

RESEARCH DEPARTMENT

VISIT TO GERMANY - 7th to 16th OCTOBER 1963

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1. INTRODUCTION

This visit had several purposes. First, to see and discuss the development, by Siemens and Halske A.G. and the Institut für Rundfunktechnik (I.R.T.) of a television storage device that employs a foil disc upon which magnetic tracks are recorded; it is possible that this device may find application in future standards conversion equipment. Secondly, to see and discuss other research and development work being carried out at the I.R.T. (Munich) and, thirdly, to attend the annual meeting of the German Television Society (F.T.G.), which took place from 7th to 11th October at Bad Nauheim near Frankfurt. Attendance at the F.T.G. meeting preceded the visit to Siemens and Halske A.G. and the I.R.T. at Munich, this being a more convenient arrangement from the point of view of Professor Theile and his staff.

2. MEETING OF THE F.T.G.

At the meeting, some 62 lectures and contributions were given, often in very abridged form. The following account consists of a series of summaries of those lectures or contributions that are thought to be of most interest.

'The Synchronizing of Line-Frequency Switching in Certain Colour Television Systems (SECAM, PAL, etc.)', Dirks, E., (Telefunken G.m.b.H.)

Herr Dirks discussed the form of the signal that is inserted in the field-blanking interval to provide synchronizing information for the pole-changing switch in the PAL receiver. He compared the signal used at present (i.e., a series of four long bursts of constant-amplitude subcarrier in +I phase relationship with respect to the normal burst) with a series of similar bursts that are amplitude-modulated at about 300 kc/s. He showed that the amplitude-modulated form of synchronizing signal can give greater discrimination against noise and interference.

'The Synchronizing of a Non-Crystal-Controlled Colour-Subcarrier Regenerator in a Receiver', Mahler, G., (Telefunken G.m.b.H.)

This was a short outline of a subcarrier regenerator for a PAL receiver in which an l.c. oscillator is used. He showed that an injection-locked oscillator can

be designed to have characteristics that are adequate for use in a de-luxe PAL receiver. One purpose of this lecture was to argue that, although the de-luxe PAL receiver employs a line delay, economies may be effected in the subcarrier regenerator.

'Improvement of the Colour-Analysis Process', Doury, J.P., (Companie Française de Télévision)

In the arrangement outlined in this lecture, the output signals from a scanner or camera are first matrixed to form the luminance and colour-difference signals and each colour-difference signal is then applied to two or more one-line delays. Each colour-difference signal used to modulate the subcarrier is obtained by combining the signals at the input of the series of delay devices with those available after delay by one and two (or even more) line periods. Thus each of the colour-difference signals is the average of three or more lines. The advantages claimed for this suggestion were that the signal/noise ratio in the colour-difference channels is improved and that the compatibility of the SECAM system is improved. The latter claim is, no doubt, justified in that this arrangement should reduce the likelihood of the so-called 'ladders' that can be seen on the compatible SECAM picture with certain arrangements of coloured objects in the scene. The vertical resolution of the chrominance channel would suffer appreciably, but flicker at horizontal edges should be reduced.*

'Comparative Investigations of Several Colour Television Systems', Müller, Dr. J., (Fernmeldetechnisches Zentralamt)

The information given in this lecture has already been communicated to the EBU Ad-Hoc Group on Colour Television.² Dr. Müller described the results of experiments comparing the relative sensitivities of NTSC and PAL to both source noise and transmission noise. The subjective tests were carried out using both the 'tolerable' and 'just perceptible' criteria. 'Flat' noise was added in all cases and it appeared that the SECAM system requires R,G,B signals having signal/noise ratios some 3 dB better than in the case of NTSC. For flat transmission noise the SECAM system requires a signal/noise ratio between 1 and 3 dB better than in the case of NTSC; for noise added to the chrominance channel only, SECAM appears to be 2 dB more sensitive than NTSC. Some tests using sine-wave interference were also described. It was found that the NTSC and SECAM systems have the same average sensitivity near the vision carrier. However, when 1/2-line offset with respect to vision-carrier frequency is used, NTSC is more sensitive than SECAM. When 1/2-line offset with respect to the colour subcarrier is used, NTSC is less sensitive than SECAM.

'Opinions on the Design of a Colour Television Camera', Dillenburger, Dr. W., (Fernseh G.m.b.H.)

