. Except for the vidicon (and the CRT in the viewfinder camera), both are completely solid-state, and I am inclined to agree that no other camera at present meets the needs of educational television so completely and professionally.

Turning now to the Rediffusion facilities, it will be recalled that some eight years ago Mr Paul Adorian, managing director of Associated Rediffusion (now Rediffusion Television) led the way in producing some of the first TV programmes for schools in Britain. More recenty, Rediffusion's wired services have been giving schools in towns and cities improved reception of BBC and ITV schools programmes. At Whitelands we were shown how as an alternative to establishing an independent control studio in each school—or in addition to it—education authorities may find it convenient to have a central control studio serving all schools in a particular area. This permits standardisation and control of programmes in accordance with local educational requirements.

If a number of schools are to be linked in this way to a central studio, a separate independent network would normally have to be used; but where schools themselves are located within the area of an existing Rediffusion network, it is often possible to allocate a spare channel for education, and then to extend the network to include all those schools requiring the local service. Of course this is subject to the granting of a special GPO licence, which under present circumstances is hardly likely to be refused unless there are particular local technical difficulties. Hull Teachers Training College is a fine example, as the CCTV system is being used to distribute lectures and demonstrates to a far wider audience than would normally be possible.

Over most of its distribution network a Rediffusion wired TV system uses a multi-pair cable in which an individual pair of wires carries both picture and sound for a particular programme. The sound is carried at audio frequency; the picture information is modulated on to a 'system frequency carrier' of between 5 and 10 Mc/s. Ordinary Rediffusion cables can handle from one to six TV channels in either monochrome or colour, and in this way up to twice this number if a second multi-pair cable is added. The multi-pair cable is used for the secondary or feeder system, in which an area with a radius of 1,000 yards can be served from an amplifier 'kiosk.' These kiosks are located in a primary or trunk network of coaxial cables. In this way an area with a radius of 10 miles can be served. A multi-position switch, mounted on wall or desk, enables the ETV operators to select the picture and sound simultaneously for an appropriate programme without adjusting the set. There is a very ingenious facility by which the teacher has remote control of all programmes on all receivers in his network. With his programme selector switch he simultaneously selects whatever programme he needs, changing automatically from 625 to 405-line standards and back, and controlling audio volume. This demonstration at Whitelands College was the first occasion on which we have been able to see perfect 405/625 switching remotely, without need to get up an make additional regulation at the receiver itself.

Because the cable feeding the individual receivers is designed to operate at audio frequency (as well as to carry vision

▶

Sound and Vision for schools—continued

▶

signals) it is a simple matter for a school or classroom to 'talk back' to the studio. One of the standard Rediffusion cables contains six pairs of wires for TV plus three additional pairs which may be used for talkback or for audio. Even if the teachers do not require this talkback facility, it is useful for maintenance since it removes the need for local phones between classrooms and the central studio. Naturally, Off/air broadcast programmes can be transmitted on the Rediffusion system along side the closed circuit channels, and selected at the multi-position switch. Provided they operate both on 625 and 405-line standards, existing TV sets can be connected without modification to the distribution system by means of an inverter.

In discussion with James Van den Bergh it was elicited that whereas the BBC began schools broadcasting (radio) in 1921, and that after the wartime gap nearly 15,000 schools were receiving these programmes in 1945 (this figure was doubled by 1960), the introduction of television ETV was a major development, and it was in May, 1957 that Associated-Rediffusion pioneered TV for schools in Great Britain and the Commonwealth. The BBC also expanded its schools broadcasting by introducing TV programmes in September, 1957, and today there exists complete co-operation between the two organisations, so classes get the best of both channels. 'Rediffusion London' programmes, together with those produced by Associated Television Ltd, the Granda TV Network, and Scottish Television Ltd, can now be seen in the greater part of the United Kingdom, and over 6,000 schools are registered as viewers. At first, programmes were limited to children of 11-15, mainly in secondary modem schools. Since September, 1959, however, programmes have been introduced to top classes in primary schools and also sixth forms in grammar schools. Says Van den Bergh: 'When Rediffusion first started schools television, it set up an Educational Advisory Council and Schools Broadcasts Committee to advise the School Broadcasting section. The council and committee include representatives of recognised educational bodies as well as individual members. . . . An outline of school programmes for the ensuing year is published each May. Programme notes for individual series are sent before the beginning of each term to schools who have registered with their local Independent Television Company as regularly receiving Independent Television schools programmes. . . . The BBC, too, provides Teachers' Notes and pamphlets.

At Whitelands College in this joint display with Marconi, Rediffusion engineers showed many technical facilities including their 27-in 2S 2785 'wired' schools receiver, and the companion ND 2783 27-in 'aerial' schools receiver. The wired receiver is 405/625-line automatic switchable, with 11 valves and eight semi-conductors. The ND 2783, with its receiver, employs 15 valves and 11 semi-conductors. Audio amplifier with 4-watt amplifier is used on both, and the construction complies with BS 415 and meets the approval of the Education Engineer of the Schools Broadcasting Council for safety.

Looking to the future in educational TV, both wired and off/air, the ND 2783 has a tuner which on Bands I and 3 has a rotary selector for channels 1 to 13, and fine tuning for individual adjustment on each channel. On Bands IV and V the separate UHF tuner gives selection of any four channels in these bands by pre-setting four push-button controls to the channels required. Thus all proposed ITA and BBC channels are catered for.

DATA SUMMARY

Ambient temperature: -10 to $+45°C$ for continuous operation. **Humidity:** Up to 95 per cent over temperature range. **Power supply:** 100 VA at 100-125 or 200-250 V, 48-62 c/s. **Scanning standards:** 625 lines, 50 fields or 525 lines, 60 fields. **Scanning linearity:** Camera less than 1.5 per cent departure from the ideal. **Video bandwidth:** Camera: ±0.5 dB at 7 Mc/s – 3 dB at 8 Mc/s. **Horizontal resolution:** 600 lines per picture height Marconi resolution chart Zone 1,500 lines per picture height elsewhere. **Sensitivity (with P842 Vidicon):** Usable picture at 1 ft lambert with lens at f/1.4 and limited movement. Virtually lag-free pictures at 50 ft lamberts with lens at f/2. **Viewfinder highlight brightness:** Not less than 75 ft lamberts. **Video output:** Internally pre set to give from 1 to 1.5 volt peak-to-peak compostie or non-composite into 75 ohms. **RF output:** 100 mV rms with at least 70 per cent negative modulation at peak white. Choice of one of three pre-tuned channels in frequency range 50-88 Mc/s. **Auto-sensitivity range:** 2000-1 above 0.25 ft candles on Vidicon face-plate. **Auto-black level range:** Stable black-level set up over Vidicon dark current change from 0. to 0.25 uA. **Signal-to-noise ratio:** Peak-to-peak signal to rms noise is 36 dB at 0.3 uA signal current.

New Ford D.800 truck for Intertel (VTR Services), London

Interior view of recording room showing one of the two Ampex fully transistorised audio video tape recording units operated by Intertel (VTR Services) Ltd and mounted in a Luton body on a Ford D 800 chassis.

INTERTEL (VTR Services) Ltd, a London company providing a videotape recording service for television companies in Great Britain and overseas took delivery of the new Ford D.800 chassis, fitted with a Luton-type body, to house more than £100,000 of electronics equipment, the day before it was to leave for a recording assignment in Greece on behalf of the National Broadcasting Company of America. The vehicle was, in fact, run-in on the 2,700 miles trip to Athens, and it gave no trouble at all during this arduous first journey.

Whilst in Greece a message arrived from England. Due to the launching of the Early Bird satellite the unit was required back in Manchester within 48 hours. If it could keep an appointment a £5,000 booking would be possible for the company.

The D.800 left Greece for Italy and covered the 2,000 miles from Bari to the North of England between Friday night and Monday morning. Drivers were changed frequently and on the first day it travelled more than 800 miles to Frankfurt. The journey was made on time without any mechanical trouble or mishap.

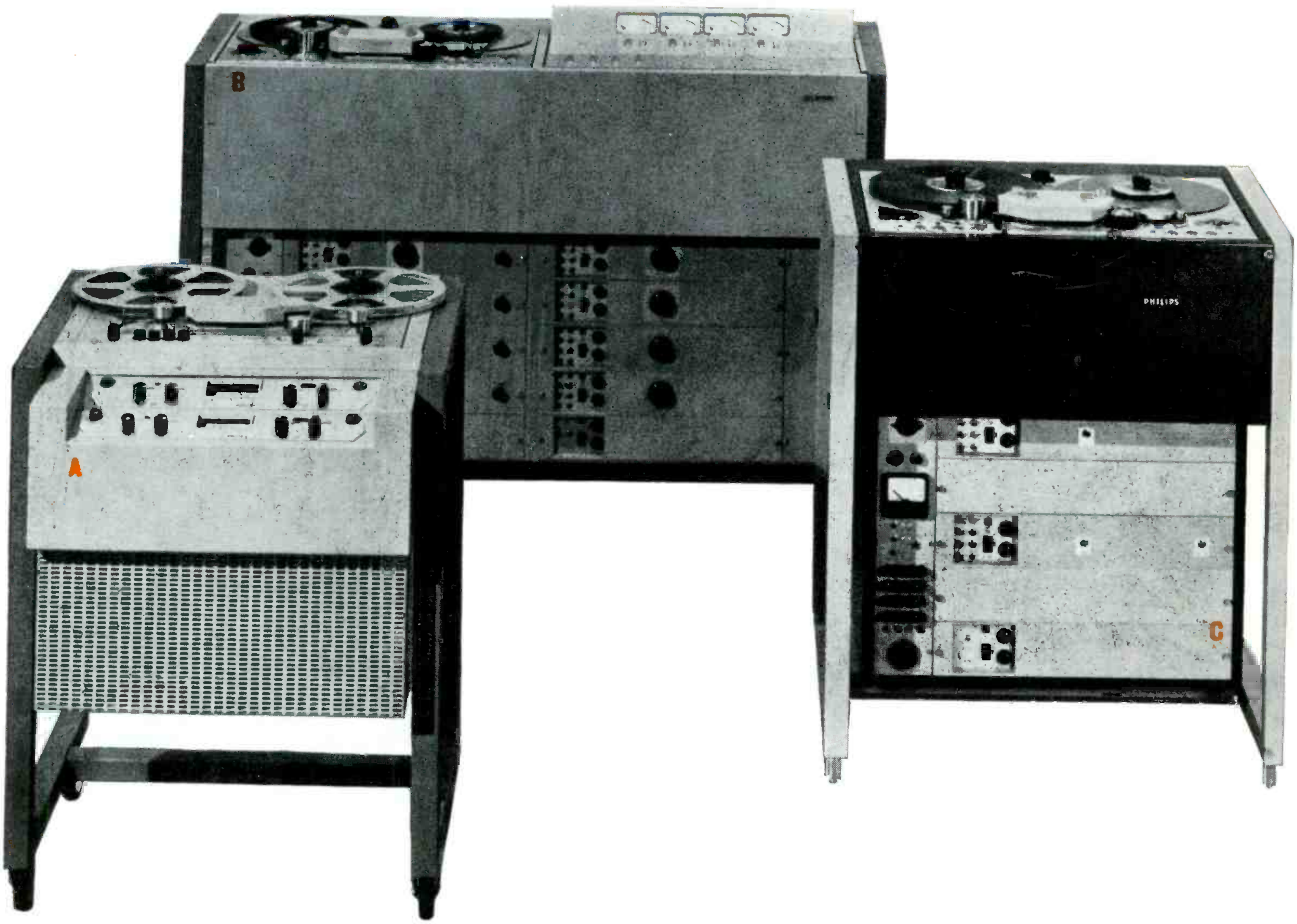
The body of the truck is divided into two and has internal dimensions of 20 ft 6 in by 7 ft 10 in. In the forward compartment, the recording room, are the two Ampex videotape machines, capable of recording on 405, 525 and 625 lines and are fully transistorsed. The Luton type head measuring 2ft by 7 ft by 5 ft contains refrigerating equipment, so that the recording room is fully air-conditioned. The rear compartment, 11 ft in length is used for transporting 24 lights, 4 rolling bases and tripods, 5,000 ft of camera cable, 5,000 ft of sound cable, and other ancillary equipment.

D.W.A

NEW STANDARDS IN SOUND AND CAM

—a complete range of

PROFESSIONAL SOUND RECORDERS

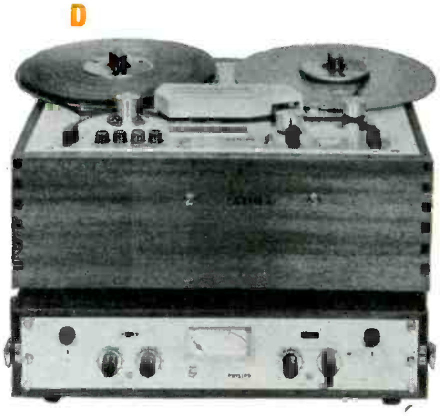


A new range comprises three types of recorder, available for 50 c/s operation, and with CCIR or NARTB equalisation.

All models are available in unit form for mounting in customer's own consoles.

In all cases, values of wow and flutter and of signal-to-noise ratio are appreciably better than accepted standards.

D



A PRO 20 and D PRO 25

High quality range, capable of an exceptional standard of sound quality. For mono, stereo or half-track recording on $\frac{1}{4}$-in. tape. Console (Pro 25) or rack mounting or in teak cases for transportable use (Pro 20).

B PRO 50

for mono or stereo recording, $7\frac{1}{2}/15$ or 15/30 ips. Ferrite heads for long life. Electronic tape tension control. Photo-electric end-of-tape switch permits also of stopping on transparent inserts.

C PRO 70

for 3 or 4 track recording on $\frac{1}{2}$-in. or 1in. tape, $7\frac{1}{2}$ ips. Ferrite heads for long life. Particularly suitable for dubbing, post-synchronising or transfer.

PETO SCOTT ELECTRICAL INSTRUMENTS LTD.

Sound and Vision Systems

EMI London Symposium - part 2

TV's 'THRUSTERS' SCAN THE FUTURE

● By KENNETH ULLYETT FRSA, International Broadcast Engineer's Television Editor gives a final report of highlights of Papers at the big EMI Symposium and private London Exhibition

'A RECENT survey has indicated,' smiled Maurice Unstead, General Sales Manager, Commercial, of EMI Electronics Ltd, at the recent big EMI London Symposium, 'that the electronics industry is blessed with a high proportion of thrusters as opposed to sleepers, who it is said are more common in other industries.

'But such a state of affairs does have its inherent dangers. We may sometimes be carried by our enthusiasm and thrusting nature in unrewarding directions. It pays, therefore, occasionally to pause awhile, take technical stock of our position. . . .'

An important group of EMI experts plus a guest speaker from Imperial Chemical Industries, Mr K. I. Sherrard-Smith, BSc (he dealt with the importance of polyethylene terephalate in the capacitor industry) contributed to this valuable EMI London Symposium, helping many of us in other branches of professional television, to take technical stock of our position.

In the July issue of INTERNATIONAL BROADCAST ENGINEER I introduced the Symposium and gave advance edtited extracts of addresses by Mr R. C. Hall, AMIEE, on **Transistorised Scanning Circuits for Television Cameras,** Mr. A. C. Dawe, BSc (Eng), ACGI, AMIEE on **Television Camera Tubes,** and Mr L. A. Woodbridge, BSc on **High-resolution CRT's.** This month I am able to give a further selection of technical papers based on notes taken at the Symposium.

