No. 115-A

E.B.U. REVIEW

JUNE 1969

EUROPEAN BROADCASTING UNION

E.B.U. REVIEW

115 - A
TECHNICAL
JUNE 1969

E.B.U.

REVIEW

published by the
EUROPEAN BROADCASTING UNION

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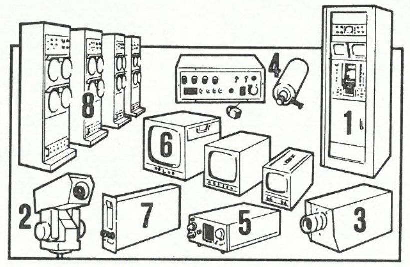
HERE IS THE NEW ACEC EQUIPMENT FOR THE TV STUDIO



You are already acquainted with the ACEC 6970 Sub-titling Unit (1) It enables you to show viewers a film of the event, and a translation of the speech and commentaries, not only simultaneously but immediately.

ACEC can now offer you a wider range of studio equipment, such as

Pan and tilt head (2)
The parameters of the shot are stored (pan, tilt, iris, focus, zoom) and each scene is then automatically filmed by selecting the required code.

Single unit and dual unit cameras (3) (4)
Field mesh vidicon, 625 lines, 7Mc/s, interlaced or not : dual unit version can be supplied with integrated circuit sync generator.

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supplies the audio and video signals for French and Belgian TV Transmissions, to C.C.I.R. standard.

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for studio monitoring ; 53,26 and 20 cm

Video switching unit (7)
for 7 inputs and 1 output

High capacity tape recorders (8)
for programme monitoring ; 6 to 24 tracks ; self-contained operation for 24 to 48 hours.

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Ground Planes, Colinears,
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Television Arrays to 100kW e.r.p
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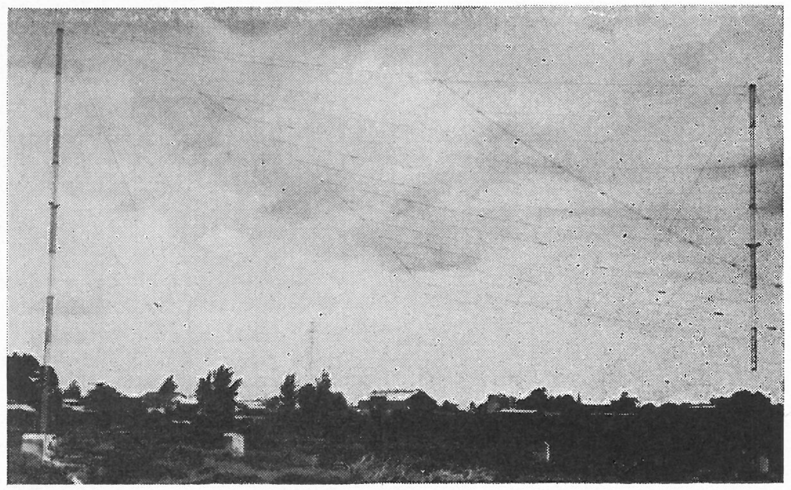

C&S Antennas Ltd

Wentworth House, Eastern Avenue, Ilford, Essex, England.
Telephone: 01-554-0102 Telex: 25850 Cables: Antennas Ilford (England)

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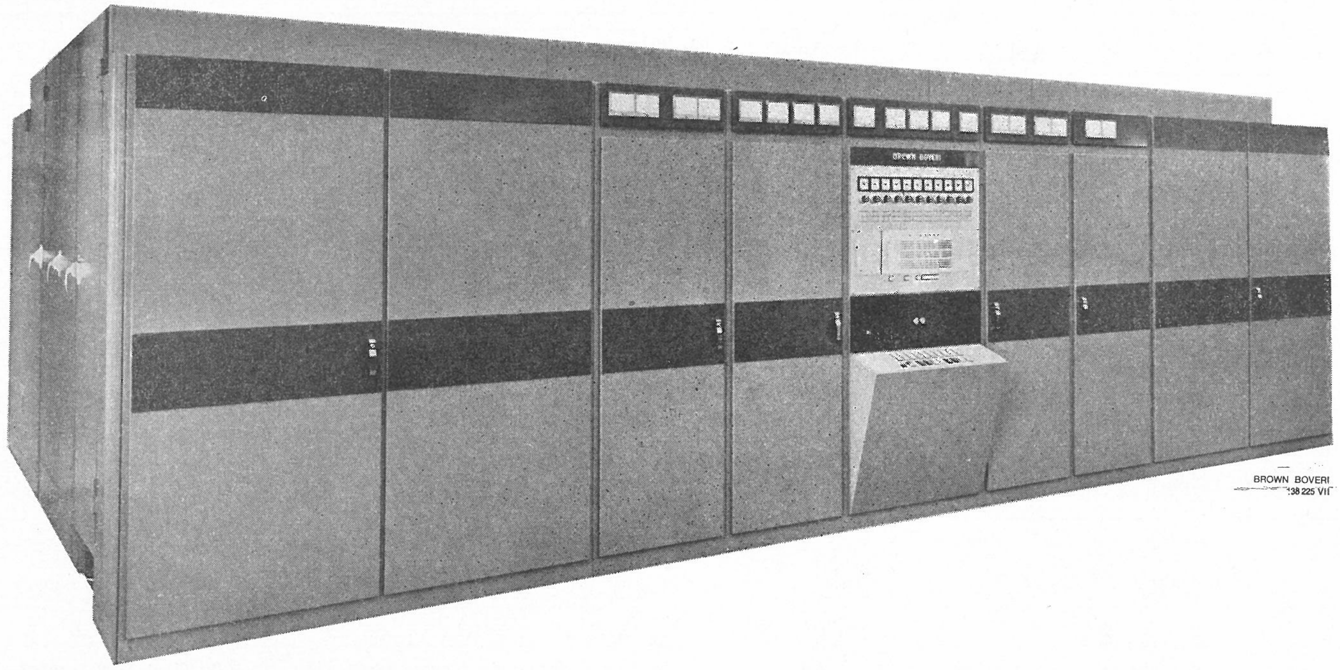

Front view of a 500 kW short-wave transmitter

Brown Boveri super-power broadcast transmitters

Short-wave 500 kW 3.95 - 26.1 Mc/s
Medium-wave 1000 kW 525 - 1605 kc/s

Rated carrier power over the full frequency range
All transmitters continuously tunable
Suitable for sinewave and trapezoidal modulation
Documentation available on request

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Manufacturing facilities and representatives all over the world

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you will find longevity, sensitivity, resolution

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If you would like to evaluate these tubes, please telephone or write for further details.

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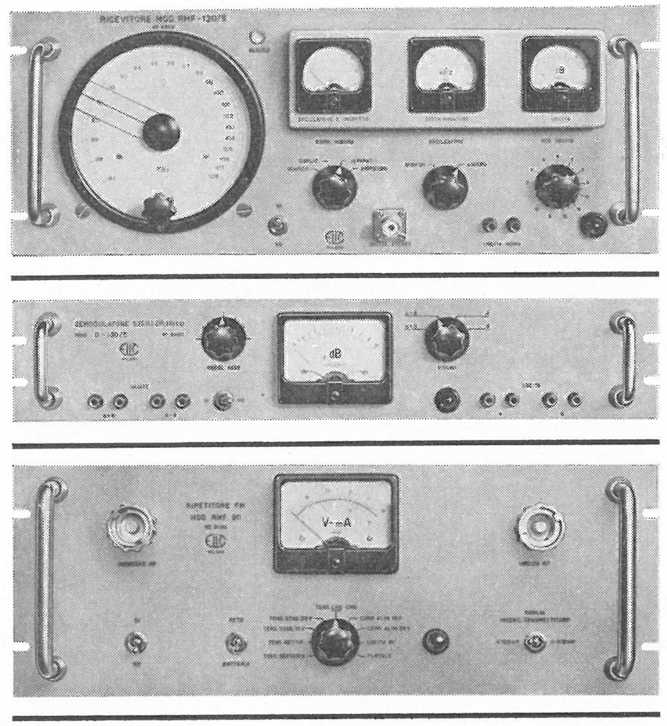
FM broadcasting



20 years experience

Relay receivers:
— Model RMF-130/M monofonic
— Model RMF-130/S stereofonic

Stereo Decoder Model D-130/S

Mono and stereo transposers:
— Model RMF-90 5 W output
— Model RMF-91 10 W output

All sets are fully transistorized complying with the most severe specifications, very high reliability

ELIT

ELIT-Elettronica Italiana
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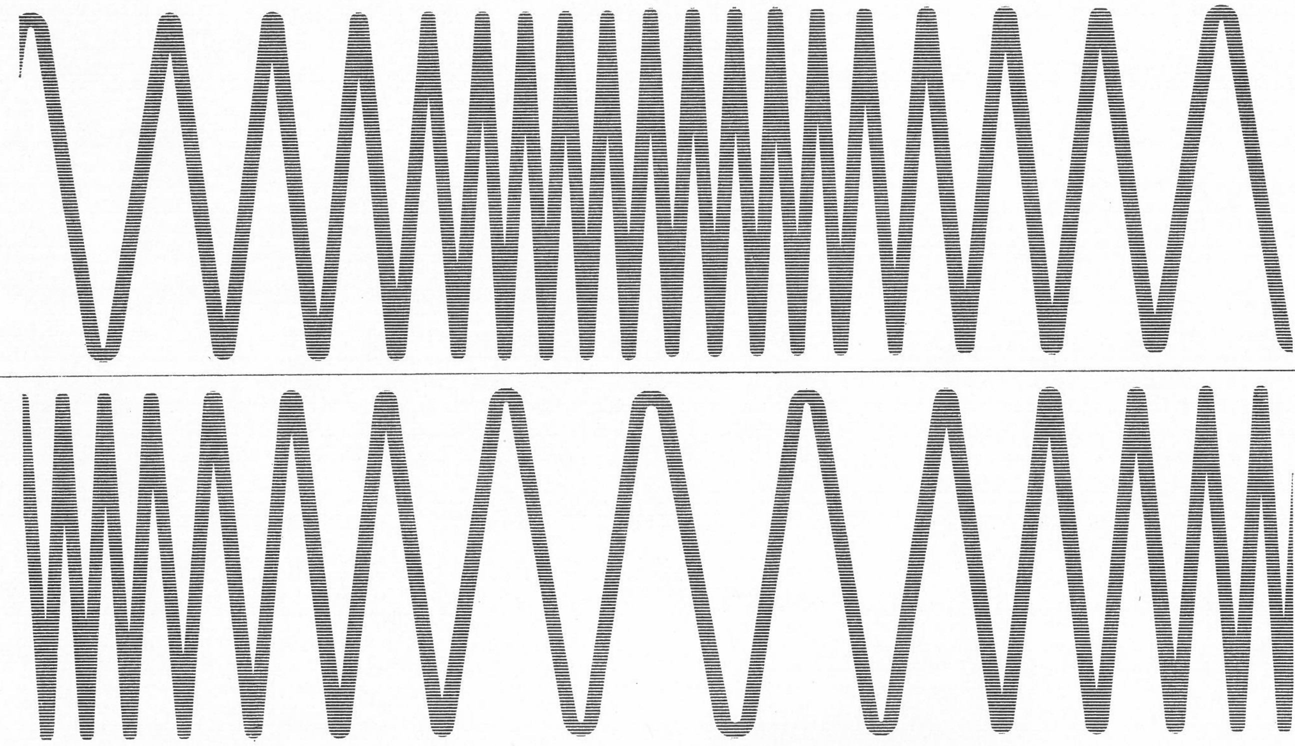

