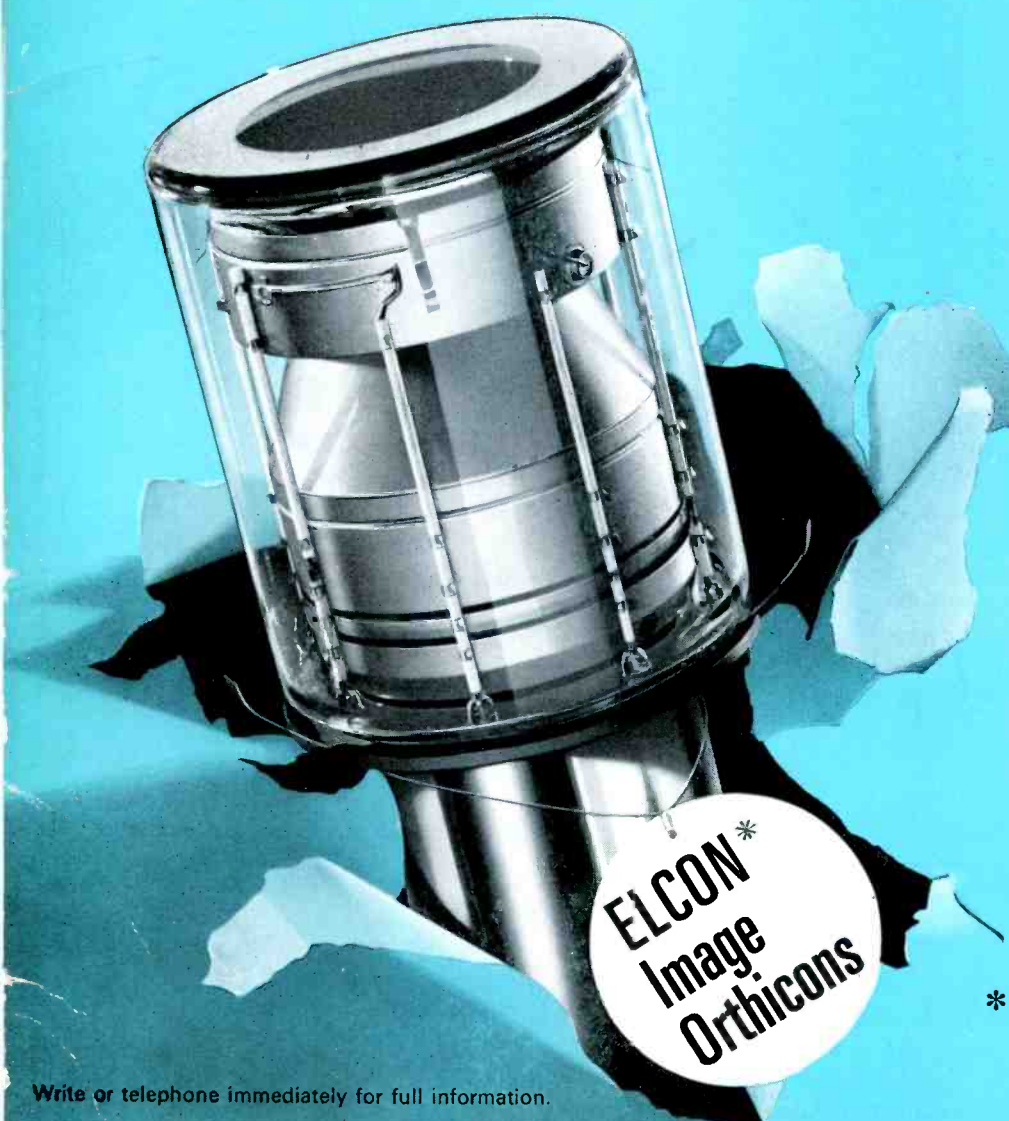
International Broadcast Engineer

No. 9
June 1965
3/6

MAJOR TECHNICAL BREAKTHROUGH BY 'ENGLISH ELECTRIC'



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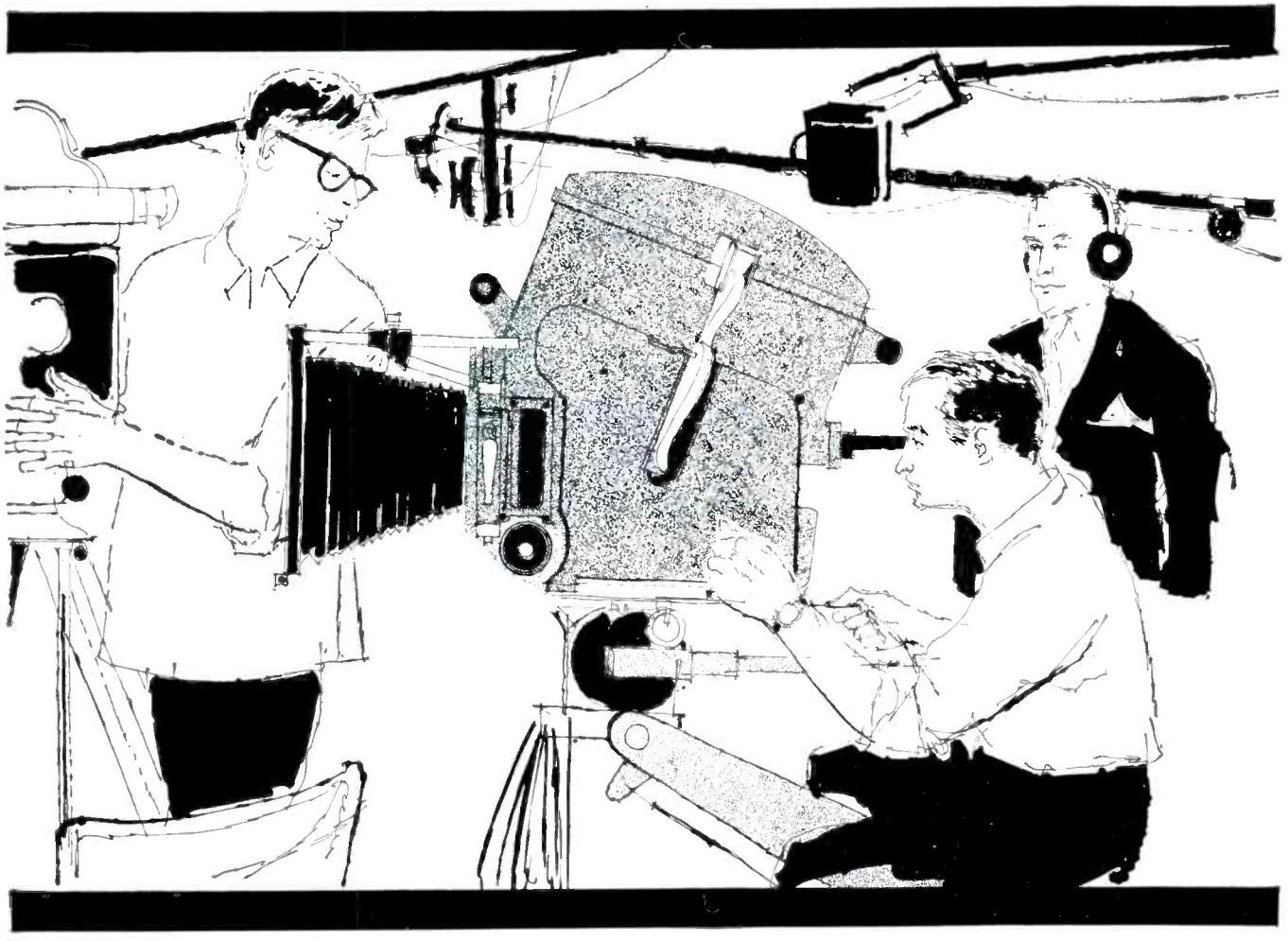

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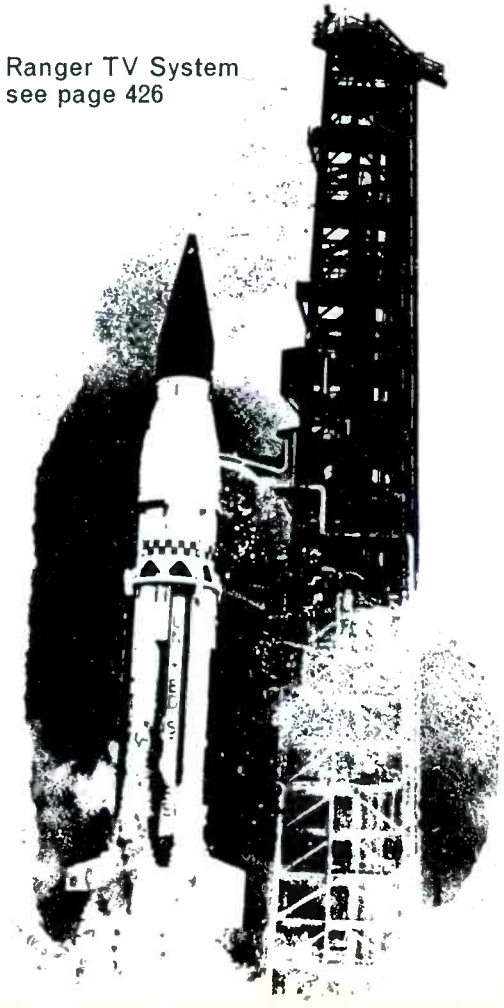

Ranger TV System
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advertisers

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9 OUT OF 10

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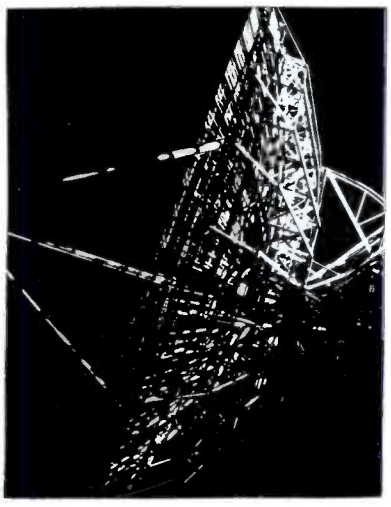

OUTLOOK

The trend to Princess Adelaide

WE ARE in great haste to construct a magnetic telegraph from Maine to Texas: but Maine and Texas, it may be, have nothing important to communicate. . . .'

So said the great Henry Thoreau when the first telegraph was installed on the American continent, linking the Pacific and Atlantic coasts.

'Either is in such a predicament as the man who was earnest to be introduced to a distinguished deaf woman, but when he was presented, and one end of her ear trumpet was put into his hand, had nothing to say. As if the main object were to talk fast, and not to talk sensibly. **We are eager to tunnel under the Atlantic and bring the Old World some weeks nearer to the New. But perchance the first news that will leak through into the broad, flapping American ear will be that Princess Adelaide has the whooping cough.'**

No longer do we attempt to 'tunnel under the Atlantic.' We have a range of communications satellites which do the same job for us, far better, higher up. But is the substance communicated worth the effort? TV engineers have the right to ask.

It will be recalled that recently under the aegis of the International Telecommunication Union, 70 nations of the world met at Geneva and reached an agreement providing frequency allocations for space communication. At the conclusion of this Conference, President Kennedy, in what proved tragically to be his last official statement from the White House, commented: 'This government and the United States Communications Satellite Corporation can now take practical steps, in co-operation with other governments and foreign business entities, to develop a single global commercial space communication system. It continues to be the policy of the United States that all countries which wish to participate in the ownership, management and use of this system will have an opportunity to do so.'

We confess to being greatly impressed by Leonard H. Marks, a member of the Board of Directors of Comsat, who when recently addressing the Association for Professional Broadcasting Education, summarised the initial attempt to use TV satellite communication. He explained that the advent of Telstar on July 10 1962, heralded the opening of a new era in broadcast communications. Thirteen days later there was dramatic proof of the potentialities of satellite transmission when Europe and North America exchanged live programmes for the first time. Viewers on both sides of the Atlantic Ocean enjoyed front-row seats at historic events taking place simultaneously 3,000 miles away. The continuing experience to date has been similarly noteworthy. When the Ecumenical Conference convened in Rome, the historic event was presented on both sides of the ocean. When the Mona Lisa was displayed at the National Gallery of Art in Washington, European viewers (who, be it admitted, had not bothered over much about the enigmatic portrait when it was displayed in Europe) saw and heard diplomatic dignitaries and watched them parade through the Gallery. And then when the leaders of the world came to Washington to pay tribute to the memory of President Kennedy, **the whole of Europe and the Soviet Union** was able to watch the funeral services via satellite. It was significant yet sad to think the world was mourning the passing of a President who had welcomed satellite communication as long ago as July 24 1961, when he announced the US policy: 'Science and technology have progressed to such a degree that communication through the use of space satellites has become possible. Through this country's leadership this competence should be developed for global benefit at the earliest practicable time . . . I again invite all nations to participate in a communications satellite system in the interest of world peace and closer brotherhood among the peoples of the world. . . .'

Consistent with this policy, the United States offered a resolution in the United Nations looking towards this goal. And on December 20 1961, the United Nations General Assembly unanimously adopted Resolution 1721 which calls for communications by satellite to be made 'available to the nations of the world as soon as practicable on a global and non-discriminatory basis.'

As Leonard H. Marks points out (and he was speaking just prior to the launching of the first commercial communication satellite Early Bird), since the existing satellites have not been designed for the transmission of regular commercial traffic, Transatlantic exchange of broadcast programmes has been purely experimental. Programmes have, as we know, for technical reasons been limited to a brief period of the day when the satellite was visible to points in Europe and North America simultaneously. With the launching of a commercial system, it is hoped the service will be available at all times, and plans for programme exchanges can be made well in advance, and with regularity.

'During the first year of satellite communications,' says Marks, 'there have been approximately 75 major programmes of world interest, comprising about 25 hours of programme time. Today these Transatlantic exchanges have become routine, and plans are now being made for a global communication system which will link all parts of the world on a 24-hour-a-day basis.'

The technical problems are not limited only to microwave channels, and to TV relaying on Gc frequencies. Quite apart from the Space techniques and satellite microwave relaying by high-flying klystrons, experts are suggesting mammoth earth-level relays so that the material handled by these satellite channels should not deal with trivia. It is suggested the dons of Oxford should share a 'school of the air' with the deans of Harvard. It is urged that by satellite, President Johnson, Premier Kosygin, Prime Minister Wilson and President de Gaulle should speak directly to the world, while U Thant should talk directly by satellite TV on the activities of the UN. It may bluntly be asked how many millions would wish to see and hear such programmes. Sadly, one admits there is a large slice of human life unable to see beyond the trivia of present-day programme television: nor can one doubt their sincere interest in Princess Adelaide's ailments. . . .

But the final technical masterstroke comes from Leonard H. Marks. 'If I may venture a prediction,' he says, 'it also appears likely that someday it will be possible to equip a satellite with transmitting facilities so that **direct radio and television broadcasts** may be beamed into the viewers' homes instead of to ground stations for relay by existing broadcast stations. Satellites hovering around the earth at distances ranging from 6,000 to 22,000 miles in outer space can reach vast segments of the world's population simultaneously. Here indeed will be the ultimate challenge!'

by John Dickson, Ph.D.

RANGER TV SYSTEM

by Bernard P. Miller
Project Manager, Ranger TV System
RCA Astro-Electronics Division, Princetown, New Jersey.

MAN tends to segregate himself from other members of the animal kingdom on the basis of his ability to observe, record, and analyse by means of both deductive and inductive reasoning. One major area of concentration of these abilities has been Earth's only natural satellite. Man has speculated as to the nature of the moon ever since he raised his eyes to contemplate the heavens. As his ability to reason developed, so also did his curiosity. He began to seek methods of improving his observations and of recording the information thus obtained. For centuries, man's interest in the moon continued, attempting to ascertain the composition and configuration of this distant body. These efforts culminated in the development of telescopes with as large as 200-inch reflectors, but the great distance between earth and the moon (240,000 miles) and the limiting effect of the motion of earth's atmosphere have prevented man from observing features of the moon less than one-half mile in size.

On July 31, 1964, man was effectively taken out from under the cover of the atmosphere of the earth, brought to within 1,700 feet of the lunar surface, and allowed to observe and record for intense analysis. This close observation was made possible by NASA's Ranger-7 Spacecraft* which successfully obtained approximately 4,000 high-resolution television pictures of the lunar surface. These pictures represented an improvement in resolution of 2,000 over the best previous photographs secured by earth-based telescopes.

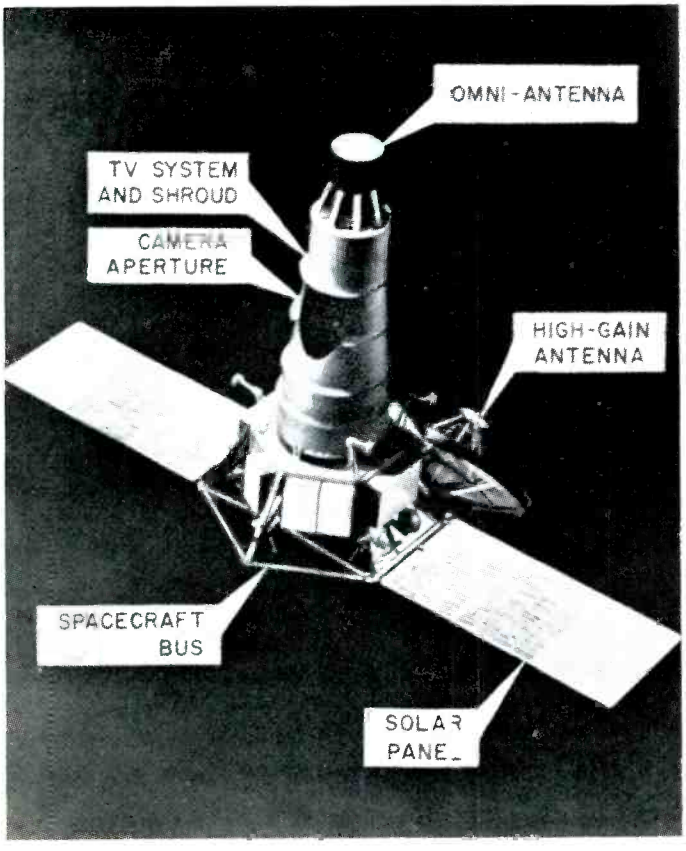

Figure 1. Ranger 7 Spacecraft.

These photographs have enabled astronomers, and the scentific community in general, to analyse the terrain of the lunar surface to a degree never before realised. The Ranger Spacecraft has provided a new tool for improved lunar topographic analysis with the ability to distinguish craters smaller than 3-feet in diameter and specifically locate them. Ranger 7 provided this information for Mare Cognitum, the name given to the Ranger-7 impact area. Future Ranger missions will observe and record other parts of the lunar surface.

Ranger Spacecraft

The Ranger-7 System teamed spacecraft-based television cameras with accurate earth-based receiving and recording equipment to perform its historic mission. In effect, the Ranger Spacecraft and ground equipment performed as an astronomical instrument which enabled the astronomer to observe and record his observation of the moon at a close range, without the limiting factors of distance and a turbulent atmosphere.

The 806-pound Ranger Spacecraft shown in Figure 1 consists of a frustum-shaped TV Camera System mounted on a hexagonal structure (or Bus). The Bus and TV System operate essentially independent of each other.

The Spacecraft Bus provides its own power, telecommunications, guidance and control, propulsion, temperature control, and pyrotechnic subsystems required to navigate the 67-hour journey to the moon and provides a stable platform for the TV System during the picture-taking sequence. The Spacecraft Bus employs two antennas: a high-gain antenna, hinged from a corner of the hexagon between the solar panels, which is used to transmit both telemetry and the video output of the TV System; and an omnidirectional antenna, mounted atop the TV System, which receives the signals transmitted from earth and transmits Spacecraft telemetry to earth whenever the high-gain antenna is not earth-oriented. The Spacecraft Bus is designed and built by JPL for NASA.

TV System

The TV System is the means by which the primary data-gathering function of the Ranger mission is performed. This self-contained unit provides the power, control and communications equipment for collecting, processing, and transmitting the photographic information of the lunar surface. In a normal mission, the picture-taking sequence is initiated by an earth-generated command, with the first picture taken at an altitude of approximately 2,000 km from the lunar surface and continuing uninterrupted until lunar impact. The initial pictures cover a wide area of the moon at resolutions comparable to that obtained by earth-based telescopes. Area coverage is traded for increasing resolution as the TV System approaches impact at a terminal velocity of 2.700 metres per second, until resolutions of 0.5 metre, or better, are achieved in the final picture sequence.

The TV System is separated into two essentially independent channels of operation to ensure a maximum probability of

* The Ranger Programme is being conducted for the National Aeronautics and Space Administration (NASA) by the Jet Propulsion Laboratory (JPL), California Institute of Technology. The Astro-Electronics Division of the Radio Corporation of America (RCA) is major sub-contractor to JPL, responsible for the design, fabrication and test of the TV System.

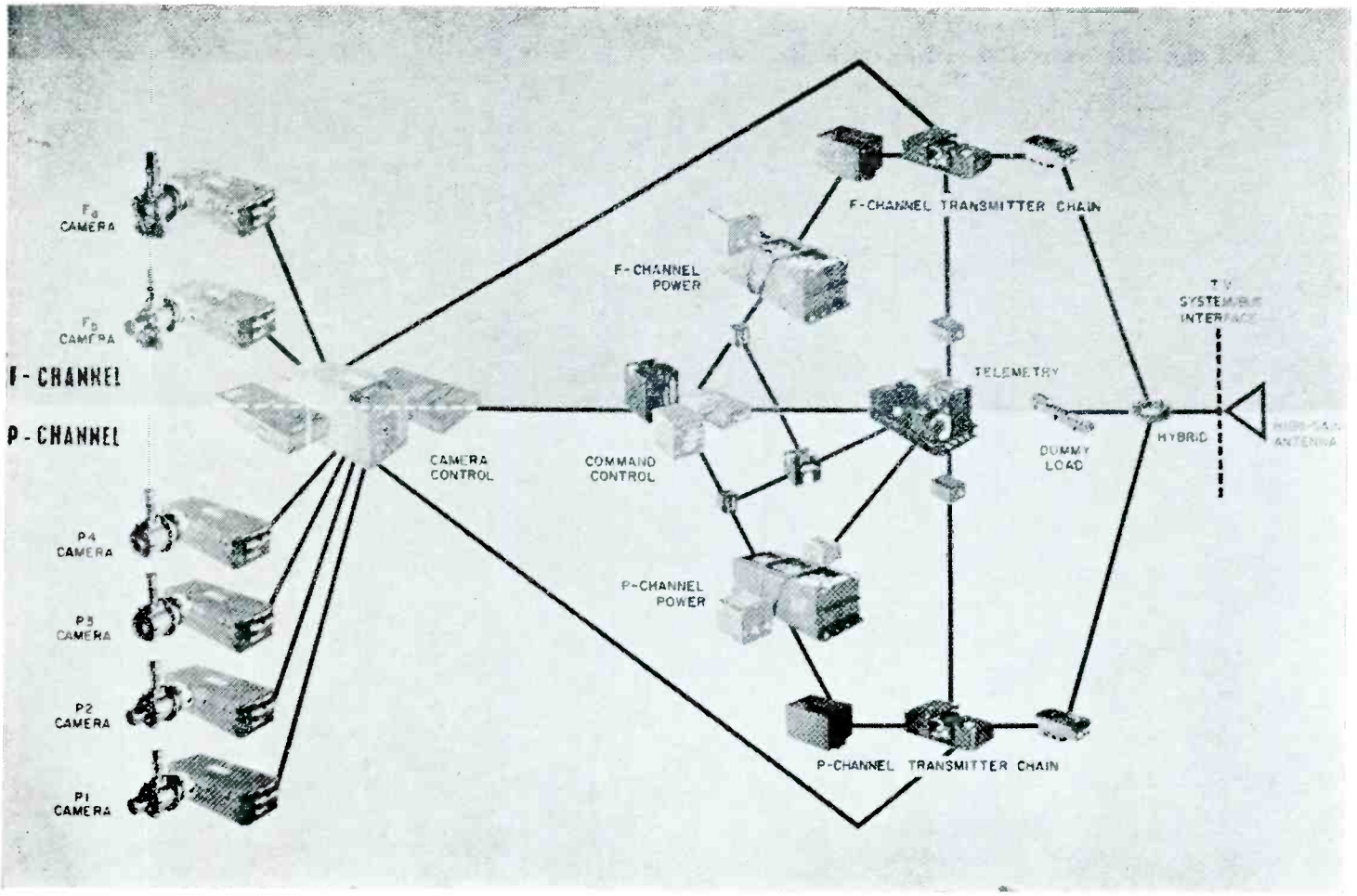

Figure 2. Channel Separation of the Ranger TV System.

mission success. Channel separation is illustrated in Figure 2. Each channel provides the functional components required to collect, process, and transmit the video information of the lunar surface. The channel separation is a function of the distinction between the two types of cameras employed: full-scan and partial-scan. There are two full-scan cameras and four partial-scan cameras. Both types employ ruggedised one-inch vidicon television tubes with a highly sensitive photoconductive target as the image transducer. The basic difference in the design of the two types of cameras is the area scanned on the vidicon faceplate and thus the time required to read out the stored image. The high sensitivity of these vidicons dictates an image retention characteristic which requires that their photoconductive surface be brought to a uniform potential, or 'erased,' after a frame readout and prior to a subsequent exposure to prevent a double image. To provide for maximum utilisation of the communications equipment, multiple cameras, operating during each other's 'erase' cycles, are used to fill what would otherwise be non-productive portions of the available transmission time.

In order to satisfy the requirements of high resolution, it was desirable that the final sequence of pictures be taken from a minimum altitude above the lunar surface. The minimum altitude for the final pictures is determined by the time required to readout the video data from the camera and by the Spacecraft terminal velocity. Minimum altitude, and thus highest resolution with a given optical system and camera design, is therefore obtained by minimising the camera readout time. However, the minimum readout time is also constrained by the number of scanning lines (or line density) required to provide the desired picture resolution, and the maximum permissible system video bandwidth, which in this case was fixed at 200 kc for each channel. In the Ranger TV System, high line density and minimum readout time were achieved by the use of a special method of raster formation with a high-resolution, slow-scan vidicon camera tube. Minimum readout time is achieved in the four partial-scan cameras by scanning only the central 282 lines of a nominal 1,125 TV line raster, enabling a 0.2-second frame time with a corresponding altitude of less than 2,000 feet for the exposure and transmission of the last complete frame. A set of four partial-scan cameras (designated P1, P2, P3, and P4) are exposed and read out sequentially at 0.2 second intervals to ensure continuous coverage until impact with the partial-scan channel, based on a complete picture cycle time (exposure, read, erase, and prepare) of 0.8 second for one camera.

The vidicon image format for the partial-scan cameras is 0.11 by 0.11 inch. The P1 and P2 Cameras are equipped with 76 mm f/2.0, narrow-angle lenses to provide films of view of 2.1 degrees, and the P3 and P4 Cameras with 25 mm f/1.0, wide-angle lenses to provide fields of view of 6.3 degrees. The sequence of operation is P1, P3, P2, and P4, so that photographs are alternately taken by a narrow-angle lens and wide-angle lens. The combination of the optics, reduced scan area, and minimum readout time provides the capability to achieve a resolution of 0.5 metre per optical line pair in the final sequence of pictures.

The TV System also contains two cameras which utilise the full 1,125 TV line raster with a correspondingly longer read-out time to provide coverage of wider areas of the lunar surface at a level of resolution that is sufficient to locate and extrapolate the data observed in the final high-resolution pictures. These cameras, designated Fa and Fb, are exposed and readout sequentially at 2.5-second intervals, and have a 0.44-inch-square image format. The Fa-Camera is equipped with a 25 mm f/1.0, wide-angle lens to provide a 25-degree field of view, while the Fb-Camera has a 76 mm f/2.0, narrow-angle lens to provide an 8.4-degree field. One reason for having several cameras with different lens apertures is that prior to the flight of Ranger the lighting conditions on the moon could not be precisely determined from earth. The different lenses employed provide greater exposure latitude, allowing picture taking over a wide range of lighting conditions. The range of lunar lighting conditions covered by the lenses and the dynamic range of the vidicons is 30 to 2,600 foot-lamberts, which roughly corresponds to lighting conditions on earth (on an average day) from noon to dusk.

The full-scan cameras provide pictures with slightly different pointing vectors to achieve a partial overlapping pattern.

Ranger TV system—continued

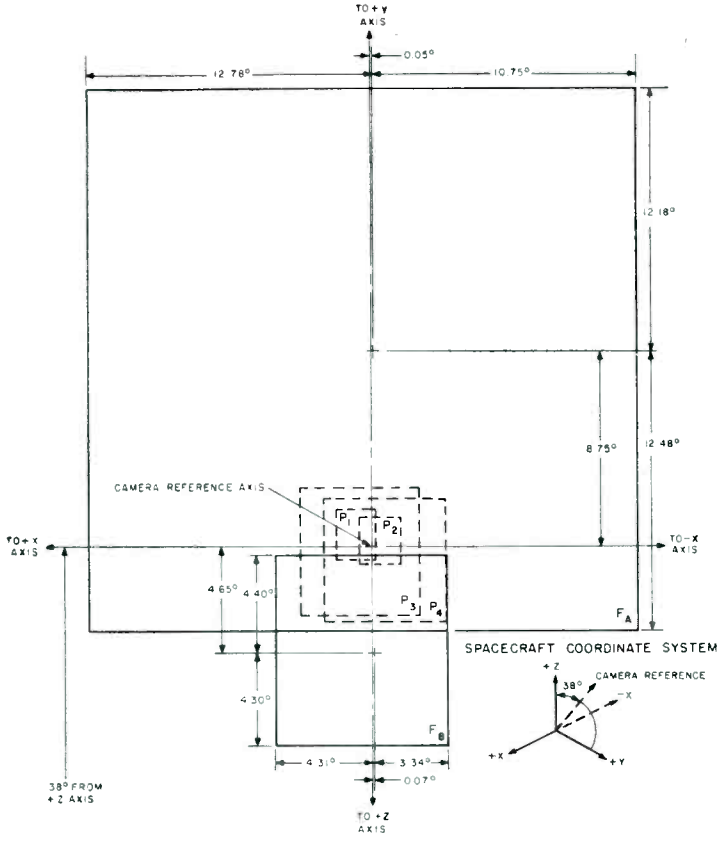

Figure 3. Picture Nesting Pattern Provided by the Ranger TV Cameras

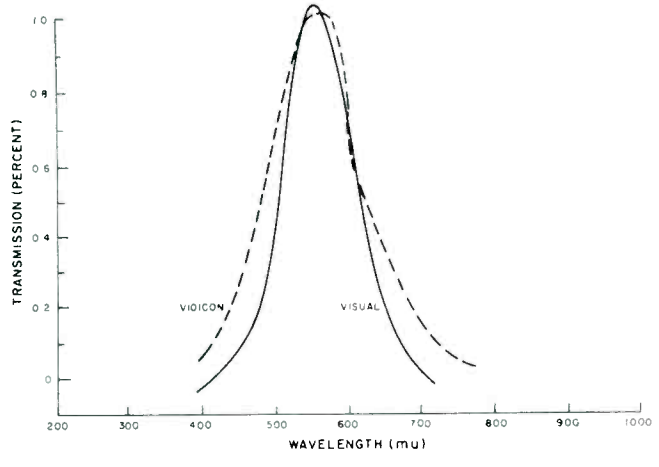

Figure 6. Spectral Response of Ranger Vidicon Compared to Human Eye

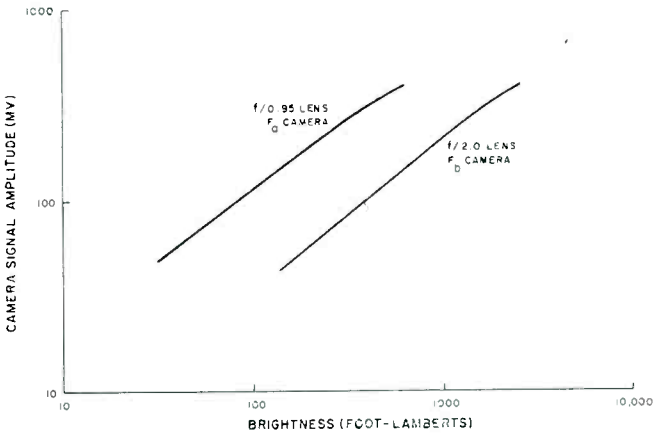

Figure 4. Sample Light Transfer Characteristics of Ranger Cameras

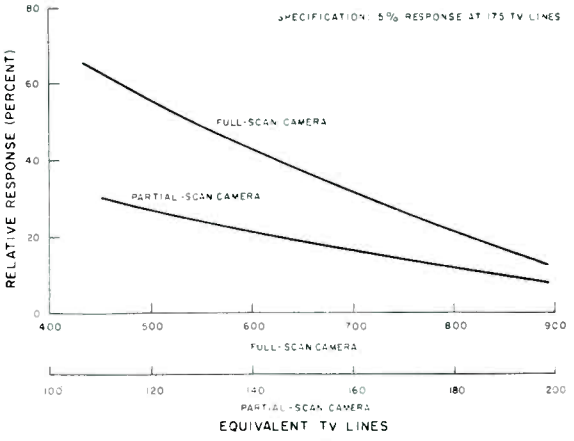

Figure 5. Sample Horizontal Square Wave Response of Ranger Cameras

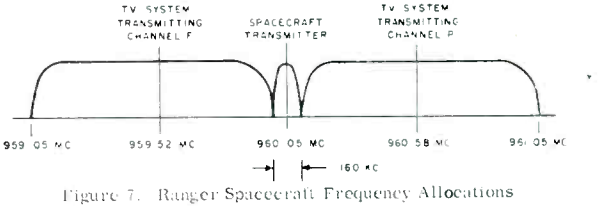

Figure 7. Ranger Spacecraft Frequency Allocations

The four partial-scan cameras are arranged with slightly divergent pointing angles to provide a series of photographs whose coverage will result in a nesting pattern around a common optical axis as shown in Figure 3. This figure shows the theoretical pointing angles and coverage for each of the six cameras. In practice, however, an accurate determination must be made of the actual pointing angles and camera overlap so that the relation of each picture received from the Spacecraft during the actual mission will be known. A special camera array alignment procedure is used to accurately determine the angular relationship of the six cameras. The integrated TV System, with the cameras in flight configuration, is positioned with respect to a stationary target to within one minute of arc using an auto-collimating theodolite. Pictures are taken of the target with each of the cameras, and the video signal is processed and displayed on a kinescope. The resultant image is then photographed with a 35 mm film camera and the film is developed for viewing and analysis. The actual pointing angle for each camera is then compared with the theoretical position by measuring the reticle position and picture edge on the developed film with respect to markings on the target.