Dealing with **Recent Advances in EMI Photomultiplier Tubes,** Mr E. M. Worster stressed how these tubes are always in a continual process of change, and that the work described in his Paper had in fact taken place over more than a twelvemonth, but has come to fruition only recently. At EMI they have always taken a pride in the fact that their tubes use SbCs photocathodes and therefore dark currents are low, but in the past this has been achieved partly at the expense of cathode sensitivity. Recent results have been obtained with large (5-in) dia tubes showing the cathode sensitivity to be consistently better than 20 per cent peak quantum efficiency at 4,000 Angstrom without unduly increasing the dark current. If the curve of absolute spectral response of a standard EMI 9558B photomultiplier with a tri-alkali photocathode be compared with that of one of the latest SbCs tubes, it will be seen that at the peak there is very little to choose between the surfaces. It is only when the red part of the spectrum is reached that the S11 begins to fall away rapidly.

Techniques involved in making high quantum efficiency S11 cathodes in large-diameter tubes have been applied to other designs, and there has been some success in 2-in dia tubes. It will certainly improve the signal-noise ratio in the blue and green channels of flying-spot colour scanners. A feature of the improved cathode is that its spectral response curve at wavelengths above 5,000 Angstroms seems to be similar in shape to the response of the standard human eye. Thus with a suitable chosen blue filter to correct for shorter wavelengths, the cathode can be closely matched to the response of the eye. The technique has also been applied to the Type 9594 (a 14-stage tube with a high-field focused dynode system which gives a pulse rise time of two or three nanoseconds). Results obtained on early samples seem to indicate that the improved quantumn efficiency has not been achieved at the expense of a fast rise time, and since the dark current in tubes of this type is in general high by comparison with venetian blind types, any slight increase in dark current is not noticeable. To obtain a small, fast tube the squirrel cage design can be operated with about two kV between anode and cathode, and using a graded dynode chain. The interstage potential is progressively increased from about the fifth dynode up to the anode, and this gives a rise time of the order of one nanosecond, and peak pulse currents of up to one amp can be drawn without damaging the tube.

There has been a certain amount of interest in recent months in the potassium caesium bi-alkali photo-surface. Several years ago this cathode was investigated at EMI and shelved as being of no great improvement over the antimony caesium surfaces in use at that time. However, we have been examining this particular cathode in view of its high 'blue' sensitivity. Peak quantum efficiencies of between 23 and 28 per cent are being claimed as typical. The feeling is that this bi-alkali surface, while being of high blue sensitivity, has little advantage. We have also believed for some time that the antimony caesium surface had not been developed to its fullest potentiality. However, the work on a potassium caesium bi-alkali cathode is continuing.

Turning from the blue end of the spectrum to the near infra-red, the introduction of the Type 9684B in 1964 has meant that a tube with an S1 response is again available in our standard range. Our experience is that the dark current associated with the silver-oxide cathode is a fairly accurate assessment of its infra-red sensitivity, and that although high dark currents are troublesome, they are at the moment an inescapable consequence of sensitivities up to 1.2 micron. It is well known that refrigeration will reduce the dark current due to thermionic emission, and in the case of the S1 cathode the effects of cooling seem to be greater. Cooling tends to depress the red sensitivity, but this loss is more than compensated for by the reduction in dark current. Reduction of dark current by refrigeration using thermo-electric elements is becoming a more popular method, and several firms in this country and overseas are offering standard units. Reductions in dark current of between two and three orders of magnitude for a temperature drop from +20-deg C to −40-deg C have been quoted for several tubes with S1 cathodes.

Another method of reducing dark current in venetian blind tubes is by the use of a small coil, placed at the cathode, and using the magnetic field associated with it to direct unwanted electrons away from the most fruitful parts of the first dynode. This been described by Farkas and Varga in Magyar Pudomanyos Acad Kozponti Vol 7 248, 1959. To a certain extent, the problem of red sensitivity with high dark current can be ovecome by the use of NaKCsSb (S20) photocathode which has some response to beyond 8,500 Angstroms and in inherently low dark current. At about 8,000 Angstroms the response curves for the S20 and S1 cathodes cross over, but since the dark current associated with the S20 surface is about a thousand times less than for the S1, the S20 surface is often preferred. We feel from our initial tests that the dark current in the 'extended red' tube is about two or three times higher than a version with high blue, but lower red sensitivity.

Extension of the spectral coverage of photomultiplier tubes is not restricted to the longer wavelengths. With the increasing demands for tubes suitable for satellite astronomy, UV sensitivity (very often associated with insensitivity to radiation) is becoming more important. To this end the EMI 1⅛-in dia tubes—which are already available with fused silica windows for transmission down to 11,650 Angstroms — have been made with sapphire windows to extend the UV cut-off to approximately 1,400 A. However, further extension by the use of Ca_2F and LiF has presented problems yet to be overcome.

As the spectral response of the SbCs cathode is limited at the short-wavelength end of the spectrum by the cut-off of the end window, this surface is quite useful for many UV needs. However, it has a high sensitivity to visible radiation so is not suitable for 'solar blind' applications. Other cathodes have to be used. We have made several tubes with CsTe cathodes, and others with CsI. Problem associated with caesiated cathodes is that the dark currents associated with them are high, and they tend to be sensitive to visible radiation. Caesium has to be kept down to a minimum. Caesium antimony dynodes give the best gain, but these dynodes cannot be used in solar blind tubes, so the less-efficient silver magnesium material is used, with a consequent reduction in gain. To increase the gain, further stages are required, but with only 14 pins on the base (and several of these needed for processing) an upper limit of 11 stages is set.

A new range of tubes, which will be available in the near future, are nearing the end of development. They are designed with rocket and satellite application in mind. At the moment, most tubes of this type have had antimony caesium cathodes, and a few made with CsTe. The difficulty has been in the past to prevent the dynode system from flexing, and so breaking when put through a frequency spectrum such as that experienced with launching a satellite. Now we have made some modifications which enable the tubes to be successfully used and put through a vibration specification laid down by one of the major organisations concerned with satellite launching. . . .

Problems of **Transistorised Television Monitors** were next dealt with by Messrs J. H. Taylor and J. F. E. Wilson, AMIEE, and the first speaker opened with a Symposium challenge: 'What is wrong with a valve monitor, anyway?' Well, nothing is wrong with a valve monitor provided you are not particular about size, weight, power consumption or reliability. We think transistor monitors will out-perform valves on all these points, so when we were asked to tender against BBC specification TV 123, we specified an all-transistor monitor. Briefly the specification is as follows: picture peak white brightness greater than 100 ft/lamberts. Stabilised EHT. Maximum positional error of less than 1.0 per cent. A main input tolerance of $\pm$ 10 per cent. Composite video input range $\frac{1}{4}$ to 2.0 V. KT rating for 405 lines not greater than 2.0 per cent and not greater than 3.0 per cent for 625 lines.

The video input feeds a high-input impedance amplifier. An ouput is taken to the sync separator and also the contrast control and subsequent video amplification. The final video output is used to drive the cathode of the tube. A black level clamp is fitted and the DC level is maintained throughout to the CRT cathode. Temperature compensation is employed to hold the DC operating point of the ouput transistor constant, as it will be appreciated that any drift in DC level represents a change in picture black level.

The field timebase follows conventional practice; a synchronised emitter coupled multivibrator drives the sawtooth generator, and the resulting sawtooth is used to drive the output stage which is capacitively coupled to the deflection coils. To reduce the size of the choke required in the output stage, and economise in mean current, a parabolic correction circuit is used and the error signal derived is fed back to the sawtooth generator; the output transistor is stabilised against thermal runaway by means of a thermistor in its base circuit. A 'catching diode' is fitted on the collector of the output transistor. This catches the collector voltage rating of the transistor.

Flyback blanking during the field flyback time is also derived on this card. This automatically adjusts itself to the correct time for the system in use. Blanking is applied to the CRT grid with line flyback blanking. The line timebase is split in two parts: the first is contained on a printed circuit card and consists of the flywheel sync components, a voltage-controlled oscillator, a monostable multivibrator, and a pulse amplifier to drive the output stages which are separate. The power unit is of course the heart of the equipment, and produces the supplies for all the circuits in the monitor. The power unit supplies are split into several parts. A stabilised —20-volt line is produced for supplying all circuits which do not possess any 'bad habits.' To elaborate slightly, it will be appreciated that the line output stage imposes a severe requirement on its power supply. It takes large gulps of current during the first part of the cycle and then proceeds to put a large proportion of that energy back into the supply during the latter part of the cycle. This circuit is therefore run off its own stabliised supply. The EHT generator output also takes considerable current and is run off a separate but unstabilised supply. It does not need stabilising since the EHT unit itself is stabilised. To control picture width it is conveninent to vary the volts supplied to the line output stage. This can readily be done by varying the output volts of the stabiliser supplying this stage. Setting-up switch controls are provided so that on changing line standards no change in picture width occurs. The EHT unit is a self-contained job consisting of a printed-circuit card and transformer rectifier assembly. This assembly is completely screened by a metal box.

As in other monitor systems, any transient EHT discharge might take place in the tube and damage the cathode drive and blanking circuits. The focus and limiter diodes of the CRT are therefore decoupled to earth with suitable decoupling capacitors. Particular care has to be taken with earthing these, as currents involved during a transient discharge (more commonly known as a flash-over) are very great. Special non-inductive capacitors have to be used since any series-impedance in the flash-over path will cause the discharge to proceed down the tube, with disastrous results. Unfortunately cathode-ray tubes cannot be made which can be guaranteed against flash-over. We are hoping, with the advent of transistors, that manufacturers will ultimately be persuaded to produce a CRT which will not flash over, and so will not require the present elaborate precautions.

Mr J. H. Taylor, AMIEE, then dealt with other aspects of the design of tranistorised monitors, and stressed that without minimising the importance of the other circuits in transistor TV monitors, in the case of the EMI work the foundation upon which the entire circuit philosophy is built are the line scan and EHT circuits. In the next few weeks it is hoped to present a full-length report by both these authorities on the TPM 1901/2 monitors now in service, so this section of the Symposium will be given later in a full setting.

Mr K. I. Sherrard-Smith, BSc, of Imperial Chemical Industries, next dealt with the use of polyethylene terephthal film for capacitors. The traditional dielectric for capacitors is, of course paper, and Mr Sherrard-Smith pointed out that the first serious contender to paper was oriented polystyrene film, and this product has been widely used since its introduction in 1940. It has excellent low-loss characteristics, but its field of application is somewhat limited because of its maximum operating temperature, about 80-dg C, and its minimum thickness of some 10 microns. All the same, it helped the industry to become plastics conscious, so it is not surprising that polyethylene terephthalate film aroused a great deal of interest when it was introduced in 1950. Of course an immediate attraction was its availability to withstand high operating temperatures, continuously at 120-deg C.

It is stressed that plastic film manufacturers have not stood still, and today there are several new films being investigated and used for capacitor manufacture. Of these there is polycarbonate film and oriented polypropylene film.

By using single layers of plastic film in place of two or more layers of paper, a good deal of progress has already been made in miniaturisation, but there is currently a great deal of interest in the use of metallised films to give a higher degree of miniaturisation. The basic saving here is that aluminium foil with a thickness of from 6 to 12 microns is replaced by an evaporated metallic layer only a few milli-microns thick. An added advantage of this process is, of course, the phenomenon of 'self-healing.' Metallisation takes place in a vacuum chamber, and long trouble-free runs are needed to avoid excessive processing costs. Film is normally metallised in much wider widths, usually 12 to 24 inches, than is actually required for the final capacitor. The film is masked between adjacent capacitor widths to prevent the deposition of metal, and the film must subsequently be slit down the centre of these masked areas. This calls for very careful control of the film during metallising.

Turning now to polyethylene terephthal film, due to the physical structure of polyester film it does not have the wick-like characteristics of paper, and impregnation is therefore correspondingly more difficult. For this reason, development of impregnated and particularly AC capacitors has not proceeded as quickly as could be wished, but some manufacturers have made progress in this field. Epoxy and polyester resins are preferred for this as they are chemically compatible with polyester film and can operate up to the highest temperatures permissible with the film. Another impregnating technique which is being examined is 'wet winding,' and in this process polyester film is used which is vacuum metallised on one side and which is coated on the other side with a pressure-sensitive adhesive. After winding, the unit is heated to, say, 150-deg C, when the adhesive flows relatively freely and the film shrinks slightly on tightening the windings and expressing trapped air pockets.

Concluded Mr Sherrard-Smith: 'Our standard procedure for testing a batch of polyester film is to wind 20 single layer, two-in wide 0.5 microfarad extended foil capacitors from the film, and to construct a histogram of the breakdown voltages of these capacitors when tested under DC, the voltage increasing from zero at a rate of 100 volts per minute.'

Dealing with **Recent Advances in External Cavity Klystrons,** Mr P. Young, BSc, opened by commenting that the plug-in reflex klystron has been a feature of the microwave scene for some years, now. The philosophy underlying the use of the plug-in type has an obvous appeal for the following reasons: (1) The user can design his own cavity to his own specific requirements. (2) Replacement cost is reduced as only the valve body is lost when failure occurs. (3) Spares stock needed is kept to a minimum by having only one type for all the cavities in a particular frequency band. (4) Replacement causes minimum disturbance to the waveguide or coaxial line 'plumbing.' Until recently it was felt that 12 Mc/s was about the limit of 'manufacturability' for glass/metal valves of this type, and that any further advance would involve ceramic brazing. Growing familiarity with glass techniques has but not the proverbial contempt but an increase in skill so that today a plug-in tube can be made working up to 18 Mc/s.

Internally there is one significant difference from the CV 2346. In that tube there was a domed accelerator grid at the entrance to the gun diaphragm, giving essentially a Pierce-gun configuration. This grid and the first of the RF grids formed a field-free space in the tunnel in which ion build-up could take place. The resulting low frequency relaxation oscillation of the ion cloud can give troublesome modulations in some applications as Doppler systems, and it was thought advisable to avoid the possibility in new designs. Consequently the accelerator grid was dispensed with and a relatively larger cathode used to overcome the diverging effect of the ungridded aperture.

This has an incidental advantage in reducing the current loading of the cathode to only 0.3 A/cm^2 assuming uniform loading, or an estimated 0.4 to 0.5 A/cm^2 allowing for the screening effect of the beam forming electrode. The same improvement was introduced at the same time into the X-band valve, which then became R 9689, so that valves are available in all the frequency bands free from the possibility of ion oscillation. Of course the S-band designs, never having had an accelerator grid, were immune from the trouble.

In the construction of the J-band tube, copper honeycomb grids of conventional design define the RF gap, the grids having respectively 19 and 37 cells, gold-brazed to the copper diaphragm.

The biggest single problem in the design of the tube was in the location of the gun and reflector assemblies. Not only is the positioning of these more critical than in the lower-frequency types but less space is available, which precludes the use of one favoured method—a dish attached to the diaphragm to receive the assemblies. It was feared that an optical centring method would have to be used, the electrode position being monitored while the glass seal was made, as in the manufacture of HF magnetrons. However, by radically changing the method of bulb manufacture it was possible to obtain sufficient accuracy of registration of the glass tubing relative to the diaphragms to use the tubing to locate the electrodes.