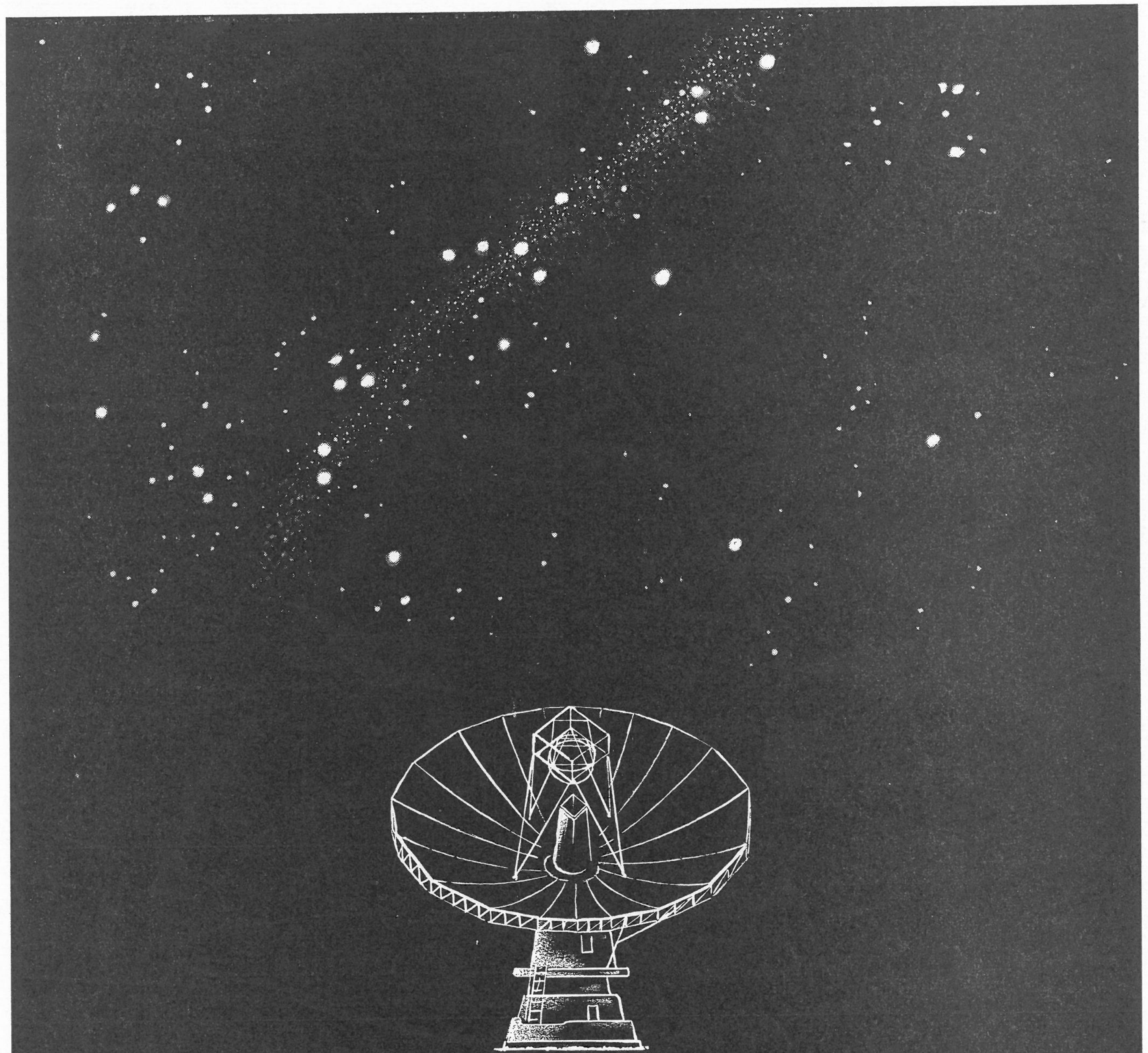

Like a radar installed in the heart of Europe, Agfa-Gevaert can detect, day after day, the changing needs of the market.
Applying well-proven market research techniques, Agfa-Gevaert is able to take these requirements into account when planning research and to solve the ensuing problems by the most modern scientific methods. Agfa-Gevaert manufactures a complete range of motion picture films which are subjected to stringent quality controls at every stage of manufacture.
In addition, Agfa-Gevaert after-sales service is outstandingly good - whatever your problems, our technicians are always ready to listen and to help you to solve them.

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AGFA-GEVAERT

DISA

STUDIO MONITORS
Advanced electronic engineering and sophisticated styling – Designed for application...

MONOCHROME MONITORS

High-quality Studio Monitors in five sizes from 8½ in. to 27 in. Available in either rack-model or cabinet style depending on size.

COLOR MONITORS

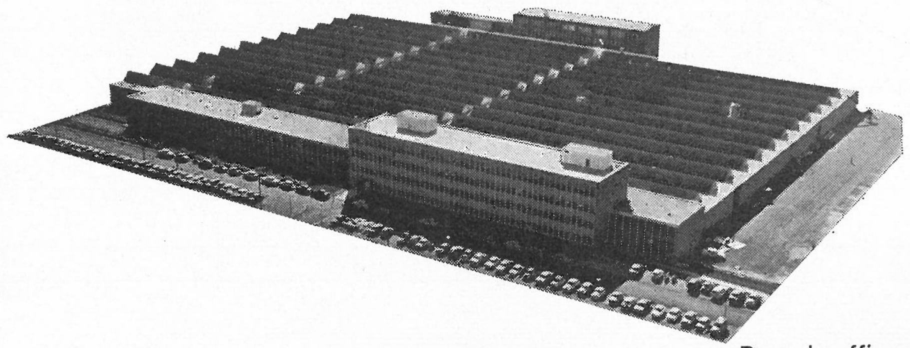
High-quality Studio Monitors in three sizes: 15 in., 19 in., and 25 in. Available with or without integrated decoder. All sizes available in both rack-model and cabinet style.

DESIGN

The fully transistorized circuits are mounted on modular circuit boards. This facilitates service to an unprecedented degree, permitting full circuit interchangeability in all DISA Monochrome and Color Monitors.

EXPERIENCE

DISA has supplied Studio Monitors to all Scandinavian broadcasting services for more than a decade. This is why DISA possesses a maximum of experience in this field.



DISA

DISA, Dansk Industri Syndikat A/S
Herlev, Denmark.
Phone: Copenhagen (01) 94 52 11
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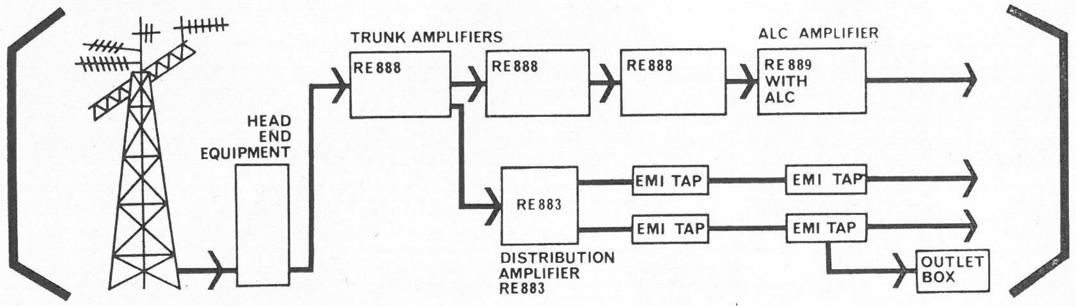
The 'Colorline' solid state C.A.T.V. system



EMI Colorline C.A.T.V. is based on a range of purpose-built solid state amplifiers designed for performance and reliability. The units in this advanced VHF co-axial C.A.T.V. system include: Distribution Amplifiers, Trunk Amplifiers, and a complementary range of passive devices. Each unit is housed in an aluminium alloy case coated with a heavy texture PVC finish. It is corrosion proof and weather-proof.

EMI Colorline Amplifier features are:

- Omission of sub-unit plug/socket interconnections results in basically simple construction and extreme reliability.
- Amplifier/Power unit assembly quickly removed from housing without disturbing cable terminations.
- Individual amplifier power stabilisation. Each amplifier incorporates a rectifier/stabiliser circuit fed by an isolating input transformer, full line powering facilities are incorporated.
- Frequency range 40 MHz to 245 MHz. Suitable for both "octave band" and "mid band" 20 channel concepts.
- Alternative mounting facilities. Units can be supplied for either wall or catenary (messenger) wire mounting.
- Universal cable entries. Amplifiers will accommodate fittings suitable for all cables up to 0.75 inch diameter.
- Input and output monitoring points accessible without opening housing.

EMI Colorline C.A.T.V. covers immediate and future requirements for trunk cascade up to 20 kilometres. Once installed, the basic network will accommodate without modification, additional programmes including all forms of colour transmission. **EMI** have wide experience in this field. This experience is at your service.