Dr. Dillenburger gave a summary of various possible approaches to the colour-camera problem and outlined the well-known three-tube and four-tube solutions. He revived a rather old idea in which an image-orthicon tube provides the luminance

*A similar proposal for this purpose was made by one of the authors (G.D. Monteath) some time ago.¹

signal and a vidicon with a striped filter in its light path provides colour signals. The proposed filter has 100 sets of vertical strips in the sequence, grey, red, green, blue, ~~white~~, red, etc. The signal from the grey strip is used to gate the red, green and blue signals so as to provide low-bandwidth red, green and blue outputs from which the chrominance signals are derived.

'A Colour Television Check-Receiver Using Transistors', Trost, E.G. (Standard Elektrik Lorenz, A.G.)

This was a description of a small partially-transistorized colour monitor/receiver employing a Japanese 17 in tube. More than 100 transistors are employed, but the e.h.t. and line-scan circuits employ valves. There was some amusement when Dr. Müller attempted to lift the unit from the table; he guessed its weight to be about 20 kilograms. It was stated that the prototype monitor/receiver had only just been made and that its development was not yet necessarily complete.

'A Phase and Frequency Correcting Circuit using Sine Waves, which could be Used for the Synchronization of a Colour Reference Carrier', Gassmann, G.G. (Standard Elektrik Lorenz A.G.)

This lecture outlined a rather interesting circuit for controlling an oscillator so as to lock to and remain in phase with a reference signal. This circuit arrangement has the characteristic that when the oscillator is not locked to the incoming reference signal an effective control voltage is provided which is determined by the frequency difference between the oscillator output and the reference signal.

The development of this circuit arrangement is based upon a circuit suitable for pulses which has been described previously.³ Herr Gassmann suggested that the characteristics of this circuit are such that it could be used to control an l.c. oscillator in the subcarrier regenerator circuit of a colour receiver and that such an arrangement would offer a saving in cost.

'A Transistor Video Amplifier for a Television Receiver', Juhnke, E., (Valvo G.m.b.H.)

The problem of providing suitable video drive to display cathode-ray tubes by means of a transistor output stage was outlined; a video voltage of up to 80 V (black-to-white) was considered necessary. The circuit described uses a silicon n.p.n. mesa transistor type BF 109 driven from an emitter follower. It was shown that good linearity may be obtained with a frequency response that is substantially uniform to beyond 4 Mc/s, and that a suitable drive can be provided for the intercarrier-sound stages of a receiver.

'The Influence of Variations in the Black Level of the Transmitted Signal on the Viewing of Modern Television Receivers', Janssen, P.J.H., (Philips Gloeilampenfabrieken)

In this lecture it was assumed that all television receivers preserve the d.c. component fully (not true in the United Kingdom!) and it was shown that variations of the black level within the limits set by the CCIR can cause appreciable differences in the reproduction of the pictures.

'Comments on the Influence of the Screen and its Immediate Surroundings on Picture Quality', Springer, Dr. H., (Institut für Rundfunktechnik)

This lecture reviewed the glass and plastic panels that are placed between the front of the cathode-ray tube and the viewer's eye. Dr. Springer discussed the use of neutral-grey filter glass and polaroid filter material as means for improving the subjective contrast of the picture. For studio monitors he recommended that polaroid filter material be used in an attempt to reduce the visibility of reflexion of other objects in the viewing room.

'A New Circuit Concept for Horizontal Deflexion in a Transistorized Television Receiver', Gassmann, G.G., (Standard Elektrik Lorenz A.G.)

Herr Gassmann reviewed the advantages of valve circuits when used in the sine-wave oscillator circuits of a fly-wheel time base, and pointed out that the valve circuit presents a high impedance to the output of the phase-sensitive detector. He outlined a new circuit in which a transistorized line-output stage also acts as an l.c. oscillator; in this arrangement the effects of damping by the transistor are minimized. He also mentioned a reactance-modulator circuit, employing a variable-capacitance diode and two transistors, which permits the frequency of the oscillator to be varied and yet preserves an input impedance to the control voltage of greater than 5 M/ohms.

'Measuring Equipment for the High-Frequency Transmission of Black-and-White and Colour Signals', Strössenreuther, W., (Rohde and Schwarz)

Descriptions were given of a test modulator and a demodulator suitable for measurements. Modulation is performed at intermediate frequency for both sound and vision, and the resulting signals are then transferred to the required frequency band. The demodulator incorporates i.f. group-delay correction. The quoted results showed both units to have good performance.

'Modern Measurements and Test Gear for use in Colour Television Studios', Schönfelder, Dr. H., (Fernseh G.m.b.H.)