Each TV camera employs a magnetically focused and deflected vidicon tube having a special photoconductive surface with excellent sensitivity, high retentivity, and good erasure characteristics. The sensitivity of the vidicon used in the Ranger TV cameras is similar to a photographic film with an ASA rating of five to 20 (DIN of eight to 14). Each vidicon is capable of supplying a signal current greater than 10 nanoamperes at a light level of 0.3 foot-candle-second. The peak-to-peak residual signal after erasure is less than five per cent

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Mark V on location

Ilford Mark V negative was used throughout in the new Raymond Stross production "Ninety degrees in the shade" starring Anne Heywood and James Booth. This scene was shot at 250 A.S.A. (daylight) using filters.

The most versatile film in the world.

Mark V on the Stock Exchange

A still from a Pathe Newsreel documentary, shot at full aperture with an estimated exposure of 600 A.S.A. (tungsten).

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Mark V on TV

From the BBC TV programme "Dixon of Dock Green". The speed rating given to the negative was 1000 A.S.A. and the BBC cameraman shot at 40ft. candles at F/8. The negative received forced development.

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Ranger TV system—continued

of the peak-to-peak signal before erasure. The light transfer characteristic (gamma) is shown in Figure 4 for typical Ranger cameras. A sample of the horizontal square-wave response curve for both a full-scan and a partial-scan camera is shown in Figure 5. The spectral response of the tube compared to the human eye is shown in Figure 6. In operation, the photoconductive surface is prepared for exposure by uniformly charging the surface with the electron scanning beam. Optical exposure modifies the stored charge in accordance with the photoconductive resistance changes induced by the image. The electron beam then scans the surface using a conventional raster technique. The video signal is dependent upon the discharge which occurred during exposure. When the picture has been read out, the tube surface must be erased to eliminate any residual image which would interfere with the next photograph.

Each camera is provided with a metallic focal-plane shutter. This shutter is a solenoid-operated, sliding-aperture type that moves from one side of the lens to the other each time a picture is taken. The moving blade is located as close to the focal plane as possible. The shutter is designed to provide the full-scan cameras with a four-millisecond exposure and the P-cameras with an exposure of two milliseconds to minimise image motion. The faster sequencing of the P-cameras provides photographs from a much lower altitude than the F-cameras so that image motion becomes a critical factor in terminal resolution. The shutter is a unique high-reliability design with a demonstrated capability of one million operations; many more than could possibly occur during the testing and flight of a Ranger Spacecraft.

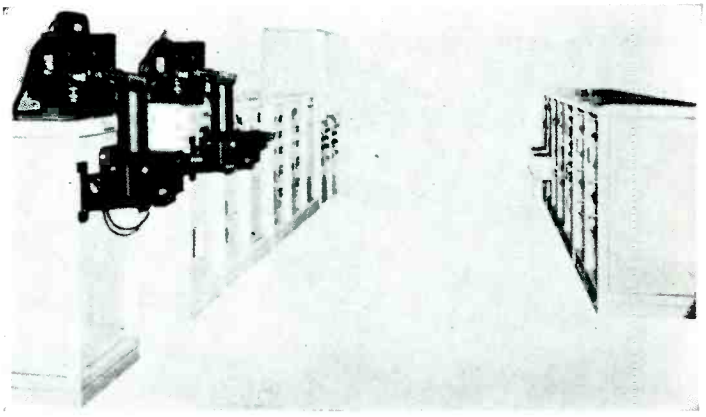

Figure 8. Operational Support Equipment at the Echo-Site Ground Station.

The Fa and Fb Cameras along with their associated electronics circuits, sequencing circuits, video combiner, a control circuit, a power-distribution circuit and transmitter comprise the F-Channel of the Ranger TV System. The P-Channel contains independent, functional circuits, identical to the F-Channel to control, process, and transmit the video information obtained by the four partial-scan television cameras. In addition, the P-Channel contains the secondary synchronising and

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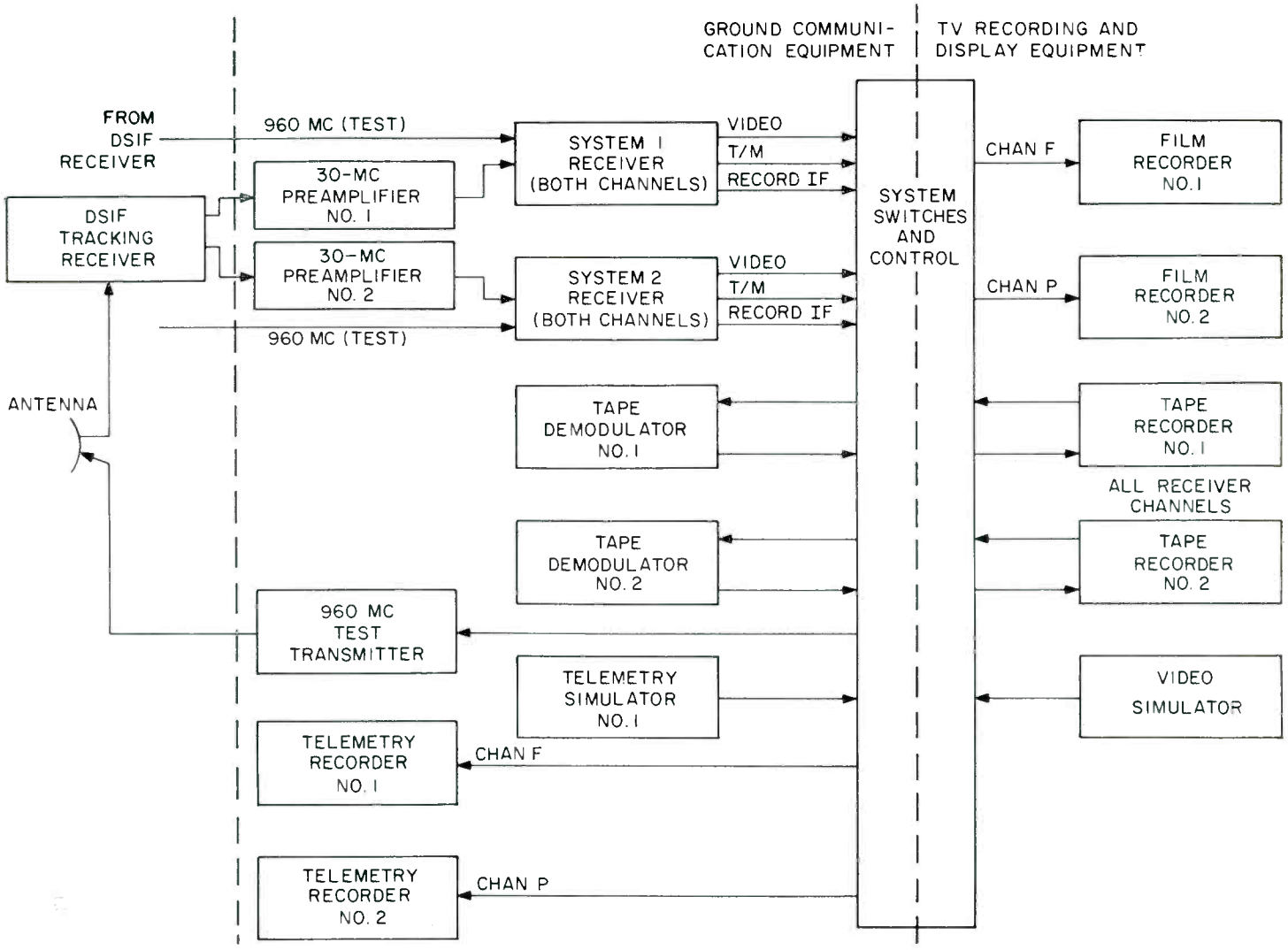
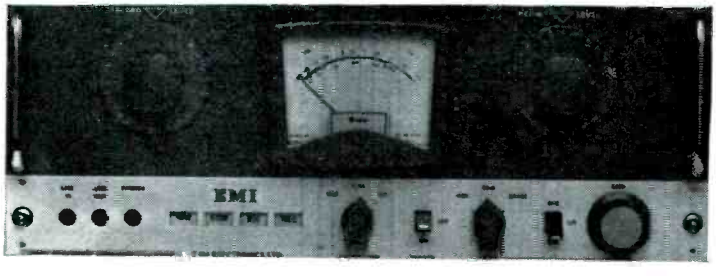


Figure 9. Goldstone Ground Receiving Equipment (Simplified)

NEW TAPE RECORDER TYPE BTR4



EMI SOUND IS INTERNATIONAL

Here is a truly international tape recorder, advanced in concept and designed to the highest professional standards—NAB, cine or 11.25 inch (28.57 cm). European spools can be accommodated and special versions are available with the head block reversed for operating with tape wound oxide out. The BTR4 can be supplied for full track, half track or twin track stereo recording on 0.25″ (6.3mm) tape and for three or four track recording on 0.5″ (12.6mm) tape. Tape speeds are 15-7.5 inches/second (38-19cm/sec) or 7.5-3.75 inches/second (19-9.5 cm/sec). Transportable, console, trolley-mounted or rack-mounted versions are available and compatible units, such as microphone amplifiers and mixers, can also be provided. The tape deck is also available without the amplifier assembly for use with other electronic units. Here are just a few of the features of the EMI BTR4 :—■ Wow and flutter at 15 inches/second, 0.1% r.m.s. Frequency response ± 2dB from 30 c/s-20 Kc/s. Signal to noise ratio is better than 60dB unweighted. ■ Plug-in head blocks of rigid construction permit pre-aligned units to be instantly inter-changed with minimum setting-up procedure. ■ Extra record or replay head can be fitted for film synchronising. ■ Three-position switch enables record/replay equalisation characteristic to be changed between C.C.I.R., N.A.B., and I.E.C. standards. ■ Variable spooling in either direction with automatic removal of tape from heads by retractable guides. Automatic action governed by manual over-riding control which can be locked in running position during spooling. ■ Instant start 0.2 seconds at 15 inches (381mm) per second.

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Ranger TV System—continued

electronics circuits necessary to provide the P1 Camera with the capability of a 'free-running' mode of operation. This capability would permit the P1 Camera to operate in the event of a failure of the P-Channel Sequencer and thus ensure that the high-resolution pictures would be obtained.

The major objective of obtaining high-resolution television pictures of the lunar surface cannot be attained by merely providing high quality cameras. To achieve total success, the image of the lunar surface obtained by the TV

▶ *to page 434*

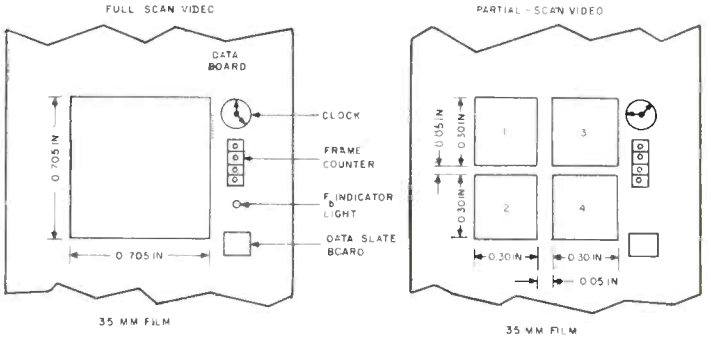

Figure 10. Film Recordings

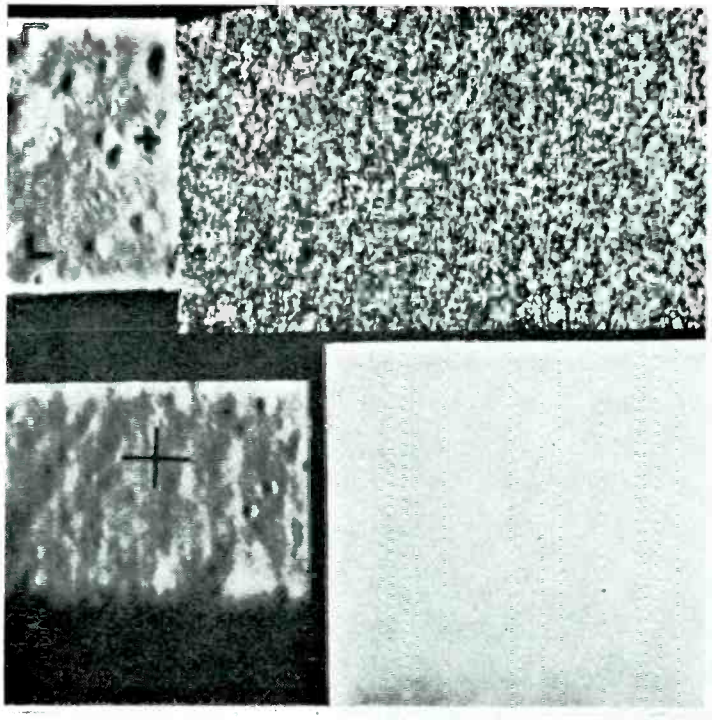

Figure 11. Final P1 and P3 Camera Frames Taken by Ranger 7

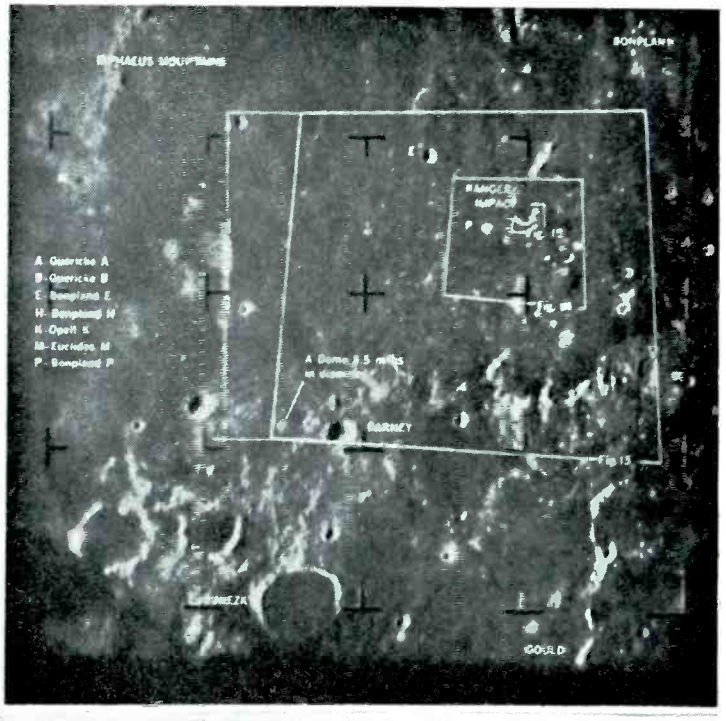

Figure 12. F_E Camera Image with Overlays Indicating Wide Area Coverage and Picture Nesting

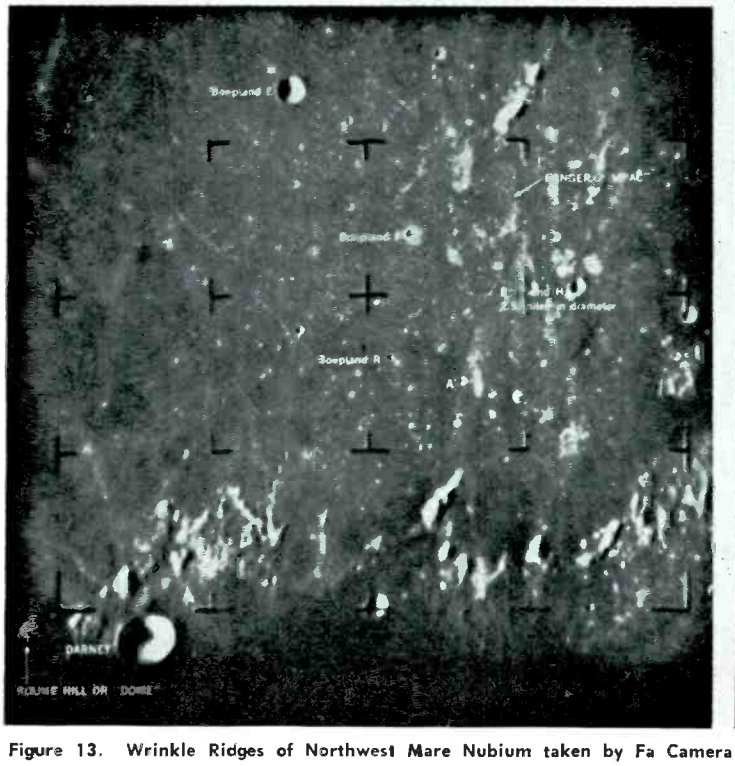

Figure 13. Wrinkle Ridges of Northwest Mare Nubium taken by Fa Camera.

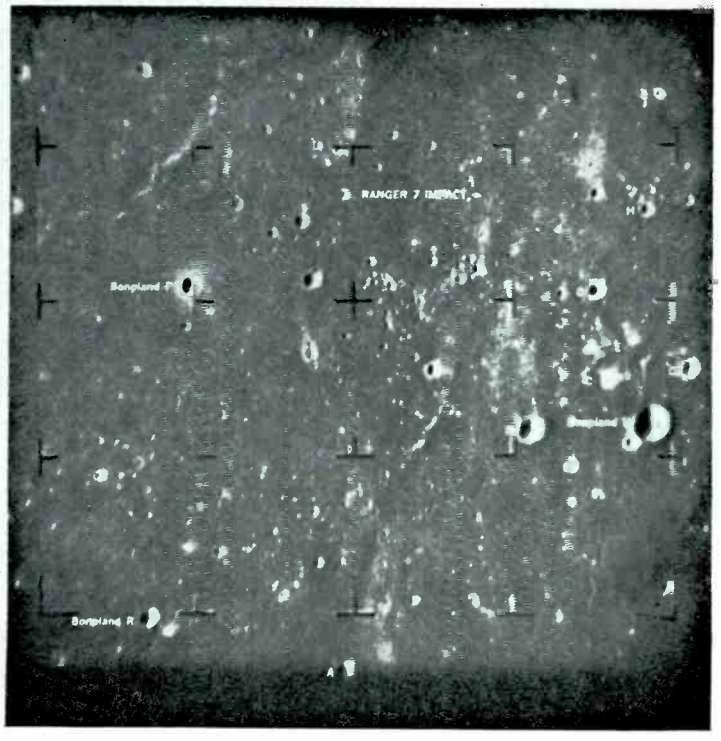

Figure 14. Last of known craters; image taken by Fa Camera.


NOISELESS – MANOEUVRABLE – VERSATILE
So silent that it will not obtrude in the quietest take; manoeuvrable, with finger-tip control, to follow every movement of the actor; versatile, for film or TV—in studio or on location—for any type of microphone. Compact, because its combination of adjustable counter-weighting and spring balance reduces the back extension and makes minimum demands upon valuable studio space.
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Ranger TV system—continued

cameras must be converted to a form suitable for transmission to earth. Additionally, the fidelity of the video data secured has to be retained throughout the communications chain, the spacecraft-to-earth link, the receiver-to-display link, and the display-to-record link. Confidence in the integrity of operation at each point in these functional links was achieved through a program of rigorous design, exacting calibration, and complete testing which verified and checked the operational readiness right to the time of launch.

Each camera of the TV System has an associated electronics unit which amplifies the signal read from the vidicon faceplate and supplies the signal to a video combiner circuit for processing. The operating voltages, sweep signals, and focus signals for the vidicon and yoke assembly of the associated camera are all generated in the camera electronics units. F- and P-Channel camera sequencer circuits provide the synchronizing and sequencing signals to the cameras; and also provide gating signals to the video combiner circuits. In the video combiner, the video signals from each F- and P-Camera are amplified, processed, and applied as composite F- and P-video signals to the transmitters.

The two transmitters employed were designed to operate in the frequency band of 960.05 ± 1 Mc. The nominal centre frequency of the F-Channel transmitter is 959.52 Mc and the nominal center frequency of the P-Channel transmitter is 960.58 Mc. This transmission spectrum is shown in Figure 7. Both transmitters are identical except for center frequency. The composite F- or P-Channel video signal, which has a 187-kc basebandwidth, is applied to the transmitter, where it is frequency modulated, frequency multiplied, amplified, and then applied to a 60-watt power amplifier. The two 60-watt power amplifier outputs (from F- and P-Channel) are combined in a four-port hybrid ring to provide two outputs with 30-db of isolation. One output is dissipated in a dummy load; the remaining signal is applied to the 4-foot high-gain antenna mounted on the Bus and transmitted to earth. The test cycle for each TV System provides for an alignment procedure for the communications equipment which assures that each transmitter chain is operating at the correct frequency, and that the equipment is providing the required power output and frequency response of a calibrated input.

Operational Support Equipment

The spacecraft-transmitted r-f signal is received by the 85-foot parabolic antenna at the Echo-site Ranger Ground Station located at the Deep Space Instrumentation Facility (DSIF), at Goldstone, California. The Antenna receiver system, using a maser front end, converts the 960.06-Mc f-m signal to a 30-Mc, dual-channel signal and applies it to the operational support equipment (OSE), through a 30-Mc preamplifier, for processing, recording, and display. A picture of the OSE is shown in Figure 8. A simplified block diagram of the OSE is shown in Figure 9. The signal is again frequency-converted to the 5-Mc region in the dual-channel limited amplifier of the OSE receiver, and separated into two individual video channels for further processing. The channel containing the full-scan video signal is centered at 4.47 Mc, and the channel containing the partial-scan video signal at 5.53 Mc. These 4.47- and 5.53-Mc signals are then applied to detector amplifiers, and 'record i-f' amplifiers.

In the detector amplifiers, the signals are amplified, limited, detected, and de-emphasised, and then applied through a low-pass filter to the TV recording and display equipment for 'on-line,' or real-time display and 35-mm film recording of the video. The outputs of the detector amplifiers are also applied to a 225-kc discriminator, which rejects all video information from the signal and allows real-time display of the telemetry data, through a d-c coupling amplifier, on a strip-chart recorder.

The signals applied to each record i-f amplifier from the limiter amplifiers are frequency-converted to the 0.5 Mc region and made available to the TV recording and display equipment for the predetection tape recording of the composite video and 225-kc telemetry data.

TV recording and display equipment provides interim storage of predetected i-f data, and reduction, display, and archival storage of the transmitted video information. Archival storage of the video data is performed automatically by 35-mm film recorders which provide photographic records of the kinescope displays of the F- and P-Channel video. In addition, photographs of selected video displays are taken semi-automatically by means of a Polaroid camera.

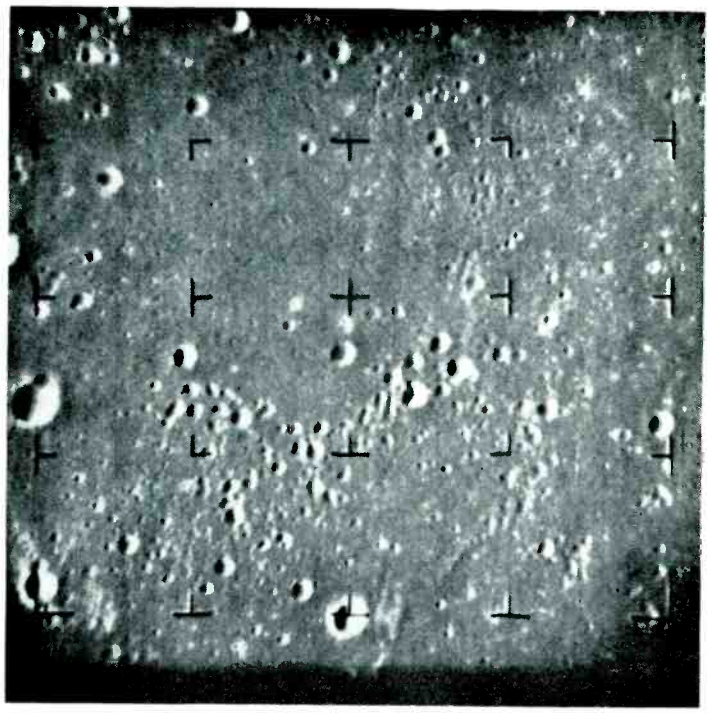

Figure 15. Crater Rays; picture taken by Fa Camera.

In the film-recorder equipment, kinescopes which utilize 5-inch cathode ray tubes (CRT) display a full frame P1, P2, or Fb video (Channel F), or four frames of camera P1, P2, P3, P4 video (Channel P). The kinescope for P-Channel presentation displays the video frames of Channel P in sequence and divided equally in area and aspect ratio in the four quadrants of the CRT. A 35-mm camera then photographs the CRT and a data board, which identifies the video display through use of a real-time clock, an indicator light to identify a Fb-Camera display, a frame counter, and a slate board for handwritten information. Additionally, a Polaroid camera is used for single-frame, sampling photographs. The film-recording formats are illustrated in Figure 10.

The tape recording equipment employed for predetection recording of the composite video and 225-kc telemetry signals are seven-channel, wideband, magnetic-tape devices. The recorders operate at a tape speed of 120 inches per second, and an interconnection technique is used whereby each recorder records both full- and partial-scan video.

Additional redundancy is provided through the use of two completely separate ground stations including antennas, receiving, processing, and display equipment at the JPL Goldstone, California Deep Space Instrumentation Facility. Both operational-support chains operate simultaneously during the terminal mode of the mission.

Maximum probability of successful satisfying the mission requirements of obtaining high-resolution pictorial data of the lunar surface is achieved by the transmitted signal being received, processed, and recorded with minimum loss of integrity of fidelity. To ensure that the ground-station equipments have the capability of performing this function, a detailed test and calibration program is carried out prior to the spacecraft mission, and also during the mission prior to the terminal mode of operation. This test program provides confidence that the pictures received and recorded are faithful reproductions of the lunar image viewed by the television cameras.

Prior to the Ranger mission, proper operation of the communications equipment is verified by checking all significant operating parameters through the use of a test transmitter, tape demodulator, and standard and special test equip-

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INTERNATIONAL NEWS

Tropospheric relay

AN EXPERIMENTAL BROADCAST of a television programme from Moscow to Petrozavodsk, a distance of 560 miles, took place on May 1 via the troposphere—that portion of the atmosphere which is below the stratosphere.

Use was made of the effect of long-distance tropospheric propagation of ultra-short waves. The waves were transmitted, not along the line of sight, but at a certain angle upwards, so that they could be reflected from the layers of the atmosphere at an altitude of 12—15 kilometres (7½—9½ miles).

As a result, the length of each relay section was nearly 170 miles instead of the usual 18–37 miles.

Powerful transmitters, special directional antennae and sensitive receivers were employed in the experiment. Picture quality was good.

In the opinion of Russian experts the results give grounds for hoping that this method of television relay via the troposphere can be used in areas which are difficult of access. Tall aerials will not be needed because the radio waves can 'step over' even the highest mountains.

Symposium

A SYMPOSIUM of over 30 papers concentrating primarily on the applications of microelectronics will be held at the University of Southampton, England, from September 21 to 23 1965. The meeting is being organised jointly by the Southern Section of the Institution of Electronics Section of the Institution of Electrical Engineers and the Department of Electronics, University of Southampton.

Sessions will be held dealing with thin-film and integrated-circuit linear applications, digital-stores, computer and switching applications, the use of metal-oxide-semiconductor transistors (MOST's), system design and interconnection methods, and human and economic aspects.

It is also hoped to arrange a small exhibition to feature displays of microelectronic circuits and components in stages of development as well as those in production.

Registration forms are now available from The Symposium Secretary, Department of Electronics, The University, Southampton.

Conference

MORE THAN 2,700 PERSONS attended the 97th Society of Motion Picture and Television Engineers' Technical Conference and Equipment Exhibit this month at the Ambassador Hotel in Los Angeles. That figure represents a new record for SMPTE Conference attendance.

Registration for the Conference technical sessions exceeded 1,300, which was also a new SMPTE record.

Attendance and registration were not the only Conference areas which scored new highs. The 97th Conference boasted the largest papers programme ever in SMPTE history with more than 130 technical and equipment papers presented during 19 sessions spanning five days.

Among the many contributing to the overwhelming success of the 97th SMPTE Conference were Kenneth Mason, SMPTE Conference Vice-President; Herbert E. Farmer, SMPTE Editorial Vice-President; Dr Richard J. Goldberg, Programme Chairman; and Jack P. Hall, Local Arrangements Chairman.

The 97th Conference marked the 21st time SMPTE has met in the Los Angeles area. The engineering society will hold its 98th Technical Conference in Montreal, October 31—November 5.

Appointments

VINCENT T. WASILEWSKI, president of the National Association of Broadcasters, announced recently the appointment of the NAB's 1965-66 Engineering Advisory Committee with Clyde M. Hunt, vice-president for engineering, Post-Newsweek Stations, Washington, as chairman. Other members are: William B. Honeycutt, chief engineer, KRLD (AM-FM-TV), Dallas, Tex; Warren L. Braun, general manager, WSVA (AM-FM-TV), Harrisonburg, Va; J. D. Bloom, chief engineer, WWL-TV, New Orleans; Virgil Duncan, chief engineer, WRAL-TV, Raleigh, NC; William S. Duttera, director, allocations engineering, National Broadcasting Co, New York; Leslie S. Learned, director of engineering, Mutual Broadcasting System, New York; Frank L. Marx, vice-president, American Broadcasting-Paramount Theatres, New York; James D. Parker, director, transmission engineering, CBS Television Network, New York, and John T. Wilner, vice-president and director of engineering, The Hearst Corp, Baltimore.

NAB booklet

THE Department of Broadcast Management of the National Association of Broadcasters has released its fourth edition of 'Awards and Citations in Radio and Television.'

The 81-page booklet provides a comprehensive list of broadcasting awards available primarily to radio and television stations, their management and personnel.

William L. Walker, department manager, pointed out that for the first time, the booklet lists scholarships available in the radio and television field.

He also urged those concerned with awards in this area to send him information which might prove useful in future editions.

A copy of the new edition has been sent to all NAB members. Free copies can be obtained by NAB members and the general public through Mr Walker.

More colour

TOP ADMINISTRATIVE, programming and engineering executives of NET (National Educational Television) at a recent annual meeting held at WGBH-TV Educational TV outlet in Boston, were convinced that there would be more colour TV programming through VTR syndication after viewing a demonstration sponsored by Visual Electronics Corporation, New York, NY.

Excerpts of the French Chef Programme, by Julia Child and recent winner of a George Foster Peabody award for distinguished achievement in TV, now syndicated in monochrome to educational TV facilities, were taped on an Allenised VTR colour system using two cameras, the Norelco PC-60 Plumbicon Colour Camera and an RCA TK60 4½" IO monochrome. On the Allenised VTR playback in colour, the NET executives seeing the colour rendition as compared to black-and-white on the number of Conrac Colour Monitors furnished by Visual and WGBH provided audible testimony to the enlarged impact of colour in a programme of this sort.

Using the same two cameras, a chemistry lesson by Professor Robert D. Eddy of Tufts University, was similarly taped with the Allenised VTR. The ability of the Norelco Plumbicon Colour Camera and Allenised VTR to capture and reproduce the significant changes in colour of chemical solutions, as well as the flame of the Bunsen burner particularly impressed the NET audience.

Irish production

CENTRALAB LTD, a recently established Anglo-American company, is to start production at Antrim, Northern Ireland, of electronic components of a type not before made in the United Kingdom, it was announced recently in London and new York. These are integrated miniature electronic circuits for radio and television sets, tape recorders and computers. These packaged circuits will provide for the first time in Britain multi-component packs of the same reliability as those used in rocketry but at prics competitive with those of components currently made in Britain. Centralab Ltd will also make a very wide range of ceramic capacitors.

J. B. Hodgson, general manager of Centralab, and formerly of Elliott Automation, said in London that initially the market will be the United Kingdom but that it is hoped to expand into Europe and the Commonwealth.