All - silicon solid state circuits

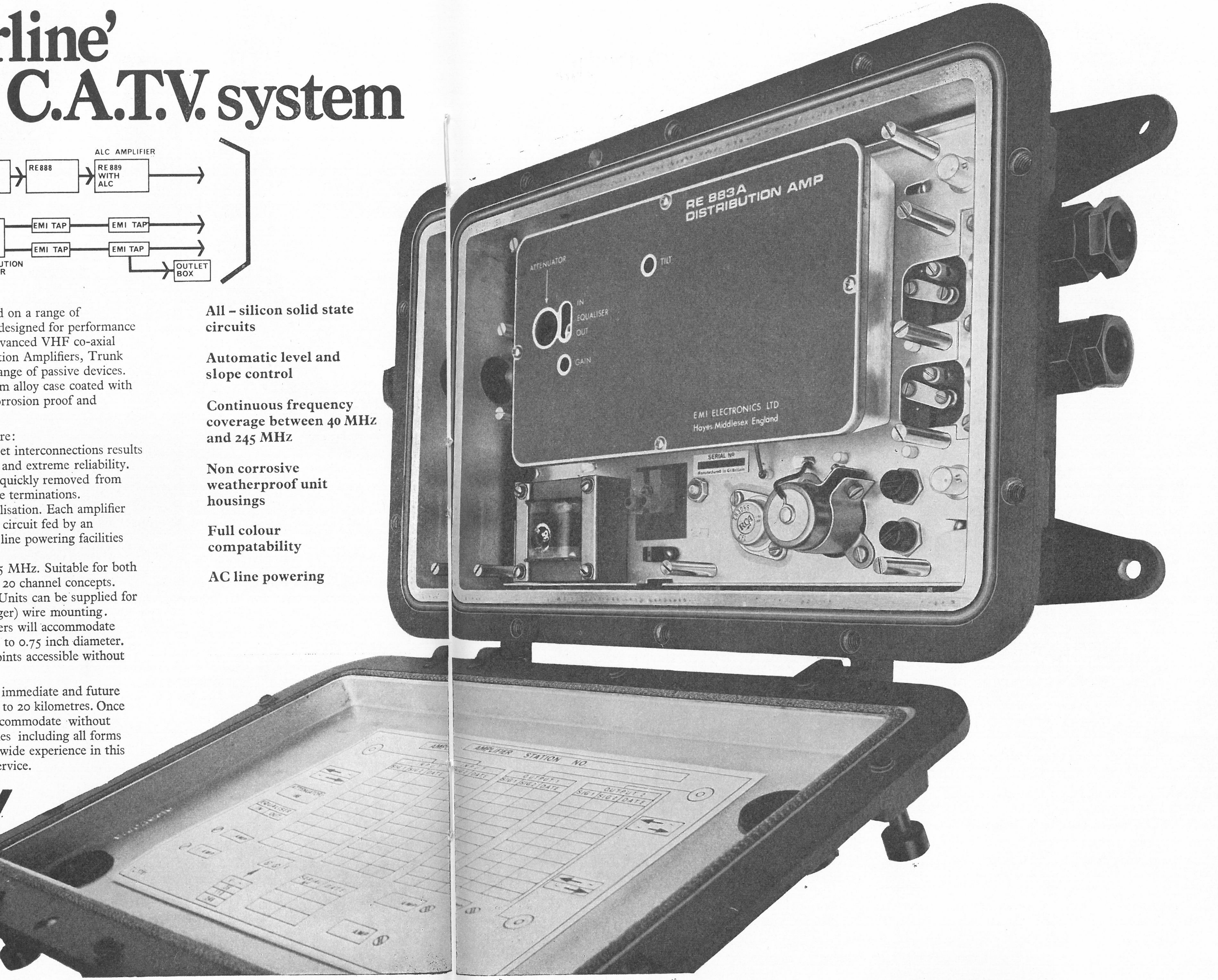
Automatic level and slope control

Continuous frequency coverage between 40 MHz and 245 MHz

Non corrosive weatherproof unit housings

Full colour compatability

AC line powering



EMI TELEVISION

EMI

Send for full details:
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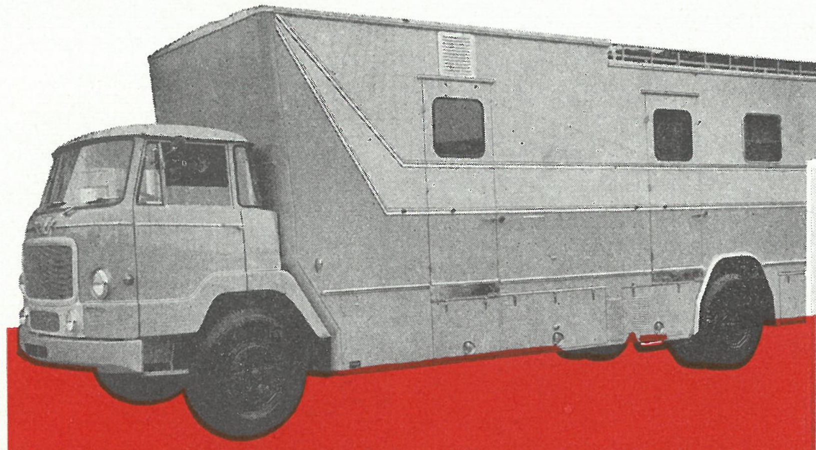
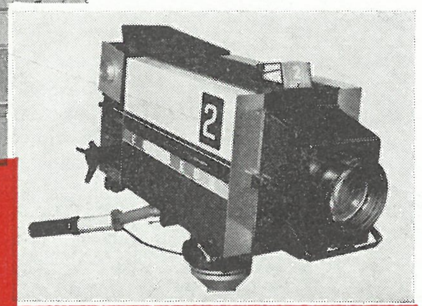
Hayes, Middlesex, England.
Telephone: 01-573 3888. Extn. 2102.
Telex: 22417. Cables: Emidata London.



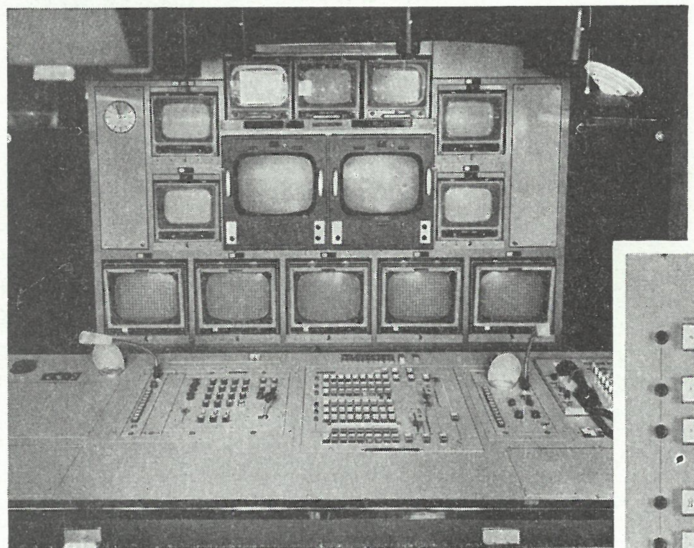


This colour television OB van, designed and built by THOMSON-CSF, carries five THOMSON colour camera TH-T. 2001 and a THOMSON 8-channel vision mixer. It was recently used with success by the American Broadcasting Company at the Xth WINTER OLYMPIC GAMES (GRENOBLE).

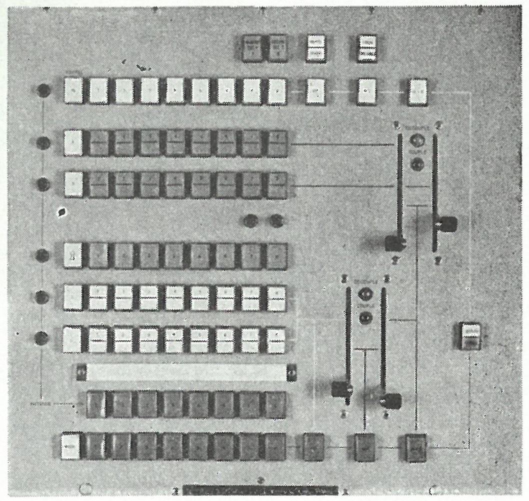
NEW GENERATION OF

VISION MIXERS:

TH.T. 1700 and TH.T. 2700



- monochrome and colour
- SECAM, PAL or NTSC
- 8, 14 or 22 inputs



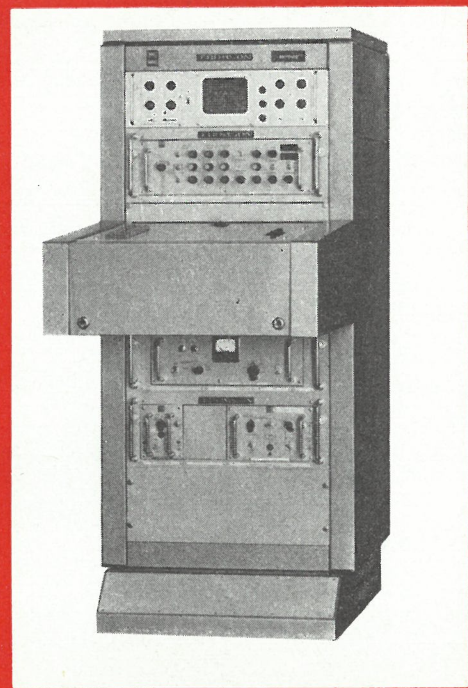
- Facilities for mixing, inlaying and overlaying
  either 2 monochrome pictures,
  1 monochrome and 1 colour picture
  or 2 colour pictures
- These units provide for
  — wipes or cuts between all synchronous sources
  — switching at will between the 2 signals obtained from 2 non-synchronous sources
  — using a TH.T. 707 Special-effect Generator, wipes, inlay and overlay
- Provides the Producer with a "Control Desk", the essential control unit of the mixer. The faders and push-buttons, ingeniously arranged and provided with clear " transmission " and " pre-view " indication, render it a tool having the maximum of possibilities for rapid and simple operations.

- *THOMSON-CSF mixers completely fulfil every requirement, from a simple training studio to the largest television studio centres producing large-scale artistic programmes.*

CATALOGUES ON DEMAND

THOMSON-CSF

DIVISION RADIODIFFUSION - TELEVISION — SERVICES COMMERCIAUX — 1, RUE D'ANJOU — 92 — ASNIERES — FRANCE
TEL. : 733-21-40 TELEX : 62 573 THOMDRT ASNIE



FLYING-SPOT COLOUR STILL-SCANNER
model TH.T 2100
- fully solid-state
- remotely-controlled drum for twenty slides
- incorporated sync. generator and encoder (SECAM, PAL, NTSC) optional

FLYING-SPOT COLOUR FILM-SCANNERS
— model TH.T 2300 (35 mm)
— model TH.T 2301 (16 mm)
- fully solid-state
- unit construction
- incorporated sync. generator and encoder (SECAM, PAL, NTSC) optional

COLOUR-TELEVISION

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Now in operational use by the O.R.T.F. in FRANCE. This equipment is also in use in BELGIUM, CANADA, HUNGARY, LEBANON, RUMANIA, SWEDEN, SWITZERLAND, UNITED KINGDOM, U.S.A. and U.S.S.R., etc.

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DIVISION RADIODIFFUSION - TELEVISION — SERVICES COMMERCIAUX — 1, RUE D'ANJOU — 92 — ASNIERES — FRANCE
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a computer-controlled, computer-monitored 250-kw transmitter

that changes frequency in 12 seconds or less

A computer in Collins' 821A-2 High Power Transmitter System automatically controls and monitors transmitter operation and performs diagnostic routines. Performance and status printouts are provided on teletypewriter machines and/or cathode ray tube displays.

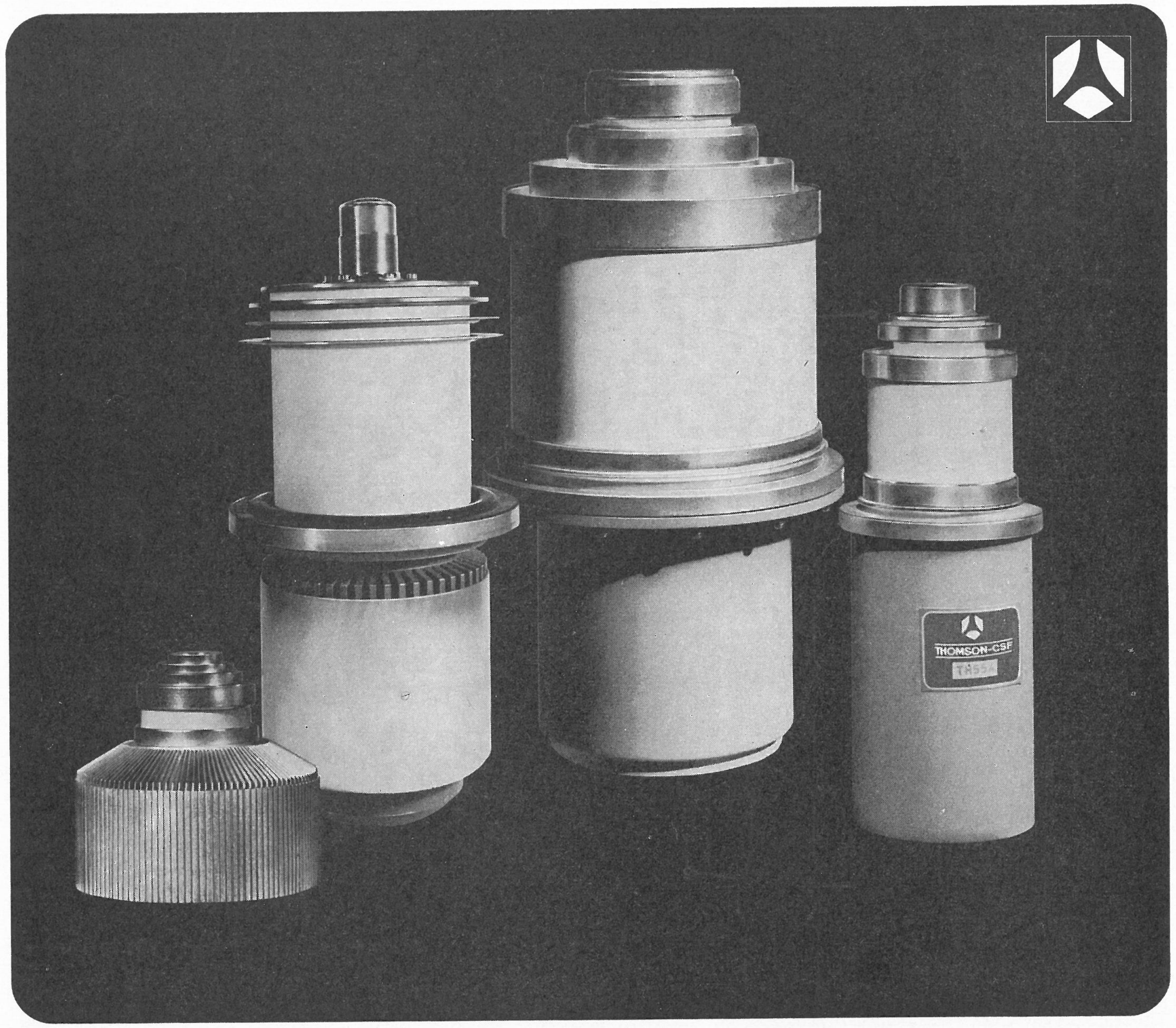
The 821A-2 changes frequency from 3.95 to 26.5 MHz in a maximum of 12 seconds. Typical frequency changes require less time.