The lecture outlined the measuring and test facilities required for colour coding equipment. Equipment was described which provided colour test signals both of the familiar colour-bar and sawtooth forms. These signals could be combined on a time-division multiplex basis so as to provide a composite picture including colour bars, a grey scale, and areas of colour corresponding to the separate I and Q axes. No doubt such equipment in skilled hands would be very useful, and would aid in ensuring that coders and decoders were adjusted correctly. However, there is some doubt whether relatively unskilled engineering staff could benefit from such complex facilities. Dr. Schönfelder also argued that vertical-interval test-signals should include suitable colour signals.

'A New and Simple Measuring Device for Measuring Differential Phase in Television Transmission Systems', Wohlberg, K., and Monastiriotis, G., (Telefunken G.m.b.H.)

This device consists, in essence, of a locked oscillator (operating at subcarrier frequency) a suitable feed-back loop and a phase-sensitive detector; the time constant of the servo is relatively long. If a sawtooth signal, together with a superimposed low-amplitude sine wave at subcarrier frequency, is fed to the circuit to be measured and the output from the circuit under test is then fed to the measuring equipment through a high-pass filter, the phase of the locked oscillator is the average of the varying phase of the test sine wave which results from differential-phase distortion. The output from the phase-sensitive detector describes the differential-phase distortion. Means are provided for calibrating the device by feeding some of the local oscillator output to the input point of the phase-sensitive bridge through calibrated delay lines.

'A New Video Noise Meter for Television', Mangold, Dr. H., (Rohde and Schwarz) and Schaumberger, A., (Institut für Rundfunktechnik)

The authors reviewed the various methods used for evaluating the signal/noise ratio in a video circuit. Mention was made of the use of an oscilloscope (a method attributed to R.C.A.), the suppression of unwanted signals such as blanking intervals by a suitable modulator (BEC: L.E. Weaver), and the direct high-pass filter and thermo-couple arrangement (F.T.Z.). The method adopted in the instrument described was developed by I.R.T. Munich, and is similar in many ways to the BEC method.⁴ However, a high-pass filter has been incorporated which rejects noise components below about 400 kc/s; thus any measurement of noise due to clamping must be suspect. It was claimed that the device can measure signal/noise ratios of up to 90 dB within a bandwidth of 5 Mc/s.

'A Possible Method of Improving Signal/Noise Ratio in Video Tape Recording', Dillenburg, Dr. W., and Krause, G., (Fernseh G.m.b.H.)

This proposal sets out to reduce the amount of noise that is added in large picture areas of uniform grey level at the expense of increasing the noise near vertical edges. The principle of the proposed arrangement is as follows:

Before recording, the signal is split into two bands, say d.c. to 0.5 Mc/s and 0.5 to 5 Mc/s. The high-frequency signal is then processed in a non-linear manner so that voltage excursions near zero level are amplified more than voltage excursions remote from zero level. The low-frequency and high-frequency signals are then re-combined and passed to the recorder. During re-play the signal from the recorder is again split into two bands. The low-frequency signal is passed to the output unchanged, while the high-frequency signal is now subjected to a distortion which is the inverse of that used before recording before being added to the low-frequency signal to form the output. A short demonstration of this arrangement was given but no marked reduction of the noise in large plain areas was apparent.

'Technical Problems in Applying the Magnetic-Disc Single-Frame Storage Unit (Folienspeicher) in Television Broadcasting', Funk, H., (Institut für Rundfunktechnik)

This paper describes the I.R.T. contribution to the application of the Folienspeicher⁵ to television, which is discussed in Section 4 below.

'The Plumbicon⁶ - A New Television Camera Tube of the Vidicon Type', Kühl, Dr. W., Valetton, J.J.P., and van Doorn, A.G., (Philips Gloeilampenfabrieken)

Three contributions were given under this heading. The first described the general properties of the camera tube in terms of colour response, the relationship between output current and incident light, resolution, etc. The second contribution described the use of the Plumbicon camera tube in a black-and-white camera and a demonstration was given. The third contribution outlined the application of Plumbicon tubes in a three-tube colour camera. Nothing particularly new was revealed during these contributions, but in the discussion the effect of introducing a bright object, such as the flame of a match, into the scene was raised. It was stated that, provided the camera tube has a satisfactory layer and that the signal current is not unduly high, little difficulty should be experienced.