Construction of an 18,000 sq ft factory at Antrim should be completed early next year. Meanwhile, production will start in a pilot plant employing initially 24 people. Employment in the Antrim factory is expected to increase to about 70 within three years. Provision has been made for considerable extensions to the factory as demand for the product increases, and this will also involve an increase in manpower.

Russian centre

A NATIONAL TELEVISION CENTRE is being built at Ostankino, Moscow. It will be the largest of its kind in Europe.

Programmes will be beamed through six channels: one colour and five black and white, including one international channel. The new television centre will be able to show daily programmes lasting a total of up to 50 hours.

It will be housed in a building about 400 metres long and 100 metres wide. The lower tier of the building will be four storeys high, while the upper central part will be 13 storeys high. It will house 18 studios. The centre will be fitted out with Soviet-made equipment.

Nearby it is planned to build a television broadcasting tower 520 metres high. The centre is to be fully commissioned by the end of 1968.

Letter

Dear Sir:

Page 321 'Is colour at the Crossroads?' by John Dickson includes an error which appears to be prevalent in UK and European TV circles.

In the sixth paragraph, fourth sentence, it states the Canadian Radio Technical Planning Board has approved NTSC as well as the Japanese Government—the assumption here being that the Canadian Radio Technical Planning Board (CRTPB) is the government agency responsible fro broadcasting.

This is not so—the only authority for the issuance of broadcast specifications in Canada is the Minister of Transport.

The CRTPB is a board comprising the equipment industry represented by the EIA, the users represented by many trade associations such as the trucking, telephone wire line companies, etc. This board, mostly through EIA committees, drafts specifications which are then submitted to the Department of Transport for approval and subsequent promulgation. The CRTPB approved the NTSC specification way back in 1957 but it has not been issued as yet by the Department of Transport so that Canada does not have a colour specification and therefore does not broadcast in colour.

Yours sincerely, TRANSONIC LTD,
W. Jones, President.

Video recorder

GRUNDIG showed at the 1965 Hanover Fair a video recorder mainly designed for professional use. It will be part of the Grundig 'Fernauge' camera system, weighs about 58 kgs and is equipped with 77 transistors. A rotating video head 'writes' the signal in diagonal tracks at an effective speed of 24.2 m/sec, while the tape moves at a speed of 19 cm/sec. Normally the signal is supplied by television cameras. Sound can be recorded in one of the normal ways. For recording in connection with television sets a special connecting unit in the television receiver is necessary and for playback via a television set an image-sound-modulator is required.

Loewe-Opta, who were the first in Europe to offer the commercial video recorder Optacord 500, are now introducing Optacord 600 which employs the same recording principles, but is smaller and easier to operate. In the Loewe-Opta system the recording speed of the video head is about 20 m/sec at a tape speed of only 15 cm/sec. This results in a recording capacity of 80 minutes per spool. The new instrument weighs only 20 kgs.

Some firms of the German optical industry, realising the new trend, offered in Hanover, by demonstrating new special lenses for television cameras, while the Agfa-Gevaert AG demonstrated their new video tape PEV 385.

Conference

AN INTERNATIONAL CONFERENCE on 'UHF Television' will be held in London, Wednesday and Thursday, September 1 and 2, 1965.

Aspects to be covered include receiver and transmitter design, propagation, receiving and transmitting aerials, parametric amplifiers, and test equipment.

The conference has been timed to take place during the Radio Show, which this year will be held from August 24 to September 4 and will have an international content, so that visitors to the Show can participate.

The sponsoring bodies, the Institution of Electrical Engineers Electronics Division, the Institute of Electrical and Electronics Engineers, the Institution of Electronic and Radio Engineers and the Television Society, are inviting papers and contributions. In the first instance synopses of about 250 words should be submitted to the UHF Television Conference Joint Secretariat, 8-9 Bedford Square, London, WC1, by April 20 1965.

Complete papers, and contributions of not more than 2,000 words or the equivalent including diagrams, should arrive by **June 1, 1965.**

It is hoped that technical visits will take place on September 3, the day immediately after the Conference. Details of these, and of the registration fee, will be announced later.

IBE selected

International Broadcast Engineer has been selected as one of the British journals to be exhibited by the Central Office of Information at the Tanganyika National Festival, Dar-Es-Salaam, from July 1 to 7 this year.

Pay-TV plans running into trouble
Some of five companies to withdraw

Britain's pay-television experiment, due to start in the Autumn after a delay of nine months (pay-TV was originally scheduled to start this Spring) may now never come off in the form originally intended.

This became clear recently as serious doubts about the feasibility of the operation were expressed in the City and by executives of the five companies concerned.

Michael Frostick, who is running the Choiceview operation, said that not only second, but also third, fourth and fifth thoughts were being had at all levels throughout the pay-TV companies.

Fundamental problem is one of lack of decision beyond the control of the companies. The new government is to review the structure of television; two years ago it could have been said that pay-TV would have been ideal to provide minority educational programmes; now that a University of the Air channel is planned, pay-TV can no longer claim this advantage. The cinemas due to be designed by the Board of Trade as having a disadvantage against pay-TV in the experimental areas have not yet even been named.

Frostick said that unless high-level decisions are taken soon, probably within this month, the start of pay-TV will be seriously delayed, probably by between 18 months and two years. It is possible that it may be postponed—at least in the present form proposed—indefinitely.

Sir Tom O'Brien, who is associated with Caledonian Television, which has not yet even taken up the licence granted to it, said that 'Things are not working out according to plan. The idea of having five experimental pay-TV firms as laid down by the last Tory government could well be a flop.

'The experimental period should be done by one and not five companies.'

It is reported that Sir Tom's statement may be a prelude to a complete withdrawal from the field of Caledonian Television.

It was as long ago as December 11 1963, that contracts were announced by the then Postmaster-General for the five pay-TV companies. They are:

Choiceview, financed jointly by Rank and Central Rediffusion, with a contract for Leicester and a London area;

Caledonian Television, with a franchise for Penycuik, which is near Edinburgh, and another area, which was probably to have been Aberdeen (though objections to this have been raised by the City Council;

Pay-TV, backed by British Relay Wireless, ABPC, and British Home Entertainment, with a contract for Sheffield, Westminster and Southwark;

Telemeter Programmes, with Granada, Paramount, Rothschilds. The Guardian, The Financial News and British Lion behind it, franchised for a North of England area, Merton, Morden, Mitcham and Wimbledon; and

Tolvision, with contracts for Luton, Bedford and a London area, backed by American interests and the City merchant bank Keyser Ullmann.

Contracts were to be for an initial period of three years. (They were, incidentally, forecast by Television Mail in the previous August). No advertising was to be shown on the pay-TV programmes.

In February, 1964, an Association of Pay Television Operators was formed in order that the battle with the cinema exhibitors organisations could be fought corporately. Strongest opposition to the slotvision plans came from the Association of Independent Cinemas. A rather uneasy solution to the cinema-TV problems has now been found, through the Board of Trade has not yet completed its schedule of designated cinemas under the agreement.

Present interest in pay-TV was sparked off by the disappointing results in the US of pay-TV experiments.

Most companies are still thinking in terms of going ahead in September or October this year. Viewers would have paymeters installed free of charge and receive programmes on closed-circuit relay lines similar to those operated by Rediffusion and British Relay Wireless; they would pay between 2s 6d and £1 per programme according to the nature of the programme.

The second starting date to be set by the pay-TV companies is quickly fading away into the realms of unlikelihood. The important question now is that of the length of the next delay.

Rod Allen

NEW DEVELOPMENTS

New recording head

THE ENGLISH COMPANY, Gresham Lion Electronics, have developed a 33 track magnetic recording head for use on 1" (2.5 cm) tape. The 33 tracks are continued in a compact head 1½" (3.75 cm) high, 1¼" (3.17 cm) deep and 0.6" (1.52 cm) wide. The track pitching is 0.030" (0.76 mm) and the track width is 0.010" (0.25 mm).

The head is fitted with a gap length of 0.00025" (6.4 micrometres), and the windings of each track have four terminals which allow the two balanced windings to be connected singly, in series or in parallel. It has an output of 1.5 mV peak to peak at 300 bits per inch at 15" (37.5 cm) per second.

Cross-talk is better than —20 dbs on a square wave signal at or below 10 Kc/s at 15"/sec (37.5 cm/sec) tape speed. (The cross-talk is measured by recording simultaneously in phase signals on two alternate tracks and measuring the signal induced in the interposing tracks when reproducing).

Synthesisers

TWO NEW FREQUENCY SYNTHESISERS from Hewlett-Packard use the direct synthesis principle to translate the basic stability and purity of a single quartz oscillator into 19,000,000 instantly selectable output frequencies. Very similar to the familiar 50 Mc/s HP Synthesiser, the two new models have less frequency range, are smaller in size and lower in cost. Both feature high spectral purity, external programmability, excellent resolution, and extremely fast switching.

Model 5102A has ranges to 1 Mc, allows incremental changes as small as 0.01 c/s. Model 5103A ranges to 10Mc/s, with incremental changes of 0.1 c/s. A search oscillator is provided to cover the complete range (in selected increments), providing any desired interpolation. Switching among frequencies occurs on command in less than 20 microseconds. Selection may be made manually with front panel self illuminating push buttons, or by remote switch closures. Output level into 50 Ohms is continuously variable from 300 mV to 1 V. In addition to the selected output frequency, two others are simultaneously available. One is a 1 V buffered output from the stable 1 Mc/s oscillator, useful as a reference or house standard. The other is 30 Mc/s+the selected frequency, useful when mixed with another stable frequency to yield a mixer sum of much higher frequency with band precisely variable by the synthesiser, and with excellent signal purity.

Each synthesiser is housed in a single rack-convertible modular cabinet 10½ inches high.

Tetrodes

NEW SIEMENS developments are two air-cooled metal-ceramic tetrodes for single sideband transmission. The 730 W tetrode RS 1062 C can be used up to frequencies of 1,200 Mc, and the RS 1072 C with a high frequency power output of one KW, a special version of YL 1050, is suited for the short wave range. The new travelling wave magnetron RW 21 operates in the frequency range from 2.5 to 2.7 Gc with 30 W saturation power, or Ns = 20 W with 40 db power gain. The two metal-ceramic resonance carcinotrons RRWO 10 and RRWO 40 have also been recently added. They can be tuned mechanically and electrically over the frequency range from 6.5 to 12.7 Gc and 32 to 40 Gc, respectively, and have an average power output of one W and 150 mW respectively. Within the appropriate frequency range, sub-ranges can be tuned in mechanically and the frequency can then be varied within the sub-range by means of the delay line voltage. These oscillations can be frequency modulated by changing the delay line voltage, or they can be amplitude modulated by keying the grid-1 voltage. The dissipated heat is removed by air cooling (conduction cooling is also possible for the RRWO 40). Tube and solenoid form a unit in each case; operating voltage connections are made by self-supporting wires. RRWO 10 is primarily suited as a power test oscillator, with high frequency power taken off through 50 ohm coaxial connectors. RRWO 40 is recommended as oscillator in radio links and radar systems, with high frequency power taken off through wave guides.

A collection of vidicons comprising four quality grades, and several number and symbol indicator tubes are also announced, which Siemens has recently added to its sales inventory. The vidicons are: 8355 is a tube with X-ray quality, TD 1318-1 has high industrial quality with high resolution and great sensitivity, TD 1318-2 has normal industrial quality for universal application, and TD 1318-3 has industrial quality for applications of less stringent requirements. The indicator tubes shown are the ZM 1020 with digits 0 to 9 of 15.5 mm height appearing on the front face, ZM 1040 with digits of 30 mm height appearing on the side, ZM 1080 with digits of 13 mm height on the side, and the symbol indicator tube ZM 1021 with symbols + — A W % of 15.5 mm height appearing in front.

Voltmeters

LATEST ADDITION to the Philips range of electronic voltmeters is type PM 2430, a compact, fully transistorised millivoltmeter for DC measurements. The instrument is battery-operated and thus independent from mains, with the added advantage of a floating input.

Measuring range is from 1 mV (full scale) to 300 V and with an optionally available EHT probe up to 30 kV. The accuracy is 2% of full scale. Pre-deflection is less than 2½% of full scale in the most sensitive range. The polarity of the voltage is automatically indicated on a small meter. This meter can also be used as a null indicator with a sensitivity of approximately 5 μV. Input impedance is 1 MΩ from 1 mV to 300 mV and 100 MΩ from 1 V to 300 V.

The PM 2430 has, as all Philips voltmeters, an internal calibration voltage for easy re-adjustment without the use of additional instruments. Power is supplied by four dry cells of 1.5 V each or NiCd cells; the latter have a life of 50 hours per recharge up to 300 recharging cycles.

The instrument measures 24 x 16 x 18 cm (9½" x 6½" x 7") and weighs 3.3. kg (7 lbs).

BPL meters

UNDER AN AGREEMENT between British Physical Laboratories Ltd and Standard Telephones & Cables Ltd, Electronic Services—STC, Harlow, Essex, is now stocking, for off-the-shelf delivery, a range of the well known BPL meters.

Three basic meter sizes are stocked by Electronic Services—STC. These have 1½in, 3 3/16in, 4 5/16in scales. They are of contemporary design with the BPL Vistavision style cover to provide fast, clear recognition of indications. The three sizes are stocked with 100 μA and 1mA movements and scale markings. Suitable shunts, resistors and rectifiers are available for delivery at the same time to enable customers to use the meters for various currents and voltages and for ac working.

These BPL meters combine the high accuracy and quality of their BS89 performance specification with the economy of the Vistavision case construction. The meter scales conform to the latest BS 3693 (1964) specification.

SECAM sets

INDUSTRIAL DEVELOPMENT STUDIES undertaken by CFT—Compagnie Francaise de Television and the SECAM working group of the FNIE — National Federation of Electronic Industries, with a view to marketing SECAM receivers, have resulted in, what they claim, an important technological advance which cannot be obtained in the other systems and makes definitely the SECAM receiver the simplest and the cheapest colour TV receiver.

Amplification functions, which formerly were separate, have been obtained by means of a simpler single circuit by virtue of the insensitivity to differential gain, a property of SECAM signals.

Further, the new low-cost, mild steel delay lines developed in CSF Laboratories already show in their pilot production such perfectly reproducible characteristics that it has been found possible to replace matching and amplification stages by simple passive circuits.

With no degradation of the qualities of the SECAM colour picture the new design ensures an overall improvement in reliability and an attendant lowering of production costs by the suppression of adjustments now unnecessary in the SECAM receiver and by a substantial reduction in the number of components. As an example, the number of tubes used in the relevant circuits is halved as compared to that in an NTSC receiver, viz, five tubes instead of ten.

Thus, while applying without difficulty only known and reproducible techniques, set makers are now in a position to produce receivers which are at the same time excellent, simpler and less costly, so ensuring, when the time comes, a wide and generalised use of colour television.

Capacitors

STC have introduced into the UK their Swiss associate's range of aluminium electrolytic capacitors. This means that there is now available a miniature, professional quality aluminium electrolytic type with axial leads and transparent insulating sleeve over the case.

These capacitors have an established reliability

acceptance in Europe. They are made with high purity materials and under full Quality Control. Cold welding techniques are used for anode and cathode connection, whilst the main case connection is made by ultra-sonic welding. The construction ensures a shelf life of at least two years without reforming requirements.

Performance and stability of this range of capacitors are IEC 103 (1959) Class 564. They are suitable for operation at temperatures from −40° C to +70° C. DC working voltages are 3, 6, 12, 25, 50 and 70 V. Miniature, aluminium electrolytic capacitors are ideal for use in telecommunications equipment, computers and professional electronic apparatus.

Monitor

A 25-INCH MONITOR which provides a picture area comparable to that currently available in 27-inch models has been developed by the Conrac Division of Giannini Controls Corp.

Designed for use in closed-circuit television installations in schools and colleges, transportation terminals, and industrial plants, the monitor provides professional quality pictures in high ambient light areas, and is voltage regulated for stable operation under varying line voltage conditions.

Designated the CEA25, the instrument can, for example, display the same number of lines of airline information in the same type size as the 27-inch models, currently the largest in general use. The CEA25's relatively small size for the large display area is made possible by using a shorter 110-degree picture tube.

Fitted for ceiling mounts, as well as pedestal and three-wheel dolly installations, the instrument, at 104 pounds, is more than 85 pounds lighter than conventional 27-inch monitors. Its width, height and depth are, respectively, 24-3/16", 22", and 15¾", providing substantial reductions in space requirements. Although the cabinet is styled to blend pleasantly with quality interior decoration, a locking trap door prevents tampering with operating controls and adjustments at unattended locations.

Dynamic focus provides the professional picture quality; centre resolution is 800 lines, corner resolution, 600 lines. A separate synchronising channel with independent gain control assures excellent interlace and stability regardless of contrast control setting.

A differential input is provided to minimise hum and other direct pick-up on long video cables.

Oscilloscope

HEWLETT-PACKARD introduce a new compact, lightweight oscilloscope, model 132A. Featuring two vertical amplifiers, two horizontal amplifiers and two sets of CRT deflection plates, the instrument not only fills the electronic industries' needs for a small, light instrument capable of fully separated displays but also includes those features which fit it to the special needs of scientific, bio-medical and mechanical engineering uses.

Extreme versatility results from the wide variety of available displays. Channel A may be shown vs Channel B; A and B may both be shown vs the same time-base; A may be shown vs one time-base while B is shown vs another; A may be shown vs the oscilloscope's time-base while B is shown vs an external base; or both channels may be shown vs an external time-base. Thus, functions such as pressure vs volume may be shown in X-Y form on one trace, while related rate functions are displayed on the other.

At the most sensitive position, 100 μv/cm, bandwidth is 200 Kc/s and the full 500 Kc/s response of the instrument is available at all sensitivities from 1μv/cm. Retention of wide bandwidth at high sensitivity maintains consistent waveform.

Two separate recorder outputs are provided, one for each channel's pair of amplifiers.

High common-mode rejection is valuable in many electronic applications and indispensable with the low-level transducers which are usual in scientific, mechanical and bio-medical work. Model 132A typically displays 86 dB rejection of common-mode signals, even at 4 v peak-to-peak values, or with 8 v RF carriers.

Steady displays are maintained in the presence of vibration. Nuvistor input tubes are used to reduce microphonism, and they are mounted together on an acoustically isolated heat sink.

The Nuvistor, sharing the same environment, contribute also to the low DC drift which is characteristic of the instrument. The amplifiers may be internally AC-coupled, furthermore, eliminating drift entirely, even at frequencies as low as 2 cps.

To be shown for the first time in Europe at the 'Salon International des Composants Electroniques' in Paris and later at the 'Hanover-Messe,' the 132A oscilloscope marks a significant advance in oscilloscope design.

Diodes

SYLVANIA INTERNATIONAL has announced the availability of three new silicon epitaxial low power step recovery diodes for use in harmonic generators. Sylvania International is a subsidiary of General Telephone & Electronics International SA.

The D5300 series have silicon epitaxial diffused junctions. They provide transition times as low as 0.2 nanoseconds in the 15 volt D5310A diode to ensure high efficiency repeatability.

When relatively low output power is required, a single step recovery diode can often be used to deliver the desired output frequency. Prior to development of the step recovery diode it was necessary to use two or more varactors.

The Sylvania D5300 series feature rapid switching characteristics that are carefully controlled. When a sinosoidal drive voltage is applied, the diodes conduct in a forward direction creating a stored charge.

When the voltage is reversed, conduction diminishes until the stored charge is depleted. This rapid transition from a conducting to non-conducting state creates an abrupt step waveform rich in high order harmonics.

The new D5300 series is available in three package configurations, miniature glass, miniature ceramic and standard ceramic cartridges. They were shown for the first time at the 1965 Salon des Composants Electroniques in Paris.

LF generators

LATEST ADDITION to the Philips range of LF generators is a compact, fully transistorised audio oscillator, designated type PM 5101. It weighs only 2½ kg (5½ lbs) and is battery-operated, making it thus especially suitable for use in the field.

In addition to portability and independence from mains, the battery-operated design has the advantages of no mains hum and negligible warm-up drift. The PM 5101 covers the frequency range 10 c/s—100 kc/s with an accuracy of 5% ± 1 c/s.

The instrument has both a sine wave and a square wave output. The amplitude of the sine wave is continuously variable from 0—2 Vrms open circuit; the distortion is less than 0.5% from 200 c/s—20 kc/s and less than 1% over the remainder of the range.

The square wave output supplies 0 to −4 V peak to peak with a rise time of 1% of period time.

The internal batteries provide power for 200 hours operation. Dimensions of the instrument are 25 x 13 x 14 cm (10" x 5½" x 5").

Travelling wave

THE LATEST STC, low-noise, travelling wave tube Type W3MQ/1A (developed originally under code LS950) is fully packaged in a single reversal permanent magnet mount. An outstanding feature of this tube is a typical noise factor of only nine dB. The unit is also claimed to be cheaper than similar components of comparable performance.

The W3MQ/1A is designed to work from a 1,200 volts dc supply and provide a gain of over 35 dB in the frequency range seven to 11.5 Gc/s. The maximum output is in the range two to 15 mW. The unit it fitted with tapered waveguide transitions to WG16. Alternative versions can be provided with coaxial connectors.

Customers requiring a tube to operate within a particular, narrow frequency band can specify this, so that, in manufacture, the tube positioning may be adjusted to give an optimum noise factor within the range specified. STC low-noise travelling-wave tubes are also available for operation in S-Band.

New range

THE M-O VALVE CO LTD has introduced a new range of ferrite isolators covering the frequency bands 5925—6425 Mc/s, 5925—6175 Mc/s and 6175—6425 Mc/s. The CIC4 is a field displacement isolator with a maximum forward loss of 0.35 dB and a minimum reverse loss of 35 dB. The VSWR is 1.02 : 1. The CIC5 and CIC6 are resonance isolators with forward and reverse loss of 0.5 dB min and 25 dB max respectively. Both have a VSWR of 1.06 : 1. The RF connections on all three devices are waveguide 14.

These devices are particularly suitable for use in broadband radio communication systems.

ment. The bandwidth, rate response, signal-to-noise ratio, modulation distortion, and linearity are checked for both the F- and P-Channel.

Extensive tests and calibrations of the TV recording and display equipment are performed using electrically generated test standards to assure that picture detail and photometric characteristics are faithfully reproduced. Magnetic tape recordings of actual video data from various Spacecraft tests are used to confirm the operating parameters of the video display equipment and the film recorders. Resolution capabilities, linearity, CRT display characteristics (optical distortion, sizing, etc.), and the integrity of the display are checked. Further test and calibration of the entire operational-support equipment are carried out up to the time of the terminal-mode operation of the Spacecraft when the video signals from the Spacecraft are transmitted. Additionally, post-flight calibration and check are performed so that proper evaluation of the received data can be made, based on the actual performance of the operational support equipment during the mission.

Evaluation of the Ranger TV System

The receipt of approximately 4,000 high-quality pictures of the lunar surface from the Ranger-7 Spacecraft is indicative of the performance of each group of equipment of the TV System. The level of performance of some portions of the TV System can be evaluated on the basis of specific information received during the mission. This is particularly true in regard to the cameras and their associated electronic equipment, since the pictures themselves are evidence of the performance of this equipment. It is also true, although to a lesser degree, of the telecommunications and OSE equipment. The performance of the command and control circuitry, however, can only be evaluated in absolute terms, that is, all commands were processed and executed on-time and in good order.

The last partial-scan picture, shown in Figure 11, was a fragment from the P3 Camera which was equipped with a 1-inch, f/0, 95 lens. A simple geometrical relationship for the 1-inch optical system and for a Spacecraft travelling at 2.64 km/sec shows that the final picture was taken at an altitude of 530 metres from a point of impact on the lunar surface and covered an area of about 42 metres by 28 metres. Craters can be recognised that occupy 1/50 of picture height, a diameter of 0.8 metres. The bright rim and shadowed rim constitute image elements of 0.4 metres; hence, the high-resolution requirements were easily satisfied.

The satisfying of the high-resolution requirements can be attributed, in part, to the superior performance of the overall system in that the camera platform was placed in an impacting trajectory such that sufficient light and shadow detail was available for the imaging system, and sufficient transmitter power was available to overcome system losses by an ample margin. These facts contributed to a high signal-to-noise ratio video output for each RA-7 camera; an essential factor for high-quality images.

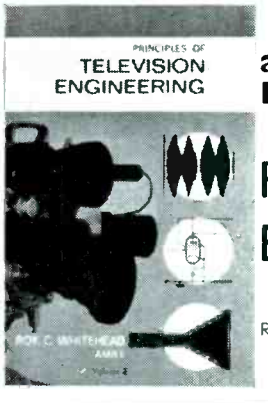
The requirements of wide-angle coverage and picture nesting were imposed as a basis for correlation of the expected data output from the Ranger camera to the well-defined telescopic photographs presently available. The success with which Ranger-7 met these objectives is illustrated by Figure 12. This image was produced by the Fa-Camera which has a 25-degree field of view, and was taken 480 miles before impact. It covers a wide area where several well known features, such as the crater Lubiniezky and the Riphaeus Mountains, can be distinguished by their characteristic images and their geographical relationships. Also indicated on this figure are the areas covered by pictures taken later in the picture-taking sequence at a higher level of resolution, including the point of impact as shown in Figures 13, 14 and 15. The realisation of the design to satisfy picture nesting is contained in the interplay of camera fields of view, the camera mounting bracket that physically ties the six-camera array into appropriate overlapping fields of view, the camera exposure sequence, and the design of the impacting trajectory.

The ability to calculate and predict the luminance of the lunar surface was also demonstrated by the Ranger-7 mission. The location of impact must contain the proper variations of lunar luminance and shadowing in order to achieve a useful image by the lens, shutter, and vidicon elements of the camera.

Review of the received video data indicated that the choice of lunar impact area was fortuitous and resulted in maximum use of the optical-to-video conversion capabilities of all six cameras. The viedo data indicated that on the three 25-mm, f/0.95 cameras the peak illuminations were occasionally near the saturation level of the cameras, but the cameras did not actually saturate nor was the signal clipped. Maximum exposure without saturation was then achieved on the Fa, P3, and P4 cameras. The Fb, P1, and P2 cameras had average exposures with signal-to-noise ratios that were 3 to 4 db lower than for the Fa, P3, and P4 cameras.

Video-line selections from the final Fa and P3 camera frames show that the requirement of high signal-to-noise ratio was also satisfied. A received video signal with a signal-to-noise ratio in excess of 30 db (peak-to-peak signal to RMS noise) will produce a picture acceptable as having high quality. Thirty-five db was the average signal-to-noise ratio for the Fa, P3, and P4 Cameras and 31 db was the average signal-to-noise ratio for the Fb, P1, and P2 Cameras. Each of the six cameras, then, provided a video signal with more-than-adequate signal-to-noise ratios to satisfy that specification and the video criterion for high-quality images.

The successful Ranger-7 mission demonstrated the value of the Ranger project. Two additional launchings of Ranger are scheduled for the first quarter of 1965. These missions will have the same goals as Ranger-7, but will provide pictorial data of different lunar areas. Together, the data from these three Ranger missions will provide our scientific community with sufficient data to greatly increase man's knowledge of the moon.



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NAB review Part 2

International Rivalries on the US-TV front

Vice-President of the United States the Hon Hubert H. Humphrey at NAB Convention, Washington, with NAB's own Willard Schroeder. The US Vice-President told 4,000 NAB delegates: 'President Johnson believes in finding the common ground on which all men of good will can unite. . . . Your 5,000 radio and 550 TV stations on the air today represent an incredible array of talent.'

ADDRESSING Washington delegates to the 43rd Annual Convention of the National Association of Broadcasters last month, there came a topical quip from James C. Hagerty, today a top TV and radio executive of the American Broadcasting-Paramount Theatres Inc., but more war-time famous as aide to Eisenhower.

This man who knows more White House secrets than any other quoted tough little President Truman as snorting to a political opponent: **'If you can't stand the heat, don't go into the kitchen!'**

This could be a watchword in 1965/6 for all international manufacturers of professional broadcast equipment yearning to market their products in the United States. The heat is on. The scene is bitterly competitive. Exhibiting through Ampex Corporation, Marconi's sprang a surprise with the Mk.V, the smallest, lightest 4½-in image-orthicon camera in the world (which, by the way, has many other world-marketing advantages, too, than just being compact and lightweight), English Electric have set a lead with new vidicon and image-orthicon tubes, and EMI made a big step forward in two differing fields, by introducing new high-grade professional audio recorders and two new TV cameras (one of them a vidicon/blumbicon camera chain) in time for this year's NAB Convention. But these and all other imports to the US, from Europe as from Japan, face intense technical competition.

After an extensive examination of TV-electronic products focused from world markets on Washington, I must warn a number of major British and other European firms who did **not** exhibit at the NAB Convention to undergo serious re-thinking.

As I was warned by the US Department of Commerce: **'Almost every day, industry in the USA undergoes such transformations that many of the very techniques and products which made the USA a leading force in the industrial revolution are now obsolete . . . US industry has refined the methods of modern mass-production until no facet of industrial life remains which is not altered by it.'**

Many electronic manufacturers, especially in the world of professional broadcast equipment, have spurned the idea of refined methods of mass-production. They were content if enough products could be laboriously bench-built to satisfy (1) the immediate demands of certain under-developed countries crying out for TV and radio networks, and (2) the urgent demands of the Government to increase exports or face heavier taxation. It has come as a shock to many to realise that while European politicians have argued TV colour systems, in the US there is actually a $10-million backlog of orders for just one colour camera chain alone, RCA's TK-42. It came as a blunt surprise to others to find how during the past 12 months great opportunities in the US have been missed because the much-discussed plumbicon tube was simply not available in mass quantities, at a time when dozens of leading US-TV chains were crying out for four-tube separate luminance colour cameras with midget tubes. At the NAB this year, EMI and Visual Electronics both made plumbicon cameras available, and other camera manufacturers are still hesitating, debating, arguing.

To those and others I repeat: **If you can't stand the heat, don't go into the kitchen. . . .'**

A hot contender this year in the Washington NAB 'kitchen' was the mighty giant General Electric. GE's Visual Communications Products, of Electronics Park, Syracuse, NY, showed no fewer than **six** cameras . . . though it is fair to say even the giant GE has not yet made the plumbicon available to US users. I tried their PE-23, GE's first professional transistorized studio vidicon which has been in use in the US for some 28 months now, in news studios, on quiz, panel and educational TV shows. A very fine vidicon camera. But when I enquired how it is that the British EMI group has beaten the pants off GE by having a 'first' with their Type 208 vidicon/plumbicon, well the official GE answer is that their PE-23 is 'soon to be available with advanced lead-oxide pick-up tubes.'

Then in the PE-26, GE have a completely re-planned all-transistor 3-in I/O studio camera, ideal for remote applications; they have introduced the PE-27, an advanced transistorized version of what I know to be one of America's most widely accepted film cameras. This new job uses a 1-in separate mesh vidicon, and new circuitry for hands-off operation; there is the PE-29 high-quality-specification monochrome camera, the PE-24, GE's first four-vidicon universal film camera for colour and monochrome (it's in use already at 26 local stations and the American ABC-TV network); and finally the PE-25, a very advanced 3-in I/O camera for colour work, which after several demonstrations I see to be extremely stable, giving excellent colour registration. It is also one of the smallest and most compact US-built colour cameras I have handled.

Now it is rather strange that while the latest GE colour camera is **not** completely transistorized, the other cameras such as the PE-26 are all solid-state. When I asked about this I was told: 'Since 1958 when General Electric introduced the first transistorized sync. generator, we have led the way in employing solid-state circuitry for camera systems. The PE-26 is completely transistorized, and of course the basic versatility and performance features have been proved

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NAB review

in its studio camera predecessor, GE's PE-20-A.' Among the specification features I particularly noted are electronic lens-capping, a four-lens turret, with lens-selection speeded up by a positive-action squeeze-grip turret control, and monitoring of all important camera voltages, including H and V sweep by a self-contained and switchable meter: Video-processing features include continuously variable delay-line aperture correction, white-clipper adjustable to desired level, adjustable black level, but (a surprise to some British manufacturers), gamma correction available only as an optional accessory.

The pickup tube field is particularly competitive, but GE have tube facilities available across the USA from their Pickup Tube Operation at Syracuse to Los Angeles, and this year the keynote is RA.M, a code which implies 'ruggedized' and 'anti-microphonic.' For example in the 4½-in I/O RA.M range there are the 7295 and 7389 tubes, both having the salient RA.M feature which I find to be mechanical isolation of the target-mesh assembly from the remainder of the tube, and therefore from the camera head itself. This cuts out the sort of microphonics arising from crowd noises, noisy blower fan, or too-rapid pan and tilt movements. The 7295 has an S/N ratio of 75-1 average, and is suitable for studio, daylight remotes and taping, while the slightly more costly 7389 has the extremely high S/N ratio of 95-to-1, and the extended linear portion of the transfer curve gives high contrast-range capability. The same RA.M philosophy is applied to GE's 3-in I/O tubes such as the 5820A/R which is a ruggedized version of the standard 5820A with an S/N ratio of 50-to-1, and the 7293/R, the ruggedized edition of the 7293 which in turn is the field-mesh version of the 5820A. It is noteworthy that in this series are the 7629A and 8092A (the latter a field-mesh version) which have magnesium oxide semiconductor targets. This gives a sensitivity five to ten times that of the 5820A, and long life averaging 4,000 hours.