In some ways this was reversion to an early klystron technique or dimpling glass tubing (in effect impressing a precision diameter at three points on the periphery) but in the present design space would not permit actual dimpling, and precision glass tubing was therefore used instead. Another and possibly more important development was the replacement of rotating mandrels and flame sealing by stationary mandrels and induction heating. The gap between the grids is set while sealing by a pellet of compressed soda which is later dissolved out, and a final adjustment made by varying the gap to give resonance at a fixed frequency in the reference cavity. Actual spacing of the electrodes from the glass tubing is achieved by dumb-bell-shaped tantalum spring fingers. In the absence of a gun or reflector dish the gun and reflector need a different method of axial spacing and space restriction again steps in to prevent another possible method being used, namely that of forward-projecting mica fingers.

At the gun end a dummy of known overall length is inserted until it makes contact with the accelerator tube, a calibrated movement being used. The dummy is then replaced with the acutlagun, and this is advanced by the calculated distance to give the correct spacing. The stiffness of the spring fingers is sufficient to maintain the position while the subsequent seal is made. A similar method is used for the reflector. Pumping, processing and ageing are conventional; in the final stage the diaphragms receive a gold plating and the leads are potted in a Silastomer rubber.

Commander C. J. Eliot next dealt with Ionospheric Sounding, beginning by stating that the use of vertical ionospheric sounders for investigation of the ionosphere is well known; these instruments transmit a series of pulses vertically upwards and receive the reflected pulses by a receiver situated at precisely the same position as the transmitter. By measuring the time for the reflected pulses to return, an estimate of the ionosphere height can of course be made.

Developing out of these purely scientific instruments has now come the oblique incidence sounder. In this device the transmitter is situated at one end of a communication link and the receiver at the other. **Thus the sounding is taken over the actual path of the communication link, and is used to determine the best frequency on which to communicate.**

The principle of operation is simplicity itself. The transmitter sweeps through the HF band, usually from two to 30 Mc/s, emitting pulses on selected frequencies either at logarithmic or linear intervals, and the receiver similarly sweeps the band in synchronisation with the transmitter. To effect this sync, some means of co-ordinating the start of each sweep must be used, or both transmitter and receiver can be synchronised to some external time source such as WWV or GBR.

At the receiver the incoming signal is made to mark a CRT which is calibrated in time along its vertical axis, and frequency along its horizontal axis. Thus where frequencies between say eight and 12 Mc/s are being received, a mark between the eight and 12 calibration on the CRT will be made. The receiving operator can see at a glance what frequencies are being received and can note the maximum usable frequency (MUF) and advise the transmitting operator of the best frequency, but these charts cannot predict sudden frequency prediction charts are reasonably good indication to the operator when to change frequency, but these charts cannot predict sudden changes in the ionosphere due to electrical storms and sunspots. The operator must watch his CRT carefully and note when frequency changes are about to take place. Once a frequency has completely faded it may be impossible for the receiving operator to tell the transmitter of the fade, and to suggest a new frequency. What he should do is to note the trend on his CRT and in good time, before communication is lost, tell the transmitting operator to change the frequency. An alternative is to sound from both ends. In this way the transmitting operator also has a receiver and can see for himself what conditions are on his circuit, and change the frequency when it is apparent that conditions warrant it. The two operators must have some prearranged frequency to move to, should a complete fade-out occur.

The sounder can also be used in the mobile role, or more particularly when there is a controlling base station and a number of mobiles. Ships at sea, aircraft and military vehicles are all examples of this communication. One technique is to equip each mobile with a sounder/receiver, and the controlling station with a sounder transmitter. The controls sounds continuously using an omni-directional aerial, and the mobiles listen. Their CRT's will be marked and they can note the MUF's that are most suitable for their locations. They then have to select the allocated frequency nearest to the indicated MUF and call their base station on this frequency. This pre-supposes that the base is capable of listening on all the allocated calling frequencies, and this is not such a major task as it might appear because, frequency allocations being what they are, probably no more than four or five calling frequencies will be allocated.

However this is only one bite of the cherry. It may well be that the base station wants to communicate with a mobile and does not know his location or the best frequency to use. In Naval communications this is overcome by broadcasting on a number of frequencies and the ships listen to whichever they are receiving best. Of course in a small land-based set-up of say four mobiles and one base station it may be very difficult to know what frequency is being best received by any particular mobile unless the latter, using his sounder receiver, finds the MUF and then calls the base with his communication transmitter on the nearest allocated frequency. The mobile can also be equipped with a sounder transmitter and the base with a receiver, and the sounder can be used continuously. Another solution is for the base to sound continuously and the mobile to transmit a pulse or pulses on the frequency he desires the base to use. This would of course mean equipping both the base and the mobile with a complete sounding outfit of transmitter and receiver; and, further, it would mean that the mobile's sounder transmitter must be capable of transmitting on one selected frequency only, instead of sweeping through the entire band. At present sounder have not been designed to do this, though it is something which may come.

Other speakers in the EMI Symposium covered electronic subjects ranging from magnetic thin film stores to EMI automatic materials handling systems, micro-miniaturisation and tool control systems. Over 2,000 technologists attended, and this publication of edited reports of major lectures of interest to broadcast engineers brings the valuable material presented before delegates to an international circle.

TELEVISION PROGRAMMES ON FILM—

By Roger J. Ross

WHEN a film is being reproduced on telecine, such faults as grey-scale distortion, loss of detail in black and white picture areas, improper placement in the picture scale of important scene areas such as faces, excessive grain, and widely varying video levels are likely to be attributed to incorrect exposure in some stage of the image-forming process. But because of the way in which film programs are produced, there is as a rule little chance of pinpointing the stage or stages in which the exposure errors may have occurred. In any event, the term 'correct' exposure has an entirely different meaning in motion picture making, compared to its significance in the television context.

From the standpoint of the motion picture maker, correct exposure is that level of exposure which produces the desired pictorial effect on the projection screen. When film is being exposed in the camera, the lens aperture is adjusted to suit prevailing light conditions, utilising a photoelectric exposure meter. The light reading shown on the meter dial together with the speed rating assigned to the film are combined in the meter calculator to arrive at the lens aperture setting (f/number).

In the design of exposure meter calculators it is assumed that scenes to be photographed will reflect light to the camera in a normal or average manner. Cameramen soon learn from experience that large areas of bright sky and heavy shadows must be avoided when light readings are being made; otherwise the film will be under- or over-exposed.

Later on, when prints are being made from the negatives, the printer exposure level is adjusted, in a procedure known as timing (grading) to compensate for any errors that may have occurred in the negatives, or to obtain prints with a more favourable appearance. The timer alters the printer setting in a higher or lower direction by visual examination of the negatives. or test prints made from the negatives, in relation to what is known as the centre printer light. This is the printer setting which produces the best possible print from a so-called 'normal' negative.

From the foregoing, it can be readily seen that control of picture densities within prescribed limits is not a requirement in achieving acceptable motion picture quality. It should not be surprising to find large variations in the densities of films intended for screen projection. Naturally, when these films are reproduced on telecine, large signal level variations will be encountered, but this does not mean that the films were incorrectly exposed. It means that different methods of exposure control must be employed in making films for television.

In the television context, a correctly exposed film is one that will generate video signals within the normal amplitude range, as observed on a waveform monitor. This implies close control of maximum and minimum picture densities—the areas of the film that will produce, on telecine, the important peak white and black reference levels in the video signals. In addition of course, important scene elements such as faces should be properly reproduced in the picture grey scale, in relation to peak white.

Defining Correct Exposure

The method of exposure control to be described here is quite simple and straightforward. With this method, correct exposure is that level of exposure which locates the luminance range of the scene in a specified portion of the film's characteristic curve. To be able to correctly expose his negatives, the cameraman requires a new and quite different type of light meter, known as a spot photometer, or spot brightness meter. With this type of meter small areas in a scene, such as the lightest or darkest areas, or a person's face, can be measured, and these measurements can be utilised to locate the areas of interest at any desired point on the negative curve. The negatives must be printed in such a way that the range of densities in the negatives will be correctly reproduced on the positive characteristic curve. This means that the printer must be calibrated prior to use, and all negatives must be printed at the same printer exposure setting. With this method of exposure control, a system can be set up, capable of yielding uniform results from day-to-day, and any desired pictorial effects can be produced by suitable adjustment of exposure conditions at the taking camera.

Part 4: Exposure control for Television films

Standardised Film Process

In last month's article, a 'blueprint' was provided for a standardised film process. This diagram is reprinted in Fig 1 for ready reference. In this illustration, standard negative, positive and print-through curves are shown. These curves are established in the laboratory by proper control of processing and printing conditions.

Plotted on the negative and print-through curves at the points marked with small circles are the maximum and minimum densities of an idealised television film process. The points marked on the print-through curve correspond with the maximum and minimum densities specified in SMPTE Recommended Practice RP7—namely 2.0 and 0.30. Corresponding points on the negative characteristic curve indicate the minimum and maximum negative densities.

The minimum negative density in this illustration is 0.42—approximately 0.10 above base and fog density. This, by the way, is the point from which ASA, BSI and DIN film speed ratings are now determined. In setting up the standardised film process, the printer exposure level is adjusted to reproduce the minimum negative density—0.42—at the desired point on the print-through curve—that is, 2.0. Then a simple calculation will give the maximum negative density—and density range—that is required to obtain the desired minimum positive density—0.30. This procedure can be easily visualised by tracing out the relationships of the plotted points in Fig 1.

Calculating Correct Negative Exposure

With a standardised film process such as this, exposure control at the taking camera becomes simply a matter of so adjusting exposure conditions that the specified maximum and minimum densities will be obtained in the negatives. To establish the vitally important relationship between the exposure conditions at the camera and the densities obtained in the processed negatives, a camera test chart is required. The test chart might be made up of two squares of paper, one white and the other black, mounted on a neutral grey card. In making up the test chart, it is desirable to have the highest possible contrast between the white and black squares. A luminance range of about 25:1 can be obtained with readily available art papers—that is the white paper reflects 25 times more light than the black paper. The chart may be made up in any convenient size, but it should be reproduced on the film in such a way that the areas corresponding to the white and black squares are large enough to be measured with an ordinary densitometer.

A series of exposure tests must be made to find the camera lens aperture (f/number) which will reproduce the white and black squares of the test chart at the specified points on the negative curve. To begin with, a single exposure should be made at any convenient f/number. The density obtained after the film has been processed, in the area of the film corresponding to the white square is plotted on the negative curve, and its location on the curve is compared with the desired maximum density. Let us say that the density for the white card appears at a point on the curve somewhat lower than the desired maximum density, as shown in Fig 3. This means that the exposure for the test chart was not great enough.

The amount by which the exposure for the test chart must be increased to match the two points on the curve can be calculated by dropping perpendiculars from the plotted points to the exposure scale. In Fig 3, the distance between these two lines is equal to one space on the exposure scale. One space on the exposure scale in this illustration is equal to an exposure factor of 2. This means that the exposure for the test chart must be increased by this amount to raise the density in the white square to the desired value. Opening the lens aperture one stop will double the exposure, and this is usually the simplest way to achieve the desired result.

Before exposure tests such as these can be undertaken, the negative processing conditions must be adjusted to conform with the standard negative characteristic shown in Fig 1, and these conditions must remain constant while the exposure tests are being processed. When the test exposures are being made, the illumination on the test chart must be as uniform as possible over the entire surface, and the illumination level must be adjusted to obtain adequate exposure of the film at an f/number setting about the middle of the scale.

When the correct exposure for the white square of the test chart has been determined, utilising the procedure just described, it may be found that the density in the area of the film corresponding to the black square of the test chart will not match the specified minimum negative density as shown in Fig 1. This may be due to a number of factors such as the degree of flare in the camera lens or incorrect relationship between the white and black squares in the test chart. In establishing the correct exposure for television films, by far the most important consideration is the density of white areas—scene highlights and the like—because these areas give rise subsequently, in reproduction on telecine, to the peak white video signal levels. In the second article in this series, on standarising the telecine grey-scale characteristic, it was shown that a density change of only 0.08 at the white end of the scale will produce a change in video amplitude of 10 IRE units, while at the black end the same amount of change in waveform amplitude requires a density change of 0.50.

Adjusting Exposure Conditions with a Spot Photometre

Now that a method is available to calibrate the film exposure system, the only remaining problem is the practical application of the system in taking pictures. The principle is quite simple—the highlight areas of real scenes should be reproduced on the negative characteristic curve at the same point as the white square of the test chart. But of course real scenes are made up of large numbers of small areas or elements reflecting light in a variety of different ways. The luminance of these areas can be measured and compared with the white square of the test chart only with a spot photometer. A number of different types of spot meters are now available. This meter covers an angle of one degree in the centre of a 21-deg field. By means of a set of circular scales attached to the side of the meter, the adjustment of the camera lens aperture that is required to compensate for differences in the luminance of selected scene areas can be readily determined. Thus, irrespective of the luminance of a particular scene area, it should be possible, by adjusting the lens aperture by an appropriate amount, to reproduce this element at any desired point on the negative characteristic curve.

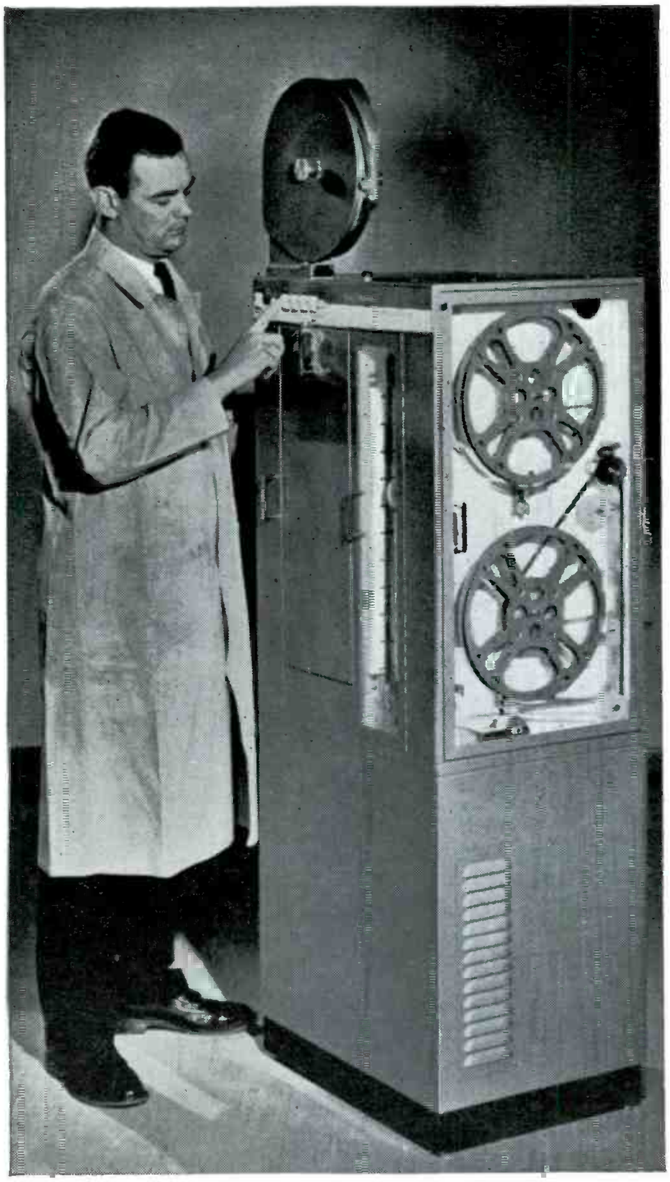
The three most important elements in any scene to be reproduced with the television system are the lightest and darkest areas, and people's faces. With the aid of a spot photometer the lightest scene area can be easily located. A number of areas that appear to the eye to be the brightest can be compared by observing the meter dial while the spot in the centre of the viewing field is moved from one area to another. The area with the highest luminance becomes the reference white for the scene, and in preparation for exposing the film, the camera lens aperture would be adjusted to reproduce this reference area at the specified maximum negative density. However, this is only the first stage in establishing correct exposure.