'The Limiting Sensitivity of the Image-Orthicon Tube Especially as Compared with Photography', Theile, Prof. Dr. R., (Institut für Rundfunktechnik)

This was a typical contribution from Professor Theile. It discussed some fundamental characteristics of a camera tube and compared the process of deriving an electrical signal, by means of storage and scanning, with the photo-chemical process of photography. The lecture showed that for very low values of illumination a television camera employing a suitable image orthicon can produce pictures with light levels at which the photo-chemical process fails.

'Remarks on the Construction and Operation of a Small Image-Orthicon Camera', Pitz, F., (Institut für Rundfunktechnik)

In the past, attempts have been made to improve the signal/noise ratio of the image orthicon by reducing the beam current in the darker tones. It was suggested that this idea could be exploited provided that the transit time between gun and multiplier could be made small enough by developing a small image orthicon tube of suitable characteristics. It was shown that, in order to provide stable wide-band feed-back to the beam, it would be necessary:

- (a) To reduce the separation between the electron gun and the target plate to the absolute minimum.
- (b) To increase the wall-anode voltage.
- (c) To increase the secondary-electron multiplier gain by a considerable factor.

'The Disturbing Effect of Spots in Television Camera Tubes', Kaufmann, A., (Institut für Rundfunktechnik)

This lecture discussed both types of spot which are likely to occur in camera tubes; one type produces a signal that is added to the output and the other modulates the output. Apparatus has been developed to simulate the effect of spots, so that their effects may be appraised subjectively. A technique for measuring the characteristics of a spot, by a comparative method, was also described.

'The Trick Converter - A Special Device for Varying the Geometry of Television Pictures', Högel, G., and Vollenweider, E., (Institut für Rundfunktechnik)

This lecture described a device that was demonstrated to the authors at the I.R.T. (see Section 3.6.).

'A Report on a New Series of Equipment Employing Transistors', Legler, E., (Fernseh G.m.b.H.)

This paper included a description of remote-source synchronizing (slave-lock) equipment employing a control tone at half-line frequency (7.8 kc/s).

'U.H.F. Tubes of Improved Linearity for Television Use', Paschke, Dr. F., and Leibschner, R., (Siemens and Halske A.G.)

This contribution described the construction and practical use of a series of u.h.f. tubes. A range of tetrodes was outlined covering powers up to 11 kW. Some travelling-wave tubes were also described.

'U.H.F. High Power Klystrons Applied to Translators and Colour Television', Bohlen, H., (Valvo G.m.b.H.)

A series of klystrons of powers of up to 20 kW was described and a method for achieving improved linearity was outlined. A translator having an output of 2 kW was also mentioned; this employed common amplification for both sound and vision.

'New Investigations Concerning the Suppression of Quadrature Distortion in Television Transmitters', Dinsel, S., (Institut für Rundfunktechnik)

A previous paper⁷ has already described a technique for pre-correcting quadrature distortion. In this contribution Herr Dinsel gave an account of its use at various transmitters in West Germany and also gave the results of some investigations made in the laboratory to determine its effect on colour transmissions. He showed that pre-correction can ameliorate those effects of vestigial sideband reception which result in the distorted reproduction of colours having both high saturation and brightness.

'Automatic and Remotely Switchable Stand-by Stages for Television Transmitters', Kniestedt, J., (Fernmeldetechnisches Zentralamt)

This contribution described some ideas for replacing faulty stages of a transmitter by stand-by stages. Such switching could be carried out automatically, or could be controlled from a suitable monitoring point. The arrangement appeared to be somewhat complicated and could in the limit perhaps prove more troublesome than an arrangement in which a complete stand-by transmitter is used.

'Television Broadcasting in the 12 Gc/s Band', Klein, Dr. W., (Fernmeldetechnisches Zentralamt)

Tests have been carried out in Berlin using 12 Gc/s television transmissions with frequency modulation of the transmitter klystron. The transmitting aerial was substantially omnidirectional in the horizontal plane but had a very narrow-angle pattern in the vertical plane. The test receiver employed either a horn or parabolic reflector and experience showed that reasonably satisfactory reception could be obtained provided a line of sight existed. It was suggested that this technique of broadcasting could be used in those large towns where a high proportion of viewers live in large blocks of flats.

'The Influence of Terrain on Propagation in Band IV', Thiessen, P., (Institut für Rundfunktechnik)

In this contribution a set of rules was proposed by which the effect of variations in height of the terrain within a certain propagation path may be assessed. If satisfactory, they could provide a theoretical model for estimating the loss over a given path based upon knowledge of the ground contours.