Through Rank, Dage is a well-known name in Europe, and from Tom Slattery and Len Lirtzman at Washington I was able to pick up on the very latest Dage products now that Dage TV is a division of the Dage-Bell Corporation. The new products range from the FC-11 vidicon film chain with optical multiplexer (this eliminates secondary ghost images, and simplifies setting-up), to a complete transistorized 800-lines-resolution educational broadcast system for science and industry. And I also spent a lot of time at the Sheraton-Park in Washington studying the new Dage portable video recorder, the DV-300 which is, to coin a phrase, quite something.

Features I like about the DV-300? Well, it uses standard **one**-inch tape, running at only 5.91 ips. This results in low wear-rate, so tapes may be used in excess of 400-record-erasure cycles. Head life is warranted up to 2,000 hours. The little machine has a built-in 4½-in monitor permitting viewing during recording and playback, so cutting out the need for separate portable monitors. Variable speed slow-motion playback is provided in both forward and reverse directions, and as a final touch of luxury there is even a built-in VHF tuner permitting direct off-air recording.

While the Dage portable video recorder might be thought to have certain revolutionary features, an even more surprising advanced technique has been introduced at Washington by CFTH (Compagnie Francaise Thomson-Houston, of Paris) in their new TH.T605 'twin-use' cine-television camera. It is not lightly forgotten by chagrined giant companies that last year at the NAB, Chicago, CFTH sprang a surprise with their first all-transistor 4½-in I/O camera. Now comes the 'twin use' which is in that bracket of why-didn't-somebody-think-of-it-before. It is a vidicon camera and cinema camera all in one!

Simultaneously it generates a video signal, and also records on 16-mm film. An optical splitter links a high-sensitivity vidicon and a 25 fps film camera, the single Angenieux 12-120-mm zoom lens doing double duty; and the scene is viewed through a 7-in electronic viewfinder. Immediately the producer gives the On/Air signal, the film camera records the shot on a 1,000-ft 16-mm spool. An automatic film marking system enables the operator to index shots recorded by several of these TV-film cameras worked in a team. An electronic device synchronizes the motor phasing so that light-marks are synchronized on each film in the magazine, at the same instant in relation to perforations. Three or four of these TH.T605's can be used to record a continuous programme.

Novel in the extreme, this TV-film camera has all the usual devices of a television camera, such as an on-air cue light, a single-button control for focusing and slow or fast focal length variation, the electronic viewfinder and a four-module plug-in unit, together with manual iris control operated from the rear of the camera. The TH.T601 camera block is a plug-in unit, together with its 1,000-ft reels.

An aid to colour-TV production is CFTH's fully transistorized colour flying-spot scanner, suitable for SECAM or NTSC. Inbuilt is a Tektronix 527 RM 'scope (alternative TH.T2102) allowing the three video waveforms to be observed. Models are available for 525 and 625-line working, and as is to be expected in this system, a dichroic mirror is used to split the image into the three basic colours. I find on inspection that a MK 1316 scanner tube is used, the red and green photomultipliers are XP 1002's, and the blue photo-multiplier is a 150 AVP. The EHT is 25 kW, and due to transistorisation the total consumption for the scanner itself is only 180 VA.

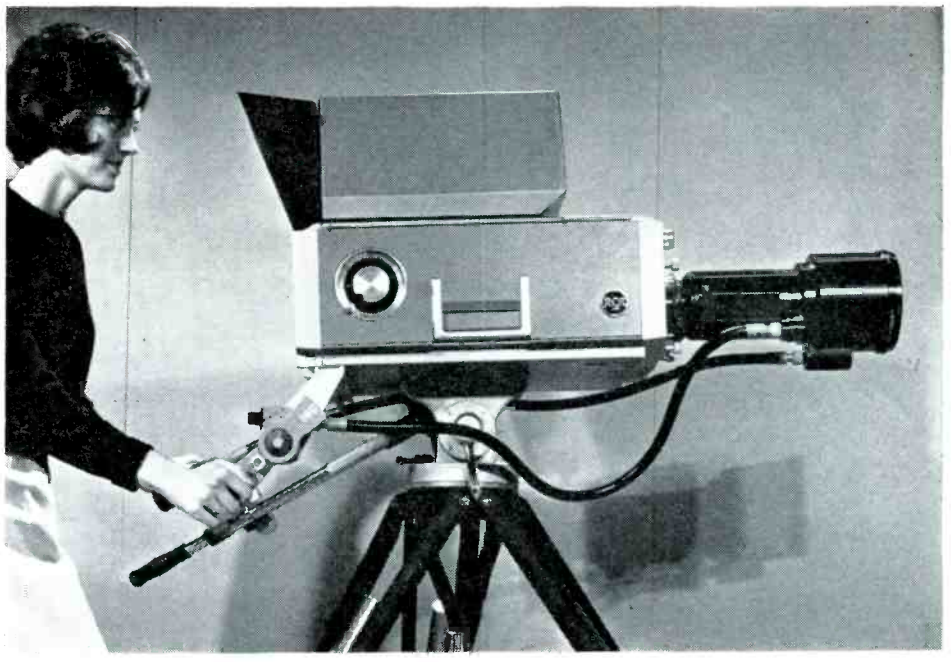
On various occasions travelling through France I have seen mobile units known as 'Transicars,' and this year at the Washington NAB CFTH were showing details of their latest in this field, the TH.T 6331/6341 transistorized mobile TV unit, on a big air-conditioned Berliet GBK6 EXL chassis. Operators in the 'Transicar' have air conditioning in the technical compartment, an oil-fired central heating equipment, a 30-ft telescopic mast, microwave link and radio communication gear, a rotating camera crane on the cab roof, and to order as desired a range of control desks, audio recording apparatus—even a refrigerator. This tough Berliet chassis has a 5-speed gearbox for heavy duty, air brakes, and a 24-volt battery system. A 15 hp Peugeot four-stroke alternator is carried, delivering 8.5 KVA and running for 20 hours without a refill. CFTH have also surprised American delegates at the NAB show this year by the wide range of TV and FM transmitters available, as the US is putting up a powerful export drive to provide the transmitters for many underdeveloped nations.

For powerful medium-wave broadcasting, the French experts have now developed a 1,000 kW transmitter, the TH.R 228, the crux of which is the Super-Vapotron tube. This, like other large valves in the transmitter, is cooled by air in the Vapodyne system (a CFTH patent) in which an aero-condenser is used. For use in cold climates a heat-exchanger can be provided to store the Tx heat for the building's central heating system. For more modest use in TV networks there are the Bands IV and V TH.R 346 television transmitters, the video partner of which has a 10 kW peak output, accompanied by an FM audio transmitter with a constant-peak output of 2 kW. This job, I found on inspection at Washington, uses medium-power UHF tetrodes developed by Thomson-Houston themselves in ther Paris laboratories, and it is interesting that the modulation arrangements of the video Tx allow of colour transmission by NTSC, SECAM and PAL. A demodulated RF counter-reaction devices gives a high suppression level stability, and as the exciter is transistorised I agree this increases the overall equipment reliability. Of course the audio and TV sections can be used independently. So far as the TV Tx chain is concerned, the chain of multipliers driven by the transistorised crystal exciter feeds to two intermediate amplifying stages equipped to TH. 6885

tetrodes. Then comes an image modulator fed with the full TV signal, and a cathode-modulated intermediate stage using a TH. 293 tetrode mounted in a wide-band coaxial cavity. Finally of course there is the 10 kW output stage with a grounded-grid TH. 290 tetrode in a coaxial cavity with forced air cooling. On the other hand the audio Tx link starts with a multiplier-modulator which produces the FM by action of AF signals on a passive network similar in structure to a delay line, to alter the phase of an RF wave form a crystal oscillator. Then comes a frequency-doubler or tripler stage using a 2C39A tube, two intermediate amplifying stages with TH 6885's as in the television transmitter, and finally a power amplifying stage with a TH. 293 tetrode in a coaxial cavity.

As US manufacturers are breaking into European and other territories with high-grade radio equipment, it is not without point that CFTH's giant **'Groupe Electronique'** have produced a rival seller in the form of the TH.R 2423, a 250-watt FM stereo broadcasting transmitter. Now this is in a field where the US is supreme, and where US transmitter manufacturers already do very nicely, so CFTH can hope to break into this extremely competitive stereo-transmitter market only by producing something-the-others-haven't-got. Basically this is not designed for the US market, since the input supply is 220-volts single phase 50 c/s. However there are such supplies in some parts of the US, and 60 c/s job can be specially ordered. Transmission frequency range is 87.5 to 108 Mc/s, and modulation type is F3.

With stereo FM transmission, absolute stability is essential, and I have seen operational figures at Washington on the TH.R 2423 which show a frequency deviation of lower than 1,000 c/s, and RF harmonic spurious radiations less than 1 mW. The rated frequency deviation is 75 Kc/s. Crosstalk between the two stereo modulation channels is better than −40 dB, and background noise, linear, is less than −63 dB. I was extremely interested to check circuitry of this new FM stereo transmitter, as the amplifier delivers 250 watts from a 1-watt exciter with only two tubes. The first (a double tetrode QQE02/5) is used as a symmetrical class-C amplifier, this stage being tuned by two oscillating circuits. The input circuit is of the magnetic coupling type. A ceramic tetrode cooled by forced air is use in the output Class-C amplifier. The RF amplifier drawer in this transmitter (fitted with a centrifugal safety device) is shielded and equipped with a built-in meter and ventilation system. Power comes via silicon rectifiers. The modulation pilot is also interesting, this basic element delivering a frequency-modulated RF signal which of course drives the RF amplifier. Frequency modulation is achieved by frequency variations produced in an oscillator operating on the Tx final frequency, the centre frequency being automatically set by the frequency-control system.



Typical of latest high-grade 3-in image-orthicon cameras is RCA's TK-33, here shown in profile by Pat Given at Washington. When the 8-in viewfinder of this camera is detached, the camera becomes two 'suitcase' units for easy carrying to TV assignments in the field.

While areas of Europe are going slow on piped-TV, 'wired-wireless,' 'television-relay' or whatever you care to call it, the US has settled in large measure for CATV, which for those who do not speak American must be interpreted as **'community antenna television.'** The CATV boys heartily dislike being grouped with Pay-TV, although naturally some pay systems work by cable. However at Washington I was greatly impressed with the arguments of CATV's Charles Wigutow and others that: 'Cable men have as many reasons to be opposed to Pay TV as do the broadcasters. Pay TV can function through the air as well as over cable. Cable TV is essentially an efficient pipe-line through which all broadcast matter coming from stations carried on cable is conveyed to the subscriber's set . . . Cable television has no more in common with Pay TV than has anyone in commercial broadcasting. . . .'

For this and other independent reasons CATV equipment has been widely shown at NAB Washington, and features as a very large slice of US industrial electronics. Two of the largest groups at NAB this year were Jerrold Electronics Corporation of Philadelphia (they make equipment, engineering and give construction serves for CATV systems, as well as providing radio microwave equipment) and Viking Cable Company of Hoboken, NJ. Viking's Robert Baum told me: 'We're grateful to the vast numbers of systems who have accelerated our expansion and who have at the same time profited from the use of our products . . . Viking is the only company in the CATV industry who manufacture both coaxial cables and components for CATV applications. Our quality assurance programme starts with the incoming inspection of all materials, continues through the manufacturing cycle, and never ends until the feed-back from customers and laboratory tests are evaluated. . . . In our lab we have the best facilities for testing and evaluating physical environmental, shock and vibration, electrical and chemical characteristics of materials and components.' I was recalling the doubtful statement of a certain European CATV company that 'all-solid-state relay-TV bristles with snags,' when Jerrold Electronics' Lee Zemnick and Jerry Hastings at the Washington Convention were showing me a neat little packet which, as Jerrolds say, is 'the first solid-state AGC that **really** works.' It is true that some other AGC units ruin the linearity of the solid-state amplifiers they control, but the new Jerrold TAGC has no adverse effect on line-TV amplifiers. It acts as a continuously variable attenuator ahead of its amplifier. Any pilot-carrier signal change varies the attenuation of the TAGC, automatically maintaining the optimum signal level (± 0.05 dB). There is no deterioration in S/N ratio, nor any variation in amplifier gain.

Also leaders in the CATV sphere are Collins Radio Company of Dallas, Texas, who from a huge booth 214 in Hall 2 at the NAB Convention showed their 830H 20 kW FM transmitter, the 820E/F 5/10 kW AM transmitter, and a number of facilities such as the 900 C FM sterio monitor. Talking to a number of Collins representatives including Jerrell Henry, John Stanberry and Theil Sharpe, I find that for the future Collins are pressing very hard with their Universal Microwave Group, a novel systems concept for microwave communication.

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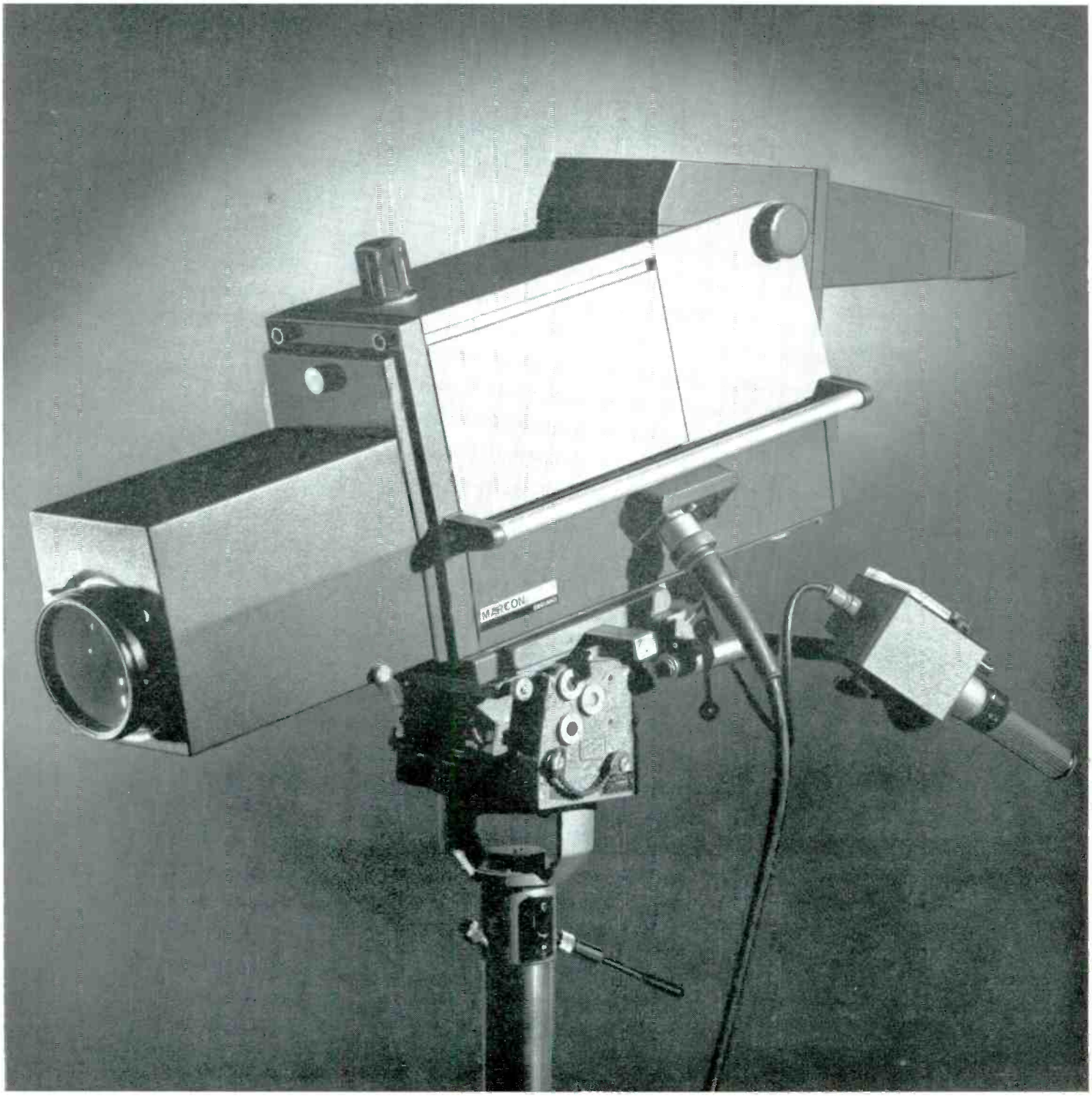
The new Marconi

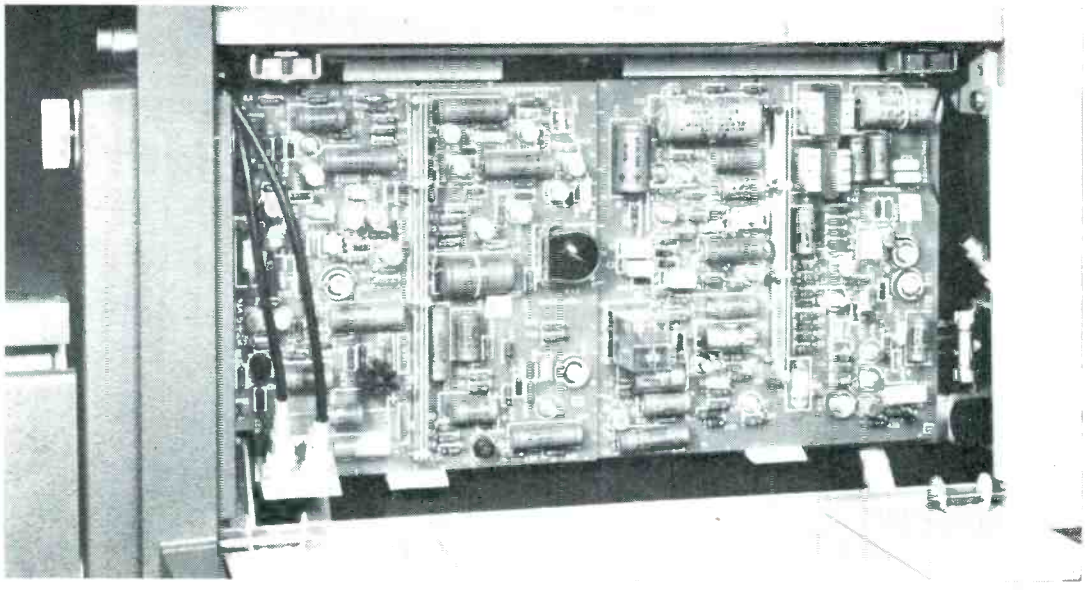


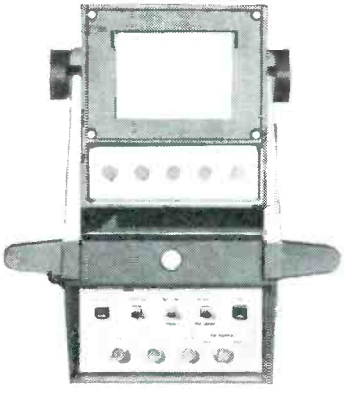
The smallest, lightest 4½ in. Image Orthicon Camera in production as simple to operate as an ordinary amateur photographic camera

MARK V solid-state television camera

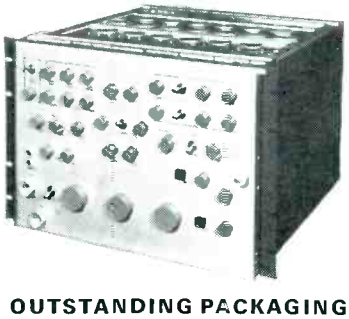
The latest and most advanced in the line of 4½ in. Image Orthicon Cameras produced by Marconi's, who pioneered the use of this type of camera and have sold more than all other manufacturers put together.

ALL SOLID STATE
Silicon transistors used throughout the chain to give outstanding stability and reliability. Constant output ensured despite mains variations, temperature changes or external fields. Easy access for tube changing. No image orthicon preset controls.



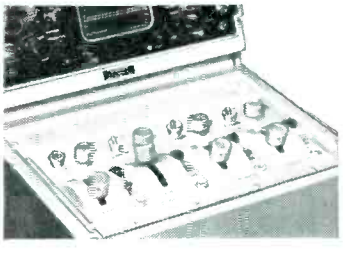


TILTING VIEWFINDER
Ensures most comfortable viewing position for all camera angles. Detachable up to 30 ft. from camera. Brilliant picture (200 ft.-Lamberts). Camera, external or mixed signals available at cameraman's choice.



OUTSTANDING PACKAGING
Single rack mounting camera control unit, control panel and power supply. Circuitry contained in seven plug-in printed wiring modules, giving easy front access for maintenance.

INTEGRATED ZOOM LENSES
Choice of servo or manually controlled zoom lenses gives infinitely variable focal length for exact picture framing. Simplified camera operation and improved programme continuity.



SIMPLE CONTROL
Simple compact control panel, four of which can be mounted on a console desk gives complete 'hands off' operation.

Marconi television systems

The Marconi Company Limited, Broadcasting Division, Chelmsford, Essex, England

LTD/B66

NAB review

U/M/G, as they call it (now in all frequency bands from 3.7 gC to 11.7 gC) is, as it was explained to me on the Collins booth 'all based on the concept of commonality, commonality from modules through layout, cabling and powering, for both remodulating and IF heterodyne equipment. . . . The basic system has a long-haul capability of 1,200 channels, or colour TV, using IF heterodyne techniques. All systems are fully transistorised, except for klystrons and TWT's.

Newcomers to the NAB Conventions are often surprised to discover that Columbia Broadcasting System have a CBS Laboratories division, who regularly support the NAB technical exposition. It is as if the BBC or ABC-TV in Britain were to have exhibits staffed by their research engineers, displaying products on commercial sale. Indeed at Stamford, Connecticut, CBS Laboratories this year have produced two new devices which they nickname the 'Max Brothers,' Audimax and Volumax. The latest Audimax is the Type 111, a transistorized audio level control able to increase programme power by 4-to-1, and automatically adjusts programme audio levels. The Volumax is an automatic peak controller which it is claimed doubles the effective radiated programme power when compared with conventional peak limiters.

CBS Laboratories' representatives including Frank B. Sobieralski, Jerry Goldman and Emil Torick showed me the circuitry of the Audimax 111, which is now a solid-state automatic level control, and also the layout of the Audimax 111 which consists of two Type 111's electronically and mechanically coupled for stereo MPX operation. Regarding the Volumax, they explained to me: 'You see, with conventional peak limiters the broadcaster has to choose between two evils. Either programme level has to be reduced so that limiting of peaks will not be drastic enough to cause 'pumping,' or this audible distortion must be tolerated. Pumping in conventional limiters is usually moderated by the use of long recovery times. Thus during the intervals immediately following high programme peaks valuable modulation capability is wasted as the limiter recovers from reduced gain. Now the Volumax analyses all programme material and automatically chooses the most appropriate regulation speed. Limiting action may be gentle or microsecond fast, depending on the nature of the programme waveform. . . .

'In AM broadcasting, negative peaks must be kept below 100 per cent modulation to prevent cutting off the carrier; positive peaks, however, may modulate in excess of 100 per cent. Since our Volumax can be operated asymetrically, at the option of the user, limiting levels for negative peaks may be kept below the 100 per cent level, while positive peaks may be allowed to modulate more than 100 per cent. . . .'

As a result of a Washington demonstration I find that the 'attack' time is less than 1 microsecond or 4 milliseconds, depending on the programme waveform. Having produced an electronic winner, CBS Laboratories are taking no head-in-the-clouds scientific approach but have gone in for the 'hard sell.' They urge you to order the two ($665 each) and try them free at your transmitter for 30 days, with no obligation.

With British, French, German and Japanese manufacturers all striving to break into the US-TV market, Europe's EMT have a big advantage in being represented (as are Neumann) by Gotham Audio Corporation, of New York. I found Gotham's Stephen F. Temmer and Hugh S. Allen Jr most enthusiastic about a number of Neumann and EMT developments which are already in use in German and British TV stations. America is taking to the EMT 927A studio turntables, the 930 turntable ('We ourselves were surprised at the cueing accuracy,' a Gotham technician admitted to me. 'We get a wow-free start to a syllable'), and of course the well-known EMT 140 reverberation unit, known in Britain as the electronic echo machine. It will be recalled this is a steel plate under tension, using a dynamic driver and a piezzo-electric pickup system, with a built-in V-54 amplifier. Remote electronic control of echo time is possible, and even a four-second echo can be produced! Because of the increasing use of stereo in the US, EMT hope to do good business with the stereo version of the reverberation unit. Gotham also have a novelty in the acoustic tempo and pitch regulator (MLR 38/15) produced by Eltro GmbH of Heidelberg. They told me: 'With this you can vary the speed or pitch during playback of a recording. For instance, when playing back a recording made at 15 ips, this regulator allows a continuous tape speed variation from half the speed (approximately 7.5 ips) to double the speed, **without involving any alteration of the pitch, the level or the fidelity of the recording.**

'When playing back a sound recording, this regulator permits variation of duration, and therefore adjustment of running-time of the broadcast. In the TV and film studio the regulator is suitable for motion-sync playback of sound films, or silent films where the sound is to be added in sync, or which have to be played back motion-synchronized as is done in films produced in foreign languages. You don't need to cut the sound track. . . .'

At first this appears to be an audio-electronic miracle, even verging on the impossible. Well, at Washington the Gotham experts who have worked on this Eltro device gave me this explanation. . . . 'The recording pitch depends on the relative speed between the pick-up head and the tape during playback. If the pitch is to remain constant at a changed speed (that is, if the relative speed is to remain the same) then minute sections of the modulation have to be "skipped" for a reduction in overall playback time. On the other hand, minute sections of modulation have to be repeated when the playback time needs extending. Now we know the length of these modulation sections is about 30 ms. To get uninterrupted playback, the tape is fed to a quadruple pickup head with a wrap-angle of about 90-degrees. It is a scientific fact that these repeated (or deleted) 30-ms sections are always shorter than the shortest sound of speech or music.'

Through Gotham, EMT's Vid-E-Dit has created another minor sensation at Washington, just as it did when first introduced at the 1964 NAB Convention in Chicago. With so much taping in US-TV, the Vid-E-Dit method of electronic cutting and splicing for video tapes is most acceptable and in its field it is without competition. It is unfortunately all too well known that to avoid interference in a picture when played back, it is necessary for every cut to be made at an exactly defined spot between the two complete pictures, with an accuracy of some hundredths of a millimetre. To indicate the beginning and end of the picture, special cutting pulses are recorded on the tape at the same time as the control frequency. These editing pulses therefore appear with every eighth oscillation of the control frequency, corresponding to the frame rate of 30th sec. In other techniques the tape is immersed in a carbonyl iron solution before editing, so that after the solution has been evaporated the cutting pulses (that is, the magnetisation spots) become optically visible. With the Vid-E-Dit method there is a tach pulse scanning head, and the editing pulses show up on an oscilloscope; also the machine includes a power-drive suction device holding edited tape ends in contact while adhesive tape is applied to the splice.

One of the senior concerns in broadcast studio audio equipment is Altec Lansing Corporation (a subsidiary of Ling-Temco-Vought Inc), and at Washington they used a special booth in the Virginia Suite to demonstrate 'Playback' (that's a trade name) amplifiers, pre-amplifiers, microphones and speaker units. I recall that at last year's NAB Convention I was invited to the big Studio A of the Universal Recording Corp, Chicago, where

▶ *to page 448*

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.

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BBC	**London**
NDR	**Hamburg**
WDR	**Cologne**
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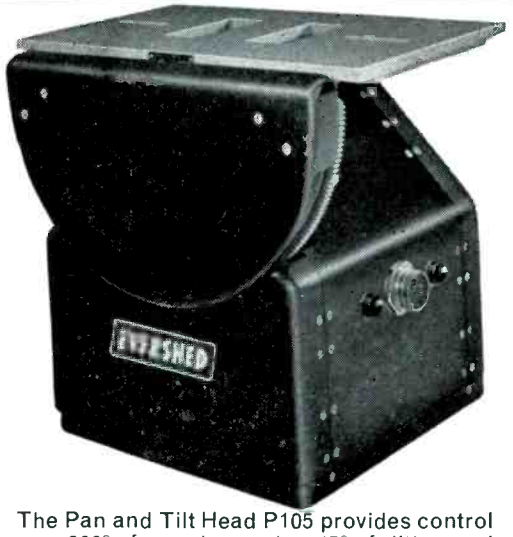
	etc. etc.

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.

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3 solid state transistorized rack-mounted amplifier
4 operator's control panel for remote control of pan, tilt, zoom, focus and iris (optional)

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✳ 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

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NAB review

four Altec A-7 systems are used in monitoring a four-channel 'Playback.' And at the main cutting room at Walton, Chicago, the Altec A-7 is used for instantaneous monitoring of edited master-tapes. There is plenty of Altec equipment in Hollywood TV and film studios. For example, Rex Harrison and other **My Fair Lady** stars used five A-2 'Voice of the Theatre' systems, together with Altec microphones, when the Broadway hit was put on celluloid, and Columbia Records Studio A in Hollywood uses a battery of CBS-built cabinets housing Altec 605A duplex speakers for playback. Turning to more immediate needs of broadcasters, Altec this year have developed the 438C compressor amplifier, based on the 436C I tested last year at Chicago. The 436C is still much in demand, as this compressor amplifier maintains a high programme level for broadcasting or recording, without danger of over-modulation on peaks; in recording this causes distortion, and in broadcasting it also generates sideband splatter. On the 436C there are variable threshold, compression and release (recovery) time controls, while the latest 438C is a similar job but with an additional stage of amplification for a low-impedance microphone and gain control. It appears the 'attack' time is 50 milliseconds, and the release time adjustable from 0.3 to 1.3 seconds. Compression ratio is 2:1 at 0 dBm threshold, and 4:1 at 16 dBm.

With increasing TV and radio coming from 'actuality' spots, Altec should do good business with a line that until this year's Washington NAB display has been rather neglected; I mean the transportable mixer amplifier. Now they have a suitcase version, also suitable for rack-mounting or table-top consoles, which is designed for outside broadcasts needing up to five audio channels. The gain is 97 dB maximum on channels 1-4, and 55 dB on channel 5, with 17 mv input for 0 dBm output. Source impedance is 30/50 and 120/200 ohms channels 1-4, with plug-in microphone transformer, and performance is such that frequency response is ± 1 dB from 30 to 15,000 c/s. This is a valve, not transistor, amplifier (the circuit uses three 12AX7 and one 6CG7, which will indicate to the initiated quite a lot about the circuitry involved), and essentially this is a US-use mixer amplifier being available as standard only for 117-volt 60 c/s input.

Also because of increasing range of televised outdoor items, American professional engineers are using a great deal of remote pick-up equipment, and the NAB this year showed several makers leading the field. From Texas came George W. and Joe Marti, with Robert E. Richards, all of Marti Electronics, Cleburne, to show a number of novel remote pickup facilities such as the RMC-2 radio remote control system for AM/FM transmitters, and an ingenious 26 Mc/s telemetering system for control and metering of a transmitter. I was able to try out the M-3/STL studio transmitter link, a 3-watt job ranging between 942.5 and 952.5 Mc/s, the transmitter unit of which is driven by temperature-controlled crystals, the total RF output having a frequency stability of better than 0.001 per cent. Phase modulation is used, and the accompanying receiver covers the bandwidth of 200 Kc/s, 3 dB points, with an overall response of ± 1 dB from 50 to 15,000 c/s. These are tube not transistor units, the transmitter using tubes such as 6U8A, 12AT7 and 6360-A, with nuvistors and Motorola Varactors.

Marti Electronics have a range of mobile and remote-control links including the M-25C/MR30/150 complete base station working on the frequency range 152 to 172 Mc/s. The M-30B broadcast-quality remote pickup transmitter works on the same channels, and there is even a fully transistorized transmitter for similar links, with a 12.6-volt supply.

From Santa Barbara, California, come Moseley Associates Inc, and this company's president John A. Moseley, and engineering manager Howard M. Ham Jr gave me details of their latest RPL-1 remote pickup system working on 148-174 Mc/s. Here the RF output of the RPL-1T transmitter is 30 watts continuous into 50 ohms, and after presetting there is at the touch of a switch a choice of two operating channels. The whole transmitter takes its power either from mains or a DC transistorised supply. Standby consumption on mains is 25 watts at 12/240 volts 50/60 c/s, and 150 watts in the on-air position. The 12-volt DC supply takes 2.0 amps on standby, and 12.0 amps on transmission. The matching RPL-1R receiver weighs only 14 lbs., has automatic and adjustable squelch, has 100 dB image rejection, and shows a sensitivity factor of 0.5 microvolts for 20 dB quieting. Thus, as a Washington test of this equipment showed, the Moseley remote pickup system features extended audio bandwidth, low modulation distortion, high S/N, and the circuitry at 'both ends' includes RF output metering, an illuminated VU-meter, automatic peak limiter, and an average levelling circuit.