A specially developed filter ensures harmonic and spurious rejection of 80 db – well within CCIR recommendations.

The 821A-2 is designed for a wide range of installation arrangements. A weather-proof high voltage enclosure requires no indoor floor area; therefore, transmitter building costs are reduced. Indoor units (AF and RF modules) are pre-wired, tested and shipped as subassemblies. Total indoor floor space is 67 square meters.

COMMUNICATION / COMPUTATION / CONTROL

COLLINS



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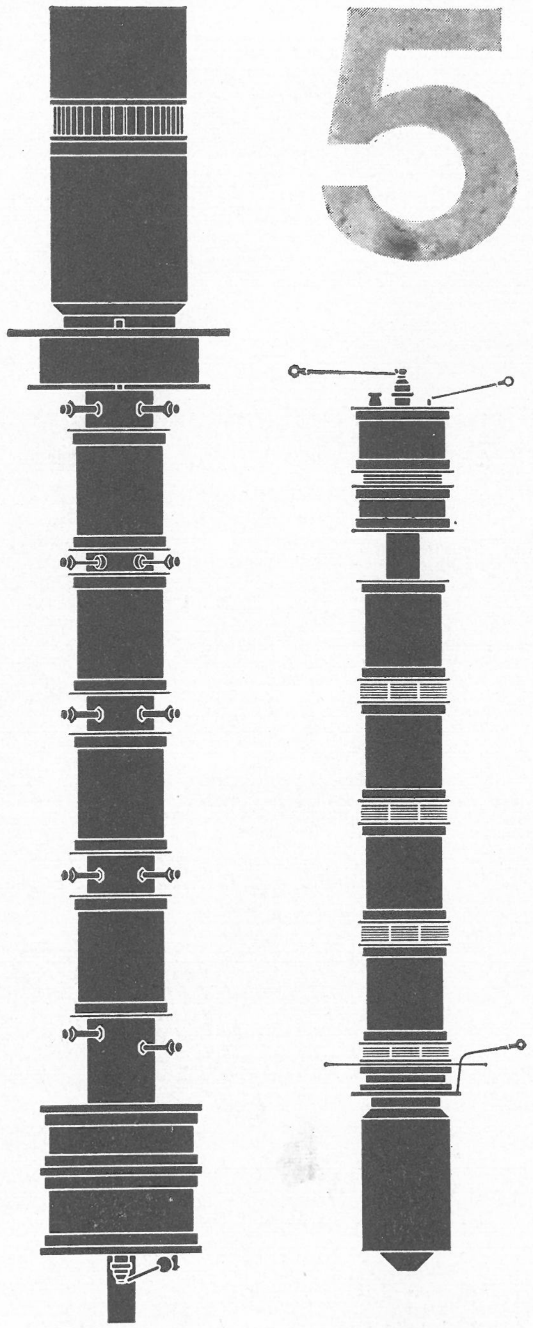
SPI 905



EEV klystrons – a wide and flexible range for UHF TV

5 7 10 25 40 kW

EEV make amplifier klystrons for UHF TV at power levels 5, 7, 10, 25 and 40kW into the aerial. Their reliability is established, their operating efficiency is good and their design provides a high degree of operational flexibility. A 40kW tube can, for example, be operated at the same efficiency at any power level between 20kW and 40kW. When operated at 40kW the tube needs only 135kW d.c. input.

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Chelmsford Essex England Telephone: 61777
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Send for full details of the complete range of EEV amplifier klystrons.

Please send me full details of your range of UHF TV amplifier klystrons.
I am interested in a klystron with the following parameters:

Frequency Range   Bandwidth   Power Level

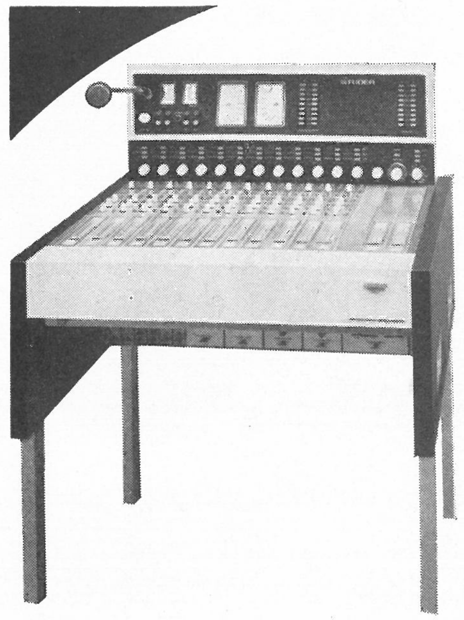
NAME   POSITION

COMPANY

ADDRESS

TELEPHONE NUMBER   EXTENSION   E.B.U. 2

AP 354

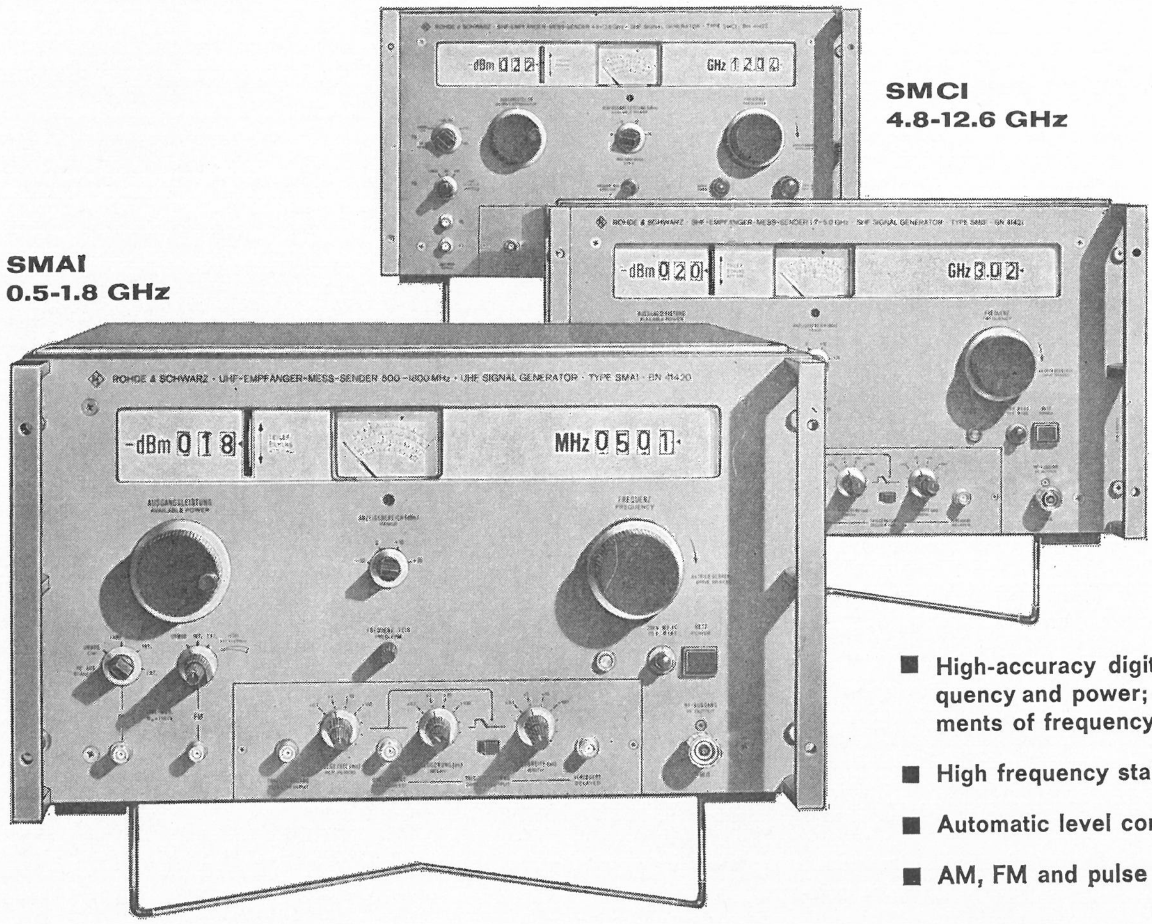


STUDER 089

The 089 is a studio control desk of the most modern conception – as cheap as a mass-produced desk but with all the convenience and above all the quality, of the highest grade studio consoles.
New construction techniques, combined with timeless lines, provide an ease of operation and control hitherto seldom found in mixing consoles.
The comprehensive, well-designed equipment of the desk and the universal switching possibilities give the 089 a technical flexibility warranting its installation in every type of modern studio.

ELEKTROMESSTECHNIK WILHELM **FRANZ** KG
763 Lahr/Schwarzwald·GERMANY

New Microwave Generators 0.5-12.6 GHz



- High-accuracy digital indication of frequency and power; ultra-precise adjustments of frequency increments
- High frequency stability
- Automatic level control (optional)
- AM, FM and pulse modulation

Microwave Generators SMAI, SMBI, SMCI

This family of three higly stable signal generators is ideally suited for accurate measurements on receivers and radar systems in the 0.5-to-12.6 GHz range. Until now five or more generators were required for the same frequency coverage. A plug-in modulation unit (optional) provides versatile modulation characteristics. The Automatic Level Control (ALC) permits amplitude modulation up to 70 %. In pulse modulation, the carrier signal is 100 % suppressed. Frequency response characteristics can be automatically plotted by connecting the recorder drive to the frequency linear shaft of the generator. A second RF output can be used for synchronizing or monitoring of the frequency.

Générateurs micro-ondes SMAI, SMBI, SMCI

Ces trois générateurs de mesure très stables se prêtent idéalement aux mesures précises à effectuer sur les récepteurs et les radars dans la gamme de 0,5 ... 12,6 GHz, gamme qui jusqu'ici ne pouvait être couverte qu' à l'aide de cinq appareils au moins. Un tiroir de modulation séparé offre de multiples possibilités de modulation. La régulation électronique du niveau de sortie permet une modulation d'amplitude jusqu' à 70 %. Dans le cas de la modulation par impulsions la porteuse est supprimée 100 %. Un enregistreur peut être raccordé sur un axe à rotation linéaire, fonction de la fréquence, pour écrire des courbes de réponse en fréquence. Une sortie HF supplémentaire sert à la synchronisation et à la surveillance de la fréquence.