'Shaping the Vertical Pattern of Television Transmitting Aerials', Gutzmann, Dr. F., (Institut für Rundfunktechnik)

This contribution reviewed some of the problems associated with 'gaps' in the vertical radiation pattern of a television transmitting aerial and gave a brief outline of methods used in the U.S.A. for 'gap filling'. Dr. Gutzmann gave a brief outline of a new aerial feed arrangement, the design of which is based upon limiting the amplitude variation for a given mast deflexion.

'Measurements of the Radiation Characteristics of Television Transmitting Aerials', Pfefferl, A., (Fernmeldetechnisches Zentralamt)

A method for measuring and monitoring the vertical radiation pattern of an aerial was given. The method consists of mounting, either immediately above, or immediately below, the aerial under test, a further aerial whose radiation pattern is known. Field-strength measurements made at a suitable distance from the mast enable the vertical radiation pattern of the aerial under test to be derived from that of the calibrated aerial. It was suggested that such measurements could take place during normal service by radiating from the calibrated aerial a test carrier spaced in frequency by about 100 kc/s from the sound carrier; measurements made using this auxiliary carrier could be compared with those made using the sound transmission.

3. INSTITUT FÜR FUNDFUNKTECHNIK, MUNICH

3.1. General

The Institut für Rundfunktechnik has been described in an earlier report.⁸ It is sufficient to say that it fulfils, on behalf of nine broadcasting organizations, a role resembling that of one of the Research Associations that operate in other fields in Great Britain. Its work, which resembles that undertaken by the Research and Designs Departments of the BBC, is undertaken in two divisions, one at Hamburg and the other at Munich. The Munich division is devoted wholly to television; its work includes problems associated with interference between transmissions, but excludes other radio-frequency work. The staff includes about 60 engineers and laboratory technicians.

During the visit the majority of research and development projects being undertaken at the Institut were discussed with the engineers actually undertaking the work; in most cases the apparatus used was inspected and actual demonstrations of the experiments were given. However, a short introductory discussion took place with Professor Theile and Herr Fix* in which Professor Theile expressed, in quite strong terms, his view that the co-operation and exchange of information between the Institut and Research Department should be increased substantially. He felt that the functions of, and the problems concerning, the two establishments are so similar in nature that a substantially increased degree of co-operation could lead to very worthwhile benefits for both.

In this Section a brief review is given of each of those projects that were discussed; apart from the Folienspeicher, which is discussed in Section 4.

3.2. Anti-Drop-Out Device for use in Magnetic Recordings (Herr Funk)

This ingenious device for mitigating the effect of drop-outs employs a one-line video-delay unit which is very similar in concept and design to one described by Research Department.⁹ An electronic change-over switch enables the video signal from the tape recorder to be fed to the output either directly or via the one-line delay. The switch normally provides a direct path through the device, but when a drop-out occurs, the amplitude of the frequency-modulated signal at the input to the limiter (in the replay circuit of the recorder) falls to a low value. This sudden fall in amplitude is used to generate a switching pulse that causes the output to be taken from the one-line delay. Thus, during a drop-out, the output signal from the device consists of a small portion of the preceding television line.

As demonstrated, the anti-drop-out device effected a valuable improvement when the direct output from the recorder was badly impaired by drop-outs.

3.3. Front Projection (Herr Kaufmann)

Work on the system of front projection using Scotchlite Sheet is continuing. Service use of this system has been delayed by patent difficulties.

* Herr Fix is the Head of Video Frequency Section at the I.R.T. and acts as Professor Theile's deputy.

The sheet being used is still 'Scotchlite Type 234 'C' (black)', which gives a remarkably high contrast range. An interesting development demonstrated was the use of material treated by the makers to reduce the reflexion coefficient slightly. This modified material is suitable for screens that simulate free-standing scenery inserted between the main background and the camera. If normal material were used, the scene projected on to these screens would appear brighter than the rest.

3.4. A Monochrome Camera Incorporating a Plumbicon (Herr Kaufmann)

This camera has been built by the I.R.T. using a Philips yoke assembly. It was demonstrated both on a studio scene and on a test card. When the camera was 'panned' across a scene including a lighted candle, the effects of inadequate target discharge by the beam were readily seen; the average camera-tube beam current was stated to be $0.2 \mu\text{A}$. Using the test card, the signal from a grating corresponding to 5 Mc/s was stated to have a peak-to-peak magnitude 40% of that obtained from a black-to-white transition. The signal/noise ratio was quoted, in weighted terms, as 52 dB peak signal to r.m.s. noise; it was stated that the CCIR noise-weighting curve was used. No figure of unweighted signal/noise ratio was available. In discussion, the I.R.T. engineers stated that, in their opinion, the movement portrayal of the Plumbicon tube is slightly inferior to that of the P.822 medium-spaced $4\frac{1}{2}$ in image orthicon (this is not the experience of Research Department).