At any Convention technical delegates are too frequently faced with static, unworkable exhibits or even mock-ups and prototypes. This year at Washington Maryland's Entron Inc had a CATV display actually working, and Edward Whitney, Heinz Blum, Don Kilbrith and others were able to show me 'community antenna' signals (up to 12 TV channels) plus the full FM band arriving from the antenna site or from a previous section of trunkline, and then being processed by an Entron R-1 transistorized repeater amplifier, feeding into a following section of trunk and then passing through units including the DF-10B directional coupler and the B-1 transistorised bridging amplifier. After the signals have passed through some 2,500 feet of ¾-in aluminium-shielded coaxial cable (a total of 22 dB attenuation at Channel 13) they are again amplified in a tube-equipped Entron LHR-45R repeater amplifier. This automatically corrects for any changes in signal level caused by temperature changes and cable-ageing. I noted that the R-1 and B-1 transistorized amplifiers are mounted by clamping to the messenger strand; they are remotely powered over the coaxial cable, and are self-contained in a weather-tight case.

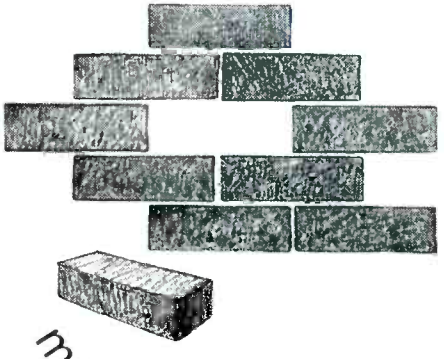
The transistorized bridging amplifier seems to me to provide a very convenient means of distribution line origination. It samples the trunk-line signals by means of a directional coupler, then boosts these signals in an amplifier module which can be removed from the weatherproof housing without affecting the trunk-line itself.

Keynote of many transistorised units now available to the **US-TV** professional public is 'computer philosophy,' and this is typified by Riker Industries' new series, especially the EIA sync generator. Mr H. Charles Riker, Kenneth V. Seelig and others of Huntington Station's Riker Industries stressed to me that this new sync generator is 'based on computer logic techniques, not merely transistorized versions of tube circuitry.' To be sure, parameters are adjustable, but once set they do not vary. Pulse widths and amplitudes are controlled by fixed delay

lines, binary counters and zener diodes. From a cold start, all levels are preset, and in long use there certainly seems to be no drift. A novel feature is that Riker do not market this sync generator as 'here-it-is-in-a-carton,' but provide some 14 different modules to cover such facilities as pulse gates, pulse amplifier, sync lock, ABC sync lock system, horizontal lock, vertical lock, bar and dot generator, relay sync changeover, and colour frequency standard. For example, the colour lock model 551 consists of two modules containing a 455/4 countdown, providing a 31.5 Kc/s drive signal from a 3.58 Mc/s input. The automatic change-over module (Type 522-2) is an automatic fail-safe sync generator change-over unit which continuously samples individual pulse outputs. Outputs of master and standby sync generators are controlled by relay switching. The fail-safe operation works this way; if power is lost on the master generator it will switch to standby. The module is normally used to provide a fail-safe selector for two sync generator outputs, and this module contains local delegation of the master generators, with provision for remote control. For special CCTV purposes in science and industry, Riker tell me they are sometimes asked to provide sync generators not only for 625 and (yes, really) 405 lines, but 819 and 945 lines. With Riker's system multistandard switchable systems can be assembled by the addition of one timber, pulse gates and counter for each standard needed.

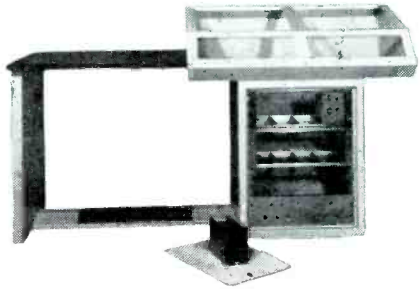
Here it has been possible to make only a brief survey of the wide range of professional broadcast equipment now being produced in the United States following the successful NAB Convention and technical exhibition. In the next issue will be given details of such innovations as Fairchild's Lumitens (level control on a beam of light), the Nems Clarke spectrum display monitor (a CRT on which a transmitter engineer can actually watch a complete picture of his transmitter's operating spectrum), Central Dynamics (Montreal) and their audio/video preset switching system with 'memory units' permitting storage of up to a dozen audio/video events, and Florida's Vital Industries' novel all-solid-state video clamper and stabilizer amplifier. First details will also be given of surprising new microwave developments by American Electronic Laboratories of Pennsylvania, who have developed FM transmitters and Davers Corporation infrared devices. . . . As a technical Postscript let me explain that these Davers detectors are in my opinion an extremely advanced state-of-the-art, as they have sensitivities approaching theoretical limits in the wavelength region from 1.0 to 5.5 microns!

To (be concluded)



BRICK BUILT?

AUDIO EQUIPMENT



meet changing needs with a *NEVE* modular audio console

Dividing up equipment into a number of BRICKS, or circuit units, is a technique we have developed to make individual design possible without impossibly high development costs.

Its flexibility is enormous, future modifications to meet changing studio requirements can be carried out easily, often leaving the main equipment in service. BRICKS are built, for example, for microphone amplifiers, equalisers, line and recording amplifiers.

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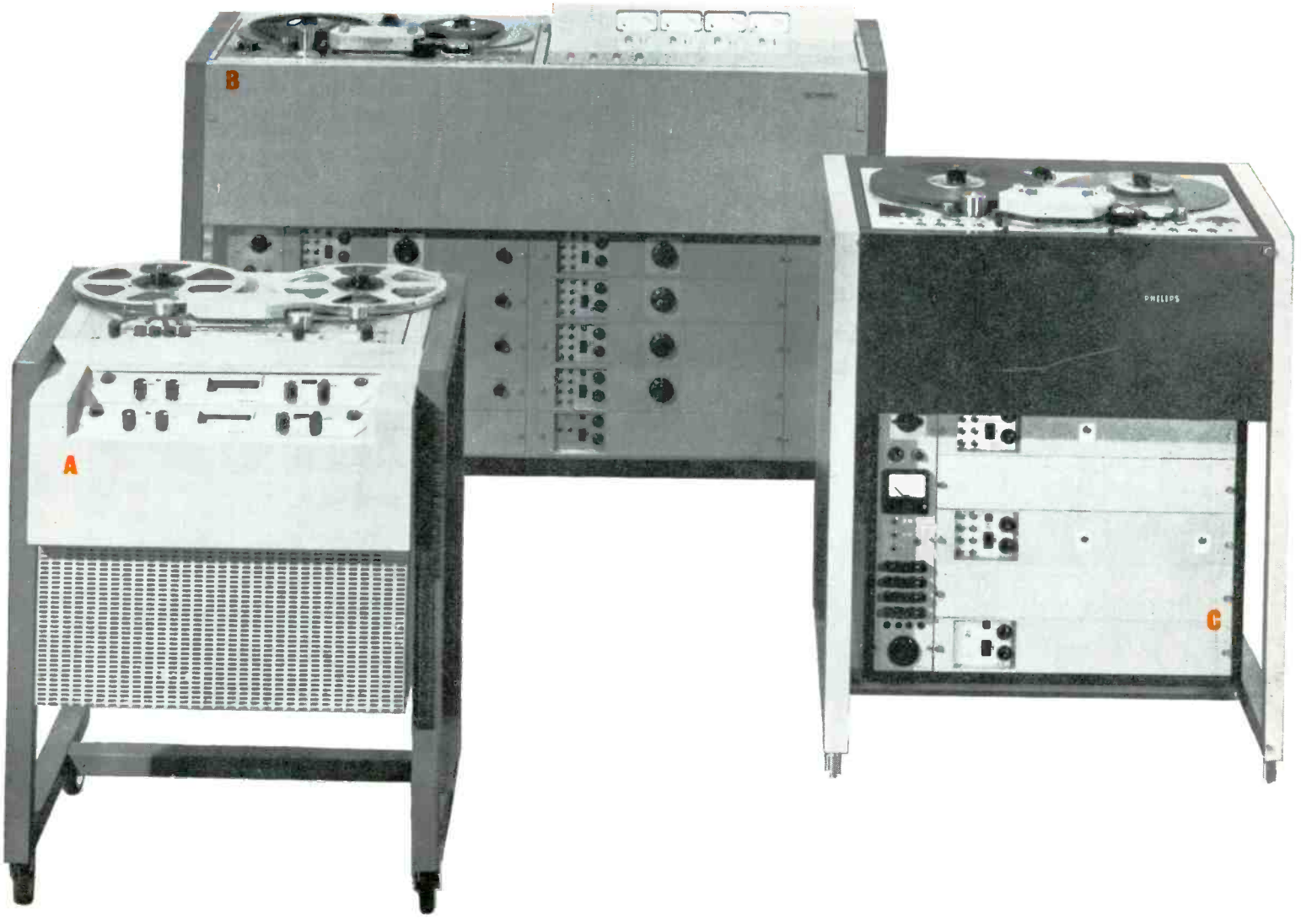
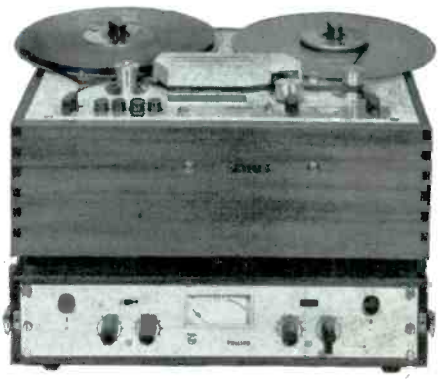


A new range comprises three types of recorder, available for 50 c/s operation, and with CCIR or NARTB equalisation.

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



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High quality range, capable of an exceptional standard of sound quality. For mono, stereo or half-track recording on ¼-in. tape. Console (Pro 25) or rack mounting or in teak cases for transportable use (Pro 20).

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for mono or stereo recording, 7½/15 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 ½-in. or 1in. tape, 7½ ips. Ferrite heads for long life. Particularly suitable for dubbing, post-synchronising or transfer.

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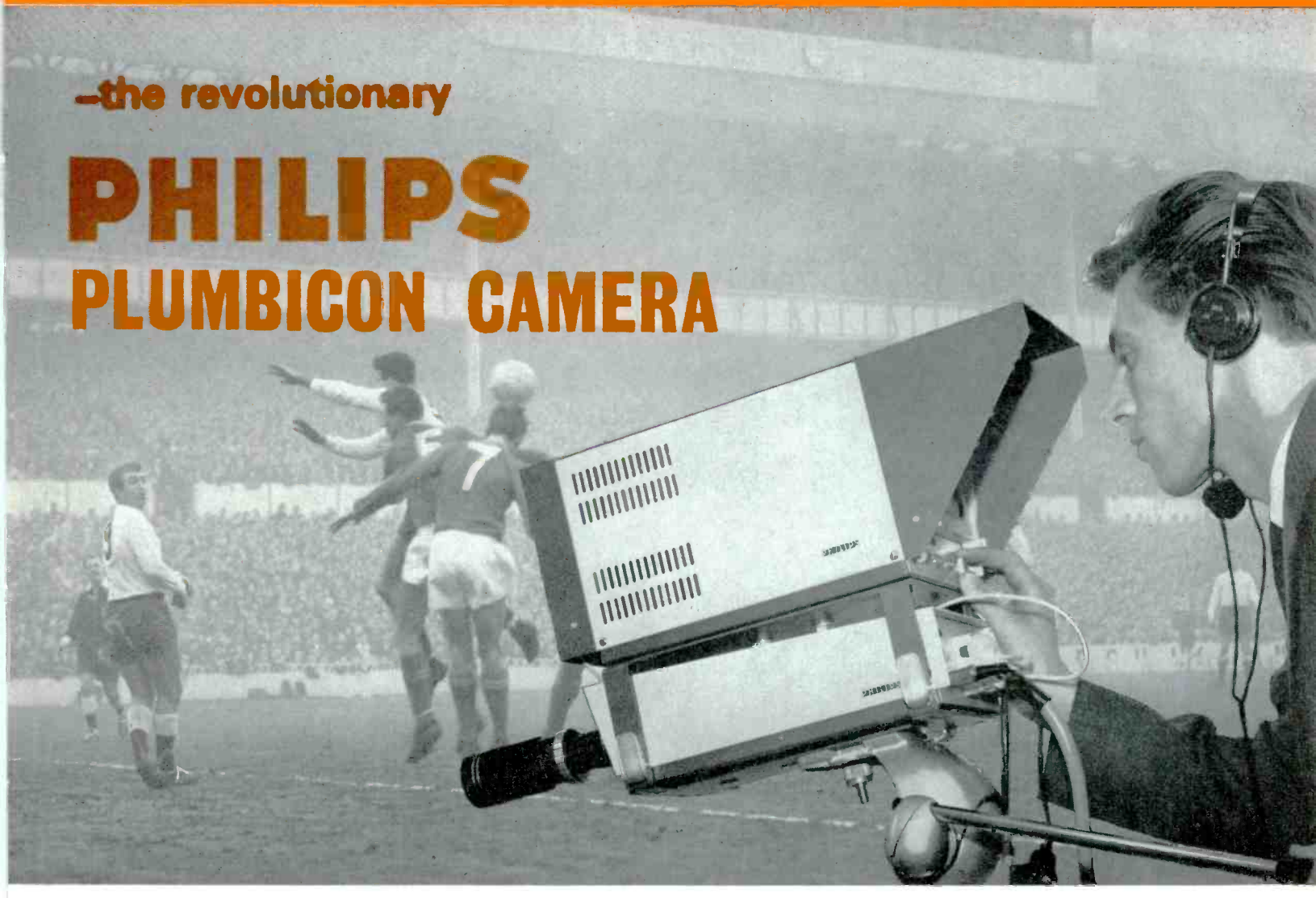

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TELEVISION PROGRAMMES ON FILM

Film as a source of Video and Audio signals

THE MOST URGENT NEED in television broadcasting today is the ability on the part of individual broadcasting organisations to produce more of their own programmes, replacing at least some of the 'canned' telefilm shows that currently take up so much air time. Utilising the motion picture film process as the recording medium, any television station should be able to produce programmes of the highest quality with only a modest investment in equipment, facilities and personnel. In the past broadcasters have been reluctant to use film because its performance as a source of audio and video signals has been as a rule very erratic.

In a series of five articles, of which this is the first, some of the exciting possibilities of film as an immensely versatile television programme production medium will be described, and a 'blueprint' will be presented indicating the modifications needed in conventional motion picture craft practices to meet the requirements of television reproduction.

The author has had over 20 years' experience in large scale motion picture and television operations. His present position is Supervisor of Technical Film Operations at the main English language programming centre of the Canadian Broadcasting Corporation in Toronto. He is a Fellow of the Society of Motion Picture and Television Engineers; an Associate of the Royal Photographic Society, and a member of the Society of Photographic Scientists and Engineers. For the past two years he has been International Vice-chairman of the SMPTE Papers Committee, and he is presently serving a second term as Governor of that Society.

by Rodger J. Ross

MOTION PICTURE FILM is in many ways a very attractive television programming medium. One might even go so far as to say that television broadcasting could not exist without film. Certainly, programmes on film enjoy widespread popularity, not only with the viewing public, but with station managers, programme directors and advertising agencies as well. According to a recent report of the Eastman Kodak Co, more than 80 per cent of the television shows that appear during prime TV time (19.30 to 23.00) in the United States are produced on motion picture film. In planning their programme schedules individual television stations have access to a wealth of filmed programme material in the form of the ever-popular old movies, as well as a great variety of drama and comedy subjects under the general heading of telefilm serials. For the convenience of television programme producers, motion picture stock shot footage is available illustrating almost every conceivable situation. Alternatively, a film camera crew can be sent out to pick up pictures and sound of specially staged events to supplement live studio programmes. Many enterprising television production groups with the whole wide world as their stage are already making outstanding use of film to assemble complete programmes. Television advertising makes very extensive use of the film medium to present their sponsors' products to the public and of course, film is the life-blood of television news.

One of the most significant advantages of film is its world-wide interchangeability, made possible by the high degree of standardisation achieved over the years by the motion picture industry in the dimensions of equipment, materials and records. A film made in England, for example, can be projected in India on a machine manufactured in the United States with no danger whatever of damage to the film or failure in the picture or sound presentation. Moreover, a standard motion picture film can be reproduced on telecine equipment operating in any of the existing television line or field systems.

At this point, however, we must recognise that film is still generally considered by television broadcasters as an inferior medium of television programme production compared with the live studio and video tape. Oddly enough, the reasons for this attitude are not hard to find. In fact, television broadcasters have been trying for years to convince film makers that the peformance of film as a source of video and audio signals is extremely variable. Investigations have shown that large variations occur in the maximum and minimum densities of film images. To overcome the undesirable effects of these variations, particularly in the picture-reproducing channel, television engineers have proposed the use of automatic gain or sensitivity control devices. In this way, it is possible to maintain fairly constant video signal levels over the wide range of image densities normally encountered in telecasting film. As might be expected, however, picture quality is often seriously degraded when this method of degradation is employed.

One might assume that, since the problem is so obvious, film makers would have long since taken appropriate steps to control image densities within a range acceptable for television reproduction. As a matter of fact, this is a much more difficult and complex problem than it appears to be on the surface. Before a satisfactory solution can be found, extensive modifications in conventional motion picture practices must be made. First, though, we must be prepared to accept the fact that a film which appears to be perfectly satisfactory in direct projection on a screen may not reproduce in an acceptable manner in the television system.

Some film makers continue to insist that the television system should be capable of reproducing any film considered to be acceptable for direct screen projection. A perfectly sensible question would be—why should the television system have this capability? Television represents a new and highly complex means for achieving picture and sound presentations in the home. When film is utilised as a programming medium for television, information should be recorded on the film in such a way that it can be recovered by the television reproducing system with minimum loss or degradation. In fact, the recorded information does not even have to be in the form of recognisable picture images—if for any reason it would be desirable to do so, the picture information could be recorded in the form of traces, in a manner similar to sound tracks. This is, by the way, how television picture information is recorded on video tape.

There are of course many advantages in recording picture information on film in the conventional manner. The point that we want to make here is that films intended for television use do not have to produce acceptable picture appearance judged by normal motion picture projection standards. The purpose of the images is only to generate

Television Programmes on Film — continued

video information suitable for television transmission. Consequently, when television films are being made, television reproduction requirements must be given first consideration. If this is not done, the results are certain to be disappointing.

To meet these requirements, film makers need to know how picture images in film are converted into television video signals. Fig 1 illustrates the process of image conversion in simplified diagrammatic form. For the purposes of this illustration the vidicon tube is utilised, but it should be understood that other methods of reproduction are similar in principle. At the left is a lamp, the light from which is concentrated in the projector aperture by a condenser. The film image in the aperture modulates the light beam, and the pattern of light and dark areas so formed is focused on the face of the vidicon camera tube at the extreme right.

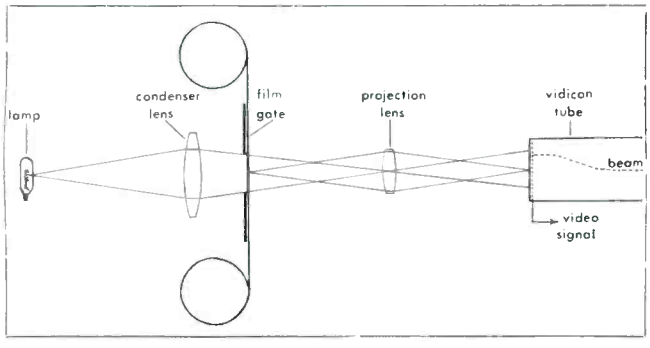


Fig 1. Simplified diagram of the image conversion process in a vidicon telecine. In this process, optical images originating with the film in the projector gate are converted into video signals by means of the vidicon scanning beam.

On the inner surface of the faceplate of the tube is a transparent coating called the signal electrode, over which a photoconductive layer is deposited. An electron gun is located at the base of the tube. A sharply focused beam of electrons is produced by the electron gun. The electron beam is made to traverse the rear surface of the photoconductive layer by means of horizontal and vertical deflection coils. In the scanning action the beam sweeps rapidly backwards and forwards across the photoconductive layer while at the same time it is moved progressively downwards from the top of the picture to trace out the complete television scanning pattern.

The total time required to complete the scanning of one television picture frame is determined by the television frame rate, which may be either 25 or 30 frames per second, depending on the television system in use (in UK. 25 fps; in USA 30 fps). The duration of each horizontal line trace also varies with the television scanning system—405 and 625 lines per frame in the UK, and 525 lines per frame in the US. We should point out that film makers need not be particularly concerned with these differences in television scanning standards. The basic scanning action that takes place in the vidicon tube is the same, irrespective of the rate at which the beam is driven. Fig 2 illustrates how this action takes place.

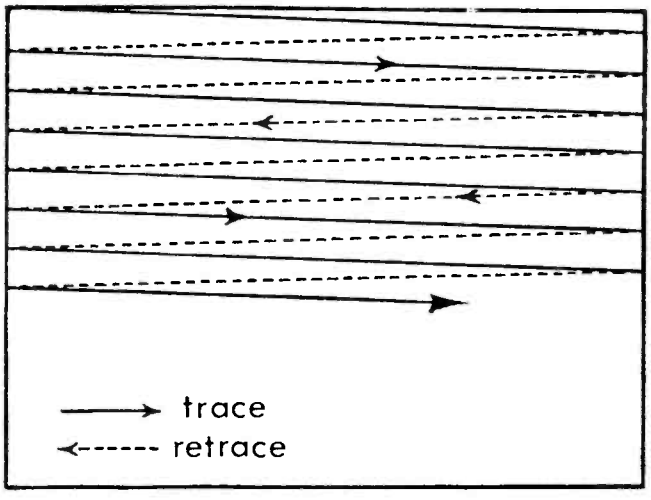


Fig 2. The basic television scanning pattern, showing successive line scans. As the electron beam traverses the photoconductive layer in the vidicon tube, the amplitude of the output signal varies in relation to the intensity of the light image produced on the face of the tube by the projector lens.

The signal electrode and the photoconductive layer in the vidicon tube form a capacitor across which a voltage is impressed. Light falling on the photoconductive layer lowers its resistance, the resistance at each point on the layer decreasing in proportion to the intensity of the light at that point. The pattern of electrical charges that builds up on the photoconductive layer corresponds with the pattern of light and dark areas produced on the tube face by the projector lens. As the scanning beam traverses the photoconductive layer, electrons are deposited at a rate sufficient to drive down the surface to cathode potential. A corresponding number of electrons flow out through the lead attached to the signal electrode, producing the video signal.

In attempting to visualise how this conversion process works, it is helpful to consider the action that takes place when a film image containing a vertical white bar against a uniform black background is placed in the projector gate. The type of image we have in mind is shown in Fig 3 (a). This image produces a pattern of black and white areas on the vidicon tube, and as the scanning action proceeds a signal is generated which varies in amplitude as shown in Fig 3 (b). Here we have what we may call zero signal level for the dark background of the image. (For the sake of accuracy it should be stated that in this illustration black level in the signal occurs at a point slightly above blanking,

but for the purposes of this discussion black level may be considered as zero signal level.)

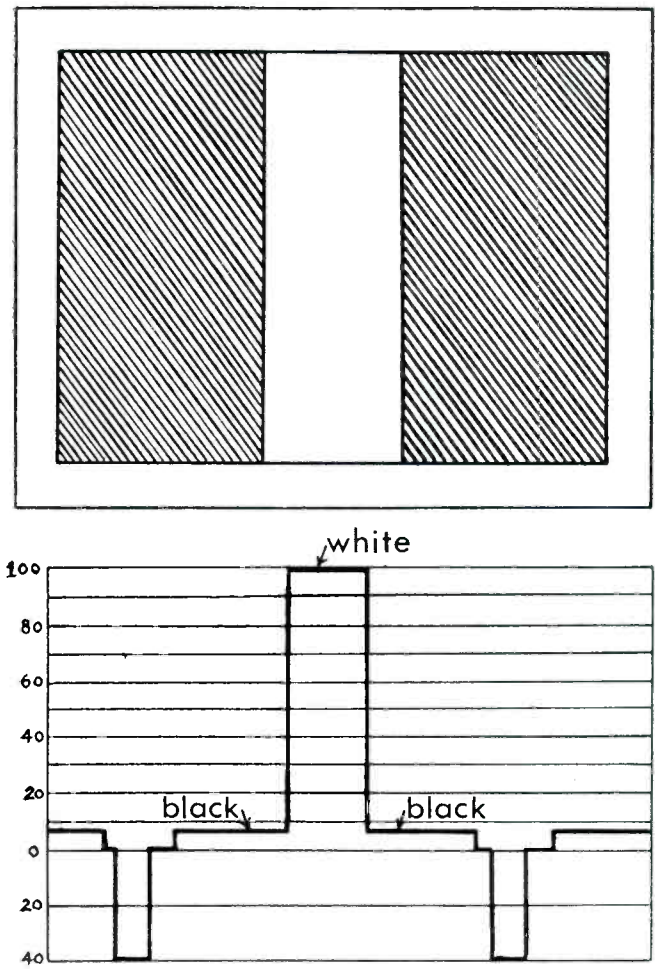


Fig 3. This diagram shows the relationship between a simple optical image consisting of a white bar on a black background, (a), and the resulting video signal (b), produced by a single line scan of the electron beam. The scale shown in this diagram corresponds with the graticule of the waveform monitor on which video output signals are displayed. By means of appropriate telecine controls, the amplitude of the signals in relation to the graticule may be altered to conform with television transmission standards.

When the scanning beam crosses the boundary between the black background and the white bar, the signal level rises suddenly to a much higher level. It remains at that level until the scanning beam again crosses into the black background. At this point the signal level returns again to zero. This action is repeated for each horizontal scanning line. Fig 3 (b) shows the signal waveform for a single line trace only.

When film containing images of moving objects is being projected continuously, the patterns of light and shade on the vidicon faceplate are constantly changing. We may have a condition where, during the scanning of a particular horizontal line (say the 50th), the beam crosses a small white area in the image, resulting in a sharp video signal peak, while in the next horizontal scan for the 50th line, the white object may have moved to another location, or disappeared altogether. Alternatively, the white object may have remained in the same position, but the lighting level may have changed between scans, resulting in a lower video signal level for the second trace.

From these very brief, simplified descriptions of the scanning beam action, it should be possible to visualise that, as the action proceeds, the video signal output from the camera tube will vary continuously in relation to the locations and intensities of the light patterns projected on the tube face. To complete the picture, so to speak, these varying video signal levels cause the scanning beams in home receivers to trace out similar patterns. With the aid of the persistence characteristic of human vision, recognisable pictures of houses, trees, horses, people, etc, are re-created. In the intermediate stages of signal handling, transmission, and reception, the pictures exist only as continuously varying video signal levels. The rapidity with which the signal levels can be made to change determines the ability of the television system to reproduce fine detail.

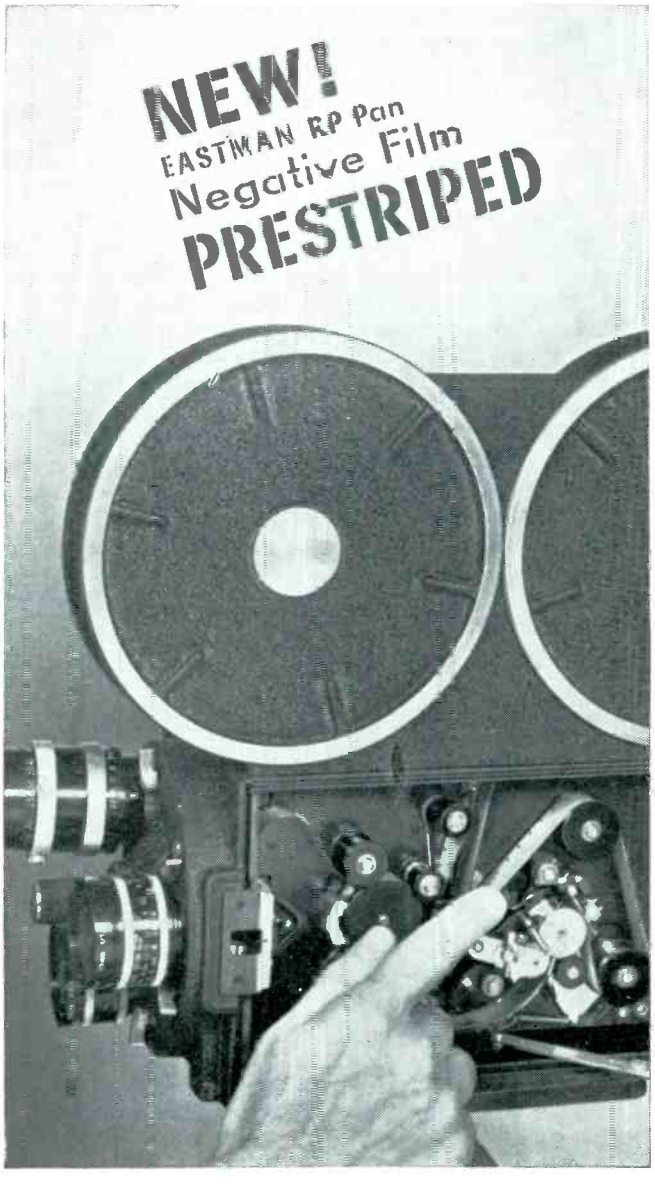
It should be noted at this point that several different methods may be employed to effect the conversion between the standard motion picture frame rate of 24 frames per second, and television systems operating at either 25 or 30 frames per second. In 25 fps systems it is the usual practice to speed up the film projector to match the television frame rate. This cannot be done in systems operating at 30 frames per second, and a different method must be used. The vidicon tube offers the very important advantage that if the light application time is greater than 30 per cent of the television field period, no adverse effects due to non-synchronous operation can be observed, even by the most critical viewers. However, the pattern of dark and light scanned areas in each field has to be the same. This can be done by using a shutter in the film projector that admits light to the vidicon five times fo reach film frame.

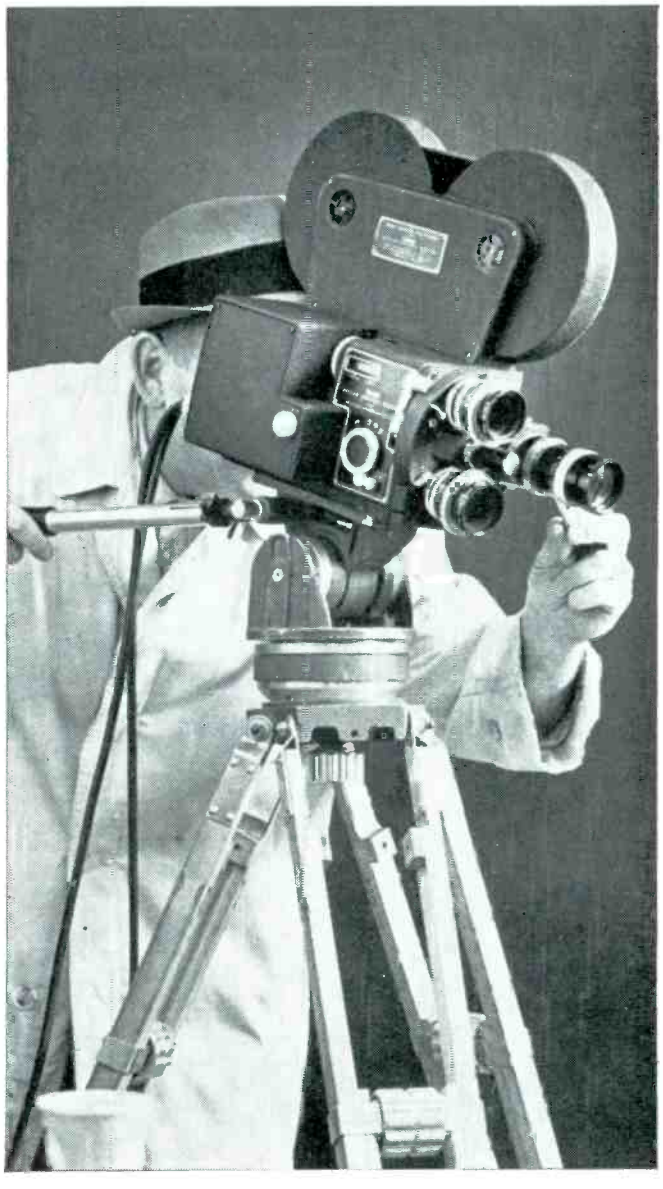
In the production of motion picture films it is the usual practice to adjust printing—and often processing conditions as well—to achieve what appears to be the most satisfactory picture appearance judged by direct projection on a screen. The actual densities in the film images are unimportant so long as the pictures on the screen are visually acceptable. Because of the way in which motion picture production work is carried on, it would be very difficult indeed to attempt to measure the actual densities in the images. Even if it were possible to do so, it is unlikely that visually acceptable pictures would be obtained by insisting that the images should have specified densities.