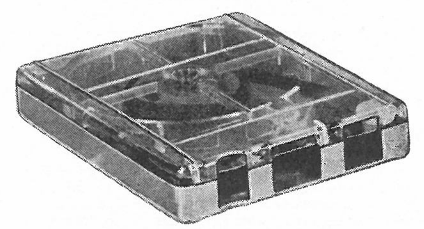
Mikrowellenmeßsender SMAI, SMBI, SMCI

Diese drei hochkonstanten Meßsender eignen sich hervorragend für genaue Messungen an Empfängern und Radarsystemen im Bereich 0,5 ... 12,6 GHz. Bisher waren mindestens fünf Meßsender nötig, um diesen Frequenzbereich zu erfassen. Ein zusätzlicher Modulationseinschub bietet vielseitige Modulationsmöglichkeiten. Bei elektronischer Regelung der Ausgangsleistung ist Amplitudenmodulation bis zu 70 % möglich. Bei Impulsmodulation wird der Träger vollständig unterdrückt. Zur automatischen Registrierung von Frequenzgangkurven kann ein Schreiber an eine herausgeführte frequenzlineare Achse angeschlossen werden. Ein eigener HF-Ausgang gestattet Synchronisierung und Überwachung der Frequenz.

ROHDE & SCHWARZ

For further information write to Rohde & Schwarz (West Germany), 8000 München 80, Mühldorfstr. 15, Telex 05-23 703, or contact your nearest R & S distributor.

You only get out of a thing



what you put into it.

Our new Criterion series tape cartridge system is the certain, for-sure way to get the best sound into your cartridges, then get it out of them at air time. Here's why:

▪ Improved tape drive – exclusive 450-rpm 4-pound Hysteresis synchronous positive-speed motor. ▪ Speed accuracy of 0.2% – direct Capstan drive comparable to finest reel-to-reel machines. ▪ No tape skewing – exclusive triple tape guide assembly with precision-machined cast aluminum head mounting. ▪ Positive alignment of tape cartridges and other components – heavy duty machined cast aluminum base. ▪ Low signal to noise ratios – space-age alloy motor shielding. ▪ Superb fidelity – solid-state plug-in electronics and fully regulated power supply.

We'll be happy to send you all the technical details on this newest and finest tape cartridge system. Just jot down your name, station and address on this ad and mail it to us.

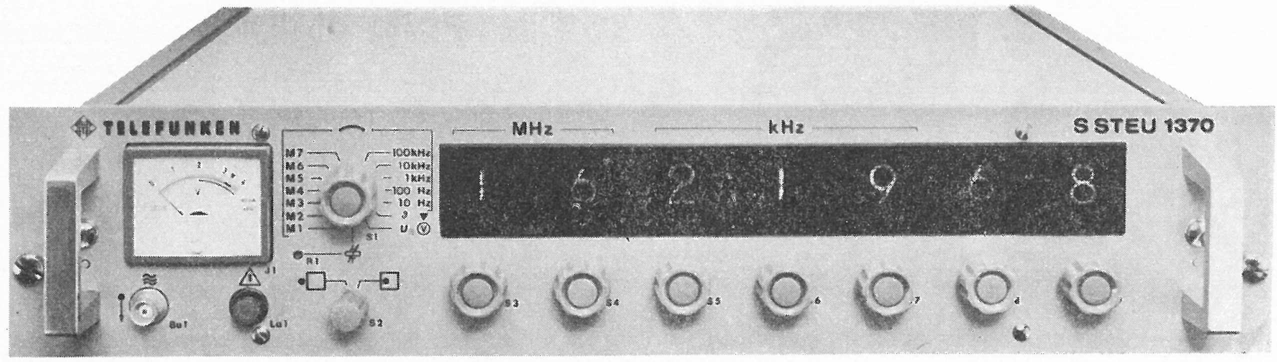
Basic Criterion series solid-state playback unit and recording amplifier. Available in slide-out rack panel mounting or trimline desk console. Mono or stereo. 1-, 2-, or 3-tone.

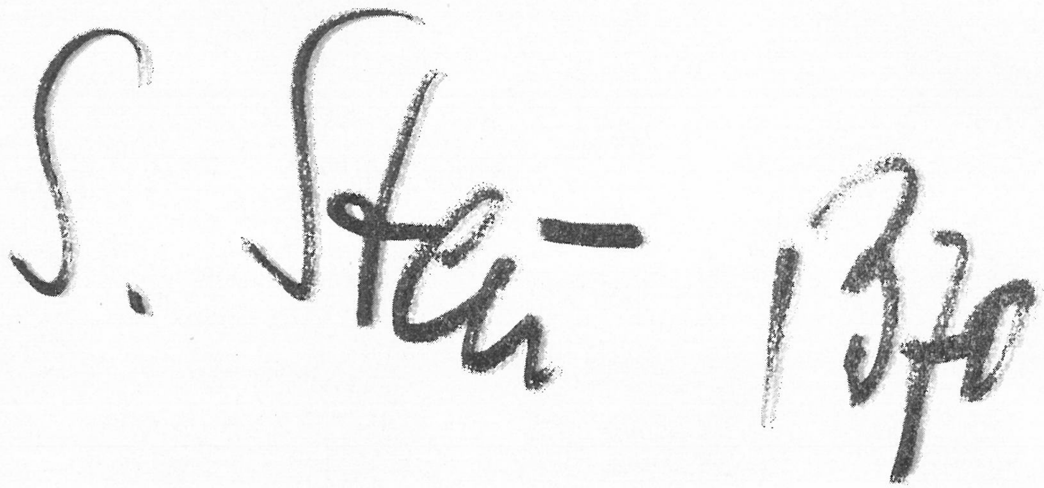
AUTOMATIC TAPE CONTROL DIVISION
1107 East Croxton Avenue
Bloomington, Illinois 61702, U.S.A.

GATES

HARRIS INTERTYPE CORPORATION

Gates Radio Company,
Quincy, Illinois





N1 993.793

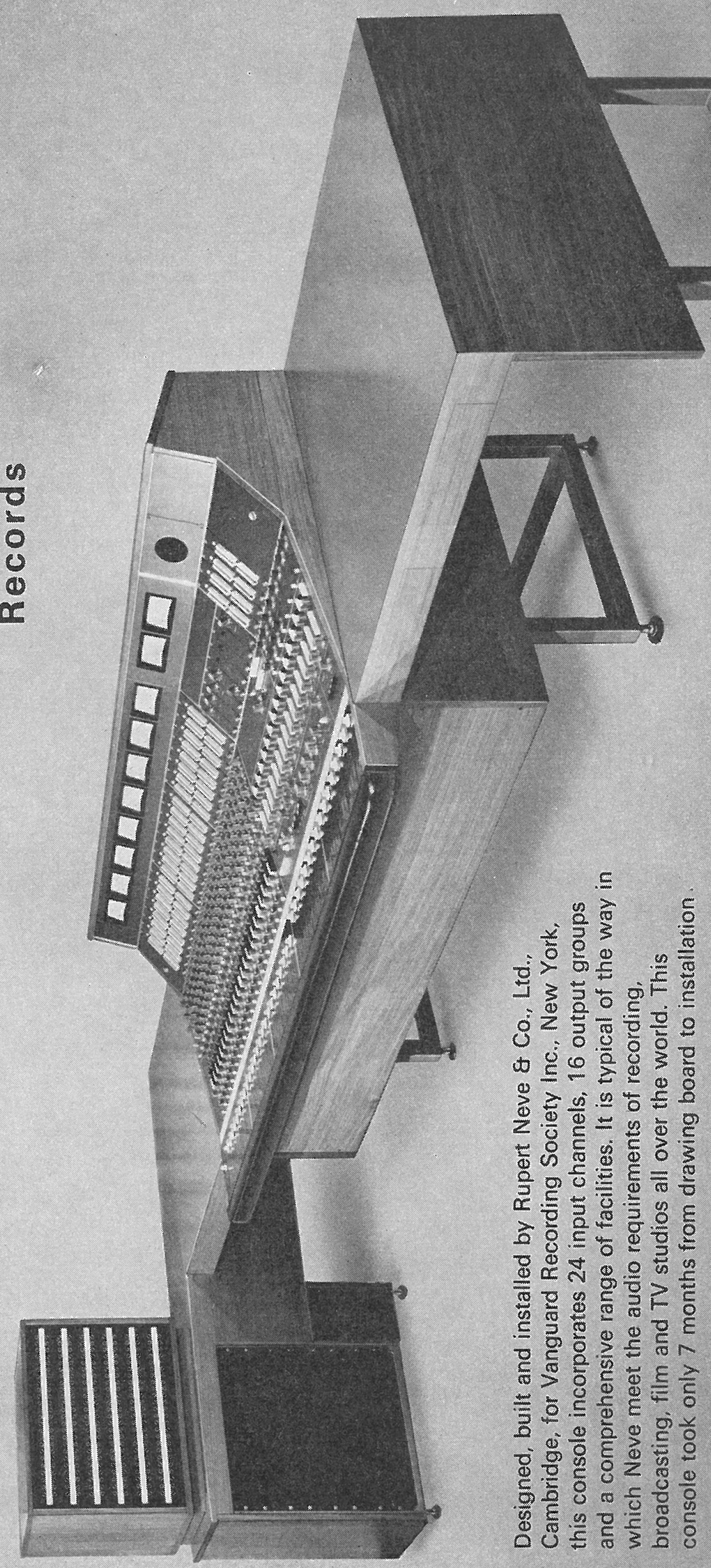
An unfailing star

Frequency Synthesizer Drive Unit S Steu 1370 for HF, MF, LF and VLF transmitters.
Also used as highly stable signal generator.
Frequency range: 14 kHz to 31.99999 MHz.
Rapid frequency changing by decade switches in increments from 10^7 to 10^1 with manual or remote control.
Frequency display by numeral indicator tubes.
High frequency stability and spurious radiation attenuation.

Automatic fault monitoring.
Incorporated carrier blocking.
Printed circuitry with silicon transistors.
Small, light, reliable.

AEG-TELEFUNKEN
Fachbereich Anlagen Hochfrequenz
79 Ulm, Elisabethenstraße 3

Neve designed and built it for Vanguard Records



Designed, built and installed by Rupert Neve & Co., Ltd., Cambridge, for Vanguard Recording Society Inc., New York, this console incorporates 24 input channels, 16 output groups and a comprehensive range of facilities. It is typical of the way in which Neve meet the audio requirements of recording, broadcasting, film and TV studios all over the world. This console took only 7 months from drawing board to installation.