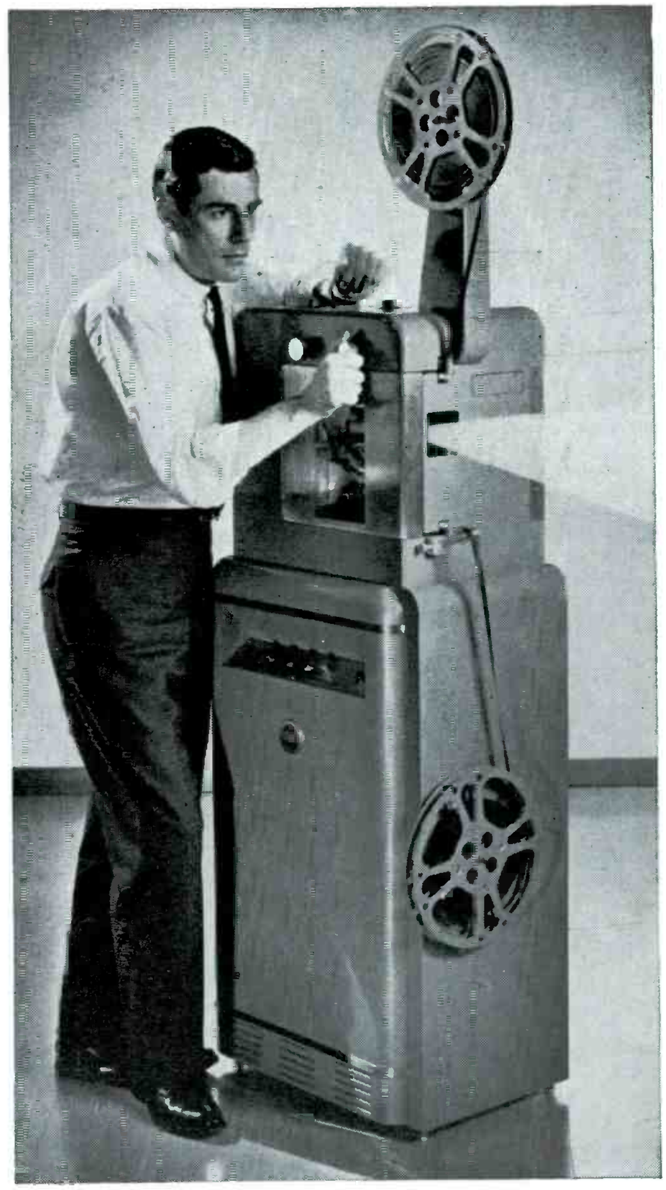
The scene luminance range—that is, the difference in luminance between the lightest and darkest areas—can also be checked easily with a spot photometer. From the preliminary tests made with the white and black squares the maximum luminance range that it is possible to reproduce on the film in the specified portion of the negative characteristic curve can be calculated. If the spot photometer measurements indicate that the luminance range of a particular scene exceeds the limits of the image-forming system, black compression (loss of detail) will occur when the film is reproduced on telecine, unless steps are taken to correct this undesirable situation.

There are two ways in which the luminance range to be recorded on film may be reduced. The first—and perhaps most obvious—procedure is to make use of reflectors or supplementary lighting to raise the luminance of the shadows. A spot photometer can be used very effectively in determining the amount of fill light needed to reproduce the shadow areas of the scene at the correct point on the negative curve.

A much simpler and often less expensive alternative is to alter the camera's angle of view, so as to exclude a scene area with excessively high luminance. An example of a situation of this kind is a scene with an area of bright sky in one corner

GET KODAK QUALITY ALL THE WAY





PROCESS...

the film in minutes with the new 16mm **Eastman Viscomat** Processor. Evenly—beautifully! It operates at a sizzling 36 ft/minute, delivering dry, ready-to-project footage. It has push-button simplicity, no chemicals to mix or replenish and a unique one-time-use chemical system that provides considerable savings in labour, time and consumable supplies.

PROJECT

the film with the **Eastman** 16mm Television Projector, Model 275. It's built for critical accuracy, long, long life, *and* it's designed for use in both 50- and 60-field television. A unique heavy-duty film advance assures more power in the film drive. Accessory available for magnetic playback. **Kodak Ektar** Television Projection Lenses assure maximum sharpness and brilliance.

Camera, processor and projector are available in both 50- and 60-cycle models. Write for detailed literature or see your local Kodak Representative. Motion Picture Products Sales Department, EASTMAN KODAK COMPANY, ROCHESTER, N.Y. 14650

Kodak

Television Programmes on film—continued

of the field of view, or in the angle between the roofs of two buildings. By simply moving the camera slightly, it may be possible to avoid these bright sky areas. This will permit another scene area to be selected as the white reference, with a lower luminance level.

Indoors, under artificial illumination, lighting conditions may be adjusted in any desired manner with the aid of a spot photometer. It is in these conditions that the concept of black and white references has the greatest value. The spot photometer may be used to select and illuminate these reference areas at the correct levels so that the desired maximum and minimum densities will be obtained in the film. In some cases, a lighting effect may be utilised as the white reference, while in others a costume or a set prop may be the lightest part of the scene. Different areas of a set may be lighted in any desired manner, within the limits established by the reference areas, to obtain the desired pictorial effects. In this way full advantage can be taken of the grey-scale range of the film-television system.

One of the most annoying faults in television film is the presence in the pictures of bright windows and lamps. Inevitably, these objects produce peak white spikes during reproduction on telecine that are far beyond the upper limit of the waveform graticule. Bringing down the video levels by adjustment of telecine controls usually results in severe distortion of the picture grey scale. Faults of this kind can be avoided easily by making a quick check of the scene with a spot photometer, lower wattage bulbs being used in excessively bright lamps, while windows may be covered with grey plastic sheeting.

Another very disturbing television film fault is the type of grey scale distortion that occurs when a speaker with white hair or a bald head is staged against a white background. Cases have occurred, too, in which persons with dark complexions have been placed in front of dark backgrounds. The extremely important separation between face and background in television pictures can be adjusted quite easily with a spot photometer. It is essential that all scenes contain some area lighter than the face or bald head, so these areas do not become the white references. Faces may be lighter or darker than the backgrounds, depending on the pictorial effects desired.

These exposure control methods have been criticised mainly on the grounds that no allowances are made for exposure errors. The elimination of the negative timing procedure, and the possibility of adjusting the printer exposure level to compensate for incorrectly exposed negatives seems to be the most disturbing feature.

A paper by Wright in a recent issue of SMPTE Journal[1] demontrates by way of waveform photographs, the nature and extent of grey-scale distortion caused by negative exposure errors and printer exposure adjustments. These illustrations show quite clearly that errors as small as one camera lens stop in negative exposure will result in some compression at the white or black end of the picture grey scale. Of even greater interest is the disclosure in this paper that adjustments in printer exposure level in attempts to compensate for negative exposure errors will not correct the grey-scale distortion.

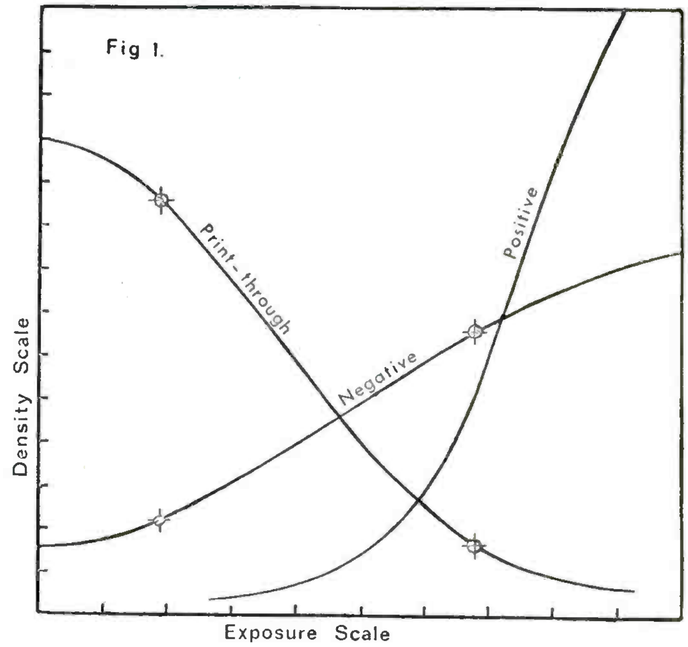
Because of the number of variables in the film process and the difficulty of maintaining precise control over the image-forming process at all times, situations will be encountered in the practical appliction of these control methods where adjustments in printer exposure level will have to be made to salvage valuable programme material. In these cases, the resulting distortion of the picture grey scale will have to be tolerated, but at least the cause of the distortion will be known, and appropriate steps can be taken to ensure that the error will not be repeated.

[1] Wright, H., 'Factors Affecting Determination of Monochrome Television Film Exposure and Speed Indexing,' Jour SMPTE 73: 4 (April 1964) p 305-313.

Fig 1 Diagram of the standard film process, including negative, positive and print-through curves, with the luminance range of a typical scene plotted on these curves.

Fig 2 Construction details of a simple test pattern for calculating correct negative exposure.

Fig 3 Calculating adjustment of camera lens aperture (f/number) needed to correctly expose the negative film.



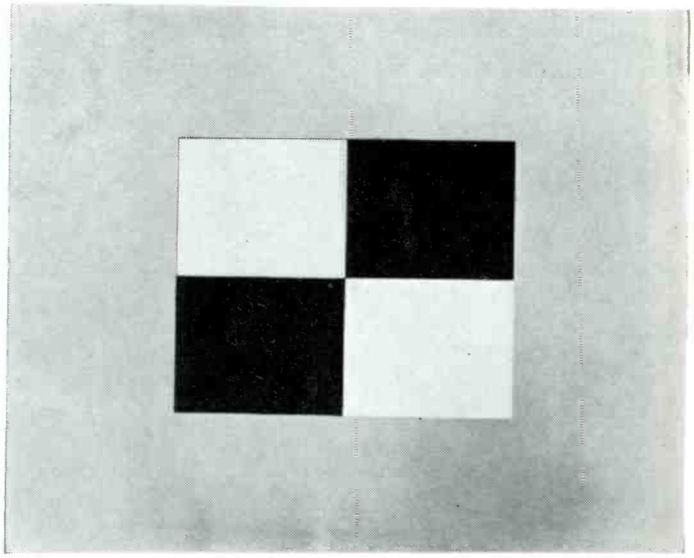
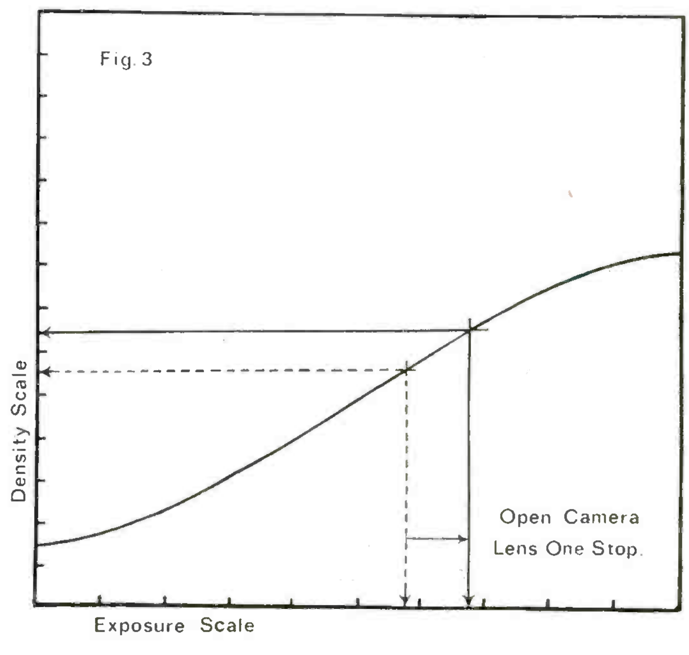
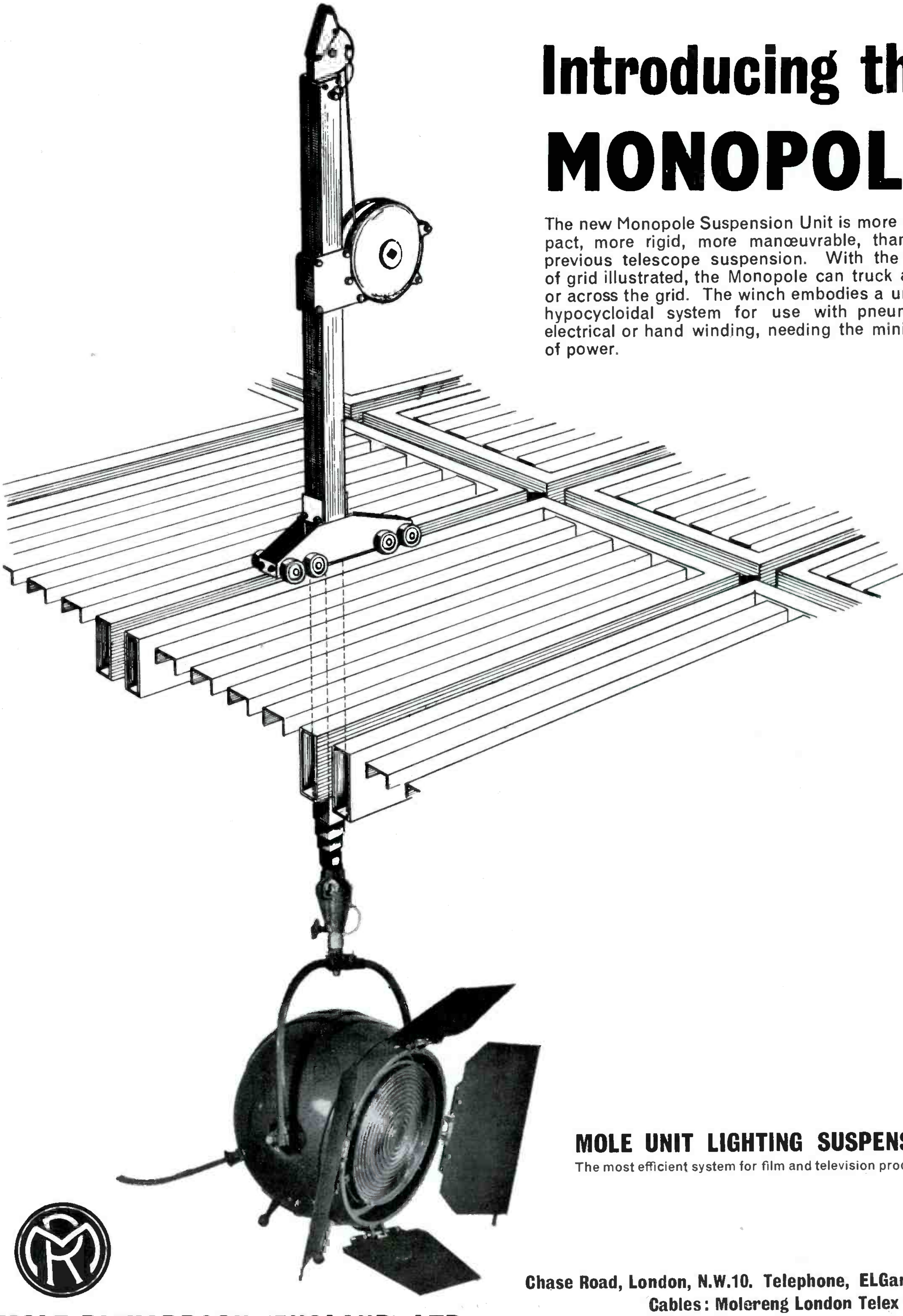


Fig 2





Lord Hill on ITA future

SPEAKING at the Emley Moor transmitting station on June 3 1965, with a closed circuit transmission to London, the British ITA's Chairman described some aspects of the Authority's planning for the future. He said:

'We non-engineers can't fail to be impressed by the technologists who have thrown up this extraordinary tube nearly a quarter of a mile into the sky. The height of the Eiffel Tower, say, plus a couple of Nelson's columns.