We might take, as an illustration, the familiar motion picture practice in which negatives made in broad daylight are deliberately over-printed to produce the effect of a night scene on the projection screen. Since the images in films made in this way are not likely to have any normal white areas, video signals obtained in television reproduction would have no white signal peaks. Television operating personnel might recognise a scene of this kind as a

▶ to page 458

LOAD, SHOOT, SHOW... IN MINUTES





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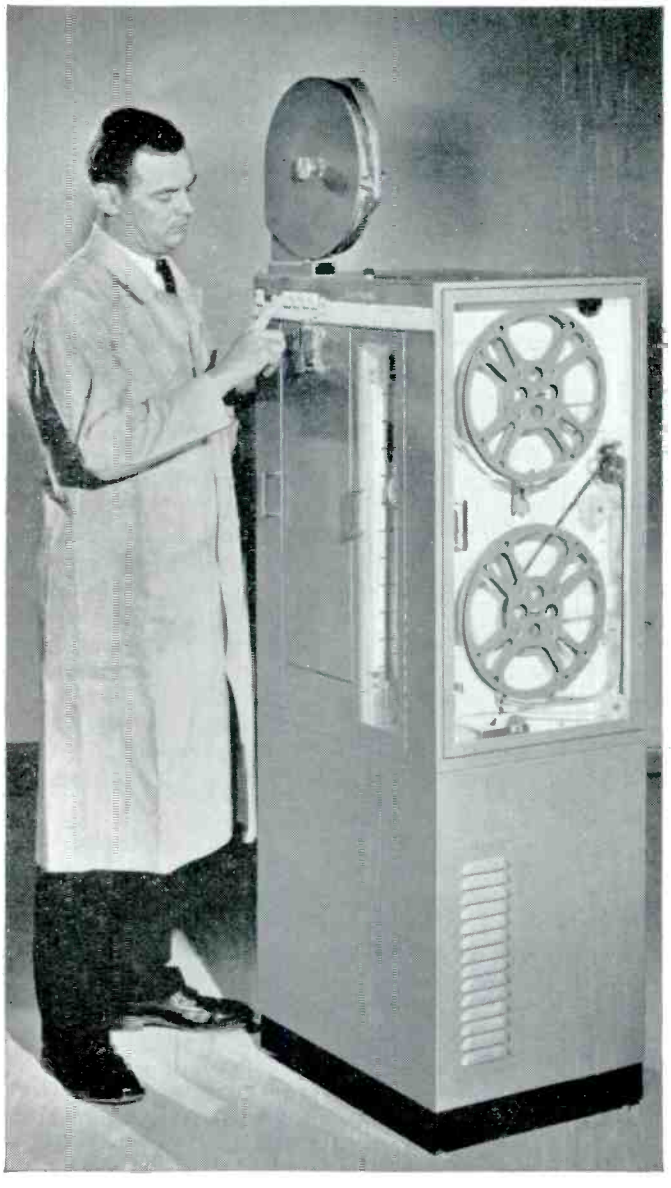

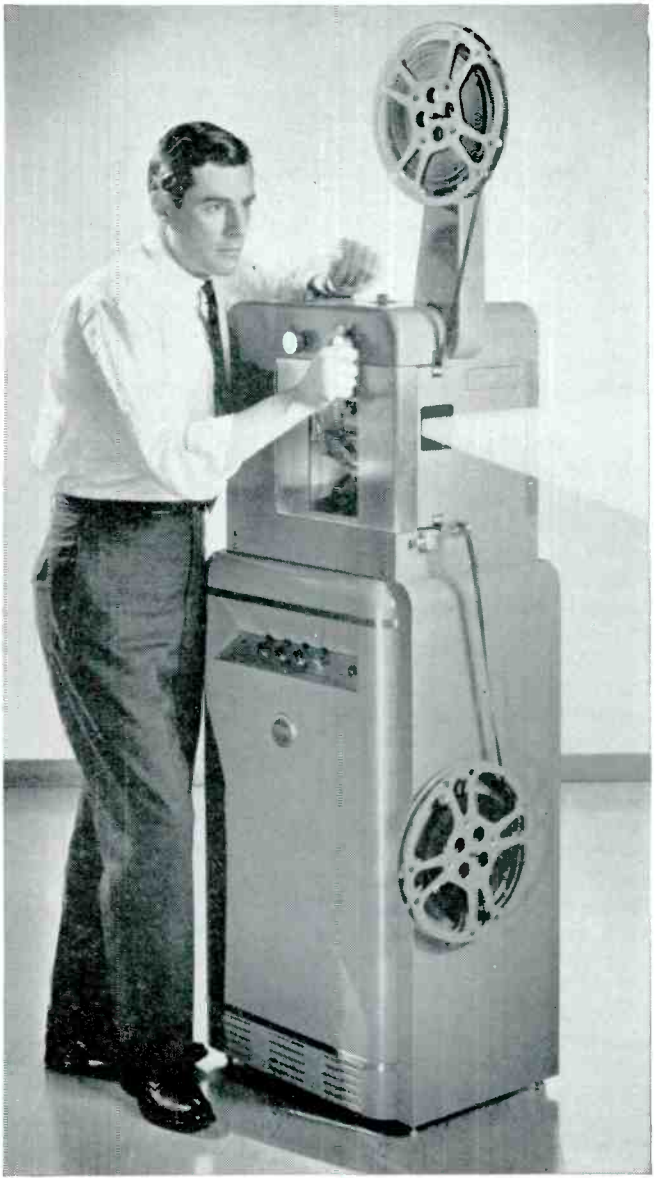

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the film in minutes with the new 16mm **Eastman Viscomat** Processor. Evenly—beautifully! It operates at a sizzling 36 ft/minute, delivering dry, ready-to-project footage. It has push-button simplicity, no chemicals to mix or replenish and a unique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

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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.

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Television Programmes on Film — continued

special effect and make no attempt to raise the signal level.

But what is to be done when another scene, obviously staged in the middle of the day, is so dark that it reproduces in the television system as if it were a night scene? The usual procedure would be to raise the video signal level to produce normal peak white amplitudes. This can be done by raising the light level in the projector gate; by increasing the gain of the video amplifier at the output of the vidicon; or by altering the sensitivity of the vidicon tube. Vidicon sensitivity, by the way, can be varied considerably means of adjustments in the signal electrode voltage. When the tube is utilised in telecine camera chains for film reproduction, it is normally operated in the minimum sensitivity mode to reduce dark current and lag.

All of these methods of video signal level control have been utilised at one time or another to compensate for variations in the densities of film images. Each method has some disadvantages. For example, it is very difficult to alter the projector light level quickly enough to overcome the drastic effects upon signal amplitude of large density variations occurring at film splices or scene changes. In any event, a mere change in projector light level cannot compensate for variations in film density range or picture contrast. When changes in image contrast occur, video signal level may be adjusted either for the light or the dark areas of the images. Further refinements may be introduced by separate adjustments of video gain for whites and black level for the shadow areas. The use of video gain control to compensate for large density variations leads to severe image distortion, mainly in respect to noise.

Signal level control is effected with the aid of a special oscilloscope fitted with a calibrated graticule, known as a wave-form monitor. In many television stations skilled video operators are employed to adjust camera controls as required by the varying densities of the films being telecast. It is the usual practice to set the signal levels corresponding to the lightest picture areas at the peak white line engraved on the waveform monitor. At the same time adjustments of the black level control may be made to reproduce the picture shadow areas at zero signal level. In this way, it is possible to avoid to some extent at least the loss of detail that occurs when excessively contrasty pictures are being reproduced, or alternatively to improve the appearance of excessively flat, low contrast images.

The video operator must conform with established television operating practices in controlling telecine signal levels, but manual operation permits some discretion to be exercised. This type of work is very tedious and wasteful of skilled manpower however, and in many television stations there has been a tendency in recent years, especially in North America, towards the use of automatic signal level control equipment. In general this equipment maintains the video signal peaks at the white level irrespective of the circumstances or the nature of scenes.

The use of either manual or automatic signal level control methods to compensate for variations in film densities is an outstanding example of tackling a problem from the wrong end. The case already mentioned of the day scene which was printed so dark that it had the appearance of a night scene illustrates the futility of this approach. Here we have a case in which the film obviously was incorrectly made in the first place, either through carelessness, ignorance or lack of adequate equipment and facilities.

In the past even the largest television broadcasting organisations have followed the practice of accepting any and all films offered to them by film makers and distributors, and then attempting, by one means or another, to obtain video and audio signals suitable for transmission from these films. Only recently have any serious attempts been made to devise methods for separating improperly made films from those that conform with television requirements.

For some time past there have been in existence, both in the UK and the US, official industry specifications for the maximum and minimum densities of television films (1, 2). Yet films are still being made, and still being accepted for television reproduction that obviously do not conform with these specifications. Does this mean that these specifications are not really necessary after all? Or that the film industry is incapable of meeting these specifications? The answer to both of these questions has to be 'No.' But if we were to ask why the published specifications are not being adhered to, the answer would not be quite so simple or straightforward. For their part, film makers are not likely to abandon well-established film production methods until television broadcasters insist that the densities of film images conform with the published specifications. Television broadcasters, on the other hand, have not yet taken the first essential steps towards the enforcement of these specifications—namely, the adoption of a standard telecine transfer characteristic and a standard telecine set-up procedure.

There is no doubt whatever that the quality of film reproduction can be significantly improved by controlling film densities within the published specifications. This has been demonstrated over and over again in practical film programming operations. An additional — and perhaps unexpected—advantage is that film with controlled image densities will render inoperative any automatic gain or sensitivity control device with which telecine chains may be equipped.

In the next article in this series, methods will be described for standardising the telecine transfer characteristic and set-up procedure, as well as the use of calibrated telecine equipment in the evaluation of television films.

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1. Recommended Practice RP7, 'Density and Contrast Range of Black-and-White Films and Slides for Television,' Society of Motion Picture and Television Engineers, Vol 71, No 5 (May 1962), page 369.
2. BS3115 : 1959—Recommendations for density and contrast range of monochrome films, slides and photographic opaques for television. British Standards Institution.

Mr. Ross is the author of a book, 'Television Film Engineering', to be published shortly by John Wiley & Sons Inc., New York.

New BBC pilot-tone stereophonic test transmitter

by Donald Aldous (Audio Editor)

SINCE April 5, 1965, BBC stereophonic test transmissions using the Zenith-GE system have been radiated from the Wrotham 91.3 Mc/s and Swingate (Dover) 92.4 Mc/s transmitters at the following times: Monday: 14.30 to 15.00 and Thursday: 11.00 to 11.30. The programme material—mainly stereo gramophone records—forms parts of the normal schedule of the Music Programme, which has now reached its third and final phase, providing 71 hours of music per week. As these are compatible transmissions, listeners to other transmitters on the Third Network can hear the same programme monophonically.

TECHNICAL DETAILS:

Instantaneous Deviation of transmitter (as a fraction of 75 kc/s):

$$0.9\left[\frac{A+B}{2}+\frac{A-B}{2}\sin 2\omega_p t+0.1\sin\omega_p t\right]$$

where $\omega_p/2\pi = 19{,}000$ c/s is the pilot subcarrier frequency and A and B are the respective left and right stereophonic audio-frequency signals. For 100 per cent modulation in either of the stereophonic channels A or B varies within the range ± 1.

Frequency response:

Uniform within $\pm$ 1.0 db from 60 c/s to 13 kc/s. and $\pm$ 1.0 db from 60 c/s to 13 kc/s.

Harmonic distortion (at 400 c/s):

Not greater than 1.5 per cent at 100 per cent modulation.

A to B crosstalk:

Better than -30 db from 60 c/s to 13 kc/s from A to B and vice versa.

Sum-to-difference crosstalk:

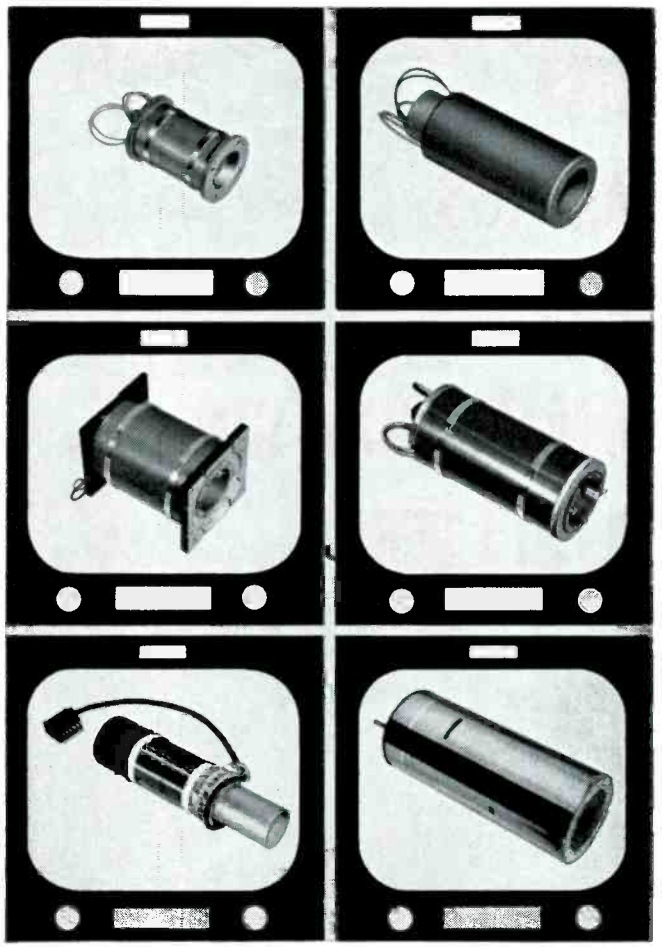
When A and B are nominally in phase at 400 c/s, the antiphase or (A-B) signal has a relative level not exceeding -25 db, and vice versa.

Pilot signal:

Frequency is maintained within $\pm$ 2 db of the nominal value. Phase (in relation to the 38 kc/s sidebands) is within $\pm$ 4 per cent of that specified for the system.

Incidentally, this extension of the programmes using the Wrotham transmitter has meant that the BBC could not this year provide signals for companies demonstrating multiplex stereophony equipment at the recent Audio Festival and Fair in the Hotel Russell, London. However, the BBC undertook experiments on the site and provided local stereo transmissions from the Hotel Russell itself.

With an aerial indoors, programmes were radiated on 94.1 Mc/s—by the Zenith-GE system—and were picked up by the manufacturers with suitable tuners within the building. The transmitter, modulator and encoder were located on the eighth floor of the hotel, and attracted a lot of technical visitors.



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COST SAVINGS ON COMMUNICATION SATELLITES

TESTS of four recent inventions have now progressed far enough to assure the feasibility of saving an eventual global satellite communications network more than $2 billion (over £650,000,000), an official of Hughes Aircraft Company told a press conference, including 35 reporters from Europe, recently.

'The inventions make a "sure thing" of the saving that has always been inherent in the synchronous stationary system as opposed to medium altitude systems,' Paul S. Visher, assistant manager of the company's space systems division, declared. 'The saving will be realised if the interim international Comsat Consortium adopts a permanent system based on advanced version of its own Early Bird.'

For an advanced Early Bird type of system employing 20,000 two-way voice channels and 100 ground stations in a network of approximately that number of nations, the total system hardware cost would be $277 million, compared with $2,575 million if an equivalent medium-altitude moving satellite system were adopted, Visher said. There would be annual savings of many millions more in lower rates, he added.

Describes Inventions

Early Bird, soon to be launched as the world's first commercial communications satellite by Communications Satellite Corporation, is itself an advanced version of the Syncom 'stand-still' satellite invented by Dr Harold L. Rosen, Hughes scientist, and his associates, who are also responsible for the four later inventions cited by Visher. Hughes, which developed and built it for Comsat, is scheduled to deliver the first Early Bird to Cape Kennedy next week.

The four inventions, which Visher said have now undergone sufficient testing by Hughes space systems laboratories to assure their success, he listed as:

1. A new satellite antenna concept which concentrates all the satellite's power in a pencil beam instead of dissipating much of it in space.
2. A new control system for keeping a satellite stationary, which uses water for fuel and extends the possibility of control life from only a few years to as much as 20 years.
3. An efficient 'multiple access' communications system —a new technology which permits a synchronous stationary satellite to accommodate 200 stations at one time without important degredation of communications quality.
4. An electronically 'de-spun' antenna beam which keeps all of the satellites' transmitted power focused on earth even though the satellites are spinning. ('Early Bird type satellites are spinning satellites but with this improvement the satellite figuratively doesn't know it's spinning,' Visher said.)

The original basic invention of the Rosen group, the orbital orientation control of a spinning satellite, has been proved without question in the Syncoms,' Visher declared.

Syncom Set Record

'Syncom II, launched July 26, 1963, long ago logged more communications times than all other satellites combined. Syncom III, launched August 19, 1964, carried live telecasts of the 1964 Olympic Games and has been used for US Government communications with South Vietnam.'

There are fundamentally three different systems being considered by the consortium for eventual use, Visher said. In addition to the Early Bird synchronous type, with which three operating satellites provide global coverage 'except for polar regions of no commercial significance,' he cited:

a. The random polar orbit system at medium altitude, which requires more than 24 satellites to provide satisfactory global coverage. (Visher said there is no simple way in this system to replace satellites which fail, a condition particularly undesirable in time of emergency or disaster.)

b. The phased polar orbit medium-altitude system. This system favours east-west communication.

c. A phased equatorial medium-altitude system. This system favours north-south communication.

'The type of orbit and the communication links it favours would become a highly political and controversial subject if one of the moving orbits is selected,' Visher said. 'The Early Bird type of satellite is unique in that it would

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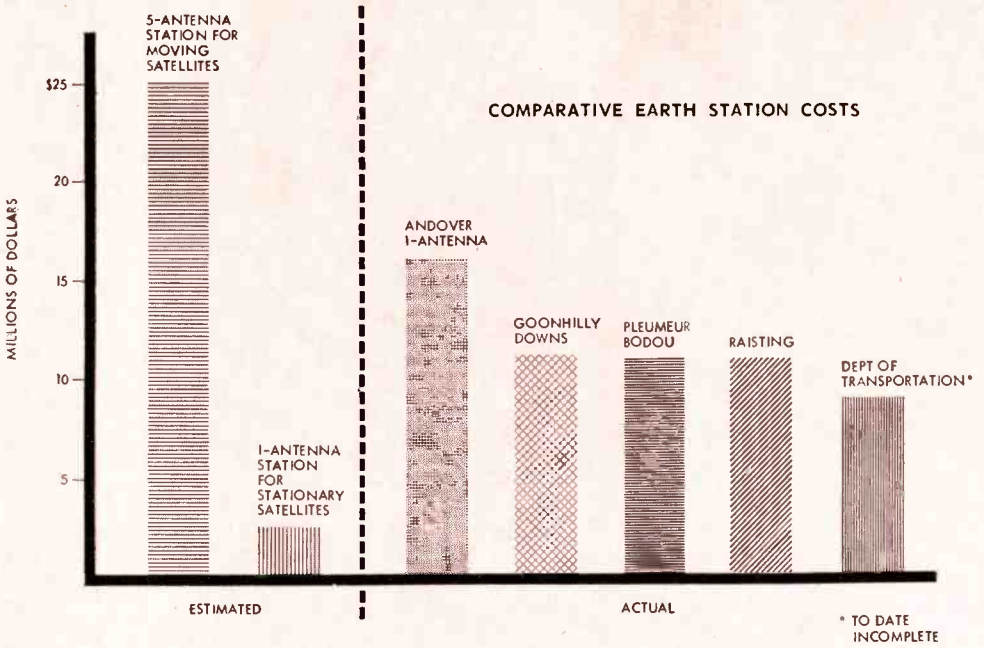

Chart shows (left of dotted line) comparative cost of earth station in global communications satellite systems employing 20,000 voice channels, using on one hand moving satellites and, on the other hand, using the Early Bird type of synchronous stationary satellite, as presented by Paul S. Visher, assistant manager of space systems division, Hughes Aircraft Company, at a press conference in Los Angeles. Right of dotted line, chart shows actual cost of several European stations and the Canadian Department of Transportation station, each having only one antenna, whereas each would need five antennas in a global system, according to Visher. He said that, if the international Comsat Consortium selected the Early Bird type of global system, ground stations would need only one simple antenna each, and that selection of the Early Bird type of system could result in a total saving of more than $2 billion.

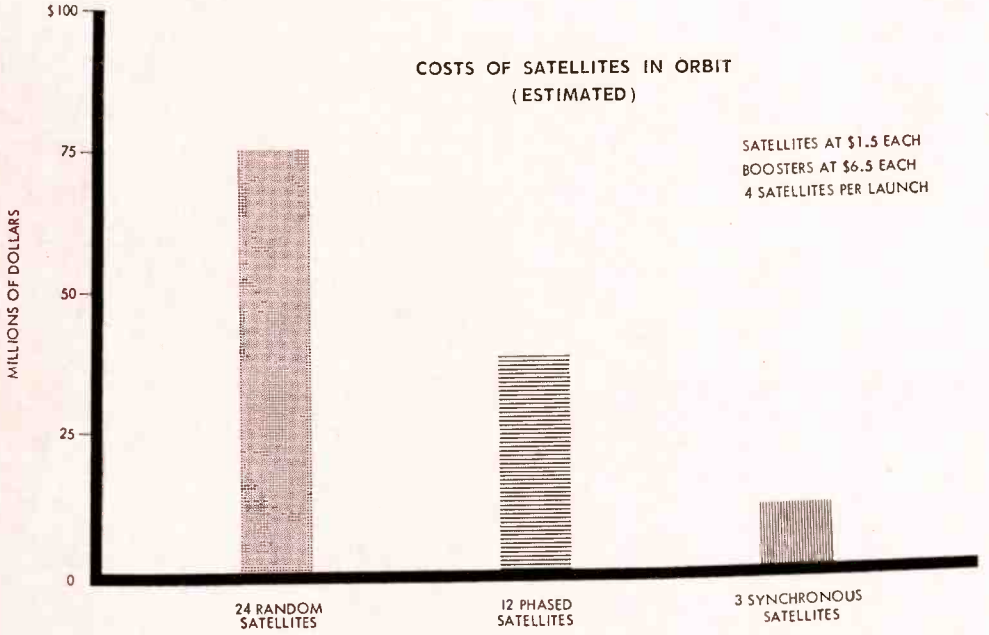

Chart shows comparative costs of satellites in orbit for an eventual global communications satellite system employing 20,000 voice channels and 100 stations. From left to right, first column represents such cost for random polar orbit; second column, for either phased polar or phased equatorial orbit, and third column, for stationary synchronous satellite of Early Bird type.

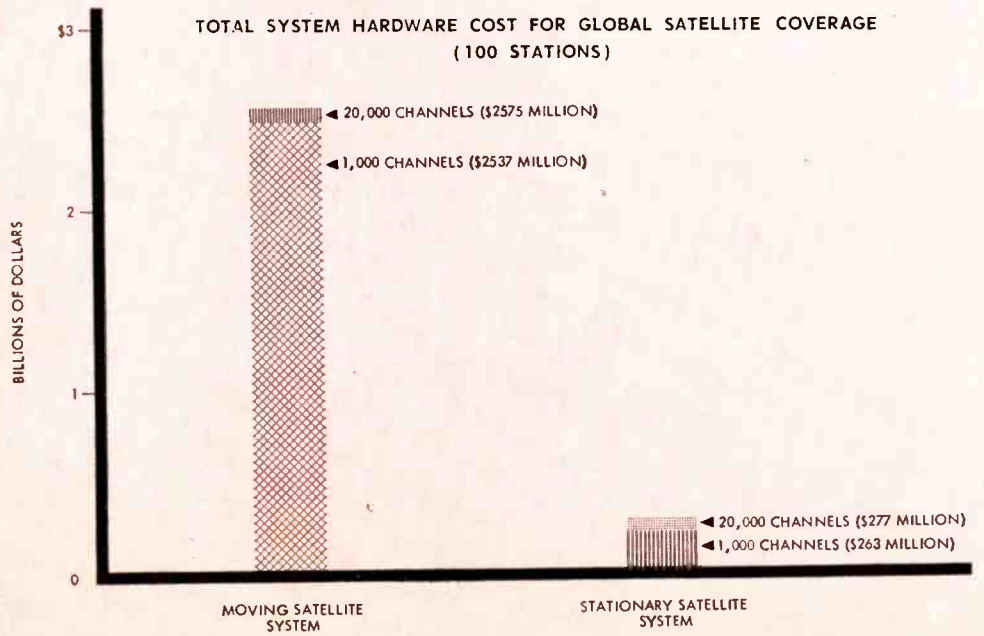

Chart shows comparative costs of total system hardware for Early Bird type and moving satellite types of global communications satellite systems employing 100 stations.

impose no penalties upon either east-west or north-south traffic.'

Compares System Costs

Moving-satellite systems require approximately 12 to 24 satellites, Visher said. Since the total cost of the spaceborne hardware is directly proportional to the number of satellites required, the cost of the spaceborne hardware in a three-satellite stationary satellite system would be only a fraction of such cost for a moving-satellite system, he said.

'The difference in cost with regard to ground stations is even more dramatic,' Visher said. 'For a global system with 20,000 channels and 100 stations using moving satellites, each ground station would need five huge tracking antennas and heavy computerisation and would cost some $25 or $30 million. With an equivalent stationary satellite system a ground station would need but one antenna and would cost but $2.5 million.

'Existing stations, built for tracking moving satellites and having only one antenna—not sufficient for the eventual global system—bear out the objection of high cost. The Andover station in Maine has cost in excess of $15 million. The Department of Transportation station in Canada has cost in excess of $9 million and is not completed. Goonhilly Downs (England) and Pleumeur Bodou (France) have been reported to cost in excess of $10 million each.

'If earth stations are simplified by not imposing costly tracking requirements and need for redundant antennas to transfer between moving satellites, the emerging nations will obviously find it far easier to participate.'

Cheaper Than Cable

Visher said the stationary satellite system would be far more economical than cable systems handling the same traffic.

'Over a 20 year projection,' he related, 'these costs were compared (by Hughes) with the cost of installing cables to provide the same types of service. In the Atlantic basin area, the satellite system costs were less than one-sixth of that of cable to provide service for the projected growth for all the countries of South America, Africa, Europe and North America. In the Pacific Ocean basin the satellite service cost was less than one-seventh of the comparable cable service.'

Visher said Early Bird will carry as much traffic as the first three cables under the Atlantic, which required 10 years to lay at a cost of many millions. The next satellite in the Early Bird series, now under construction at Hughes, would carry more telephone traffic than all the cables in all the world's oceans, he declared.

Improvements in this Hughes satellite (known as HS-304) will reduce the cost of satellite and launch from Early Bird's $16,000 per channel per year to $600, considering life expectancy and number of channels, Visher said. Full time utilisation would reduce this cost to $100, he added.

Coming Events

JUNE

7–9 International Symposium on Global Communications, Boulder, Colorado.

12 International Exhibition of Electronics, Nuclear Energy, Wireless, Television & Cinema at Rome. (Rassegna Elettronica Nucleare edella Cinematografia, Via della Scrofa 14, Rome.)

18–29 International Exhibition of Nuclear, Electronics, Television Radio and Cine, Rome.

30 to July 2 IEE/IERE Symposium on Microwave Applications of Semiconductors. London.

JULY

14-16 International Conference of the National Committee for Audio-Visual Aids in Education, London.

AUGUST

24–27 IEEE WESCON Show, San Francisco.

25 to September 4 International Radio Show, Earls Court.

27 to September 5 German Radio Show, Stuttgart.

30 to September 1 IEEE International Symposium Antennas and Propagation, Washington, D.C.

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.

18–23 The 1st International Festival of Television in Hong Kong.

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.

British Patents

G5R Recording and playback

985,517 RANK-BUSH MURPHY LTD, 11 Belgrave Rd, London, SW1. (Peter W. Blaxtan).
Magnetic recording transducer heads. Mar 10 1965

985,558 HONEYWELL INC, 2747 Fourth Ave, South, Minneapolis, Minn, USA.
Improvements in reel holders. Mar 10 1965

985,929 AKAI ELECTRIC CO LTD, Tokyo, Japan. (Katsuya Atsumi).
Magnetic recorders. Mar 10 1965

986,108 PLESSEY CO LTD, 1 Broad Street Place, London, EC2. (David W. H. Hampshire)
Automatic selection of magnetic reading heads. Mar 10 1965

986,173 SPERRY RAND CORPN, New York, USA.
Tape handling apparatus with non-linear buffer loop boxes. Mar 17 1965

986,206 CLARKE & SMITH MANUFACTURING CO LTD, Melbourne Works, Melbourne Rd, Wallington, Surrey. (Alec Smith).
Magnetic tape cassettes. Mar 17 1965

986,282 MAGNAVOX ELECTRONICS CO LTD, Alfred's Way, By-Pass Road, Barking, Essex. (Peter J. Aldridge).
Sound recording and reproducing apparatus. Mar 17 1965

986,283 MAGNAVOX. (Eric Cooper).
Improvements relating to bearings (of tape recorder capstans, etc). Mar 17 1965

986,543 SONY CORPORATION, Tokyo, Japan.
Method of manufacturing a magnetic head assembly. Mar 17 1965

987,161 WARWICK ELECTRONICS INC, Chicago, USA.
Spindle adapter (for record-players). Mar 24 1965

987,223 ADOLPH WILLIAM RENKE, Lovell St, Lincolndale, New York, USA.
Combined picture and sound recorder. Mar 24 1965

987,695 VECTRON ELECTRO-PHYSICS LTD, Spur Road, North Feltham Trading Estate, Bedfont, Middx. (Laszlo Namenyi-Katz).
Improved construction and method of manufacturing a magnetic recording head. Mar 31 1965

987,696 VECTRON ELECTRO-PHYSICS LTD. (Laszlo Namenyi-Katz).
Improved method of manufacturing magnetic recording and play-back heads. Mar 31 1965

987,697 VECTRON. (Laszlo Namenyi-Katz).
Improved magnetic recording head. Mar 31 1965

987,721 AMPEX CORPORATION, Redwood City, Calif, USA.
Tape driving apparatus (employing fluid or air pressure differentials to move the tape). Mar 31 1965

988,277 AMPEX CORPORATION.
Magnetic tape recording and playback machines (tape driving and/or transducing means). April 7 1965

988,287 PHILIPS ELECTRONIC & ASSOCIATED INDUSTRIES LTD, Abacus House, 33 Gutter Lane, London, EC2.
Magnetic recording and/or playback apparatus employing magnetic tape. April 7 1965

988,751 AMPEX CORPORATION.
Improved control mechanism for magnetic tape machines. April 7 1965

988,886 NIPPON VICTOR KABUSHIKI KAISHA, Yokohama, Japan.
Magnetic recording and playback system (for wide-band signals). April 14 1965

988,906 PHILIPS.
Recording tape apparatus (having a flanged take-up reel). April 14 1965

988,940 TELEFUNKEN PATENTVERWERTUNGS-GESELLSCHAFT MIT BESCHRANKTER HAFTUNG, Elizabethenstrasse 3, Ulm/Donan, Germany.
Magnetic recording apparatus (for audio or video signals). April 14 1965

988,981 AMPEX.
Read/write amplifier circuits. April 14 1965

989,482 RANK-BUSH MURPHY LTD. (John L. E. Baldwin).
Apparatus for reproducing signals transversely recorded on magnetic tape. April 22 1965

989,500 SONY CORPN.
A magnetic head and an iron alloy therefor (suitable for video tape recorders). April 22 1965

989,525 AMPEX.
Readout of stored information. April 22 1965

989,526 AMPEX.
Information reproducing systems. April 22 1965

989,527 AMPEX.
Improved information readout system. April 22 1965

989,665 DECCA LTD, Decca House, 9 Albert Embankment, London, SE1. (Terence C. Sharpe).
Tape handling apparatus. April 22 1965

990,504 AMPEX.
Recovery of recorded information (from thermoplastic film). April 28 1965

990,534 SONY CORPN, Japan.
Improvements in systems for reproducing signals recorded on magnetic medium. April 28 1965

technical abstracts

Television—general

256. LAW, D., McKERRELL, A. A. and BARRITT, T. D. Television service planning for overseas. Telev Soc J, vol 10, no 12, 362—373, Oct—Dec 1964.

The many problems connected with the setting-up of television services in the developing countries of Africa and Asia are discussed in detail. The various problems are illustrated by reference to installations which have already been made: diags, plans, maps, photos.

257. McGEE, J. D. Television and space research (The Fleming Memorial Lecture).

Telev Soc J, vol 10, no 12, 348—357, Oct—Dec 1964.

A review is given of the impact of space techniques on television and, more important, the role which television has to play in space research. The first part of the paper deals with the various methods of communication via satellites and the second with observations made from satellites: diags, photos, bibliog, refs.

228. WELTMAN, J. Television university.

Telev Soc J, vol 11, no 1, 2—8 Jan—Mar 1965.

Examples of the present uses of television, both closed- and open-circuit, in higher education are described in detail: both British and American experience is included. The future uses and advantages of this new medium are examined.

259. WILLIAMS, R. C. G. The technical opportunities for community television.

Telev Soc J, vol 11, no 1, 20—23, Jan—Mar 1965.

After consideration of the radio spectrum, wired broadcasting and the 'national electronic grid,' the author discusses the possibilities of various forms of local television in the UK: photos.

Colour television

260. COX, M. Colour captions using monochrome equipment.

Telev Soc J, vol 10, no 12, 358—361, Oct—Dec 1964.

It is shown that colour pictures suitable for captions can be synthesised or simulated using simple and cheap equipment. An equipment is described which allows a number of effects to be selected by switching: diags.

261. GARGINI, E. J. Colour television by wire.

Telev Soc J, vol 11, no 1, 9—19, Jan—Mar 1965

An interim assessment of the NTSC signal handling properties of wired systems is given which is based on a theoretical and practical study and certain transcoding possibilities are also considered which may permit a significant simplification in the manufacture, maintenance and operation of colour receivers on wired systems. Attention is drawn to SEQUIN transcoding system which in a modified form might also be suitable for radiated broadcasting: diags, graphs, bibliog, refs.