Rupert Neve & Co. Limited, 'Priesthaus' Little Shelford, Cambridge, England.
Telephone Shelford 3537

RCA

Take a long look at this one and you can forget about the others

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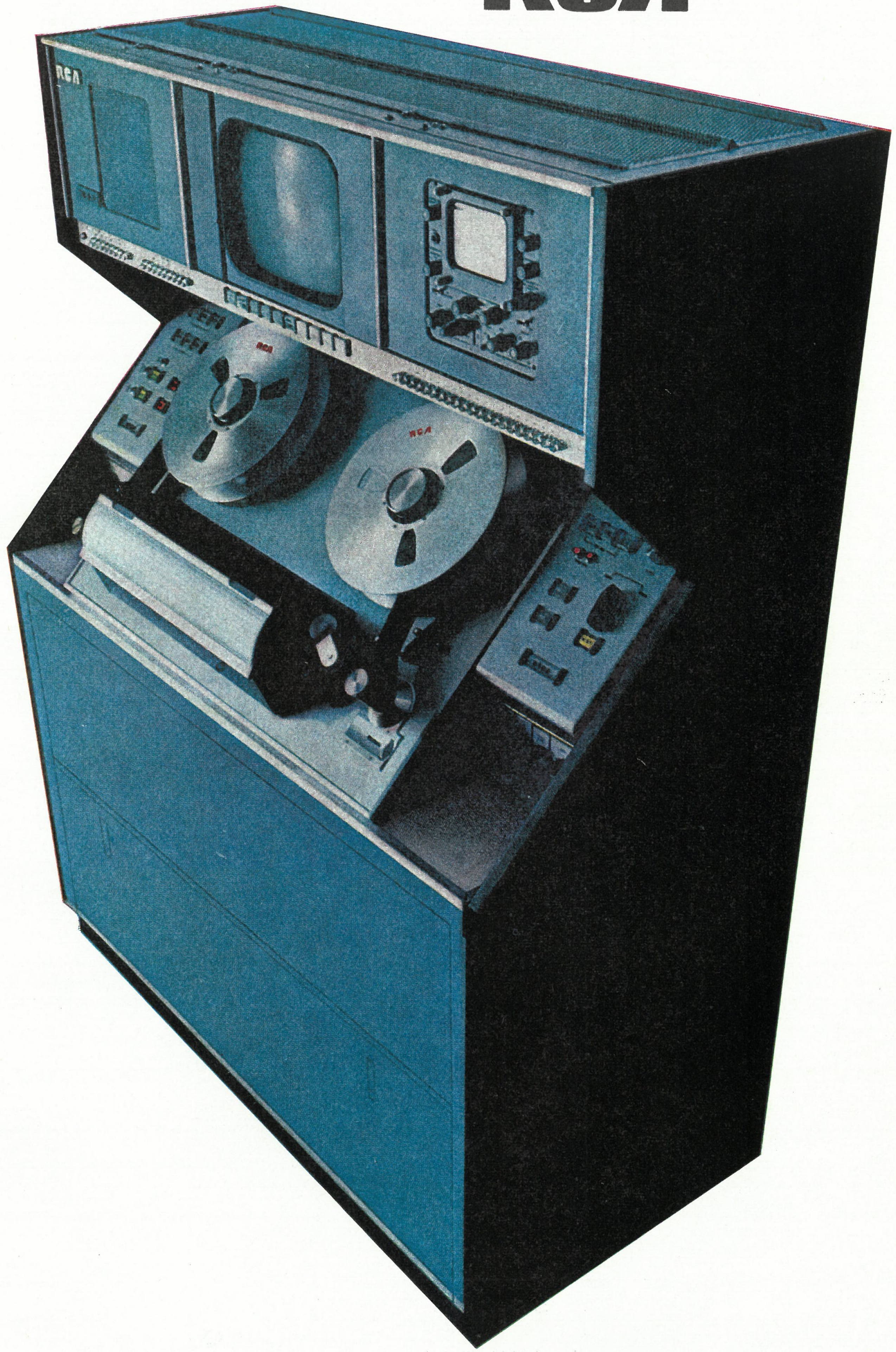

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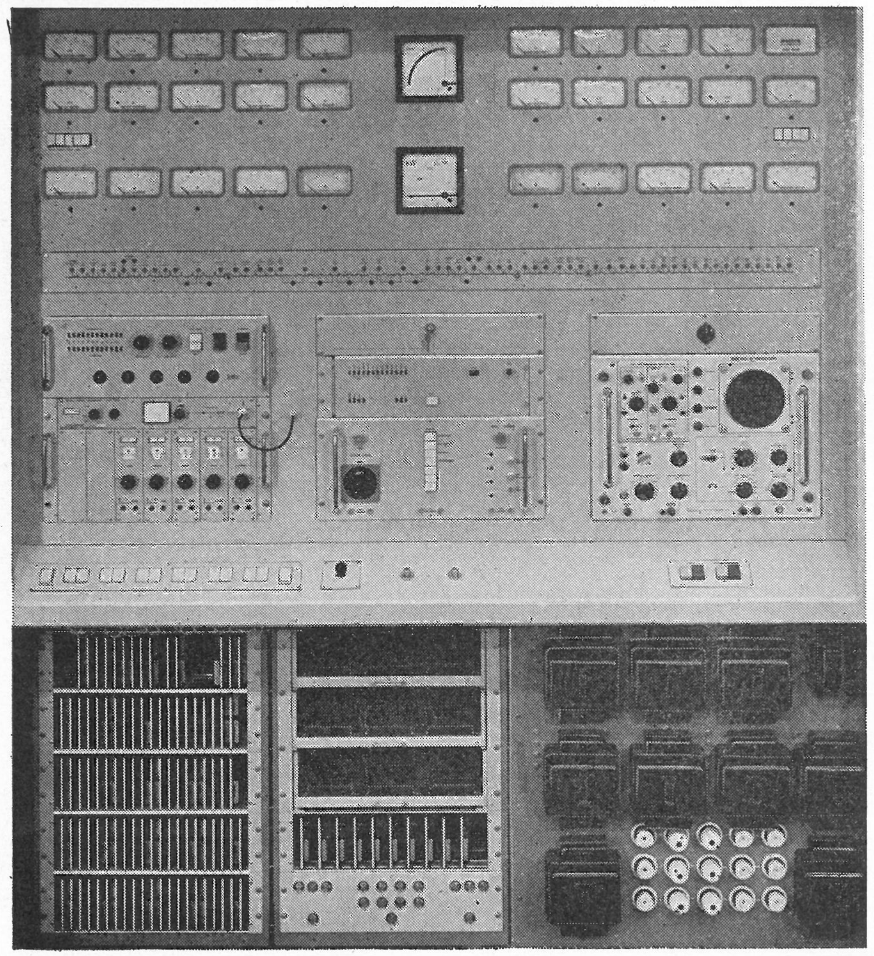

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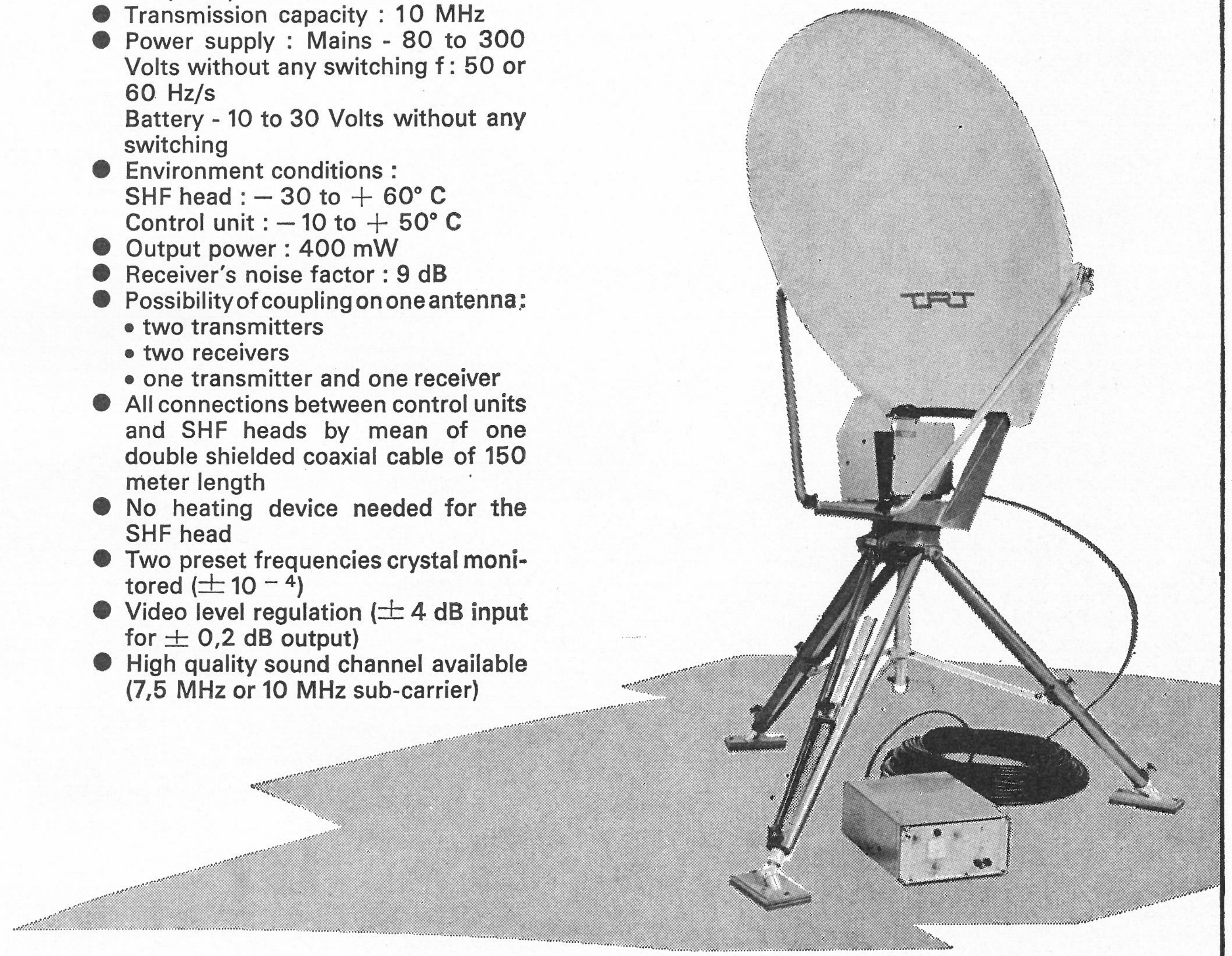

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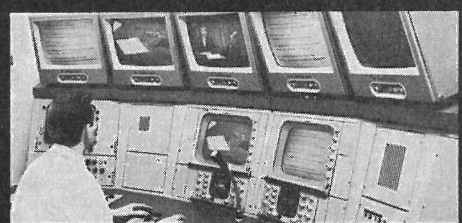

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CONTENTS

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A COMPARATIVE STUDY OF COMMUNICATIONS SYSTEMS USING DIFFERENT MODULATION-DEMODULATION TECHNIQUES*

by R.P. HAVILAND **

Summary

Various systems of modulation and demodulation are compared in this article, with application of the concepts of " communication potential " and " interference potential ". These concepts refer respectively to the ability of a signal to transmit the desired information despite a constant level of interference, and the extent to which this signal causes interference when it is unwanted. The differences between the types of interference produced when the spectrum is divided into channels, and those when it is not, are examined also.

Introduction

In a number of telecommunication services, the occupancy of the allocated bands has reached the point where the quality of service to the individual receiver is less than ideal. In some bands the degradation has become so great that corrective action appears to be necessary or, in some cases, has already been initiated.

Some of the services and bands in which these problems exist are the HF maritime service, the broadcast service in the LF, MF and HF bands, the amateur service in the HF band, and, in the United States, the Citizens' Service, also in the HF band. Although there are differences between these services, they have in common large numbers of transmitters and receivers, appreciable or marked propagation variations, and the information transmitted is restricted to a bandwidth of 3000 - 5000 Hz for speech or music.

The existence of these interference problems raises the question as to what technical steps can be taken to secure improvement in the signal-to-interference ratio, thereby allowing an improvement in service or additional use. Here " technical " is intended to include such factors as choice of modulation and design of receivers, and to exclude operational steps as modifying hours of use, maintenance of communication discipline and the like.

To conduct this examination it will be necessary to make a number of assumptions. These will be of two types : a set of basic assumptions to establish the method of comparison, and sets of detail assumptions to establish numerical values for estimation.