3.5. Colour Episcopes (Herr Pilz)

This was a more highly developed device than the laboratory episcopes seen at Philips Research Laboratories, Eindhoven in 1961.¹⁰ It has been developed for scanning captions and similar material used in programme production but it also appeared to provide a very useful picture source for the laboratory. By using such a device it should be possible to produce colour signals that correspond, in terms of luminance and saturation, with those obtained from a colour camera; normal transparencies cannot give colour-difference signals of high amplitude.

The episcopes use an R.C.A. zinc-oxide flying-spot tube type 5 AUP 24, operated at 24 kV with a beam current of $120 \mu\text{A}$. The raster is projected on to the picture to be scanned by means of a 150 mm lens operating at $f/2$. There is no light-integrating box as in the Philips scanner, so that the danger of the white-point being moved towards the predominant colour in the picture is avoided. There are two groups, each of three photo-multipliers, with their associated filters placed so as to view the scanned area at angles of about 45° to the normal. Each set of photo-multipliers is contained in an open-ended, rectangular box that is painted white on the inside and arranged so that the open end points at the scanned area; light that fails to enter one of the boxes strikes a dark surface and is lost.

Zooming is performed by moving the lens and the cathode-ray tube, thus avoiding the need to vary the size of the raster on the tube. When the scanned area is varied, mechanical linkages cause the two boxes containing the photo-multipliers to move nearer to or further from the scanned area so as to keep the sensitivity unchanged. The maximum area scanned is 28×21 cm.

The outputs from the photo-multipliers are fed through conventional signal-processing circuits including gamma and aperture correctors. As demonstrated, the device appeared to produce very acceptable pictures. No signal/noise figures were quoted, but it was estimated that the lowest figure (for the red channel) was about 32 dB peak signal to r.m.s. noise.

3.6. Trick Converter (Herr Högel)

This consists of a standards converter that enables special effects to be obtained by distorting the geometry of the picture. It employs a small cathode-ray tube that was designed by the Fernseh G.m.b.H. for recording purposes; the phosphor is of the blue-emitting type with an afterglow of about 2 ms and is thought to be zinc sulphide. The camera tube used in the trick converter is a Plumbicon, the camera itself being of I.R.T. design. Arrangements are made to distort the geometry of the picture displayed on the screen of the cathode-ray tube by adding suitable additional scanning waveforms to those of the normal sawtooth form. Aperture loss and distortion of the grey scale in the converter are compensated by adjustable aperture and gamma pre-correction located in the signal path prior to the displayed cathode-ray tube; a further 'trimming' gamma corrector is located after the camera.

The demonstration showed that difficulties could arise in using this device when the field-synchronizing pulses of the input and output signals were co-incident. Under such circumstances, distortion of the picture geometry in the vertical axis which is not repeated field by field can result in a situation analogous to that occurring in an image-transfer standards converter operating between standards having different field frequencies. This problem is encountered when attempting to produce a form of picture-geometry distortion in which any vertical strip of the picture is moved up and down a few times per second. In discussion, it was agreed that in order to permit the trick converter to be exploited fully, it might well be necessary to arrange that the field-scanning processes of the cathode-ray tube and the camera tube are phase-shifted, one with respect to the other, by a substantial portion of the field interval, and to compensate for this by some suitable wide-band delay device.

3.7. Characteristics of Film and Magnetic Tape (Herr Gondesén)

An instrument has been developed which can be connected to the output of a video recorder in order to count the total number of significant drop-outs in a given recording time and to integrate the total interval that they occupy. It is proposed by I.R.T. that this equipment be used by broadcasting organizations in order to test new tape stock.

An experimental arrangement is being developed by which it is hoped that the characteristics of heads and tape used in video recording may be measured. The apparatus consists of suitable feed and take-up spools, a drive capstan, and two complete head units. Tape from the feed spool is taken past the two head units in succession; the first head is a recording head unit, the second is a replay head unit. Standard head units will be used for comparison purposes.

Work is proceeding to standardize a multiple-step grey scale for use in making films for television. The aim appears to be to adjust the brightnesses of the various steps so that equal voltage steps are obtained in the television waveform that results from scanning the film.