Television transmission—UHF

262. ARNAUD, J. F. Propagation des ondes decimetriques du point de vue de la television (Propagation of decimetric waves from the television point of view).

L'Onde Electrique, vol 44, no 452, 1099—1106, Nov 1964. In French.

Methods of field strength measurements of metric wavelengths are given together with practical and experimental results. Practical conclusions are drawn about the future development of the second network chain: diag, maps, photo.

263. AUCOUTURIER, P. Klystrons pour emetteurs de television de grande puissance en ondes decimetriques (Klystrons for high power television transmitters at decimetric wavelengths). L'Onde Electrique, vol 44, no 452, 1121—1127, Nov 1964. In French.

After an account of the way in which multicavity klystrons work, this article describes the construction, the technology, the electrical characteristics and the performance of two klystrons intended for television transmitters working on decimetric wavelengths. These tubes, covering Bands IV and V, have an output power of 30 kW, a gain of 30 dB for the television pass band and an efficiency of 45%: diags, graphs, photos.

264. BABILLON, C. Emetteurs de television decimetriques a klystrons (Klystron decimetric television transmitters).

L'Onde Electrique, vol 44, no 452, 1128—1138, Nov 1964. In French.

Three particular aspects are described: the coupling of klystrons, sound modulation over two stages, and the arrangement of supporting equipment. Development trends of the near future are discussed: diags, photos.

265. DEPAILLAT, R. Emetteurs de television CFTH a tetrodes pour ondes decimtriques (CFTH television transmiters using tetrodes for decimetric waves).

L'Onde Electrique, vol 44, no 452, 1145—1156, Nov 1964. In French.

There is a detailed account of the arrangement and operation of a 50 kW tetrode transmitter with shorter sketches of trans-

mitters of intermediate power (2, 10 and 20 kW) using the same technique. After an account of diplexers, various measured results are given, particularly those relating to colour television signal transmission.

266. GERLACH, M. Tetrodes de puissance pour emetteurs de television en bandes IV et V (Power tetrodes for television transmitters in Bands IV and V).
L'Onde Electrique, vol 44, no 452, 1139—1144, Nov 1964. In French.

The author describes the basis of the calculations which determine the geometrical dimensioning of the different electrodes. There is an account of the principal results obtained: photos, bibliog, refs.

267. GOUSSOT, L. Les normes francaises pour la deuxieme chaine. (French standards for the second channel).
L'Onde Electrique, vol 44, no 452, 1093—1098, Nov 1964. In French.

France has chosen for its second programme the L-system of CCIR (625 lines) differing little from other 625-line systems as far as the video frequency signal is concerned. However, the need to simplify as much as possible receiver circuits having to receive the two systems of 819 and 625 lines has had effect on the transmission standards: diags, graphs.

268. HUET, M. Le Plan de Stockholm en ondes decimetriques (The Stockholm plan for decimetric wavelengths).
L'Onde Electrique, vol 44, no 452, 1115—1120, Nov 1964. In French.

Variations in the principles decided at Stockholm applied in each European country have complicated the setting up of the plan. The French network makes possible the distribution of three programmes on decimetric wavelengths: diags, maps.

269. LACHARNAY, S. Specifications des materials d'emission de television en ondes decimetriques (Specification of transmitting equipment for television at decimetric wavelengths).

L'Onde Electrique, vol 44, no 452, 1107—1114, Nov 1964. In French.

Transmitter power was settled in relation to technical and economic considerations including transmitter range, minimum necessary field strength, propagation and antenna gain. The design of transmitters and aerials is described: diags.

270. LAMOITIER, L. A. La television en ondes decimetriques: Introduction (Television on decimetric wavelengths).

L'Onde Electrique, vol 44, no 452, 1091—1092, Nov 1964. In French.

The use of very high powers in decimetric wavelength techniques has made a new kind of technology necessary. The increase in the number of transmitting centres makes special identification measures essential.

271. LE DAVAY, L. Les guides d'ondes et leur utilisation en television (Wave guides and their use in television).

L'Onde Electrique, vol 44, no 452, 1201—1208, Nov 1964. In French.

Because of the very high losses involved in conventional transmission lines between Bands IV and V transmitters and their aerials, it was worth while to use wave guides instead. The properties of wave guides are sketched briefly and there is a description of a particular guide design using polyester resins reinforced glass fibre: diags, graphs, photos.

272. MARTIN, R. Distorsion de phase dans les guides d'ondes (Phase distortion in wave guides).
L'Onde Electrique, vol 44, no 452, 1197—1200, Nov 1964. In French.

A formula is given as a guide to phase speeds, together with results of measurements of group propagation time in a particular transmitter: diags, graphs.

Television antenna

273. CHESNEAU, R. Antennes de television CFTH pour ondes decimetriques (Bandes IV et V) (CFTH television antennas for decimetric waves (Bands IV and V).

L'Onde Electrique, vol 44, no 452, 1164—1176, Nov 1964. In French.

After sketching the new problems which arise in the extension of television to decimetric wavebands the writer surveys studies which have been made concerning aerial radiation diagrams and also avoiding arrangements. There is an account of two types of design and the arrangements necessary for the multiplexing of several programmes on a single antenna: diags, graphs, photos.

274. KAISER, L. Problems poses par le mise en place des antennes d'emission en orders decimetriques (Problems arising in the installation of transmitting aerials for decimetric wavelengths.

L'Onde Electrique, vol 44, no 452, 1189—1196, Nov 1964. In French.

Some mechanical problems have to be overcome over the installation of aerials on existing masts. To erect the larger antennas use is made of a light helicopter jointly with a crane installed at the top of the mast: diags, photos.

275. RATEAU, M. Les antennes-panneaux a fentes (Slot anneas: principles and practice).
L'Onde Electrique, vol 44, no 452, 1177—1188, Nov 1964. In French.

After discussing design characteristics, the author describes performance of a single slot antenna in the frequency band 470—640 Mc/s. Applications are discussed and there is a description of a 40 kW television antenna: diags, graphs, photos, bibliog, refs.

276. RENOIR, M. and others. Les anternes CSF pour la television en ondes decimetriques (CSF antennas for television at decimetric wavelengths).

L'Onde Electrique, vol 44, no 452, 1157—1163, Nov 1964. In French.

Conflicting requirements have posed difficult problems for CSF in setting up antennas for the second television programme. Aerials meeting these requirements are formed of networks of doublets disposed within a self-supporting cylinder of plastic material: diags, graphs, photos.

Television receivers

277. DUBEC, A. Recepteurs d'emissions de television dans les bandes de radiodiffusion metriques et decimetriques (Television receivers for transmissions in the metric and decimetric wave bands).

L'Onde Electrique, vol 44, no 452, 1209—1219, Nov 1964. In French.

An explanation of French solutions to the problems involved in producing receivers capable of receiving programmes transmitted at 625 and 819 lines and on metric and decimetric bands: diags, graphs, photos.

U.S. Patents

3,164,672 OWENS-ILLINOIS GLASS CO, Toledo, Ohio. (Burton W. Spear & Elgin M. Tom).
Controlling implosions in cathode-ray and other tubes. Jan 5 1965

3,164,673 GENERAL ELECTRIC CO, New York. (Al U. Sharon).
Automatic brightness and contrast control circuit (for television receivers). Jan 5 1965

3,164,683 AMPEX CORPORATION, Redwood City, Calif. (John W. King & Robert F. Pfost).
Rotary head position determining apparatus. Jan 5 1965

3,164,685 THOMAS A. BANNING, Jr, 5520 South Shore Drive, Chicago, Ill.
Wide band recording system. Jan 5 1965

3,164,737 RADIO CORPORATION OF AMERICA, Delaware. (Paul J. Messineo & Josef Gross).
Cathode ray tube. Jan 5 1965

3,164,744 RADIO CORPORATION OF AMERICA, Delaware. (John D. Bowker).
Colour tube beam indexing with ultra-violet rays. Jan 5 1965

3,165,578 FELIX LAURICELLA, 68 Post Street, San Francisco, Calif.
Three dimensional television method and means. Jan 12 1965

3,165,579 RADIO CORPORATION OF AMERICA, Delaware. (John Stark Jr & Gordon E. Kelly).
Colour television receiver video amplifier. Jan 12 1965

3,165,581 RADIO CORPORATION OF AMERICA, Delaware. (Jack Avins).
Keyed AGC circuit with means for controlling horizontal sync pulse level of signals below the AGC threshold (in television receivers). Jan 12 1965

3,165,582 MAGNAVOX CO, Fort Wayne, Ind. (Paul Korda).
Automatic contrast and brilliance control system for television receivers. Jan 12 1965

3,165,585 MARCONI CO LTD, England. (John Frederick James).
Synchronising apparatus for television cameras. Jan 12 1965

3,165,587 RICHARD L. ALDERSON, 154 W 57th Street, New York, NY.
Multiple loudspeaker system. Jan 12 1965

3,165,666 RADIO CORPORATION OF AMERICA, Delaware. (Alfred H. Rickling).
Vertical deflection circuit with height control feedback (in a television receiver). Jan 12 1965

3,165,673 THOMPSON RAMO WOOLDRIDGE INC, Euclid, Ohio. (John H. Teaf).
Radio tuner with printed circuit terminal board. Jan 12 1965

3,165,677 GENERAL INSTRUMENT CORPN, Newark, NJ. (Ernest Gostyn & John T. Harten).
Television tube deflection coil assembly with separable yoke sections. Jan 12 1965

3,165,696 BELL TELEPHONE LABS INC, New York, NY. (Kenneth M. Poole).
Collector voltage control circuit for travelling wave tube employed in a radio repeater. Jan 12 1965

3,165,697 US SECRETARY OF THE ARMY. (Alfred Reich & Dale M. Osterman).
Automatic tuning circuit for a transmitter cavity amplifier. Jan 12 1965

3,165,698 MICRODOT INC, South Pasadena, Calif.
Automatic frequency stabilisation utilising oscillation search sweep. Jan 12 1965

3,165,699 MOTOROLA INC, Chicago, Ill. (Frank Henmueller).
Automatic gain control system for suppressed carrier single sideband radio receivers. Jan 12 1965

3,165,700 MOTOROLA INC. (Bernhard Birkenes).
Mixer circuit for autodyne receiver in which untuned coil couples signal to intermediate frequency transformer. Jan 12 1965

3,165,701 US SECRETARY OF THE ARMY. (Lance R. Jacobsen).
Radiofrequency oscillator, amplifier and converter. Jan 12 1965

3,166,714 RADIO CORPORATION OF AMERICA, Delaware. (Vo Dinh Hien).
Manual tuning control system for FM radio receivers with AFC. Jan 19 1965

3,167,611 HAZELTINE RESEARCH INC, Illinois. (Karl M. St John).
Colour-television apparatus for improving resolution during monochrome reception. Jan 26 1965

3,167,613 PHILCO CORPN, Philadelphia, Pa. (Theodore I. Millen).
Slow-scan composite signal-producing apparatus with means for producing sync pulses by offsetting black level. Jan 26 1965

3,167,614 RADIO CORPORATION OF AMERICA, Delaware.
Multiplicative stereophonic sound signalling system. Jan 26 1965

3,167,615 TELEFUNKEN PATENTVERWERTUNGS GmbH, Ulm (Danube), Germany.
FM stereo demodulator using a diode ring modulator switching circuit. Jan 26 1965

3,167,680 COLLINS RADIO CO, Cedar Rapids, Iowa. (Frank E. Seestrom).
Dual sweep generator. Jan 26 1965

3,167,681 RADIO CORPORATION OF AMERICA, Delaware. (Robert A. Dischert).
Electrostatic deflection circuit (colour television). Jan 26 1965

3,167,682 FERNSEH GmbH, Am Alten Bahnhof, Darmstadt, Germany.
Circuit arrangement for generating a voltage with an impulse and a sawtooth component for feeding a low-impedance load. Jan 26 1965

3,167,711 PAUL N. WRIGHT, Wabash, Ind.
Transceiver having means for neutralising inherent distributed capacity. Jan 26 1965

3,167,713 AVCO CORPN, Cincinnati, Ohio. (Donald W. Bastian).
Electronic automatic control circuitry for satellite command receiver. Jan 26 1965

3,167,715 WELLS - GARDNER ELECTRONICS CORPN, Chicago, Ill.
FM automatic frequency control circuit using mixer tube. Jan 26 1965

3,167,759 STANDARD ELECTRIC CORPORATION, New York, NY. (Jacques Villiers).
Air navigation information system. Jan 26 1965

Installation services for transmission systems

The STC Transmission Systems Group Installation Division offers a world-wide service for the installation, maintenance and overhaul of all types of telecommunications transmission systems manufactured by STC and other companies. It covers tropospheric scatter, microwave and VHF radio, coaxial cable, repeatered submarine cable, and open-wire carrier systems, including all associated telegraph and multiplex terminal equipments. Allied specialized services can also be provided.

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The struggle for power (VHF version)

by International Broadcast Engineer's Television Editor, KENNETH ULLYETT

'THE prodigious growth of the television industry in the past two decades has brought about vast social change in America,' says Desmond Smith reviewing the economic impact of television in **Electronic Age.**

'It has satisfied the public demand for television sets at a phenomenal rate: some 625 sets every hour, every day, have been sold since the end of World War II. The public's investment now stands at the fairly staggering figure of $22-billion. . . . How the television industry and the national economy will affect each other, the future alone can tell. Certainly, the positive aspects have been strengthened by the following factors: a rising public demand for colour television: the prospect of a new burst of ultra-high-frequency TV station growth as a result of the enactment last year by Congress of the all-channel TV (UHF-VHF) receivers law. . . .'

Not only in the United States is this UHF struggle for power clearly evident, and manufacturers of professional broadcast equipment are keenly alive to the need to get more TV-kW on the air. It was at this year's NAB Convention the Radio Corporation of America introduced the fourth and largest member of the New Look UHF-TV transmitter line, a 50-kilowatt unit using a vapour-cooled klystron to cut operating costs. At last year's NAB Convention RCA introduced New Look 2, 10, and 30-kW transmitters.

Mr. C. H. Colledge, Division vice-president and general manager, RCA Broadcast and Communications Products Division, told me that the new 50-kW unit is designed 'for the growing number of new UHF television stations, and for broadcasters now on-air and planning to increase their signal coverage. . . .'

I have discovered, too, that the new transmitter, type TTU-50B, supersedes an earlier 50-kilo RCA transmitter which was chosen by the Federal Communications Commission for the year-long test of UHF broadcasting in New York City area.

It goes without saying that the use of an integral cavity vapour-cooled klystron reduces input power needed by some 10-kW over that demanded by certain other transmitters using water-cooling. And integral cavities make possible factory tuning the klystron to the specified UHF channel. **In fact when the 50-kW Tx is coupled with the correct RCA ultra-gain aerial array, the system produces more than two megawatts of effective radiated power!**

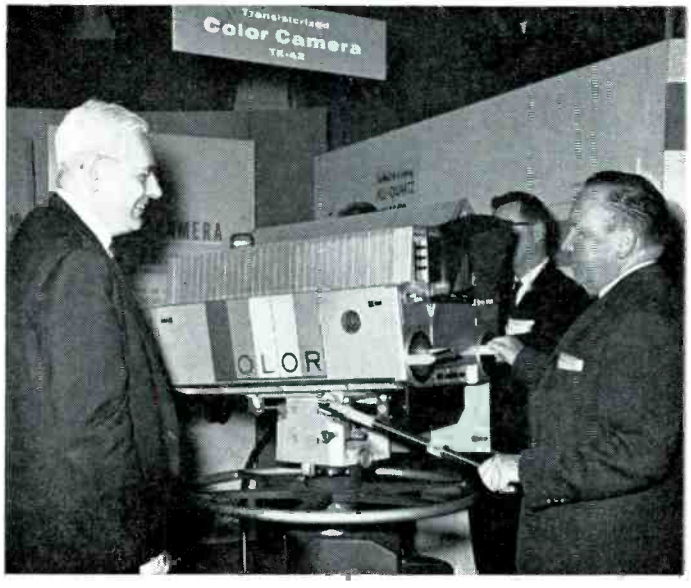
The four transmitters in this UHF family now comprise, in addition to the 50-kW job, the TTU-30A, a 30-kW unit designed for one million watts ERP, and using a lower-power version of the vapour-cooled klystron in the TTU-50B. In fact the 30A can be modified **in situ** to the 50B specification should this be needed. Next comes the TTU-10A, an-cooled 10-kW transmitter delivering 250,000 watts ERP with a suitable antenna array: it is compact, taking about half the floor space of preceding water-cooled versions. The visual output stage uses diplexed 8501 coaxial tetrodes driven by a travelling-wave-tube amplifier, and by an 8501 IPA. Thus for 10-kW output there are only three RF stages following the exciter. Finally in this group of UHF transmitters there is the TTU-2A, a 2-kW unit designed for the minimum power station with plans for subsequent expansion to higher power. For 2-kW output there are just two RF stages following the exciter; a TWT amplifier driving an 8501 tetrode PA. In going up from 2- to 10-kW, a matching cabinet is added containing diplexed 8501 output valves. All four transmitters in this group use the well-known RCA BTE-10C **direct FM** aural exciter and a simplified single-unit exciter-modulator which generates the modulated visual carrier at a level of only a few watts, so cutting out the need for a high-power video modulator.

Reverting to the vapour-cooled klystron philosophy, it is interesting to note that these contribute considerably to size-reduction in the transmitter as a whole, since steam is the heat transfer medium, and steam condensers are smaller than water condensers of equal cooling capacity; indeed only one-tenth as much water is needed for a steam system. The huge TTU-30A and 50B employ klystrons engineered and manufactured by the Varian Associates. Depending on frequency these tubes are designated as VA-890, 891 and 892 for the TTU-30A, and for the larger series VA-893, 894 and 895. Klystrons for the TTU-30A have an estimated life of 10,000 hours, and are warranted for 8,000 hours in audio-transmission service, and for 4,000 hours in TV. It is also possible to rent these klystrons on an economical hiring basis. Last year at the NAB, Chicago, I was given a demonstration of the beautifully engineered rolling-cradle system which RCA have developed for klystron changing. A single operator can easily change klystrons in either the 30- or 50-watt transmitters by sliding the tube out of the transmitter after tilting it to the horizontal, guiding it on to the rotating cradle which, when turned, brings the replacement klystron up into position, this in turn being slid back into the transmitter.

It is a fact that vapour-cooled integral-cavity klystrons were selected by RCA engineers had made a lengthy evaluation of this type of tube to determine its practicability for future UHF transmitters. Back in 1950 RCA's evaluation of klystrons versus tetrodes resulted in the decision to employ tetrodes in the TTU-12A/25B UHF transmitter design. The wisdom of this choice is a matter of industry record now, because since 1952 when RCA exported the first UHF transmitter, more UHF stations selected these RCA transmitters than those of all other manufacturers combined.

'But klystrons in the last ten years have shown many improvements,' commented RCA's Ed Dudley when we were examining the 50-kW job together this year at

Our Television Editor Kenneth Ullyett in Washington, at the controls of the latest final prototype of RCA's four-tube colour camera. In 1964, at the NAB Convention in Chicago, he was privileged to compare the 'almost-ready' laboratory model of this camera, so is in a unique position to note final improvements.



Washington. 'One advance in particular is better differential phase and gain performance, essential to good colour transmission. . . .'

New UHF receiver developments have come to the fore, and more applications are being received by RCA for the high bands, where in contrast to the tetrode the klystron efficiency is greater. Finally, high-power klystrons (integral cavity type) have established records for long and reliable service in the BMEWS installations. Performance subsequently showed klystrons as the logical choice for high-power UHF, and pointed the way for economical ultra high-power transmitters which in turn led to the present designs of the 30- and 50-kW transmitters.

'Audio modulation is applied, as you see, via the direct-FM method using our new BTE-10C exciter,' a Camden transmitter engineer told me. 'This layout is the heart of all RCA FM transmitters in this series, giving what we call "full fidelity." What happens is that video modulation takes place in a simplified exciter-modulator which produces a video-modulated peak output of two watts, eliminates the need for a high-power video modulator.

'Following these exciter units are two identical RF stages in each channel, consisting of a cavity-tuned 7289 tetrode IPA and the klystron power amplifier. These tubes and cavities are identical, and therefore can be interchanged between audio and video channels. As for the power supplies, why silicon rectifiers are used throughout. They've increased reliability to an enormous degree. . . .'

RCA are not averse to putting a price tag on their goods. I wonder what you think is the correct cash value of this, one of the most powerful UHF television transmitters in the world, and certainly the most advanced design? One must remember it is not just a matter of costing components, for many years' research go into the production of such a mammoth transmitter. Perhaps half a million dollars might be thought a fair estimate, but in fact the huge 50-kW transmitter carries a list price of $275,000, or around £90,000 depending on how the machinations of the British government have 'bent' the £ at the moment you order your TTU-50B!

Was it not the late Sir Winston Churchill who said Britain and America are two great nations separated by a common language. . . . ? There are times, especially after an NAB Convention, when I am not so certain about the commonalty! It makes sound commonsense in Americanese that a man with a flat has a puncture, not an apartment. It is practical vivid English (and American) when at an airport or coach station you ask for your coffee **'to go,'** instead of having to request: 'Would you please put it in a paper cup with a plastic top so I can drink it on the way!' But English ears perk up and hesitate aurally at that other time-saving vivid way of saying 'channels 14 thru 83' when the Englishman who does not speak in computer-English would perhaps, express it more leisurely: 'from channel 14 to 83 inclusive.' All this comes to mind because in fact it is—well, let's have it the New Jersey way—'channels 14 thru 83' which indicate the frequency range of RCA's new TTU-10A, a completely new 10-kW UHF television transmitter. It is the first commercial RCA TV broadcast transmitter to use the travelling-wave tube, and we all know how this simplifies transmitter design as the TWT is a broadband tube requiring no tuning devices. I am told that the power gain provides an amplification from one watt to 250 in a single tube.

Audio and video power amplifiers of the TTU-10A use air-cooled 8501 UHF power tetrodes, this tube featuring a thoriated-tungsten mesh filament and coaxial cermolox construction. The cavities of all these high power stages are identical. The video amplifier makes use of the diplexing circuitry, that type which permits continued operation on one amplifier tube (at reduced output, naturally should the other amplifier fail. This cuts loss-of-air time. Also it permits the use of identical tubes (and cavities) in the driver and output stages, reducing spare tube inventory requirements so important to the budget accounts of small TV chains.

Just imagine what a difference it makes to Spares costing to have (as is the the case in the RCA 10-kW transmitter) only two different tubes above the 2-watt level. All the power comes from solid-state rectifier plug-in modules, so even here first and operating costs are reduced.

RCA are called on to supply TV transmitters in the

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Struggle for power—continued

10-kW range for what in Britain is known as 'relaying,' and this involves sometimes having to site the transmitter remotely, with many of the on-air jobs remote-controlled from a distant operating station. Now the TTU-10A is designed primarily for remote control. Metering points are provided for monitoring several operating parameters, and as many of the Tx functions are motor-driven there is no problem about operating them at a distance.

One-man operation, or even unattended remote operation, is also part of the design-philosophy of the small 2-kW UHF transmitter introduced at the NAB Convention. As Ed Dudley put it to me: 'This TTU-2A is designed for the station that seeks to keep transmitter investment and operating cost at a minimum, but with an eye to future expansion.'

What results, is that the TTU-2A as delivered, is capable of delivering up to 50-kW ERP with a suitable antenna array, and it offers the possibility of future expansion up to 10-kW output by a matching add-on cabinet containing an amplifier using the same PA tubes. In this way the original transmitter remains substantially intact; in fact the TTU-10A ten-kilo job **uses the TTU-2A as a driver.** That shows how simple it is to convert when the UHF broadcast just starting grows up and becomes a bigger contender in the kilowatt battle for supremacy.

In my experience simplicity of transmitter design generally makes for reliability and low servicing costs, and with the little 2A as there are only two RF stages following the exciter in each channel, it is difficult to see what could be simpler. A forced-air-cooled 8501, driven by a travelling-wave-tube, serves as the PA in both audio and video chains. The FM audio signal comes, as I have said, from the BTE-10C direct-FM exciter, and the video signal from the exciter-modulator which applies video modulation at a level of only a fraction of a watt.

As a Camden transmitter engineer pointed out to me: 'The 2-kW output of this transmitter is indeed conservative duty for the 8501 UHF power tetrode, which is capable of delivering 5.5-kW output in Class-B television service, to 900 Mc/s.'

If one is planning to use a series of 2-kW transmitters for relay work, and remote control is vital, then it may be noted that metering points for **remotely** monitoring power output, plate voltage and plate current are provided. Several operating functions such as video gain, pedestal level, excitation and overload reset are motorised, and thus can be operated remotely by normal electrical controls.

I was intrigued to see that although the RCA 'direct-FM' exciter system is not new—it must be at an NAB Convention four or five years ago that I first had the principle outlined—the FM exciter used in the 1965/6 series of FM transmitters is of new design in detail. Asked to describe it, an RCA engineer told me: 'As you can see from this blueprint, the oscillator is modulated by capacitative diodes. . . . There are no cascaded modulators . . . indeed, there are only four RF tubes in the whole thing. . . . This is the new type of AFC which uses a magnetic amplifier. The idea is that it precisely controls frequency without the use of tuned circuits. In my opinion the exciter is the simplest ever designed. . . .'

The video exciter-modulator deserves a rather more detailed description as it is certain to be of prime interest to television engineers, even to those not yet working in UHF fields.

This exciter-modulator develops a very stable and crystal-controlled frequency which is then heterodyned with the modulated video and with the audio signal from the FM exciter, so producing audio and video output carriers separated by 4.5 Mc/s for US working, and by 5.5 Mc/s for CCIR standards. Video modulation takes place at the grid of a pencil triode, type 4055. All RF stages preceding this are operated Class-C, and are simply tuned for maximum output by observing indications on the transmitter's built-in meter. Audio and video carrier outputs operate separately, so should the audio carrier fail the transmitter still gives a picture signal.

These are exciting days for TV and FM aerials—'antenna arrays' to those with mid-Atlantic idiom!

For one thing I was able to take a rapid trip to RCA's 42-acre antenna test site at Gibbsboro, NJ, where they have been putting last touches to the huge pylon system radiating WNJU-TV's signals. This: I should explain to those outside New York, is the huge new metropolitan New-York-New Jersey-area station due to begin broadcasting in colour and monochrome a few weeks ago. The big aerial array after testing at Gibbsboro was dismantled and installed atop the Empire State Building, 1,200 feet above street level. Eight tubular panels, joined electrically to produce the signal pattern for WNJU's four-sate viewing area from the top of the tallest office building in the world, make up the system. Four panels in a vertical array 52 feet high are mounted on the Empire State's north side, the other four on the south. As with conventional pylon antennas, energy is radiated through a series of slots running lengthwise in the aerial's surface. The size and arrangement of the slots control the coverage pattern of the broadcast signal.

Out at Gibbsboro they told me with pride: 'The WNJU antenna design was the outcome of an engineering study, sponsored by the Empire State, to determine how additional television stations could broadcast from the building without interfering with those already there. Our study determined that at least six more broadcast antennas could be accommodated. . . .'

Whether New York needs more TV services is something I'd much rather not go into here. New York channels 2, 4, 5, 7, 9, 11, 13 and 31 (prior to the addition of WNJU, which is on channel 47) share the Empire State skyscraper as a common antenna site, a technical arrangement unequalled in the TV world. Broadcasts are radiated over a four-State zone, reaching an audience of some 15,000,000.

With regard to more normal TV aerials, a design book is one thing, but an order book is also a useful guide to performance. As I was told in some confidence by an RCA technical sales executive: 'The trend among FM broadcasters towards maximum signal saturation—through antennas which combine vertical and horizontal radiators—is being reflected in equipment sales. Last year we recorded an increase of nearly 25 per cent in the sales of antennas of this type, compared with 1963. Stations radiating a "vertical" signal in addition to a horizontal pattern as normal with FM, are in a position to provide better reception. With sales of FM radios for home and automobile use on the increase, the number of stations adopting the combined-signal techniques is expected to grow.'

The established RCA antennas such as the BFA (for horizontally polarised signals) and the 300-V (vertical polarisation) are very popular, and to these were added at the NAB Convention two new directional antennas in the BFA-BD series. One of these provides a cardioid pattern, the other a bi-directional pattern somewhat like a figure 'eight.'

At Washington this year I was privileged to meet a number of RCA and other experts who are facing the fact that soon many more transmission channels must move into the realms 'beyond microwave.' Lack of ether space alone makes this essential, and in **Electronic Age** Bruce Shore comes to the heart of this quest to go into higher and ever higher frequency channels. Says he: 'At stake in this contest is the future of a communications industry

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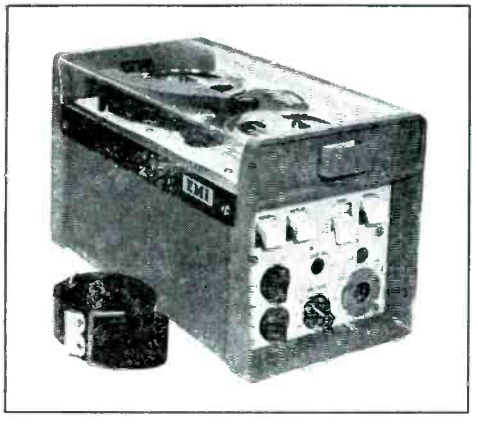

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Struggle for power—continued

whose channels stand soon to be swamped by a rising flood of information spilling into the air waves from a multiplying host of transmitting antennas inside and outside the earth's atmosphere. The day is already in sight, in fact, when such transmission forms as AM and FM radio, short wave, international telephone and teleprinting, television and radar, will not permit simultaneous operation without producing a composite din of electromagnetic crosstalk, intermodulation and fade-out that will be impossible to decipher. . . .'

He explains, as I was able to witness for myself, that at the RCA Laboratories in Princeton, NJ, this quest has led to three unique developments: (1) a beam-plasma tube that employs the interaction between an electronic beam and a gaseous cesium plasma to generate or amplify mircowave frequencies verging on the millimetre domain; (2) a gaseous plasma 'cathode' from which dense electron beams can be siphoned for the purpose of one-day generating millimetre waves, and (3) the industry's first superconductive amplifier, a device that amplifies microwaves when immersed in liquid helium, and may soon do the same for millimetre waves. Equally significant is the work going forward on solid-state plasmas. Plasmas, be it noted, are energetic concentrations of positively charged ions (that is atoms missing one or more electrons) and negatively charged electrons held together, at long range by a mutual electrical attraction. The way we are going in this respect can be seen from the fact that even while I was in Washington, RCA's Defence Electronic Products division delivered to the US Army Signal Corps for 'battlefield evaluation' eight strange, secret devices. What were they? Why, laser rangefinders. I can foresee an NAB Convention perhaps not so far distant, when we shall be reviewing TV transmitters working at laser frequencies, on submillimetre wavelengths.

During operation the TK-33 auxiliary remains in the two field cases. One of these contains the modules for the main DC power supply, while the other field case houses the following modules: auxiliary DC power, image-orthicon focus supply, equalizers for line and viewfinder, video and video output, blanking, and the remote control panel. The camera, control panel and viewfinder all have on-air tally indicators, those for the camera being mounted on top and at front. The viewfinder also carries a preview tally indicator. The 8-in viewfinder can be transported separately, and at setup it is then plugged in at the top of the camera, being locked in place with quick-release fasteners, and a self-aligning connector does the rest. This viewfinder uses a high-brightness (150 ft/lamberts) kinescope, and the viewfinder case also contains plug-in modules for video, sync, high-voltage and deflection.

Much was made at Washington of the 3-in 'long life,' and when I enquired of RCA's Ed Dudley I was informed the image orthicon used (developed at Lancaster) is of high sensitivity permitting focussing on bright and still scenes without the usual burn-in or image-retention often found on other types of tube. A new target overcomes the difficulty, and of course it also obviates the need for an image orbiter or for continually moving the camera to prevent stationary scenes from 'sticking' on the target. New circuitry in the TK-33 provides a number of automatic features which reduce manual operation to basically one control, sensitivity or iris control. Included are **automatic** controls for white level and black level, self-adjusting cable timing delay, and automatic DC power regulation.

Self-adjusting cable timing delay is a novel feature, and an RCA engineer explained that in the TK-23 layout the camera circuitry automatically detects and compensates for any cable timing delays by advancing the horizontal pulses, so assuring accurate timing regardless of the cable length. Another feature of convenience to the field or 'OB' operator is electronic lens capping. As effective as the mechanical cap, the electronic cap may be applied at the camera or at the remote control position, and lamp tallies at both positions show when it is capped. How is it accomplished? I found that in the RCA system capping is achieved by a switch which cuts off the accelerating voltage in the image section of the pickup tube, and applies bias voltage to the tube's target.

This TK-33 will be a big export rival to cameras produced in the United Kingdom, in Germany and in Japan, for it operates not only on the US 525-line standard but is switchable to 625-line 50 fields.