In the following, the basic and detail assumptions are first of all set forth. They are then applied to the general problem, and results deduced. These results are evaluated and conclusions are drawn from them.

* Dieser Aufsatz erscheint gleichzeitig in Deutsch unter dem Titel « Eine vergleichende Studie von Nachrichten-Übertragungssystemen mit verschiedenen Verfahren der Modulation und Demodulation » in Rundfunktechnische Mitteilungen, Heft 3, 1969, S. 97 bis 102.

** Mr. Haviland is with the General Electric Company, U.S.A.

Basic assumptions

It is assumed that a wanted signal exists, and that it is being received at a single location.

It is also assumed that the number of signals producing interference is large, so that some level of interference is inescapable, and that this interference is the limiting factor in reception. This eliminates consideration of the " exclusive channel " case, for which a simple reduction of bandwidth increases the number of channels.

To simplify the problem, the received interference is treated as arising from a single source. Propagation from both the wanted signal source and the interfering source is assumed to be independent of the variables considered. These assumptions are equivalent to the coupling of all sources to the receiver by a passive linear network, with the totality of interfering sources being replaced by a single equivalent source, by application of Thevenin's theorem. The representative circuit is shown in *Fig. 1.*

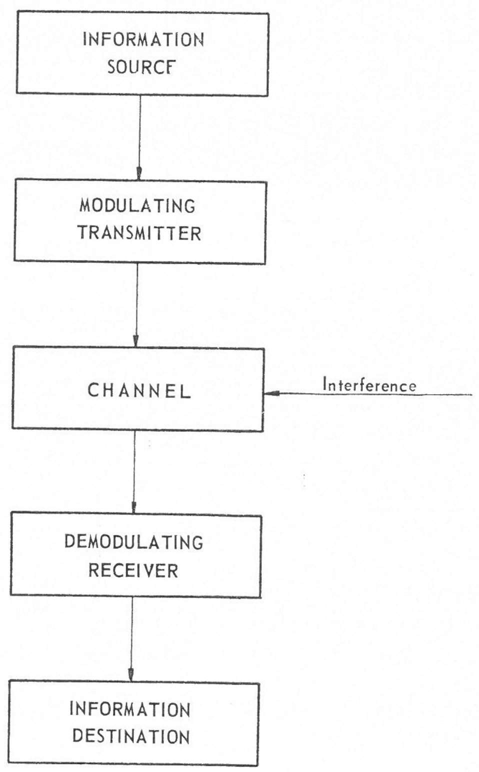


Fig. 1. — Diagram of a telecommunications system affected by interference.

The detailed statistical analyses of both the wanted and interfering signal sources are neglected. The effect of this assumption is considered later.

The choice of modulation at the transmitter and method of demodulation at the receiver are assumed to be independent. However, it is assumed that the wanted and unwanted signals use the same method of modulation, and that both are restricted to " narrow band " techniques. These assumptions are consistent with present and expected future use of the HF band and lower bands.

Emission assumptions

It is assumed that those emissions having a carrier operate at a carrier level of 1 kW carrier output, and those with suppressed carrier at a level of 2 kW peak envelope power, values which are often used to establish power equivalence of such modes. Basic data are determined for a test-tone producing 100 % modulation. The information is assumed to be a smoothly-read text, and to have an average level 10 dB below the test-tone average level [C.C.I.R. Recommendation 326-1].

The emissions considered, and the supplementary assumptions made, are :

AM : Double-sideband with carrier.

NFM : Narrow-band frequency modulation or phase modulation, asymmetric double sideband with carrier. At full modulation, sideband energy is assumed to be equivalent to that of an AM signal modulated 60 %.

SSB/C : Single-sideband with carrier. 100 % modulation is assumed to occur with modulation voltage equal to carrier voltage, that is to say, at 4 kW peak envelope power.

SSB : Single-sideband with suppressed carrier.

DSB : Double-sideband with suppressed carrier.

The numerical values associated with these assumptions are tabulated in *Table 1,* and the general structure of the signals is shown in *Fig. 2.*

Reception assumptions

It is assumed that reception is adequately measured by the input signal-to-noise ratio required to produce a standard output of 20 dB signal-to-noise ratio. To give a common basis of comparison, the input signal-to-noise ratio is calculated with respect to the output information power.

TABLE 1
Numerical values associated with the basic assumptions of emission.

Modulation method	Bandwidth kHz	Average power (W)		Peak envelope power (W)	Average total power (W)
		Carrier	Information		
AM					
Sine-wave		1000*	500*	4000	1500
Speech	10	1000*	50**	4000	1050
NFM					
Sine-wave		820	180**	1000*	1000
Speech	10	982	18**	1000*	1000
SSB/C					
Sine-wave		1000*	1000	4000	2000
Speech	5	1000*	100**	4000	1100
SSB					
Sine-wave		0	2000	2000*	2000
Speech	5	0	200**	2000*	200
DSB					
Sine-wave		0	1000	2000*	1000
Speech	10	0	100**	2000*	100

* Basic assumption
** From C.C.I.R. Recommendation 326-1

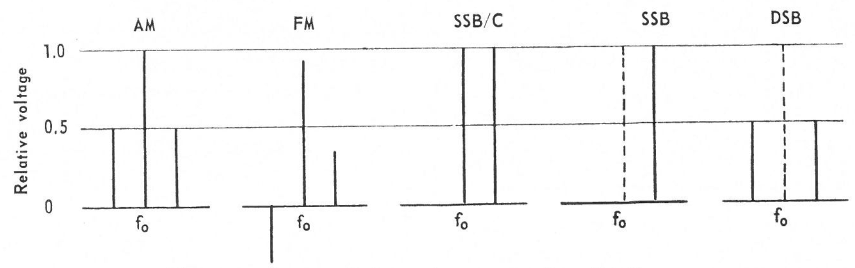


Fig. 2. — Spectra of the various types of modulation.

TABLE 3
Communication potential in dB, in the case of speech modulation.

Modulation method	Detector type					
	Envelope	Slope	Product	Select product	Lock-loop	Bi-aural
AM	27	–	24	27	27	33
NFM	9.6	22.6	19.6	22.6	22.6	28.6
SSB/C	27	–	30	30	27	30
SSB	–	–	33	33	30	33
DSB	–	–	27	30	30	36

– indicates not applicable

TABLE 4
Inteference potential in dB, in the case of speech modulation.

Modulation method	Distribution of transmitter frequencies	
	random	in channels
AM	30.2	17
NFM	30	12.6
SSB/C	30.4	20
SSB	23	23
DSB	20	20

TABLE 5
Relative communication effectiveness in dB, in the case of speech modulation.

Modulation method	Detector type						Bandwidth (kHz)
	Envelope	Slope	Product	Select product	Lock-loop	Bi-aural	
" Random " case							
AM	— 3.2	–	— 6.2	— 3.2	— 3.2	+ 2.8	10
NFM	— 20.4	— 7.4	— 10.4	— 7.4	— 7.4	— 1.4	10
SSB/C	— 3.4	–	— 0.4	— 0.4	— 3.4	— 0.4	5
SSB	–	–	+ 10	+ 10	+ 7	+ 10	5
DSB	–	–	+ 7	+ 10	+ 10	+ 16	10
" Channel » case							
AM	+ 10	–	+ 7	+ 10	+ 10	+ 16	10
NFM	— 3.0	+ 10	+ 7	+ 10	+ 10	+ 16	10
SSB/C	+ 7	–	+ 10	+ 10	+ 7	+ 10	5
SSB	–	–	+ 10	+ 10	+ 7	+ 10	5
DSB	–	–	+ 7	+ 10	+ 10	+ 16	10

– indicates not applicable

in dB above 1 W per kHz, and the bandwidth in dB relative to 1 kHz.

It appears desirable to distinguish two interference situations. In one, the transmitting frequencies are uncontrolled or random. In the other, the spectral band is divided into channels, with transmitters assigned to a given channel. For the "random" case, the total radiated power must be considered, but for the " channel " case, only the sideband power (assuming frequency stability is adequate). The amateur band is an example of the random case, the idealised broadcast band corresponds to the channel case ; the practical broadcast band may be intermediate in nature, however, or even random.

These two measures may be combined into a single " figure of merit " : since the reference is arbitrary, this may be called the Relative Communication Effectiveness. Since this should increase as the communication potential increases and increase as the interference potential decreases, the form is :

Relative Communication Effectiveness =
communication potential — information power (in dB)

It is believed that this single figure of merit represents a new approach to the evaluation of a communication system.

Values for these three measures, on the assumptions stated above, are tabulated in *Tables 3, 4* and *5*.

Analysis of the measures

Consider first the usual points of discussion regarding SSB and AM : as commonly stated, this involves SSB received with a product detector, and AM with an envelope detector. *Table 3* shows SSB to have a 6-dB communication advantage (advocates of SSB usually assume equal peak envelope power input, for an added 3 dB of SSB input, and quote a 9 dB advantage).

Consider now the interference potential, as shown in *Table 4*. In the random case, SSB generates about 7 dB less interference than AM. Overall, SSB gives an improvement of more than 13 dB over AM, as shown by the relative communication effectiveness values of *Table 5*. This has been recognised by the amateurs, who have virtually abandoned the use of AM in the bands under consideration.

In the channel case, the results are markedly different. Since the carrier beats are sub-sonic and assumed to be negligible, SSB now produces more interference than AM, although is uses less bandwidth. Overall, as shown in *Table 5*, the two systems AM (envelope detector) and SSB (product detector) are identical in relative communication efficiency.

A similar result occurs in comparing AM and DSB (with lock-loop detector). It appears that, in the random case, the important factor is the elimination of the carrier : the spectrum occupancy is not a factor. In both the channel and random cases, use of a detector adapted to the signal is important. This factor is just as important as the type of modulation.

Strictly speaking, two other factors should be considered. First, the envelope-detector output signal-to-noise ratio drops more rapidly than the input signal-to-noise ratio as both decrease. As a result, under weak-signal conditions, normal SSB would be better, even in the channel case. Furthermore, if selective fading is present, normal AM would be seriously distorted, whereas SSB would not be seriously affected, and again normal SSB would be preferred. However, both of these improvements would be due to the detector, and are inherent in any properly designed detector using a locally generated carrier. The improvement is not due to the method of modulation, but to the method of detection.

The second factor is the fact that these tables neglect the relative sensitivity of the human ear, which causes, for example, an interfering carrier displaced 4 kHz to be some 10.7 dB more annoying than one displaced 1 kHz [C.C.I.R. draft Recommendation E.1.d.]. This could affect the random case if only a few interfering signals were present. With many signals present, the results would converge toward the tabulated values.

Consider now some of the other possibilities. The values also provide an evaluation of the merits of SSB (product detector) and DSB (lock-loop detector). For both the random and channel cases, these are found to be equal. The additional bandwidth of the DSB signal is compensated by its lower interference power.

For the channel case, NFM is seen to be equal to the other systems when received with a lock-loop or slope detector. For the random case, the presence of the carrier reduces the relative effectiveness, as in AM. The importance of the detector is clearly evident for this modulation.

A basic assumption was that the use of a selectable-product detector gives an improvement of 3 dB, and that bi-aural detector is another 3 dB better. This assumption is clearly seen in *Tables 3* and *5*. If these assumptions are valid, for the random case the system having the highest effectiveness would be DSB (suppressed carrier) with a bi-aural detector. For the channel case, any double-sideband signal with bi-aural detector is preferable.

Even in the random case, the bi-aural detector can give appreciable improvement in the reception of AM signals. Also, since these detectors use locally generated carriers, they are essentially immune to weak-signal and selective-fading effects.