'So let's do a little boasting about these poles, only nine feet in diameter, which the Independent Television Authority is having built here at Emley Moor; at Belmont in Lincolnshire; and at Winter Hill in Lancashire. In a way, I feel rather sorry for Winter Hill. It's only 1,015 feet high. For a few months it was the tallest mast in the United Kingdom, but its glory was short lived. I should explain that Winter Hill stands on one of the Authority's finest sites. Its commanding position overlooking the Lancashire plain makes it excellent for sending out television signals.

'Nevertheless, Emley Moor, and its sister in Lincolnshire, when they go into action in the Autumn, will not only be the tallest in Britain, they will also be the tallest in Europe. Twelve hundred and sixty feet from the ground—or as we must now learn to say, 386 metres. And perhaps it's not inappropriate that Independent Television, which produces more hours of broadcasting than any other service in Europe, should also have the highest masts.

'Now a word about the functions of these three structures. They have been designed to accommodate transmitting aerials for all likely future broadcasting needs of both the ITA and the BBC. They will be able to carry the aerials for up to four programmes in UHF, including BBC 2. They will also carry the existing ITV services in VHF, the extra height providing greatly improved coverage.

'Winter Hill will carry a new aerial to improve reception of BBC 1 in Lancashire. Belmont will do the same, and in addition will carry an aerial for BBC sound programmes, to improve reception in Lincolnshire. The BBC and ITV are rivals, constitutionally, but, as you see, in the technical sphere we co-operate in full amity.

'At present broadcasting policy is being examined by the Government. And so it's not for me to say who should run a fourth service or even whether should **be** a fourth service. But I can say this: whatever the future may hold for the ITA service there's one thing we have got and are constantly trying to improve, and that is our present service. These three new masts will improve the existing coverage and they're part of the biggest annual programme of station building we have ever had.

We intend to go on expanding, and only recently the Authority has decided to seek the approval of the Postmaster-General for a building programme that will expand its present 97 per cent coverage of the population towards the full 100 per cent. We are contemplating building perhaps six stations a year for the next three years, with the first of this new batch coming on the air towards the end of 1966.

'We have also decided that we need new return lines to enable the studio centres in Aberdeen, Belfast, Norwich and Plymouth to supply live programmes to ITN and to all other companies. We hope that these new amenities will give further impetus to the supply of regional programmes to the whole sytem.

"It is clear that UHF broadcasting is here to stay, but it may not be going to make the complete take-over bid that once seemed likely. Expert opinion has altered somewhat since 1962 when the Government White Paper proposed to charge, by stages, the existing 405-line services to 625 lines. It now appears that there are technical and financial difficulties in duplicating the services in UHF. Some minds are turning to the possibility of changing to 625 lines **within VHF.** It seems clear that, whatever its merits, the UHF system could not provide the same total coverage as VHF; and then, of course, UHF requires so many more stations.

'If a suitable method of conversion to 625 could be found, several advantages are argued for keeping ITV and the BBC 1 in VHF. First, it would avoid the great and continuing expense of duplication; second, it would avoid using valuable air space which may be needed for future services. Third, it would give the television industry a firm technical basis on which to plan their operations for the foreseeable future. In any case, as I said, the Authority now wishes to complete its VHF coverage, whatever the final decision about duplication.

'If, in the end, the policy of duplication goes forward, ITA will be ready with its new high masts. If VHF continues to hold the field for ITA and BBC 1, well, we're ready for that too. At present, it rather looks as though the 405-line services may become a permanent feature of British Television. If this were so, then there might be grounds for reconsidering the original idea that only the 625-line services should have colour; and there is good cause to hope that colour can be employed in VHF no less successfully than in UHF.

'But all that is for the future. For today it is enough to salute everybody concerned in the engineering achievement represented by this new generation of masts.'

At the beginning of 1965, 22 transmitting stations owned and operated by the Independent Television Authority were bringing programmes to 97 per cent of the population of the United Kingdom. By the end of 1965 ten new or modified VHF (very-high-frequency) stations will have been opened to fill gaps in coverage. In addition a UHF (ultra-high-frequency) station network is being jointly developed by the ITA and the BBC, both at new and existing sites, for the provision of future services.

The VHF stations which have already come into operation during 1965 or will be completed before the end of the year are as follows:—

South Wales. From February 15 viewers in South Wales have been able to receive TWW's Teledu Cymru service from the ITA's St Hilary station on Channel 7 in addition to the general service on Channel 10. The new service on Channel 7 each week provides about five hours of programmes in Welsh at good viewing hours (in addition to locally-originated programmes in English). Linked with the three other ITA stations in Wales—Presely, Arfon and Moel-y-Parc—it provides a very large proportion of the Welsh population with its own Independent Television service.

North of England. New higher masts, adjacent to the existing towers, are being erected at both the ITA's main stations. Although they are being built primarily for future UHF transmissions they will bring an improved VHF service to a number of local areas, particularly in Sheffield and Hull. The 1,015 ft mast at Winter Hill should come into operation later in 1965, as should the 1,265 ft mast at Emley Moor, the tallest in Europe. In addition a satellite relay station serving the Scarborough area came into operation on June 11. The programme companies are Granada and ABC.

Midlands. The Membury station, near Hungerford in Berkshire, came into programme operation on April 30 1965, providing an improved service to Oxford,Swindon, Newbury, Marlborough and surrounding areas. The programme companies are ATV and ABC.

East of England. The 1965 programme includes two new stations—at Sandy Heath near Bedford, and at Belmont in East Lincolnshire. The Sandy Heath station, which went on the air during July, serves the Bedford area, where reception was inadequate, and provides improved reception in the Peterborough area. The Belmont station, which should become operational by the end of the year, will have a 1,265 ft mast of a design similar to those being constructed at Emley Moor and Winter Hill. It will provide improved reception in the East Lincolnshire area. Anglia Television will be the programme company.

North-East Scotland. Reception will be extended and improved by the provision of two additional stations. The Rumster Forest station came into operation on June 25 1965, providing a service for Caithness and Orkney. The other new station at Angus will give improved coverage in the Dundee and Perth areas. Grampian Television is the programme company.

Isle of Man. On March 26 1965, a new ITA station was opened at Richmond Hill to serve the south-eastern part of the island and in particular the important town of Douglas. Other parts of the island, and indeed certain parts of the Douglas area itself, already received a reasonable service from other Authority transmitters. Border Television is the programme company.

REMOTE PLACES CAN BE REACHED by REMOTE CONTROL

The Evershed Servo operated camera mounting in conjunction with an Angenieux Zoom Lens (servoed by Evershed) is used for precise orientation and framing up in remote places. Correct positioning is achieved instantaneously with maximum sensitivity, the camera and lens following the operator's hand on the controls so that the movements of the camera are perfectly synchronized with those of the man.

Now in use with:

BBC	London
NDR	Hamburg
WDR	Cologne
RAI TV	Rome
ABC	Sydney
KOTV	Tulsa
	etc. etc.

See it on STAND C12 at the INDUSTRIAL PHOTOGRAPHIC and TELEVISION EXHIBITION
EARLS COURT LONDON
15-20 NOVEMBER 1965

Angenieux 10×15C Zoom lens for Broadcast Vidicon Cameras fitted with Evershed Servo Drive Unit for control of Zoom, Focus and Iris functions of the lens. (covers removed)

The Pan and Tilt Head P105 provides control over 360° of panning and ± 45° of tilting and accommodates a combined camera and zoom lens weight of 150 lbs.

THE ESSENTIAL ELEMENTS IN THE EVERSHED SYSTEM ARE

1 servo controlled ANGENIEUX 10:1 zoom lens for orthicon, vidicon or plumbicon TV formats
2 servo controlled panning and tilting camera head type P.105—for all makes of monochrome cameras
3 solid state transistorized rack-mounted amplifier
4 operator's control panel for remote control of pan, tilt, zoom, focus and iris (optional)

INDIVIDUAL OPERATIONAL REQUIREMENTS THAT CAN BE PROVIDED INCLUDE

✳ automatic pre-set push button control from a remote point of all five functions—pan, tilt, zoom, focus and iris ✳ smooth manual control at a remote point with bumpless transfer from pre-set shot to manual operation ✳ automatic fading from one pre-set shot to the next at pre-determined speed of operation ✳ local control at TV camera for busy periods of TV programming—switchable to remote when desired ✳ automatic operation of pre-set shots over telephone lines

All enquiries to:

IMPORTANT POINT: Control panels are custom built to your own specifications

EVERSHED POWER-OPTICS LTD

214 HARLEQUIN AVENUE, BRENTFORD, MIDDLESEX, ENGLAND

Telephone: ISLeworth 6151

Coming Events

SEPTEMBER

7–11 International Industrial Electronics Exhibition, Basle, Switzerland.

9–11 IEEE Industrial Electronics & Control Instrumentation Conference, Philadelphia.

9–19 International Salon of Radio and Television, Paris.

12–18 International Congress on High Speed Photography, Zurich, Switzerland. (National Committee for High Speed Photography, Institute of Physics & The Physical Society, 47 Belgrave Square, London, SW1.)

13–18 Engineering Materials & Design Exhibition & Conference, Olympia, London.

16–17 IEEE Joint Eng. Management Conference, New York.

17 to October 3 British Exhibition, Tokyo.

22–24 IEEE International Convention on Military Electronics, Washington, D.C.

28 to October 1 European Symposium & Exhibition on Medical Electronics, Brighton.

28 to October 2 Institution of Electronics Annual Convention & Exhibition, Manchester.

OCTOBER

4–6 International Canadian Electronics Conference and Exhibition, Toronto.

6–17 Communications International Fair, Genoa.

21–22 IEEE Electron Devices Meeting, Washington, D.C.

25–27 IEEE Electronics Conference, Chicago.

31 to November 5 SMPTE Exhibition and Convention, Montreal.

NOVEMBER

15–20 Industrial Photographic and Television Exhibition, Earls Court, London.

DECEMBER

1–3 14th Technical Symposium on Technical Progress in Communication wires and cables, Ashbury Park, New Jersey, USA.

4–7 9th International Visual Communications Congress, Detroit, USA.

NEW DEVELOPMENT

Plastic-coated steel

■ EXTENSIVE USE has been made of Stelvetite, John Summers' plastic-coated steel, in the panelling of control areas in the new studios at the Television Centre, White City, London. Studio 6, (designed especially for colour television), Studio 7 and the Topical Film Unit in the East Tower have large areas of acoustic tiles made from Stelvetite by Burgess Products Company Ltd. Studio 8 control areas, now under construction, are to be similarly equipped.

To date, nearly 17,000 square feet of Burgess tiles have been installed.

Stelvetite was chosen for the tiles mainly to keep maintenance costs to a minimum. The pvc finish of the material eliminates the need for periodic painting, and also provides a more durable surface than that of the traditional finishes. The panels, which are formed by Burgess Products from 22 and 24 gauge Stelvetite, are clipped into special T-sections and are thus easily moved to give access to electrical services.

The degree of perforation has been varied on different sections of the wall for two reasons. First, because of stroboscopic considerations—to cut out risk of spots-before-the-eyes—which might occur from uniform perforations, and second, to give the varying degrees of sound absorption required. Some panels have as much as 25% open area to absorb high frequencies and others as little as 0.5% to cope with the low. Black, dark grey and light grey, three of the standard colours in which Stelvetite is available have been used.

Architects and Consulting Engineers were Norman & Dawbarn of Stockwell Road, London, SW9, in association with Mr R. H. S. Howell, OBE, FCGI, MInst, CE, Head of the BBC's Building Department.

BRITISH PATENTS

Class H4F Television, etc

987,211 MULLARD LTD, Abacus House, 33 Gutter Lane, London, EC2. (Peter L. Mothersole).
Television receivers (circuit arrangements). Mar 24 1965

987,628 FERNSEH GmbH, Am Alten Bahnhof 6, Darmstadt, Germany.
Arrangements for ensuring continuity of colour synchronisation in colour television systems. Mar 31 1965

987,677 FERGUSON RADIO CORPN, 105-109 Judd Street, London, WC1. (S. C. Jones, D. J. S. Westwood & J. C. King).
Television receivers (colour television using fibre optics). Mar 31 1965

987,898 COMPAGNIE FRANCAISE DE TELEVISION, 19 rue Ernest - Cognac, Levallois-Perret (Seine), France.
Systems for switching devices for sequentially transmitted signals. Mar 31 1965

988,288 FERNSEH GmbH.
Objective lens assembly for cinematograph film cameras (using television pickup tubes) April 7 1965

989,315 GENERAL ELECTRIC CO, 1 River Rd, Schenectady 5, New York, USA.
Modulation circuit (colour television). April 14 1965

990,003 FERNSEH GmbH.
Method of operation of image orthicon tubes. April 22 1965

990,597 COMPAGNIE FRANCAISE DE TELEVISION.
Colour television receivers (output circuits). April 28 1965

990,872 11T RESEARCH INSTITUTE, Chicago 16, Ill, USA.
Area scanning systems and visual display systems. May 5 1965

991,761 PHILCO CORPN, Tioga and C Streets, Philadelphia, Penn, USA.
Colour television apparatus (automatic chroma control). May 12 1965

992,192 HAZELTINE CORPN, Little Neck 62, New York, USA.
Colour-television test signal generator. May 19 1965

992,626 RANK-BUSH MURPHY LTD, 11 Belgrave Rd, London, SW1.
Cathode ray tubes for colour television. May 19 1965

993,191 BRITISH BROADCASTING CORPORATION, London, W1. (Stanley M. Edwardson).
Television standards conversion. May 26 1965

993,448 FERNSEH GmbH.
Deflection arrangement for television devices. May 26 1965

993,578 FERNSEH GmbH.
Television camera (improvements facilitating the replacement of the pickup tube). May 26 1965