This year at Washington RCA have come into professional and educational CCTV in what can only be described as the Cadillac manner. Their PK-301/302 series gives us not 'just-another-CCTV-vidicon-camera,' so much as a fully professional job. RCA's Mr W. B. Varnum explained that these professional CCTV cameras 'were specifically designed to meet a market for closed circuit equipment which provides reliability of operation and picture clarity approaching broadcast industry standards, at considerably lower cost.'

The PK-301 is a completely self-contained system with a hinge-open top giving access to the interior components, the processor circuitry being mounted in the top portion. The PK-302 is similar except that the processor circuitry is housed in a separate case. Both are built for continuous automatic operation, but if you ask for a specification RCA's Mr W. E. Morrison (Chief Engineer) or one of the other engineering moguls will explain that flexibility is the keynote, and just as in the automobile industry where nobody buys a car without a wide choice of 'options' ranging from robot dipping headlamps to spring-like weather controls, so this RCA camera chain comes in no fewer than 16 options, extending the usefulness of the PK-301/2 into many more areas of industry, education and military and governmental facilities. These 16 possible options are random interlace, positive interference, EIA sync, battery operation, remote controls, and many more. All can be factory installed at Camden, or readily added in the field at any time.

Heart of the PK-301/2 series is an entirely new 1-in electrostatic vidicon (that is, electrostatic focus and magnetic deflection) tube developed by RCA for spacecraft TV systems. This tube is commercially available only in the RCA professional TV cameras.

This novel tube is the Type 8134, and the overall camera specification is as follows: Horizontal resolution 700 lines in picture centre and 500 lines in corners, all at the same control setting. Aperture correction, phaseless adjustable from 0-12 dB. Gamma correction by Day/Night switch, choice of 1.0 or 0.7 local or remote control. Signal to noise ratio, nominal 38 dB peak-peak signal to RMS noise. Total scan distortion within 2 per cent at any point on the raster. The automatic light control handles a range of over 2000-to-1 with less than a 50 per cent change in video level, and the recommended scene illumination is 50 ft/candles.

Turning back to colour, Washington delegates saw the TK-27 in its latest form, a modular transistorized colour film camera which is quite revolutionary in design, and looks less like the conventional notion of a camera, indeed resembling a small office filing cabinet. The floor space required is only about three square feet. The TK-27 made its bow last year at NAB Chicago, and now is in full swing.

This TK-27 is not so much a new camera as a new system of colour film transmission, a major breakthrough with features such as a larger (1½-in) vidicon, automatic circuitry and sealed prism optics. The four vidicon pickup tubes are all electrostatically focussed, this eliminating focus coils and their heat-dissipation problems; in fact I

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am assured by Camden experts I met at the NAB Convention electrostatic focus has reduced heat in the camera head (the main cause in all cameras for the rise in dark current) by at least 40 per cent. The luminance channel in the TK-27 uses the Type 8480 1½-in vidicon, the result being a 6 dB gain in S/N ratio due to the good aperture response minimising need for aperture correction. An ingenious feature, I find, is an input transistor mounted on the vidicon to minimize input capacitance and present a constant impedance to the tube, the overall effect of this being stable high-peaking. Another advantage of the 1½-in vidicon compared with the standard 1-in job used in other cameras is the high resolution capability not only in the centre of the picture but at the corners, providing a relatively flat 'plateau' response curve, resulting in unusually sharp film and slide reproductions.

Unlike cameras of the four-tube type needing an experienced operator to monitor individual colour levels, the TK-27 presents a single waveform that is similar to a standard monochrome signal. The RCA method employs non-additive-mixing (NAM) of colour and monochrome signals, to produce a single waveform that at any instant represents the correct values of colour and monochrome **in one presentation.** As I see it, the advantage of this system is accurate control of picture brightness and hue, and no doubt also the prevention of transmitter overload. In other techniques almost continuous monitoring is sometime needed to prevent this overmodulation at the Tx.

When I first saw the prototype version of the TK-27 at Chicago it was rightly hailed as the first colour film camera to use a four-tube vidicon layout, with a vidicon in its monochrome or luminance channel separate from the RGB tubes. And now that we have seen the final production version of the film camera at Washington, other claims can now be justified that it is the only film camera using the larger 1½-in vidicons, and—since it is completely transistorized—the only camera of its kind with a total power consumption of under 200 watts. In common with RCA philosophy relating to similar studio equipment, plug-in transistorized circuit modules are used, with convenient front panel test jacks. Some of the circuit functions in the four vidicon channels are identical, and this sort of interchangeability offers greater circuit familiarity for the maintenance engineers and makes their task easier in the otherwise not always simple job of servicing colour equipment. On this film camera I find there is a multiplicity of test points— almost 100 test jacks, in fact—that trouble can often be isolated within a module without removing this module from the frame. Automatic circuitry in the TK-27 controls white and black level proportionately in all four vidicon channels to compensate for density variations in slides and movie films. This automatic control feature applies even in the manual control mode by maintaining the levels of the two signals at the points determined by the settings of the controls.

Horizontal and vertical drive signals for the TK-27 now originate in the film camera itself instead of in the master sync generator as with some other film colour cameras. This simplifies cabling and reduces the number of distribution amplifiers, and it should be observed that monochrome and colour cameras can utilize the same distribution system due to an automatic sensing circuit which first detects delay and then compensates by advancing the horizontal drive signal. The design of this camera makes it possible to include all the remote controls for the system in three control panels mounted side-by-side in a console housing only 7¼-in high.

On trying the camera at Washington I discovered a number of unusual features about the controls. For example, white and black balance controls (used individually to control levels in each chrominance channel to compensate for deficiencies in the colour film being projected) are completely non-interacting. Chroma level may also be adjusted from this control panel. With NAM monitoring there is no fear of overloading the system since it is always apparent when maximum chroma levels have been reached. In a forthcoming issue of this journal I hope to give a full description of this revolutionary film camera—indeed, the first complete technical survey made by any engineer outside the United States.

While on the theme of colour—a theme which naturally tended to dominate the RCA exhibit just as it did at so many Washingtan NAB booths—it is necessary to note that here for the 1965 exhibition RCA have introduced the latest version of the major video recorder, the 22 HL, which as this label possibly signifies covers high-band and low-band operation. Indeed, as pointed out to me by Charles Colledge, the 22-HL is the only video tape recorder which can be switched instantly to high-band universal, low-band colour or low-band monochrome modes of recording. The RCA advertising blurb calls the 22-HL a 'super deluxe TV tape recorder,' and while this may sound rather like gilding the lily with overripe commercials, the fact is that in same judgment I believe RCA truly have introduced here an innovation in video tape recording excellence.

When I had been given a demonstration, it became obvious that on the 22-HL master tapes and copies are almost indistinguishable on playback from the original, whether in colour or monochrome, and I felt it no exaggeration of Mr Colledge when he said it was 'a new sophistication in colour tape recording, with picture quality significantly improved even over the already good-quality reproduction we are accustomed to.' Well we have enough RCA TR-22's already working in Britain and throughout the rest of Europe to know what fine recording and playback performance they give, and now the 22-HL brings a sort of Cadillac or perhaps I may be permitted to call it a Rolls-Royce performance which is—well, if the RCA ad-men insist—'super-deluxe!'

Where does this extra performance come from? A number of sources. For example, not only is there the air-bearing introduced on the headwheel by RCA a few years ago, but in the 22-HL they now have a **universal** air-bearing headwheel, operating on all switchable tape standards, high and low band; moreover, it can also be used in any other RCA transistorized recorder. Also built into the 22-HL is a new tape lifter which allows the tape to contact a selective erase head only while actually recording. Thus when used with the electronic splicer, the selective erase head allows erasure of existing video without disturbing the original recorded control or audio tracks.

Chiefly, of course, the 22-HL gets its improved performance from the inclusion of the switchblade high-band feature, using higher FM deviation frequencies both for colour and monochrome. Built-in high-band circuits and a selector switch in the HL eliminate any need for modification or adjustment when changing from standard low-band to high, or back again. A single switch selects from five FM deviation ranges to provide a choice of three US domestic and four international TV standards.

Among the thousands of NAB delegates were many no doubt wondering if it is worth while investing in the HL version if their TV station already has a battery of TR-22's. With technical impartiality, RCA engineers were bluntly frank about the position between these two internationally famed video recorders, and after talking to several Camden video recording experts, this seems to be the position:

	22HL	*Existing TR-22*
High-band feature	Built in and switchable	Modification possible to give this facility
Monochrome ATC	Built in	'C' Model only is pre-wired for plug-in modules
Colour ATC	Both recorders prewired for plug-ins	
Pixlock	Built in on both recorders	
Electronic splicing	Prewired for plug-ins	Modification accessory
Dropout compensator	Prewired for plug-ins	Modification possible
Switchable TV standards	Built in on both recorders	
Pulse Cross Monitor	Built in	None

Incidentally at Washington I was told there are about 350 owners of TR-22's and similar machines in the RCA

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Struggle for power—continued

range, and it is good to find machines which make certain facilities available in the form of plug-in modules, so minimizing obselescence. As Ed Dudley pointed out: 'This approach of up-dating predecessor recorders, and thus minimizing obsolescence, is in contrast to others where design changes are made infrequently but extensively, resulting in complete obsolescence of equipment. The result is that many of the features now advertised by others as 'completely new to industry' have been, in fact, in use in RCA machines for some time. . . .'

In addition to the 22-HL, RCA showed at Washington the popular TR-3 'playback only' unit, the compact TR-4 recorder/reproducer, and the TR-5 transportable, familiar from last year's NAB and now in full-scale production. The TR-5 transportable is designed of course for mobile work, or for indoor use where it is sometimes necessary to move a video recorder from one studio area to another. It has built-in playback, for instant previewing or for high-quality CCTV presentations. On-air playback is provided by adding a separate signal processing amplifier.

To equal what RCA have done in the field to tape recording, there is the production version of the TFR-1 television **film** recorder which Ed Dudley showed me last year at Chicago for the first time, and which now at this year's NAB is showing its full capability.

'Ever mistake a taped TV programme for live pick-up?' I was asked. 'You certainly can on this film recorder, for the blacks are blacker, the whites brighter, the tones softer. Furthermore, TFR-1 resolution capability is 800 lines. . . .'

As I saw it this year at Washington, the TFR-1 consists of a single air-pressurized cabinet containing the display tube, film magazine, controls and all electronic components. They get the high resolution (it really is 800 lines at the picture centre, 600 at the corners) with a precision aligned electron gun providing a controller spot 3-mils in diameter, which is a 2-to-1 improvement over other commercial tubes. The highlight brightness is in excess of 160 ft/lamberts. Gamma correction and exponential correction are applied to the display tube to produce linear video to light conversion, and true reproductions from black and white. In this display tube there is a feature of which I have so far seen only a cross-sectional line diagram sketched for me by an RCA laboratory engineer, since it is a feature not obvious just by handling the tube. They call it 'sub-screen' design. The phosphor screen suspension is so arranged that a 0.015 gap at the end of the tube, behind the faceplate. This, I am told, increases resolution by removing the faceplate from the focal plane, virtually eliminating dispersion of light by a thick faceplate.

Facing the display tube, of course, is the film camera; and this is of the clawless type with film pulldown achieved without vibration by one small component weighing less than an ounce. This new shutter spreads the 'picture splice' over about 40 video lines, eliminating shutter bar effects. A solid-state drive system powers the camera motor, and of course since drive timing signals are supplied from vertical deflection, the film transport is synchronised with the picture to be photographed.

Based on what they saw at last year's NAB Convention, NHK (Japan's largest TV network) bought six of these TFR-1's to produce syndicated film from TV coverage of the Olympics. Now, after the Games, these machines are used for NHK's nation-wide broadcast TV network. I also saw that one TFR-1 has gone to the US Naval photographic Centre at Anacosta, DC, where it is used for production of technical training films from televised subjects. TV sources can be recorded separately, or combined for special effects, as the machine produces standard 16-mm film that can be quickly edited and copied.

In the centre of the control desk is a series of press-buttons and other simple controls. In advance you simply preset the mode of operation—that is, positive or negative film, aperature for live or tape, gamma on or off, aperture on or off, and so forth. For the calibrated light output you set the calibrated standard, select the neutral density for the right contrast, then simply push the 'CAL' button. Pushbuttons also allow sequential selection of signal points for waveform display, for rapid setup and adjustment. I worked a TFR-1 at Washington and noted there are really only two operating controls. Virtually only the video gain and pedestal controls may need occasional touch-up; one simply 'rides' incoming video signal to the reference pulse appearing on the monitor scope. There is a warning series of indicators telling of a possible fault. An inoperative circuit is indicated by an illuminated red button, and under normal operation the indicators are either yellow or green.

As there are a number of TV-film applications where it is important to get quick processing of the film resulting from the TV display, I was interested at the NAB to see that RCA can couple the Viscomat processor to the TFR-1's output. This machine gives high-quality films, dry and sparkling, in only 60 seconds for TV printing. One does not have to mix chemicals, or test solutions. Push-buttons start the Viscomat, which is pre-controlled to maintain commercial laboratory quality. RCA use a novel start-stop sequencer, a coupling unit between the TFR-1 and the Viscomat which automatically stops and starts both sections at required time intervals. There is also the PM-80 double sound system, a complete optical recording channel permitting **separate** processing for the sound portion of the film. Of course this is ideal for repro copies, negative or positive sound tracks. The PM-80 includes transistorized amplifiers, and employs the proven RCA variable area recording technique.

Completely away from routine RCA developments are two novel facilities displayed for the very first time at this year's NAB Convention, Divcon, and Unilock (Universal Interlock).

Unilock has many interesting facets, an 'internal 'one of which, so far as RCA is concerned, is that it comes not from the laboratories on the East Coast but from the Burbank, California, plant, so is just one example of the way in which RCA spans the nation. What does Unilock do? Well, basically it is a new electronic means for acomplishing interlocked playback of two or more devices in absolute reference to each other. For example, it has been common practice to 'cue up' two ¼-in tape recorders or two TV tape recorders to a common start mark and then start both machines simultaneously, in the hope of achieving synchronous playback. Unfortunately there has been no real way of assuring both machines come up to speed together. Worse, there has been the problem of maintaining precise sync of the two machines during the whole playback run.

Widespread use of ¼-in audio tape for on-location

sound recording has led to the need for requirement which permits interlocked playback. As an example, audio tape is extensively used in TV newsreel work, usually in conjunction with sprocketed devices such as 35-mm or 16-mm cameras. To get quick editing, this is commonly handled by the simultaneous recording of sync tracks for the ¼-in tape to correspond with picture information. In this pilot tone system a 'magnetic perforation' is added to the tape during the picture recording of a track offset from the sound-recording proper, this pilot-tone being derived directly from the picture repetition frequency of the motion-picture camera. On playback, the pilot recording serves to sync the sound tape with the picture. Thus far is common practice.

Now, with the Unilock system I watched at Washington, you use what for the want of a better term I must describe as 'electronic sprocketholes,' such as the control track on the TV tape recorder, or the sync signal on the ¼-in audio tape, to provide a precise pulse count which allows maintaining a synchronous or locked condition. This is done by comparing two pulse counts on tape mechanisms linked by Unilock, obtaining a difference-signal (either plus or minus) and then making the correction by controlling the speed of one of the machines. After reaching zero (or the state of 'no pulse difference') Unilock becomes a phase-sensitive device controlling motor speed by phase comparison, much like the capstan servo in a TV tape recorder.

This, so far, is not difficult to understand, but on seeing the device for the first time at the NAB Convention, I was amazed to discover that in addition to controlling motor speed by phase comparison, **Unilock has a memory storage feature which allows it to store plus or minus 100 frames in terms of a 24-cps frame-rate.**

As a Burbank technician explained to me: 'Unilock "memory" is non-volatile—that is to say it will store an error indefinitely, or until rest to zero. Power removal or start-stop operation does not affect the error.'

From Unilock we step into the TV computer world with RCA's Divcon. Though new to NAB, Divcon was shown during the 1964 US national elections. NBC used seven computers at Press HQ, and set up one of these RCA robots to control a Divcon unit. In this way NBC newscasters were able to interrogate the entire RCA computing system, read in plain language off the face of a standard television monitor tube the standings of the races being processed by the computers, and put On Air to TV and radio stations those results of significant interest to the watching and listening public . At the time this was rightly acclaimed a milestone in the development of TV news broadcasting, but we had to wait until the 1965 NAB Convention to see the technical features of Divcon. As you will appreciate, **Divcon converts information in the form of digital coding to 525 or 625-line video signals, for display on standard TV monitors, for on-air use.**

Up to now, information in printed form could be brought to TV screens only by first recording it on film or slide, or by the use of a live TV camera trained on printed characters. By using digital techniques, Divicon makes it possible to convert coded character intelligence from such sources as keyboard, teletype lines or computer, directly to standard 525 or 625 line video. As I saw it at Washington, Divcon is housed in an apparatus rack 78in high, 28in wide and 24in deep. It needs about 1,500 vA at 115-volts AC, and the EIA sync generator is a separate sync source not supplied as standard. Spot announcements in text form can be stored and recalled at the touch of a button, and superimposed comments or subtitles may be rapidly composed during sports events, panel discussions and similar programmes where the technique would be appropriate. With optional extra equipment, cartoons can be generated on the screen.

In video switching and special effects, I find that Divcon outputs can be handled in the same manner as other TV programme material. Special effects such as the superimposing of symbols or lettering on moving or still backgrounds can be done (I tried this for myself at the apparatus rack), and, for example, during a TV weathercast the gradual accumulation of weather data on a map background is possible without the use of a visible weathercaster, or even of a live TV camera. This Divicon technique opens an entirely new field to television broadcasting, for of course one can handle prepackaged TV messages requiring instant release over a broadcast system.

1965 INTERNATIONAL FESTIVAL AND FAIR REVIEW

THE THEME for this 10th Audio Festival and Fair, held at the Hotel Russell, London, was 'Modern Sounds for Modern Homes' and this year it was apparent that presentation was receiving more attention. As **John Gilbert** (Hon Technical Press Officer) said at the Press luncheon, presentation of British audio/radio products might well have something to learn from Continental designers, although fundamentally British hi-fi designs could still lead the world. Apart from the enthusiast, the days of trailing wires and exposed equipment would seem to be over. Integrated equipment (perhaps with separate loudspeakers) would seem to be in fashion, coupled with a trend towards reduction in physical size, particularly of loudspeakers.

The international nature of this exhibition is evidenced by the countries of origin of some of the products—for example—Japan, Sweden, Austria, Germany, Norway, Switzerland, the USA and the Netherlands. Of course, most of the products seen and demonstrated are intended for the domestic user, and our survey will concentrate on items with professional applications.

Let us take a look at some of the tape recorders displayed. The **Sony UK Sales Division (Debenhams Electrical & Radio Distribution)** had a complete range of models available. The TC.777A studio console type professional 2-track mono machine is a 3-head, 3-motor system, with feather-touch push-button electrical control. Vertical or horizontal operation, with electrical tape speed selector, wow eliminator, auto-shut-off, VU meters, index tape counter, remote control, and all transistorised circuitry.

Another well known range of Japanese tape machines is now available in the UK through **Pullin Photographic (the Rank Organisation)**—the five **Akai** models, four of which were shown for the first time. All units are intended for stereo-mono recording and replay, with various features to extend the fidelity and versatility of the designs. One of the models that attracted a lot of interest is the Akai X-4, a rechargeable battery/mains portable compact and only 12½ lbs in weight. It employs the unique Akai cross-field head to improve the useful frequency response at slow tape speeds (this model operates at speeds from 00 in to 7½ in ps). It has a specially developed constant speed DC micromotor for low wow and flutter performance. The Akai M.8 is another four-speed recorder incorporating this X-field head technique, as well as a vertically directed loudspeaker system to supplement the output from the matched twin speakers. A 'sound-to-sound' arrangement is included in the M8's specification enabling foreign languages to be studied, or multiple recordings from a single source to be made.

Planet Projects Ltd demonstrated a new continuous-play tape deck, type **CD.2,** whose design is based on experience gained from several years use of the U1 deck. Operating at 1⅞ in ps and using standard twin-track double-play tape it will provide 8½ hours of music without repeating, and it can then repeat, from the beginning, giving continuous performance indefinitely. This is achieved by automatic switching at the end of a tape, reversing in direction and switching over to a playback head on the upper track in one direction and the lower track in the other. Standard 7 in reels are used without a cassette, and stereo or mono heads can be accommodated. Two speed drive at 1⅞ or 3¾ in ps.

The Swiss **Revox** 736 stereo tape machine, first seen at the 1964 Fair, was again demonstrated by **C. E. Hammond & Co,** of Windsor. Made by the famous **Willi Studer** organisation in Switzerland, this model is a mono¾ stereo recorder operating at 3¾ and 7½ in ps, with stacked erase record/replay heads, six audio preamps, a mono power amplifier of six watts output, handling spools up to 10½ in diameter, including NAB type. Twin VU meters are fitted, calibrated from −20 to + 3 VU's, which are set 6 db above constant tone level to allow accurate register of signal peaks. Equalisation is to the latest CCIR standard of 70 and 140 microseconds. New this year was the Revox 'Slide-O-Matic' accessory, a transistorised unit for use in conjunction with an automatic transparency projector. It also includes a remote stop-start facility for the Revox recorder. Another new product from this source is the **Hammond** condenser microphone, which is an entirely redesigned version of the original 'Microkit' condenser microphone. Supplied assembled at 28 guineas.

Shown for the first time in the UK was the latest **EMI** type **L4** professional portable tape recorder. Weighing only 10¾ lbs (with batteries) it offers five additional facilities over its predecessor: provision for a fourth magnetic head (useful for sound sync); two tape speeds (3¾ and 7½ in ps); remote control; press-button operation; and two microphone input mixing. Two bigger machines were displayed—TR.52 and BHR.4 (previously known as type 311). This streamlined model has many applications from studio sound to scientific and industrial research. Available in half or full track mono form, two track on normal ¼ in tape—the head block is easily changeable—or three/four track on ½ in tape versions, in rack mounted, console or transportable form. Simple conversion from one model to another is possible. Individual track erasure is available on the multi-track versions. Variable spooling in either direction is provided, with automatic removal of the tape from the heads by retractable guides. Automatic action is governed by manual over-riding control which can be locked in the running position during spooling. A three-position switch enables record/replay equalisation characteristics to be changed between CCIR, NAB and IEC standards. The **BTR4** is fully tropicalised.

A new version of the **Fi-Cord 202A** tape recorder was demonstrated. This has a new battery testing system, a redesigned control panel, a new VU meter and a fresh colour scheme. It will operate from a 12V car battery, 105-240V AC mains or accumulators which can be re-

by Donald Aldous (Audio Editor)

charged with the aid of the **Fi-Cord** charger unit. It will accept 4 in spools, has two speeds ($3\frac{3}{4}$ and $7\frac{1}{2}$ in ps), weighs only $6\frac{3}{4}$ lb and measures 9 by $6\frac{1}{2}$ by $4\frac{1}{2}$ in. As well as the Beyer range of microphones handled by this company, two new microphones—FC.901 directional and FC.801 omni-directional dynamic units—were shown. This company is also handling now the Synchrodek and Synchroslide devices for linking tape recorders with cine or slide projectors.

Mr E. Field (Studio Sound Manager in the UK) for **Peto Scott Instruments,** handling the **Philips** Studio Equipment here introduced me to **Mr Nolthenius De Man,** of the ELA Professional Recording Department of **Philips** in Eindhoven. Mr De Man kindly arranged a special demonstration of the latest MD8 Audio Mixing Desk (available in many versions) and the new Philips multiple tape copying machines. In fact, I had the pleasure of being given $3\frac{3}{4}$ and $7\frac{1}{2}$ in ps tape copies made from the master tape in my presence. The results were first class. The MD8 mixing desk is fully transistorised and consists of a standard (framework) desk with space for up to seven plug-in control panels. If required, a filter panel, or a filter panel and a reverberation panel, can be added to the input panels, master panel and monitor panel found in all mixing desks, without sacrificing the obvious advantages of the basic construction. Another attraction in the Philips' rooms was the EL.3400 video tape machine, selling for around £900.

The **Ferrograph** company introduced their Series 6 tape recorders, which are basically unchanged electronically and in the decks, so that their reliability is unimpaired, but the new models have three speeds ($1\frac{7}{8}$, $3\frac{3}{4}$, $7\frac{1}{2}$, or $3\frac{3}{4}$, $7\frac{1}{2}$, 15 in ps), with new synchronous capstan motor with ball-race bearings.

Transistors continue to find fresh applications in tape recorders, amplifiers and radio-tuners, but valve-operated equipment is still in widespread use and production. Of the many advanced designs some can be described as hybrid, for instance, the latest **Radford** Control Unit, SC.22, has been developed to work from the anticipated new pickup cartridges with outputs of the order of 2 mV. The signal/noise ratio has been improved over the conventional previous pre-amplifiers by the use of a planar epitaxial transistor in the input stage, operating in a 'feedback pair' equalisation circuit with a low noise valve. **Arthur Radford** has also improved his FM tuner with a three-gang capacity tuned input unit fitted with pre-RF tuning, providing a high spurious noise ratio. In addition, tuners will also be available possessing a low distortion stereo facility having automatic noise immune stereo/mono mode switching.

Mullard showed their complementary npn/pnp transistors giving outputs from 40 mW to 40 W included in —what has been called—the 'Harmonious' range for the construction of amplifiers with transformerless push-pull output stages. Single-ended Class A output up to 5 watts can be obtained from an AD.149. For pre-amplifiers the BC.107 silicon planar epitaxial transistor provides high gain with low noise level over a wide range of currents.

Several new models of high precision turntables were shown by **Garrard Engineering,** including the 401 with ▶

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IBE's Audio Editor Donald Aldous (left) is seen here with Pathe News' commentator and broadcaster Bob Danvers-Walker examining a Fi-Cord portable tape recorder. Brian Dangerfield, representative of the Fi-Cord company is seen right.

heavy 12 in turntable, machine-cut stroboscope around edge of the turntable, neon lamp and speed variation control. One outstanding new model is the Garrard LAB.80, a transcription unit incorporating an afrormosia wood, counterbalanced pickup arm with stabilising aluminium channel and integral pickup cueing. It has finger-tab controls and an illuminated record-size indicator.

Loudspeaker designs of many types, with the accent on the compact mini size unit, proliferated at this year's Fair, stemming from the breakthrough made last year by **Goodmans Industries** with their MAXIM, about the size of a shoe-box. One such model was introduced by **Celestion Ltd** termed the 'Ditton 10,' measuring only 12¾ by 6¾ by 8 in. The internal volume of this speaker is 480 cubic inches, and it has a special bass driver unit (covering the 35 to 3,500 c/s band) with a pressure type HF unit over the band 3,500 to 15,000 c/s. A half-section LC crossover unit provides the frequency division.

Another remarkable loudspeaker in this 'small' category is the new **Rogers Developments'** '35' model to be known as a 'wafer' unit, as it is only 2½ in front to back. This can be wall mounted. It has excellent transient response and a bass response down to 40 c/s. Two units are fitted—a 5 in design with 15,000 gauss magnet and roll surround and a 3½ in treble unit with 13,000 gauss magnet and foam plastic suspension. Overall dimensions: height 13 in by 16½ in width and 2½ in depth.

The **Jordan-Watts** module, introduced last year, attracted a lot of interest, and a development in the reproduction of stereo sound by a modification of the radiating pattern control techniques used in the A.25 and B.50 was introduced in the **Jordan-Watts** DPS.100. This new system is intended to provide a more precise image, which offers good stereo effects throughout a room and not just in the 'stereo seat.'

The **Special Products Division** of **Decca Radio & Television** has taken over the marketing and production of loudspeakers designed by **Stanley Kelly.** The several **Kelly** LF drive units are now in production as well as the admirable Mark II ribbon loudspeaker, and for use with this latter model Stanley Kelly has developed an Acoustic Lens. This has a cardiodal polar diagram and is intended to avoid 'beaming' effects and give increased listening area on which true stereo effects are experienced.

From the professional users' standpoint the **K.E.F. Electronics'** version of the **B3C Monitor** speaker proved to be of the greatest interest. Employed to assess the quality of radio and TV programmes, this final model has evolved over a long period of years. It has three units (a 15 in LF unit with 3 in diameter voice-coil and PVC roll surround, and two identical HF units) and the axial response is checked against a BBC approved standard sample so that the frequency curve of each loudspeaker tested does not differ from that of the reference loudspeaker by 1.5 to 2 db in specified parts of the band, and between 200 and 400 c/s, no variation at all is acceptable. The complete design incorporates a 35 watts fixed bias push-pull amplifier. Two versions are available, one a floor-standing model for studio and control room work and a suspended model for use in TV control rooms. Type LS.5/1A costs £110 and the hanging model, LS.5/2A is priced at £120.

Another sophisticated loudspeaker is the latest **Radford Electronics'** XLS design, now also known as the Radford 'Monitor.' Measuring 26 by 15 by 11½ in it is fitted with three units, equalised and integrated by an 18 element network, it produced superb quality at the demonstrations.

The **Fane Acoustics 'Ionofane'** design with 'no moving parts' has already been described in these pages, and in conjunction with this company's own midrange and bass units, it provided clean sound reproduction. **George Tillett's** demonstrations of the newest **Wharfedale** speakers, the modern version of the W.2 known as 'Dovedale' and the neat 'Dalesman' that will handle 8 watts at 40 c/s in spite of being only 6¼ in deep, were most satisfying sonically.

Of exclusive interest to the professional user, the **STC.4126** capacitor microphone (only 2 in long) incorporates its own integral field effect transistor head amplifier, with a characteristic that can be cardioid or omnidirectional. Price complete is around £120.

A few exhibitors received the BBC FM-multiplex stereo test transmissions, radiated by a system rigged on the eighth floor of the Hotel Russell by BBC engineers, directed by **Mr A. Gee.** Four hours of taped material (mainly from commercial stereo gramophone records) were broadcast within the building daily. The BBC issued a statement at the Fair that repeats the comment that no decision has yet been reached on the introduction of a regular stereo service in the UK, for which Government sanction would be needed, but it is apparent that agreement has been reached by the CCIR Study Group X at Vienna on the technical characteristics of two broadcast stereo systems, the pilot zone Zenith G/E system supported by Western European stations and the polar modulation system favoured by Eastern European countries.

From talks with BBC representatives at their Stand in the Audio Fair, it is clear that the BBC is pleased with the audience reaction to their recently introduced Music Programme (on the Third Network), but is of the opinion that the radio industry could do more to promote listener interest in the 46 stations making up he BBC's VHF/FM network throughout the country.

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Advanced Production Control Desk for the Decca Record Company

by Donald Aldous (Audio Editor)

DUE for release in May by the Decca Record Company in the UK is the last of Wagner's **Der Ring des Nibelungen**—'Götterdämmerung.' As John Culshaw, producer of this gigantic 'Ring' cycle on records, says in an article in a booklet accompanying this latest set, 'We thus reach the curious situation where, as the theatre moves steadily away from drama as Wagner thought of it and so towards a static symbolism, the gramophone recording is using its aural capabilities, especially in stereo, to support the original drama.'

Decca has long been renowned for its experiments in techniques of recording large-scale operas, and it is their practice to observe every stage direction that can possibly be conveyed in terms of sound alone, and in the 'Götterdämmerung' every indication of vocal or instrumental deployment specified by Wagner, was followed, whether or not his wishes are carried out in the theatre today.

Coupled with the special sound effects and acoustic atmosphere often demanded in such recordings, it is apparent that the problems encountered in recording the master tapes for the production of the final disc records are constantly becoming more complex, with a single mono and one two-channel stereo tape no longer being sufficient for these requirements.

To provide these complicated sound facilities, Decca engineers prepared a specification for a versatile production control desk which, after extended discussions, was constructed by the Wiener Schwachstrom Werke, of Siemens & Halske Gesellschaft MBH.

Installed in the **Sofiensaal** in Vienna, this equipment was employed for the Decca recording of 'Götterdämmerung,' for another opera 'Don Pasquale' and symphonic works of various kinds. Fig 1 shows the control desk in operation with Decca producer Erik Smith at the central control position. Tape machines in the foreground.

The desk (see Fig 2), more than 11 ft wide, offers most comprehensive facilities. It has more than 400 controls (vertical faders, tone contour units, push buttons, selector switches, monitor controls) and more than 150 programme amplifiers, most of which are transistorised. The desk caters for mono, 2-channel, 3-channel, 4-channel recording by any known system.

Designed to be operated by two engineers with one producer, 20 input channels and two echo channels are provided and may be grouped into two or four master channels. Television links are used to monitor and control the positions of soloists and musicians.

A BBC-2 TV 'Workshop' programme called 'The Golden Ring,' shot throughout the production of the opera in the Sofiensaal, was shown in May, and may be repeated on BBC-1 in the autumn.

Fig 1. New Decca Production Control Desk

Fig. 2. Decca Production Control Desk.

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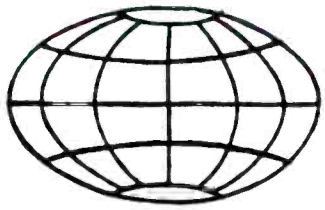

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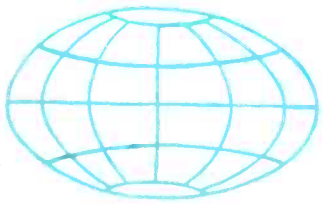

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