A demonstration was given of a device used for measuring the degree of graininess and the resolution of a film from the point of view of television requirements. The film is exposed to a multiple-step grey scale and to various high-contrast test bar patterns of different degrees of fineness. After processing, a projection

microscope is used to form an enlarged image of a small area of the film and this is scanned by a hole (corresponding in size to the scanning-spot of the film scanner) that moves in a circle. Light from the hole is passed to a photo-multiplier whose output current may be measured using both a galvanometer (the d.c. component) and a calibrated oscilloscope. Calibration is effected by means of a known black-to-white transition. Resolution is expressed as the ratio of the peak-to-peak excursion of the photo-current derived by scanning the reproduced test patterns to the change in photo-current obtained by scanning the black-to-white transition; the degree of graininess is expressed in terms of the r.m.s. fluctuation in photo-current when scanning a neutral-grey area of the film.

3.8. Optimum Viewing Conditions for Television Pictures (Dr. Grosskopf)

The condition with which Dr. Grosskopf has been mainly concerned is the ambient illumination. He had found that a neutral filter (density 0.6) placed in front of the cathode-ray tube was sufficient to eliminate the effect of ambient light on the objective contrast. Nevertheless, the subjective impression of contrast was still affected by the ambient light and by illumination of the tube surround. He claims that an increase in the ambient light can increase the subjective contrast, and recommends that the tube surround be illuminated to 5% of white brightness.

An interesting method has been used to measure the contrast law of a cathode-ray tube, as observed in the presence of ambient illumination and flare. A patch is inlaid into a normal picture and its brightness varied cyclically. A photo-multiplier viewing the patch enables the contrast law to be displayed on an oscilloscope.

4. FOLIENSPEICHER

4.1. General Description

The primary object of the visit to Munich was to see the Folienspeicher⁵ in order to form an opinion as to its suitability for certain experimental applications connected with television standards conversion. These are:

- i) A delay of one field. This would enable each field of the outgoing signal to be derived from two interlaced fields of the incoming signal,^{11,12} and would greatly improve the vertical resolution while reducing various spurious effects generated by vertical detail.
- ii) A method of field conversion suggested by Rout,¹³ which requires a magnetic drum or disc having two or more tracks, each track being associated with a 'read' head and a 'write' head; either head would be moved along the track in order to provide a continuously-varying delay.
- iii) Methods of field conversion suggested by Davies,¹⁴ and by Rainger,¹⁵ which require a delay approaching one field period, the total delay being subdivided into a number of separate fixed delays.

Herr Funk demonstrated the work proceeding at I.R.T., and, together with Herr Fix, accompanied the authors to the Munich works of Siemens and Halske A.G., in order to meet and discuss progress with Herr Bödenstein and Dr. Otto.

The essential component of the Folienspeicher is a disc, or foil, about 40 cm in diameter of flexible sheet similar to that from which magnetic recording tape is made, which rotates at 50 revs/sec with the coated side almost in contact with a fixed circular metal plate. Magnetic heads protrude through slots in this plate. The disc would, if flat, touch the heads but it is prevented from doing so by aerodynamic forces developed by a stream of air which is drawn, by the rotation of the disc, from a hole near to the centre of the fixed plate and blown out at the periphery. (In order to avoid contact with the heads while running up to full speed, a separate blower injects air between the foil disc and the metal plate during the 'run-up' period.) The use of air as a lubricant is a device common to both the Folienspeicher and to the Philips Wheel Store;¹⁰ it enables a very small gap to be maintained between the head and the magnetic track thus avoiding head and track wear.

One form of Folienspeicher - perhaps the most important form economically - is to be produced as a store for computers. This device has 100 fixed heads/^{each} operating on a single track. As in other digital stores, the same head is used for both reading and for writing, the act of writing also performing erasure. The capacity and performance should be similar to that of a conventional drum store, but the cost should be less.

The television application is understood to have originated in connection with medical radiography; this was also the application envisaged for the Philips Wheel Store. It was intended that a single short exposure would enable a still picture to be viewed by a radiologist or surgeon for as long as required, and then be replaced by another. Siemens and Halske are co-operating with the I.R.T. with a view to using the Folienspeicher in broadcast television service in order to enable still pictures to be recorded from a normal television signal and displayed soon afterwards (e.g., a still picture of a knock-out could be shown immediately after the fight). The device would also act as a substitute for a slide scanner as a source of pre-recorded still pictures.

Two heads are arranged on radii at about 120° apart with facilities for moving each head rapidly, and independently, to any one of ten tracks by pressing buttons. In this way, each of five complete pictures may be recorded on two tracks, one track for each of the two interlaced fields. Each head is used, in turn, for reading, erasing and writing.