993,823 COMPAGNIE FRANCAISE THOMSON-HOUSTON, 173 Boulevard Haussmann, Paris, 8e, France.
Television camera system having improved temperature control. June 2 1965

994,120 FERNSEH GmbH.
Apparatus for the regeneration of television signals (containing a test line occurring within the standard vertical blanking interval). June 2 1965

994,121 FERNSEH GmbH.
Image-orthicon circuit arrangements. June 2 1965

994,967 MARCONI CO LTD, English Electric House, Strand, London, WC2. (Douglas A. Pay).
Signal clipping circuit arrangements (for television signals). June 10 1965

994,968 MARCONI CO LTD. (Douglas A. Pay).
Pulse amplitude control circuits (for television signals, etc). June 10 1965

996,727 COMPAGNIE FRANCAISE THOMSON-HOUSTON.
Television camera assembly having improved checking means. June 30 1965

997,134 FERNSEH GmbH.
Circuit arrangement for cross-fading television signals. July 7 1965

997,237 DAVID S. HORSLEY, 3929 Kentucky Drive, Hollywood 28, Calif, USA.
Image signal recording method and apparatus (for reduction of redundancy). July 7 1965

AMERICAN PATENTS

3,168,618 A. FERNSEH GmbH, Darmstadt, Germany. (R. Sondermeyer).
Apparatus for recording signals and for reproducing signals recorded on a magnetisable tape. Feb 2 1965

3,168,619 BANKERS TRUST CO, New York, NY. (Stevens H. Harrison).
Two-way audio communication. Feb 2 1965

3,168,699 GENERAL ATRONICS CORPN, Bala-Cynwyd, Pa. (D. E. Sunstein & B. D. Steinberg).
Communication technique for multipath distortion. Feb 2 1965

3,169,214 VARIAN ASSOCIATES, Palo Alto, Calif. (Richard M. Whitehorn).
Mounting device for circuit boards. Feb 9 1965

3,169,221 ITTC, New York, NY. (Armand J. Franchi).
Audio actuated switch for transceiver transmitter. Feb 9 1965

3,169,222 RADIO CORPORATION OF AMERICA, Delaware. (L. M. Krugman & Robert C. Graham)
Double-emitter transistor circuits. Feb 9 1965

3,169,223 GENERAL ELECTRIC CO, New York. (Le Roy F. Hudson).
Apparatus for energising radio receiver in response to power line alarm signal. Feb 9 1965

3,169,224 GENERAL ELECTRIC CO LTD, London, England. (Peter C. Butson).
Microwave mixer. Feb 9 1965

3,169,228 RADIO CORPORATION OF AMERICA, Delaware. (Joseph O. Sinniger).
Transistor amplifier with diode feedback circuit. Feb 9 1965

3,169,245 BELL TELEPHONE LABS INC, New York, NY. (Cassius C. Cutler).
Passive repeaters for satellite communication systems. Feb 9 1965

3,170,031 SHIRO OKAMURA, 26 2-chome, Shiroganedaimachi, Minatoka, Tokyo, Japan.
Recording system with provision for fast or slow reproduction. Feb 16 1965

3,170,040 RADIO CORPORATION OF AMERICA, (John H. O'Connell).
FM stereophonic multiplex receiver having automatic disabling means for the subcarrier channel. Feb 16 1965

3,170,044 JOSEF GROAK, Ashley Cottage, 32 Ashley Lane, London, NW4.
Manufacture of magnetic records. Feb 16 1965

3,170,118 LING-TEMCO-VOUGHT INC, Dallas, Texas. (Jimmie J. Logan).
Panoramic receiver for multiplexing communication signals from multiple sources. Feb 16 1965

3,170,991 RALPH GLASGAL, 39-43 46th Street, Long Island City, NY.
System for stereo separation ration control, elimination of cross-talk and the like. Feb 23 1965

3,171,083 WESTINGHOUSE ELECTRIC CORPN, East Pittsburgh, Pa. (Charles B. Heffron).
Vacuum tube heater idling circuit (for television receiver). Feb 23 1965

3,171,084 WESTINGHOUSE ELECTRIC CORPN. (George C. Sziklai).
Television receiver power supply. Feb 23 1965

3,171,087 RADIO CORPORATION OF AMERICA. (Kern K. N. Chang).
Solid-state non-reciprocal signal amplifier. Feb 23 1965

3,171,088 WILLIAM PERA, 6122 Main Street, Lanham, Md.
Phase-splitter circuit for use with an audio amplifier. Feb 23 1965

3,171,127 J. D. ASTERAKI, 20 Loring Road, Sharnbrook, Bedfs and others.
Radio navigation apparatus. Feb 23 1965

3,171,130 EX-CELL-O CORPN, Detroit, Mich. (Donald M. Humphreys).
Magnetic recording. Feb 23 1965

technical abstracts

Transmission

278. BERRY, J. A. Measurement of H_{01} mode loss at Q band in helix waveguide.
Marconi Review, vol 28, no 156, 22—26, 1965.
One method of measuring the H_{01} circular mode loss in a circular guide in the frequency range 26.5-40 Gc/s is described. The measured loss varied from approximately 4 dBs per mile at 40 Gc/s to 6.5 dBs/mile at 26.5 Gc/s: diags, graphs, photo, bibliog refs.

279. BOWE, J. D. and WALDRON, R. A. Coupling between modes in helix waveguide.
Marconi Review, vol 28, no 156, 65—88, 1965.
Results are given of computations of coupling coefficients between the HO_1 mode and various other modes in helix waveguide, for coupling due to the following imperfections: changes of radius, offsets of the axes of joined lengths of guide, sharp bends of the axis, and curved bends: graphs, bibliog refs.

280. CUFFLIN, M. H. The H_{01}-mode and communications.
Point to Point Telecommunications, vol 9, no 2, 23—40, 1965.
The use of over-moded waveguide, particularly H_{01}-mode circular guide, to provide long distance links of vast channel capacity is considered. In the future the system might be economic for capacities of 50,000 telephone channels or more. Meanwhile, the techniques described may offer worthwhile advantages for certain types of aerial feeder: diags, photos, bibliog refs.

281. CUFFLIN, M. H. The H_{01}-mode and the helix waveguide.
Marconi Review, vol 28, no 156, 1—21, 1965.
This article deals with the experimental work on the low loss H_{01} mode in circular waveguide carried out in the research Division of the Marconi Company during the last four years. Early work dealt with transmission problems involved in long distance communication by waveguide using millimetre wavelengths. Later work was carried out at longer wavelengths in the three cm and six cm bands to test very low losses for high-power feeds for radars or low noise receiving aerials: diags, graphs, photos, bibliog refs.

282. EAST, F. R. The properties of the ionosphere which affect HF transmission.
Point to Point Telecommunication, vol 9, no 2, 5—21, 1965.
The main properties of the ionosphere which affect hf radio waves and influence the planning of hf communication systems are described. Mention is made of recently published results and a number of recent references are given: diags, graphs, bibliog refs.

283. KOLOSOV, M. A. and others. Propagation of metric waves in interplanetary space.
Radiotekhnika i Elektronika, no 10, 1735–1739, 1964. In Russian.
Data on the propagation of radio waves at 183.6 Mc/s at a distance of up to 50 million km are given. The maximum possible attenuation of radio waves in the interplanetary space is assessed and literature data on the propagation of radio waves in the interplanetary space are surveyed: diags.

284. WALDRON, R. A. and BOWE, D. J. Normal modes of helix waveguide.
Marconi Review, vol 28, no 156, 29—64, 1965.
An outline is given of the derivation, in helical co-ordinates, of the characteristic equation for helix waveguide. A selection is presented of results of computations of the (complex) phase constant, for a number of values of the normalised guide radius and of the properties of materials. Results were obtained with the aid of computer DEUCE: diag, graphs, bibliog refs.

285. WESTCOTT, B. Statistics of the coupling into unwanted modes in a long multi-mode transmission system.
Marconi Review, vol 28, no 156, 89–101, 1965.
The effects of discontinuous defects, occurring at the junctions between sections of helix waveguide in a long-distance communications system, are considered statistically: diag, graphs, bibliog refs.

Recording

286. DOW, H. E. and others. Economical solid state stereo radio-phonograph designs.
IEEE Trans on Bdcst & TV Receivers, vol BTR-11, no 1, 13—18, May 1965.
The premium cost areas of conventional transistor circuit design are reviewed. Performance attained in simplified designs is given for the tuner, multiplex detector, audio and power source chosen. A flexible audio system design and integrated packaging results in a basic chassis for a series of high fidelity instruments. The authors are with the Philco Corpn: diags, graphs, photos, bibliog refs.

287. Foreign patents on magnetic sound and picture recording.
Tekhnika Kino i Televidenia, no 10, 85—88, 1964. In Russian.
A survey of the most important Japanese patents is presented: diags.

288. NESTEROV, V. A. & MARKHONKO, V. K. Copying of sound tracks from 6.25 mm magnetic tape on a perforated sound carrier.
Tekhnika Kino i Televidenia, no 11, 50—54, 1964. In Russian.
Manual control of the replay speed of sound tracks recorded on 6.25 mm magnetic tape by means of a synchronised pilot signal for copying the signal on a perforated sound carrier is described: diags.

289. SMIRNOV, N. I. Some problems of sound recording and replay using 16 mm film copies with magnetic sound track.
Tekhnika Kino i Televidenia, no 10, 32—40, 1964. In Russian.
The quality of sound reproduced from 16 mm film copies using a magnetic sound track and possible ways of improving the quality are discussed together with some specific problems of use of such film in professional apparatus. There is criticism of some deficiencies in the production and use of 16 mm films with a magnetic sound track: diags.

290. VAJDA, Z. Transistorised amplifiers for studio tape recorders.
Radio & Television, no 2, 26—30, Mar 1965.
Since 1961, the Development Dept of the Hungarian Radio have been developing transistorised electronic units for a studio tape recorder. These are described in detail. Serial production of the complete new recorder is expected to start in 1965 after the necessary operational experiments: diags, graph, bibliog refs.

Studio equipment

291. KATCHEROVITCH, A. N. Sound absorbing materials and constructions.
Tekhnika Kino i Televidenia, no 10, 67—74, 1964. In Russian.
Sound absorbing materials and constructions manufactured in several countries are discussed. The designs using such materials are described and the frequency responses of the sound absorption factor are presented: diags.

292. POPESCU, M. Transistorised isolating amplifiers for modern studio equipment.
Radio & Television, no 2, 31—35, Mar 1965.
The importance of isolating audio amplifiers in studio equipment is stressed and the technical requirements are outlined. Three transistorised isolating amplifiers are compared, one by Marconi, the second by WSW-Austria and the third by the author designed and constructed in the laboratories of the Rumanian Radio and using Rumanian transistors: diags, bibliog refs.

293. PTACEK, M. Sensitivity of ribbon microphone with variable directivity pattern.
Slaboproudy obzor, no 12, 694—696, 1964. In Czech.

Variation of sensitivity of a ribbon microphone model with the change of the directivity pattern (spherical, cardioidal and figure-of-eight) is discussed: diags.

Television transmission

294. BERLIN, B. A. and VOVSI, L. M. Correction of video signal distortion with the transmission by means of coaxial cable.
Tekhnika Kino i Televidenia, no 10, 13—19, 1964. In Russian.
Properties of coaxial cables important for the distortions arising with the transmission of video signals by means of a cable are discussed. A method used for the design of an equivalent of the cable and of passive correcting networks is presented, and a method used for designing the correction amplifier is also described: diags.

295. FAINSTEIN, E. O. A two-channel television equipment.
Tekhnika Kino i Televidenia, no 11, 37—43, 1964. In Russian.
A television equipment using two channels (the announcer and the film channel) is described. The system includes equipment for the accompanying sound signal and a transmitter, operating in an extensive cable network using the spectrum of one television channel: diags.

296. RYFTIN, Y. A. and others. Device for checking the responses of a whole television chain.
Tekhnika Kino i Televidenia, no 11, 10—14, 1964. In Russian.
The paper describes a stroboscopic device with automatic scanning of the picture in the vertical and horizontal directions for recording and observing the responses of the whole chain. Results of experimental tests are also presented: illus.

Colour television

297. DOURI, J. Comparison of the SECAM, NTSC and PAL systems.
Tekhnika Kino i Televidenia, no 10, 6–12, 1964. In Russian.
The author (who is French) claims for the SECAM system a number of merits including low sensitivity to phase distortion and differential gain distortion, suitability for use with existing studio equipment and transmitters and the fact that no further control elements are required for the regulation of brightness: illus.

298. REHAK, J. Combination of rasters in a colour television system using quanticon camera tubes.
Rozhlasova a televizni technika, no 4, 100—106, 1964. In Czech.
Fundamental principles of design of a colour television scanner using three quanticons are described. The main attention is paid to the registration of the three pictures corresponding to the primary colours. On the basis of a short qualitative analysis of the geometric distortion of the television picture, conditions are defined under which the distortion interferes with the registration of the rasters and remedies discussed: illus.

299. VARBANSKI, A. M. and ISAYEV, A. N. Problems of the introduction of colour television in the USSR.
Tekhnika Kino i Televidenia, no 10, 1—6, 1964. In Russian.
A continuation of the discussion on the selection of a colour television system started in the preceding issue of the journal. A report is given on the comparison tests of the NTSC, SECAM and PAL systems.

Television studios

300. KUBICEK, F. New method of electronic production of captions.
Rozhlasova a televizni technika, no 4, 107—109, 1964. In Czech.
An interesting new method of producing simple captions on the screen of a picture tube by means of electronic circuits is described: diags.

301. VANCURA, A. Trends of development of illumination techniques in television studios.
Rozhlasova a televizni technika, no 4, 110—117, 1964. In Czech.
Methods used in the early years of television broadcasting are compared with present methods and modern requirements are discussed in detail: diags.

Television Receivers

302. BABUK, G. V. Use of test line method for inspection of television receivers.
Tekhnika Kino i Televidenia, no 11, 15—26, 1964. In Russian.
The possibility of using the test line method is discussed and the merits and deficiencies compared with the standard method using a test pattern. Results of experimental checking of the new testing method are reported. The method uses sine-square pulses and a test signal consisting of a series of sinusoidal oscillations at various frequencies: diags.

303. HELLSTROM, M. J. Reduction of horizontal overscan probability.
IEEE Trans on Bdcst & TV Receivers, vol BTR-11, no 1, 21—23, May 1965.
Quantity production requirements and the vagaries of line voltage in customers' homes lead to the design of television receivers with overscan rather than underscan. This paper supplies a quantitative appraisal of the dilemma and suggests a design direction for improving overall performance: graphs.

Television film

304. SHEIPHIS, I. I. and others. Film-scanning system for multicamera production.
Tekhnika Kino i Televidenia, no 11, 27—36, 1964. In Russian.
Considerations on the selection of fundamental units of a system intended for the production of television films by means of several cameras are presented. A special design of a film and television camera used for producing a picture without parallax error in the camera chain is described. A vidicon picture tube is used: diags.

Pay TV

305. TARASENKO, L. G. Pay television systems.
Tekhnika Kino i Televidenia, no 11, 75—84, 1964. In Russian.
Some pay television systems used in experimental operation in the USA, Great Britain and Canada are described. The systems are characterised in general and are compared from the point of technical operation (circuits), transmission method (wireless and wired systems) and method of collecting the fees: illus.

Closed circuit television

306. ELLIS, A. B. E. A field interlace system for closed circuit television.
Marconi Review, vol 28, no 157, 135–146, 1965.
A new approach is described to the generation of field interlace synchronising pulses for television systems whereby most of the disadvantages of the present method can be overcome using pulse techniques. Good performance at greatly reduced cost and complexity is shown: diags, bibliog refs.

In France: Colour TV in the home by 1968

by Robert Jackson

IT now appears certain that France will be operating a colour television network in about tow and a half years. The network should be ready in time to televise the Winter Olympia at Grenoble in January 1968.

However, not every viewer will be able to afford to watch the Olympics in all their natural splendour. It is estimated that a colour TV receiver will cost about 5,000 francs or £375. Most of the high cost is accounted for by the fact that the receivers will be equipped with a cathode ray tube containing three electron guns in place of the usual one—one for each primary colour, red, blue and green.

It is three years since the technicians of the experimental division of the ORTF (French Radio and Television Organisation) succeeded in transmitting the first colour TV sequences. In their laboratory at Issy-les-Molineaux, the 15 technicians carried out exhaustive studies on the three competitive colour TV systems—the American, German and French.

In May 1964, the French team leaped ahead with their SECAM system, but this was still in the laboratory testing stage. Ten firms were enlisted to build the first colour TV receivers, and six months later the completed sets were presented to President de Gaulle, his Ministers, the directors of the ORTF and a number of other specialists. Those first receivers were bulky affairs, twice as large and twice as heavy as ordinary sets. In the course of four months, the 100 or so 'guinea-pig' viewers watched a total of 70 hours of experimental colour programmes, including plays, variety, documentary features and cartoons. They were asked to report their impression and criticisms.

The programmes were produced by Jean-Marie Coldefy in two garages at Issy-les-Moulineaux, which had been converted into studios. The transmitter was set up in Paris's 20th arrondissement, and from time to time the ORTF studios received telephone calls from irate viewers who were picking up fragments of the transmission on Channel 2, and who thought that a 'pirate' tranmitter was behind it all!

For a whole week during January 1965, the technicians took a bold step by transmitting a series of programmes. in colour, from the Eiffel Tower transmitter. Something like a million viewers picked up the programmes in black and white, and noticed nothing odd at all. This was ample proof that colour transmissions could be picked up by the new receivers, and also by normal sets, thus eliminating the necessity for having yet another channel.

However, there is quite a formidable list of problems to be solved between now and 1968. For example, studios will have to be air-conditioned, as the high-power lamps required throw off an intolerable heat. Separate colour-cameras, costing £17,500 each, view the same scene from different angles, and it is extremely difficult to harmonise their signals. The first difficulty is the apparent tendency of the subject to change colour as the distance between it and the cameras is varied: 30 per cent of the 'guinea-pig' viewers' criticisms concern this aspect. Another point is that extra-specal care has to be taken with the background sets, as the colour cameras show up any flaw with brutal clarity. Some colours, bluue for instance, show up very poorly.

Much work still remains to be done, too, on the receivers. For the moment, American tubes are in use. These are the round-screen type. 70 centimetres long, and are considered by no means powerful enough. Work is goining on towards perfecting a normal-size rectangular tube with a tenfold increase in luminosity. It will not be ready for another 18 months.

Meanwhile, laboratory work and experimental transmissions continue. Hundreds of pre-production sets will be tested, but receivers will not be on sale until the latter part of 1967. By nearly 1968, ORTF will be in a position to produce a two-hour colour programme each evening. It is anticipated that a preliminary batch of 100,000 receivers will be sold within a year.

The ORTF technicians have taken careful note of America's experiences in colour TV, which started in the US more than ten years ago. Several hours of colour programmes are transmitted daily on a number of channels. Receivers cost well over £100, yet out of 85 million sets in use only three million are equipped for colour reception. The reason is, say French technicians, that the American system is inadequate. It is no rare thing for red objects to turn suddenly green, or for the shirts of a baseball team to change abruptly from yellow to violet. In an effort to correct these deficiencies, American sets are equipped with three contrast controls which have to be manipulated by the viewer.

Such faults are claimed to be eliminated in the French SECAM system. Even so, colour TV has not burst upon France as a kind of eighth wonder of the world. The French public is very conservative, and even the conversion from radio to black-and-white TV was a slow one. In 15 years, only 5½ million sets have been sold, compared with over twice that number in England.

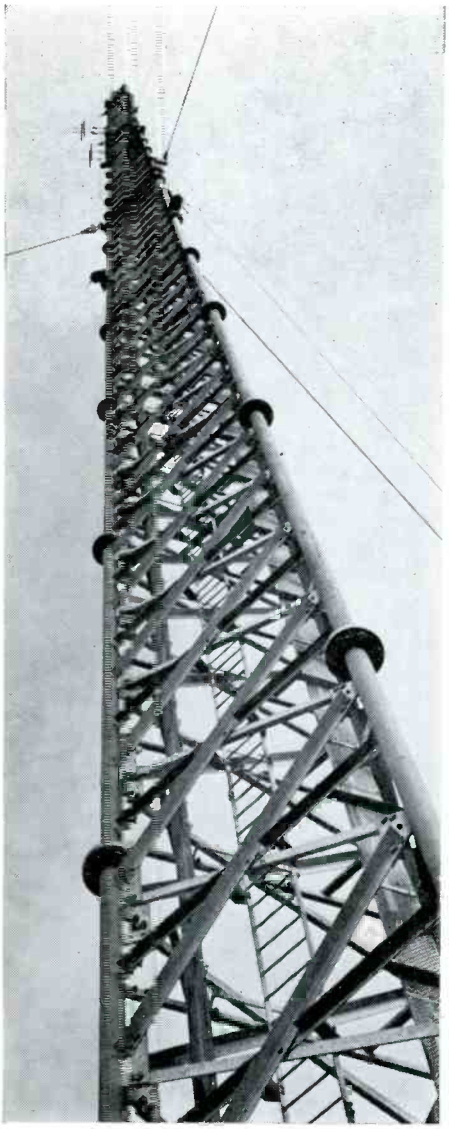
This years the colour TV battle has reached a decisive phase. Many firms expect that anticipation of a practical colour network will lead to a substantial drop in sales of 'conventional' sets. However, there can be no question of colour TV ousting its elder brother to any great extent. Cost of receivers will be prohibitive for several years to come. Hours of transmission will be relatively short and viewing will be restricted to a very small segment of the population.

In 1968, then, French viewers will fall into three distinct groups: eight or nine hundred thousand will be faithful to their old sets, which can only receive one channel; seven million or so will have sets equipped for both channels; and only a few thousand will have colour TV.

It will be a complicated, and typically French, situation. But it will be a beginning.

Robert Jackson is a freelance journalist who specialises in European affairs. It should be added that the engineering and programming costs which ORTF will incur in the introduction of its colour television service will be prohibitive unless some other method of financing the service can be found; and informed French opinion says that the only of providing continuing financing for French colour TV is by the introduction of advertising on French TV. The availability of colour commercials should provide a spur for the swift development of this medium in France. It might also be relevant to note its support of the French SECAM system in view of the fact that the Russian TV service is having second thoughts about that difficulties are being met with the reception of SECAM pictures in black and white on existing Russian sets, due to differing technical parameters.

New ITA mast



The new 750 ft lattice television mast at Rumster Forest, Caithness, designed, supplied and erected by British Insulated Callender's Construction Co Ltd to the order of EMI Electronics Ltd for the Independent Television Authority. It was erected by a team of eight men and is the most northerly ITA mast in the United Kingdom. The Station came into service on June 25 and transmitted Grampian TV programmes on Channel 8 over an area which includes the Orkneys.

New plant

■ THE GATES RADIO COMPANY announced last month the award of the contract to erect the first phase of its new manufacturing facility to be located in the Walton Heights area at 30th & Wisman Lane. Cost of the building will be in excess of one million dollars. The contractor advises he expects to start work immediately with intended completion during the early second quarter of 1966.

The first construction phase will consist of a modern manufacturing plant specifically designed for the Space Age era of electronics and will be 350 ft long and 350 ft deep, erected on the western half of the 40-acre tract facing 30th Street. The parking area will be developed north of the building. A second phase should follow at a later date to erect offices in front of the building to be erected now. Third and fourth follow on phases are both added factory units, which when all phases are complete, should provide about a 380,000 square feet building and one of the largest factories of its kind in the United States.

Immediately on completion of the first phase, the Gates engineering and manufacturing departments and all manufacturing activities will be moved. Only the 2nd & Hampshire facility will be retained for administrative and sales offices as well as manufacturing overflow in case of a crash programme as sometimes happens in defence work.

Television aids proton bombardment of brain tumors

by J. W. T. Field

Medical science has made vast strides in the past decade thanks to the use of isotopes in modern surgery. A group of neurosurgeons have been conducting cyclotron proton bombardment tests on brain tumours, using the Harvard University cyclotron laboratory. And, again, television monitoring using specially-designed 729-line high-definition and radiation-proof cameras, has come into its own. First full details are here given by J. W. T. Field, following a meeting with the men who designed the camera chain.

Specially-designed television camera, with plug-in binary and sync circuit, used by neurosurgeons at the Harvard University Cyclotron Laboratory, in radiation area.

IT came as a great sign of hope in January, 1963, when Dr Stuart C. Cullen, MD, disclosed in **Anesthesiology** that not only is a world-famous cyclotron laboratory being used by neurosurgeons to treat patients with brain tumours, by proton bombardment, but that as this has to be done in a powerful radiation area, television monitoring was to be harnessed.

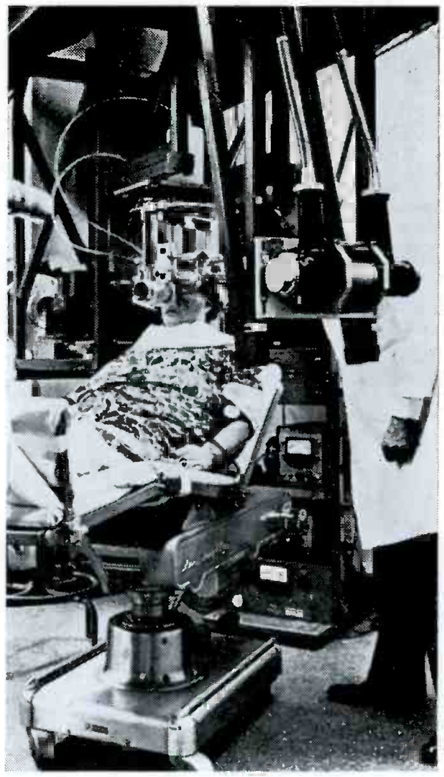
This may well revolutionise the use of 'atomic surgical' methods, since an automatic limit has always existed previously that human observation was impossible in a radiation zone; indeed, this has proved a barrier even with therapy such as treatment of cancer by X-rays.

The story began in the autumn of 1960 when the Neurosurgical Service at the Massachusetts General Hospital, Boston, USA, presented Drs E. M. Slater, A. I. Surtees, J. A. Taisse and D. P. Todd of the anaesthesia department a unique problem. It was as to how to deal with the problem of giving anaesthesia during radiation (neutron bombardmen) of intracranial tumours.

At that time a novel technique was devised in which the patient was taken to the medical treatment room of the reactor at the Massachusetts Instiute of Technology, and MIT experts along with neurosurgeons watched through an oil-filled window in a 4-ft 6-in wall while treatment was given at a relatively safe distance of 20 feet. Under general anaesthesia craniotomy was performed, a boron solution given intravenously and the area of tumour exposed to neutron bombardment for nearly 100 minutes.

The operating table was placed on an electric lift in the centre of the safety lead-lined area, it being necessary to raise the operating table and patient to a height of about nine feet to where the portal from the reactor was situated. During initial surgery of the craniotomy the usual anaesthetist trolley was able to be in the operating area. A blood pressure cuff was applied, and an intravenous infusion of five per cent dextrose in water started through a percutaneous intravenous catheter. Anesthesia was then inducted with thiopental-succinyl-choline, and halothane-nitrous oxide and oxygen administered via the open system of a Boyle anesthesia machine. None of this presented any problem during the initial stage of the operation, but when the craniotomy was completed and after the boron had been administered, it was necessary for the anesthesia machine to be moved to the other side of the lead-lined 4-ft 6-in wall, and anaesthesia continued by a sort of 'remote control' through a 30-ft breathing tube attached at one end to the machine and at the other to a Ruben valve. After all apparatus was placed and checked, all doors were closed, the radiation portal opened and neutron bombardment begun. The subsequent bombardment involved exposure to as much as 30,000 roentgens.

In the first series of tests, 16 patients were given this brain treatment, and there were no aneasthetic complications. Bombardment ranged from 45 to 105 minutes. However there proved to be limitations, and when the team considered the next step—cyclotron bombardment, at the Harvard University laboratory—a plan was devised to monitor everything by television, instead of having to observe through an oil-filled window,



Kin Tel 20/20 camera mounted on a remotely-controlled pan and tilt unit, when a team of neurosurgeons at the Harvard University Cyclotron Laboratory cure brain tumours by proton bombardment.

with the anesthetic machine at a remote distance.

It may be explained that a radiation-resistance screen is needed for electronic circuitry in certain zones. The whole point of anaesthesia, during the cyclotron bombardment, is to prevent movement of the patient while pin-pointing the proton beam on the radio-sensitive brain tumor. And, as before, constant observation of respiratory excursions, and gas flows from the anaesthesia apparatus, is needed. Due to high radiation hazards in the treatment chamber, the patient must be left unattended during the bombardment period.

After success obtained at the Boston Massachusetts General Hospital, the same group of neurosurgeons began to plan for cyclotron treatment at Harvard, where there is an experimental cyclotron available for this form of medical research. While a craniotomy is necessary for reactor patients, under cyclotron treatment anaesthesia is needed **only** to prevent patient's movement. After tests it was found that with adults it was not even necessary to anesthetize, but of course this placed even greater responsibility upon the monitoring arrangements. To this end, the Kin Tel division of Cohu Electronics Inc, of San Diego, was invited to co-operate, and to provide a special form of closed-circuit television monitoring, involving extra-high-fidelity video monitoring, with remote control of focus, lens-filters, camera positioning and camera controls. Items in the detailed specification necessitated the camera to me capable of being focussed quickly on the anaethesia flow-meters, then at a greater distance to the patient for general observation; with equally swift change of focus back to the rib-cage or breathing bag. With this equipment a wide range of patients could be given cyclotron bombardment, either under anaesthesia or not.

A difference between cycltron treatment and that initiated at Boston is that instead of one prolonged bombardment exposure is split into five or ten 3-minute periods. As Dr Stuart C. Cullen explains: 'The patient was induced with halothane and oxygen via a Ruben non-breathing valve attached to the open system of a Boyle anaesthetic machine. The patient's trachea was intubated with a Tovell tube of appropriate size which was then connected to the Ruben valve. After the patient was positioned and the vital signs checked, patient and machine were left unguarded. Respiratory excursions and gas flows were watched constantly by the television camera. . . .'

The 20/20 camera which the Kin Tel engineers chose for this application is equipped with a type 2360 Fineline 729-line sync generator. When used with an FRM series monitor, this camera delivers a picture with 500 lines horizontal and 800 lines vertical resolution. Other features of the camera used to monitor cyclotron bombardment include an 8 Mc/s bandwidth ± 1 dB, interlace 2/1, and electronically regulated power supply.