Pictures recorded previously were shown. These exhibited fluctuation noise and 'frozen' noise that resembles cathode-ray tube phosphor grain. Frozen noise is particularly disturbing when it is superimposed on a moving picture; it is much less disturbing when the picture is also frozen.

According to the Siemens and Halske design, the disc is rotated by a synchronous motor operated from the supply mains. In this form the phase stability would be quite unsuitable for broadcast television and the I.R.T. are, therefore, engaged in developing a servo system to improve it. This work was described in one of the papers read at the F.T.G. and it was demonstrated by Herr Funk at the I.R.T. 125* kc/s tone is recorded on a control track and the replayed control signal is compared in phase with a further 125 kc/s signal derived from the local synchronizing

* The eighth harmonic of line frequency for the 625-line, 50 field-per-second system.

waveform. The supply to the synchronous motor is controlled in accordance with the phase error. An interesting feature of this system is that it was found more advantageous to control the amplitude of the supply to the synchronous motor, thereby controlling the angle of lag, than to control the phase of the supply. There is little doubt that the I.R.T. servo-control will prove successful; Siemens and Halske then intend to incorporate it.

4.2. Application to Standards Conversion

In order to use the Folienspeicher as a delay unit, it would be necessary to provide, for one track, three heads performing reading, erasure and writing respectively; erasure by the act of writing, though customary in digital stores, does not appear practicable for television. Unfortunately, the disc is deformed as it passes over each head and a damped wave is set up which resembles the stationary waves in a stream passing over a large stone. These waves can be seen to extend some 15 cm 'down-stream' of the head and Siemens thought that it would be not practicable to place a read or write head closer than about 15 cm from the nearest head on the 'up-stream' side. The erase head need not bear so heavily on the disc and it would therefore be possible for this to be spaced at a shorter distance from the reading head. Nevertheless, it does not appear possible to use, for delay, an effective track length of more than about 80 cm out of the total track circumference of 100 cm. This means either that a slower speed of revolution would have to be used to give a 20 ms delay (this would reduce the signal-to-noise ratio) or that a delay of about 16 ms should be accepted. In fact, either the proposal of Davies¹⁴ or that of Rainger¹⁵ for field conversion would use about 16 ms, tapped to form 4 or 5 sections by means of multiple reading heads; the 'Davies' proposal would also incorporate shorter delays using fused silica. The Folienspeicher does not appear suitable for Rout's proposal¹³ employing moving heads. It is thought quite likely that further experiments on the shape of the heads might enable these to be spaced more closely together without ill effect.

The signal-to-noise ratio is not quite good enough for the standards conversion application, although in this application there would be no frozen noise. It appears quite possible that sufficient improvement might be made as a result of further experimental work.

The timing problem posed when the Folienspeicher is used as a delay differs from that encountered when it is used as a store. In the former case, the phase error, and therefore the timing error, is directly proportional to speed error, whereas in the latter case, it is proportional to the time integral of speed error. It is not thought that any difficulty would be experienced in controlling the timing.

One advantage of the Folienspeicher for experimental purposes is the ease with which the arrangement of heads can be altered. The heads are all mounted on the circular metal plate through which they protrude. This plate, which may be removed easily by means of four screws, need not be very flat (the levels of two points must not differ by more than 1% of the difference between them). It would therefore be very easy to try out different experimental arrangements by making new plates with heads attached.

5. CONCLUSIONS

The F.T.G.

Although many interesting papers were presented at the F.T.G., no really significant contribution to the art or very important instrumental development was reported. The German engineers appear to be consolidating their progress in the monochrome field and investigating some of the problems that colour will pose. There was no indication of a general preference for the PAL colour system.

The I.R.T. (Munich)

More frequent contacts between the BBC Research Department and the I.R.T. would be of great value. Professor Theile has expressed this view.

The programme of work at I.R.T. includes several items of considerable interest. For example, the colour episcope and the instrument for measuring the characteristics of film could prove very useful. We have asked for drawings of the former device.

The Folienspeicher

Sufficient work has been carried out on this device, by both Siemens and Halske A.G. and the I.R.T. (Munich), to show that it could prove to be useful for television broadcasting. Its present performance is sufficiently good to encourage the view that a Folienspeicher equipment should be purchased which would permit its application in standards conversion to be studied. A preliminary enquiry has been made and a reply from Siemens and Halske A.G. is awaited.

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