For medical use it is particularly convenient that the 20/20 is a combination camera and control unit; in fact it operates with only a 20-watt input from a 105/125-volt 60 cps supply, single phase. It is approximately rectangular in shape, and in $16\frac{3}{4}$-in long without lenses, $7\frac{3}{4}$-in wide and 10-in high. It consists of front, rear and base castings; a yoke assembly, vidicon and attendant hardware, four basic component etched board assemblies, and a control panel. Each of the four basic chassis boards is of epoxy glass secured to the camera frame with spring clips. All board interconnections, with the exception of the vidicon target lead, are made through connector pins. The vidicon focus and deflection assembly is fastened to a precision slide unit adjusted by a lead screw and nut block at the rear of the camera. When remote control is used, as for monitoring these cyclotron tests, this assembly is moved by a focus motor.

It is interesting to compare the specification of this camera with that of other CCTV units, and details are as follows: **Sensitivity.** Provides usable picture with f/1.5 lens and 1-ft/candle average illumination; gives specified resolution and ten shades of grey viewing standard EIA test pattern with f/1.5 lens and 20 ft/candles of illumination.

Resolution Normally 650-line horizontal resolution with wideband TV monitor; it provides better than 450 lines horizontal and vertical resolution with the 729 sync generator and Fineline monitor, with EIA standard test pattern and 100 per cent modulation at centre of picture.

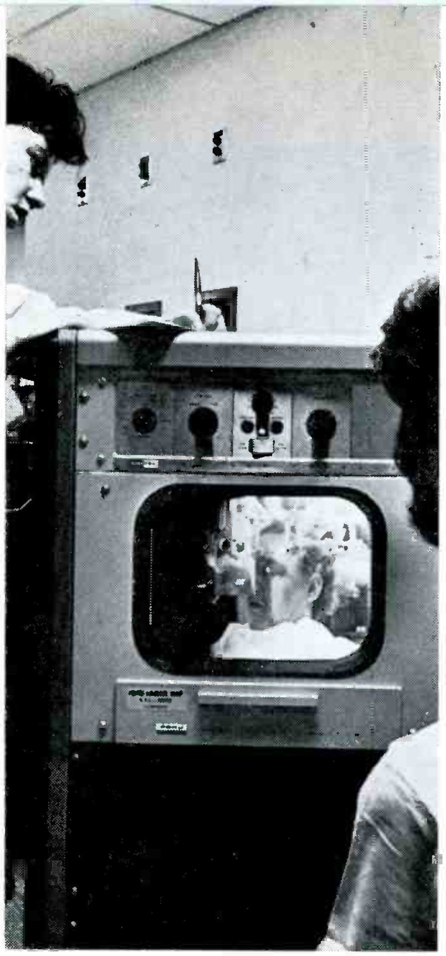
Electrical output is 1-volt peak-to-peak, video into 75 ohms. With modulator, RF output is 10,000 mircovolts or more on any channel.

Bandwidth is 8 Mc/s within ± 1 dB.

Linearity. ± 2 per cent, self compensating vertical linearity .

Shading. None visible, with flat 10 ft/candle illumination.

Aperture correction ± 8 dB at 8 Mc/s.



Watching on a Fineline 729-line monitor, nurses assist the team of neurosurgeons by checking patient's breathing, and watching flowmeters on the TV screen during cyclotron bombardment.

Horizontal sweep. Crystal controlled, locked to sync generator when used with the 729 as in the case of the cyclotron work. There is the usual facility of a protection circuit to cut off vidicon current in the event of sweep-circuit failure.

Auto target. This is an optional feature, used in the medical programme, and it gives light compensation for variations of up to 4,000-to-1.

The vertical oscillator is essentially a blocking oscillator which generates the 60 cps vertical deflection pulses, the basic frequency of the oscillation being set by the applied bias voltage. When the line-lock is jumpered, sequential scan (random interlace) is available, but with the medical tests in hand the sync generator accessory board is used and the line-lock jumper removed. In this condition the oscillator is slaved to the vertical pulses from the sync generator board. A delay network in the input circuit of the shaper/clipper stage delays the vertical sweep slightly so that system blanking starts before vertical retrace. As in any CCTV chain, failure of either the vertical or horizontal scanning signals for any cause whatsoever would result in the electron beam burning the target. To prevent this, the vidicon cathode is cut off by a safety circuit in the event of deflection-signal failure. The vidicon tube normally operates with a cathode bias of + 2 volts approximately, and this bias must therefore be applied only when both deflection signals are present. Two transistors are therefore arranged to operate as a special type of 'A-N-D gate, sampling the horizontal and vertical output as it appears across the respective yokes. These transistors are biased in such a manner as to be normally conducting. In the presence of deflection signals, however, they become non-conductive. The emitters of both transistors are connected directly to the ± 40 volt bus. In the absence of either deflection signal, the collector goes from zero to + 40 volts, and this voltage appears in the common collector load resistor. The vidicon cathode is connected to the bottom of this collector load resistor, and the ± 40 volts flyback (retrace) time, deflection signals are absent, the beam is cut off and blanking results.

As for horizontal deflection circuitry, the master oscillator is crystal-controlled, the crystal frequency for 729 Fineline scan being 43.74 Kc/s. For the medical use, in conjuction with a sync generator, this is slaved to the crystal oscillator.

Oscillator output is applied to the flipflop stage, which divides the oscillator frequency by two to arrive at the horizontal line scane frequency of 21,870 cps. Since a transistor will act as a very good switch (that is, it has a very low resistance when 'on' and a high resistance when 'off'), a simple and reliable sweep pulse is obtained. A single transistor is operated as a grounded-emitter PNP transistor switch, the transistor conducting heavily when a pulse appears in its base circuit. Its output is coupled to the horizontal output stage. This latter uses a single transistor operating as a low-disipation on/off switch to circulate energy among the various reactive components. Low power consumption and the transient difficulties which give rise to ringing' are thus substantially eliminated.

A portion of the horizontal drive pulse is made available to the video amplifier from the collector of the horizontal output stage. Its purpose is to clear hum and noise from the signal and provide a DC (black) reference level. This pulse is applied during flyback to clamp on black, when the vidicon has been turned off. The magnetic focus field for the vidicon (and therefore the focus current) must be held extremely constant since even a minute variation of this field has a marked effect on picture focus, and would certainly give a result unacceptable for monitoring work for neurosurgeons.

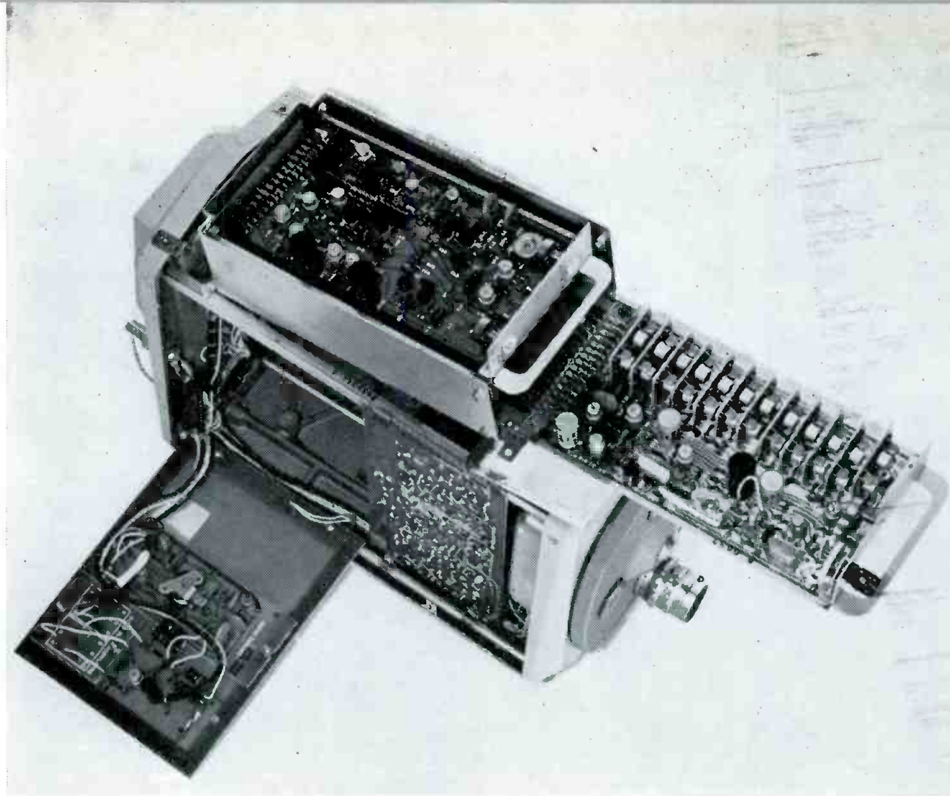
Current through the focus coil is maintained constant by a rectangular circuit in which a Zener diode provides a regulated 3.8 volts fixed bias for the base on a transistor, and hence maintains constant current through this transistor and the series-connected focus coil.

Vidicon signals are developed across the tube's target in the normal way, applied across the target electrode resistor, and these signals are conditioned in a flat-frequency response circuit prior to application to the video amplifier. The preamplifier circuit board contains a valve (tube) plus a transistor stage to give the best possible signal/noise ratio. A dual triode (a 6CM8/ECC86) is operated as a cascade low-voltage amplifier coupled to a transistor output stage. The input impedance is high (to match the output impedance of the vidicon load resistor) and the output impedance is low. Basically the circuit acts as an impedance-matching transformer between the vidicon and the video amplifier, in addition to providing amplification of the vidicon signal.

I was able to have an interesting discussion with one of the Cohu team responsible for the design of this equipment, and was told: 'The vidicon circuit has two major objectives, to obtain a maximum useful signal high signal/noise ratio) and yet retain the HF and LF components of the video signal without serious attenuation. As is so often the case in electronic circuitry, an optimum compromise has to be made. . . .

'The video signal increases directly with the value of the vidicon output resistor; however, noise rises at a substantially lower rate. Consequently a better signal/noise ratio is obtained with a higher-value output resistive load. Then this point arises. . . . The higher the value of this output resistor, the greater the attenuation of the HF components of the video signal with respect to the middle range. Thus in the vidicon curcuit the highs (which are representative of the fine detail of the viewed scene) are apt to be attenuated to establish the vidicon output video signal as far as possible above noise levels. At some stage, as close to the vidicon output as possible, it therefore became necessary to re-establish these high frequencies to the same level as those in the middle range.'

A high-peaker stage, using a single transistor, accomplishes this task. It has an opposite response/frequency curve compared to the shunt resistor-capacitor combination of the vidicon



20/20 camera as used in the Harvard experiment, opened up to show the epoxy boards and etched circuits.

output which declines with increasing frequency. That is to say, it falls with increasing frequency.

This stage uses a process of 'controlled degeneration' in its emitter circuit. A small variable capacitor is used to shunt a portion of the emitter resistance. This adjustable trimmer has a low reactance at high frequencies and acts as an effective emitter by-pass filter capacitor. Thus there is no degeneration, and the high frequencies are fully amplified.

At lower frequencies, however, the capacitative reactance rises and the filter action declines. Consequently this stage re-establishes the HF components to the same level as those in the middle and lower ranges. The camera chain also includes a High-peak control. The capacitor of this is made adjustable to allow for optimum by-passing at the portion of the frequency spectrum which will give the greatest emphasis to the higher frequencies, and produce a rising frequency response from about 100 Kc/s to 8 Mc/s.

In one other interesting feature of the camera, a single transistor is used in the aperture correcting stage. I was given this explanation by the the design team. 'The need for aperture correction arises becauses the diameter of the scanning beam spot in the vidicon tube itself cannot conveniently be made smaller. An electronic method for reducing the apparent scanning spot is therefore needed.

'Consider what happens when the scanning spot of a certain finite diameter is scanning the fine details (that is, the HF response) of a picture. Whenever a sharp transition from white to black or vice versa occurs, the beam cannot follow the change exactly because it takes a finite length of time for the spot to cross over the dividing line between the white and the black. The effect is approximately the same as that which would occur if the video signal had passed through a video amplifier with poor HF response, or inserting a low-pass filter in series with the signal. Since the scanning beam is symmetrical, the loss of the HF response is not accompanied by a phase shift. Therefore the aperture corrector stage provides a phaseless high-frequency peaking, the effect of which is apparently to reduce the scanning spot size and so improve the system resolution. The equivalent loss of high frequencies which provide the fine picture detail can de detected at 3 and 4 Mc/s, and become increasingly apparent as the frequency increases. As this loss of HF would appear to round the corners of a square pulse, pulse sharpening is accomplished by a simple circuit network containing a transistor and capacitor.'

As for the Aperture Adjust control, the collector waveform is inductively coupled in phase with the emitter waveform. The amount of compensation which may be accomplished is determined by a potentiometer which shunts the secondary of one tuned circuit. This pot provides up to 16 dB of compensation, and with a resistor shunting the secondary of the tuned circuit the stage operates as an emitter-follower. The resultant waveform is applied to the emitter of the keyed clamp stage. As in normal practice, the function of this stage is to reset the black or DC-reference level, after this level has been shifted by the coupling time constants in the video amplifier stage, and to restore the lower frequencies in the earlier stages of this amplifier.

As mentioned, the sync generator accessory board is used to provide the vertical and horizontal frequencies required in the Fineline 729-line scan, and for that matter also with the standard EIA 525-line scan. When the sync generator is used, the 43.74 Kc/s output of the crystal oscillator on the deflection circuit board is applied to the master oscillator of the sync generator board. A series of flipflop multivibrator counters divides the output frequency of the MO, with the appropriate feedback at predetermined points, to produce the vertical scan sync signal of 60 cps. Automatic frequency control corrects for phase difference between the AC line power mains and the vertical output.

After acquisition of the 43.74 Kc/s crystal and MO signal, the generation of sync pulses is essentially a series of switching operations, for which transistors are particularly well suited, to the sync generator for this camera is naturally all-transistor. The master oscillator is the conventional Colpitts type, with a slug-tuned inductance to get the precise frequency of 43.74.

While regulated mains supplies are available in technical areas such as the Harvard University cyclotron laboratory, great care is taken in the TV camera chain to provide stable supplies for all circuits. The 20/20 camera power pack consists of three separate sections. One is a voltage tripler giving + 300 volts for vidicon grind No 2, the focus and target electrodes of the camera tube, and + 40 volts for the vidicon protection circuit. The second section provides the − 95 volt regulated supply for the beam; and the third section gives the − 20 volts regulated supply.

Cohu have developed their own system (2480 series) of remote controls for camera controls, zoom lens iris and focus, pan and tilt. In the Harvard experiment it was necessary to have remote and rapid change of focus so that at one instant the flowmeters could be read, and then in a fraction of a second the camera could be panned and refocussed so that obstructed breathing of apnea could be observed by directing the camera lens to the rib cage or breathing bag. Relay switching was also introduced so that in case of difficulty the proton beam could be instantly cut, and the treatment room entered.

That the first series of tests (involving two female and two male children, ages 3-12, with complaints including glioma of hypothalamus, and pontine glioblastoma involved total doses (in rad) of up to 16,000, and were completely successful, is a tribute to the neurosurgeons who devised this first cyclotron experiment. But the success is also partly due to the safe and efficient TV monitoring; and, as a result, there were no anaesthetic complications.