The study could be extended by mixing modes of transmission, and evaluating results. For example, NFM and a slope detector could be used as the wanted signal, and AM as the interference. In the channel case, this could lead to a high communication effectiveness, since a slope detector is essentially insensitive to AM, as is a quadrature lock-loop detector.

Conclusions

Existing methods of evaluation of communication systems are largely based on considerations of communication potential and occupied bandwidth. These two factors appear to have been sufficient when exclusive-channel communications were the rule. Today, however, exclusive channels are practically non-existent, and it appears that methods of including interference generating potential must be found. The approach of this study is suggested as a starting point for such extension.

The study suggests that additional attention should be given to detection processes. In particular, tests of selectable sideband and bi-aural detectors should be conducted under a variety of conditions, to determine whether the improvements assumed above can be attained in practical situations.

The study further suggests that consideration be given to combining different forms of modulation, as a method of reducing interference in controlled situations.

With reference to particular bands, the study suggests that more emphasis should be given to channel control, in particular, to the elimination of interchannel operation, and to good frequency stability. If the assumptions stated are valid in practice, appreciable improvement in the existing bands is possible without changing transmission standards : in fact, if all assumptions are valid, the study suggests that the existing transmission standards should not be changed, but, instead, the change should be in receiver practice.

In view of these conclusions, further study of the entire problem seems to be needed.

Part B (General and Legal) of E.B.U. Review, No. 115

contains, in its *General Section,* the following articles :

" University Television - Some initial reflections on a project of the Zweites Deutsches Fernsehen ", by Professor Karl Holzamer ;
" Just watch what I'm saying : A television teaching course for the deaf and hard of hearing ", by Drs F.E. Wermer;
" The information jungle ", by W.S. Hamilton ;
" Radio Bantu - The story of the South African Broadcasting Corporation's seven programme services in seven indigenous Bantu languages " ;

tables and graphs showing Eurovision programme statistics for 1968, and Radio and television licence fees for the European Broadcasting Area in 1968 ;

news items concerning the International Catholic Association for Radio and Television (UNDA), and on recent broadcasting developments and events in Australia, France, Germany (Federal Republic), Israel, Italy, Netherlands, New Zealand, Portugal, Switzerland and the United Kingdom ;

and reviews of recent books in the fields of : Audience research, Background to broadcasting.

The *Legal Section* carries the following studies : :

" Problems of copyright and neighbouring rights in the use of communications satellites ", by Claude Masouyé ;
" Report from the Federal Republic of Germany ", by Dr Egon Wagner ;
" What attitude should the developing countries adopt following the Paris Copyright Conference February 1969? ", by Abdallah Chakroun ;

an item on the right to information and the public order in Belgium ; and Musings on a corrigendum, by Bénigne Mentha.

The *E.B.U. Activities Section* gives an illustrated account of the Eurovision Song Contest 1969.

MF BROADCAST COVERAGE BY PLANE AND SPHERICAL TRANSMITTER NETWORKS *

by H. EDEN and D. MINNE **

Summary

The most favourable MF broadcast coverage obtainable depends on a large number of parameters and can therefore be calculated only with great difficulty. Using the example of regular transmitter networks with linear channel distribution over plane grounds and spherical earth, an endeavour has been made to evaluate the possibilities of coverage. As a measure of the coverage obtainable, the coverage factor was defined and calculated by varying the most important parameters, such as, for example, shared-channel spacing, transmitter power, RF protection ratio, frequency and the like.

The relations which these investigations brought to light between the shared-channel spacing, the coverage factor, the transmitter power and — in the case of a spherical earth, that is to say, a finite overall surface — the number of transmitters used in the same channel, are of particular importance. Only one of the factors mentioned above may be chosen freely.

1. Introduction.

As the term " broadcast coverage " has not been defined unequivocally, we shall first of all explain the meaning of that term in the following text. A listener is deemed to be *covered* by a given programme if he is able to receive that programme, using a reasonable amount of technical equipment, with a quality previously termed to be at least " acceptable ".

The " reasonable amount of technical equipment " consists of a receiver equal to a commercial receiver, in good condition, produced within the past ten years, together with a receiving aerial which — without having to be directional — feeds to the receiver an input voltage of the same magnitude as a ferrite aerial in the optimum position, such as is used in commercial receivers. With this assumption, the *area of coverage* of a transmitter is the area in which all listeners are *covered,* and *broadcast coverage* is taken to be the sum of the areas of coverage of all the transmitters broadcasting the programme in question. In this, the size of each area of coverage is limited by the combined interference effect which occurs, on the one hand, as a result of atmospheric or industrial noise, when the field-strength E_u of the wanted transmitter falls below the minimum field-strength E_{min}, and on the other hand, as a result of interference from other transmitters of the network, when the ratio between the field-strength of the wanted transmitter E_u and the interfering field-strength E_n is below the RF protection ratio A.

The MF band is that ranging from 525 kHz to 1605 kHz. Because a much narrower frequency band would be sufficient for transmitting one broadcast programme with " acceptable " quality, the MF band was sub-divided into C frequency channels whose width b can be calculated from the overall width B of the band thus;

$$b = \frac{B}{C} \tag{1}$$

If the channel width b required for " acceptable " quality is fixed from the start, the number of channels is given by:

$$C = \frac{B}{b} \tag{1a}$$

If the number of transmitters working in a particular area exceeds C, some of or even all the channels must be used by at least two transmitters simultaneously. There is also the possibility that all the transmitters in a channel broadcast the same programme as members of a " synchronised group ", or that the various transmitters in the channel broadcast at least two different programmes.

The broadcast coverage that may be obtained with a given transmitter network in a given frequency band depends on a large number of parameters, such as:

- the geometrical arrangement of the transmitters in the network;
- the distribution of the channels to the transmitters in the network;
- the number of channels C;
- the minimum field-strength $F_{min} = 20 \log E_{min}$;
- the RF protection ratio $A(\Delta f) = (F_u - F_n)_{min}$;
- the powers P_u and P_n of the wanted and unwanted transmitters;
- the distance D between the wanted and unwanted transmitters;
- the wave propagation and the parameters affecting it, such as :–
  - frequency f (or wavelength λ) ;
  - distance d between transmitter and receiver;
  - soil constants : conductivity σ ; dielectric constant ε;
  - time of day.

Furthermore, the use of directional aerials at the transmitting and/or receiving end, as well as the inclusion of synchronised transmitter groups, affect the broadcast coverage.

Among the parameters mentioned there are those that must be regarded as unalterable from the physical or psychological-aesthetical points of view [σ, ε, F_{min}, $A(\Delta f)$], whereas others may be chosen more or less freely (D, F, channel distribution or C, f, geometry of the transmitter network).

* Dieser Aufsatz erscheint gleichzeitig in Deutsch unter dem Titel « Die Ermittlung der Grenzen der Rundfunkversorgung im Mittelwellenbereich am Beispiel regelmässiger ebener und sphärischer Sendernetze » in Rundfunktechnische Mitteilungen, Heft 3, 1969, S. 103 bis 115.

** Messrs. Eden and Minne are with the I.R.T., Hamburg.

It is easy to imagine that with so many inter-dependent factors, it is very difficult to assess the effect that the modification of one or even several of the parameters mentioned would have on the broadcast coverage. However, it is precisely this that would be needed if it were desired to optimalise the broadcast coverage.

In such cases, there remains in general only the determination of the best results that could be obtained under idealised conditions. The Institut für Rundfunktechnik has carried out such investigations for the cases of plane and spherical Earth.

The following idealisation was assumed for the case of spherical Earth :

the area to be covered is plane and of infinite extent;
the service area is limited by the combined effect of noise and interference;
of all possible sources of interference, only the nearest shared-channel transmitter is taken into consideration;
the powers of the wanted and unwanted transmitters are equal.

The following idealisation was assumed for the case of spherical Earth :

the area to be covered is spherical and infinite;
the service area is limited only by interference;
of all possible sources of interference only a maximum of six of the nearest shared-channel transmitters is taken into consideration;
the powers of the wanted and unwanted transmitters are equal.

In order to determine the most favourable broadcast coverage obtainable, the several parameters were varied and, as a measure of the coverage, the *coverage factor* c, that is to say, the ratio of the *area effectively covered* to the *area required to be covered*, was calculated.

2. Bases for calculating the coverage factor.

Provided that the shared-channel interference in a transmitter network is by far the most important, it is advisable to arrange the shared-channel transmitters at the apices of a plane or spherical equaliteral triangular network having sides D. If an infinite plane area is sub-divided into equal contiguous elementary areas in such a way that each elementary area contains just one apex of the network, these area elements represent a measure of the total area required to be covered S_{tot}. The elementary areas take the form of regular hexagons of sides $D/\sqrt{3}$ and area

$$S_0 = \frac{\sqrt{3}}{2} D^2 \qquad (2)$$

This hexagon has exactly the same area as a rhombus formed by two equilateral triangles of sides D. The greater the value of D, the more the spherical triangles of sides D exceed in area the plane triangles.

As long as the existence of synchronised transmitter groups is not taken into account, each of the total of C channels available for the purpose of coverage may be used just once in each of these elementary areas. In order to optimalise the coverage, the geometrical arrangement of the channels should be the same in all the elementary areas. It is, however, not subjected to any further restrictions if, apart from shared-channel interference, there occurs no other form of interference. Otherwise, such additional interference would have to be reduced to the minimum by an appropriate distribution of the channels [1].

The area S_d actually covered of the elementary area S_0 is the sum of the partial areas S_i covered in each channel i, or:

$$S_d = \sum_{i=1}^{C} p_i\, S_i \qquad (3)$$

where $p \leqslant 1$ is a coefficient which, if necessary, takes into account the unavoidable double coverage, before attaining complete coverage ($S_d = S_0$). As long as overlapping of the individual service areas is unlikely, we may put $p = 1$. However, when full coverage has been attained or exceeded, a factor of $p < 1$ gives a more realistic assessment of the coverage effectively attained. If a circular service area is replaced by the regular hexagon described, then

$$p = \frac{3\sqrt{3}}{2\pi} \approx 0.827$$

If, in an exceptional case, the value of the particular S_i were not dependent on frequency, equation (3) would be simplified to

$$S_d = p\, C\, S \qquad (3a)$$

Every single service area S of a transmitter is derived from the service radius d, the length of which is in general a function of the direction $d = d(\varphi)$.

Accordingly,

$$S = \int_0^{2\pi}\int_0^{d(\varphi)} r\, dr\, d\varphi = \tfrac{1}{2}\int_0^{2\pi} d^2(\varphi)\, d\varphi \qquad (4)$$

or, in the particular case of a radius of coverage independent of direction

$$S = \pi\, d^2 \qquad (4a)$$

The size of the covered area results from formulae (3) and (4), thus:

$$S_d = \sum_{i=1}^{C} \frac{p_i}{2}\int_0^{2\pi} d_i^2(\varphi)\, d\varphi \qquad (5)$$

and, finally, the coverage factor from equations (2) and (5)

$$c = \frac{S_d}{S_0} = \frac{1}{\sqrt{3}}\sum_{i=1}^{C} p_i \int_0^{2\pi} \frac{d_i^2(\varphi)}{D^2}\, d\varphi \qquad (6)$$

This relation is simplified, in the case of coverage radii independent of frequency and direction, and assuming $p = 3\sqrt{3}/2\pi$, to

$$c = 3\,(d/D)^2\, C \qquad (6a)$$

However, in general the coverage radius d is neither independent of frequency nor of direction. On account of the many symmetries that apply in a geometrically

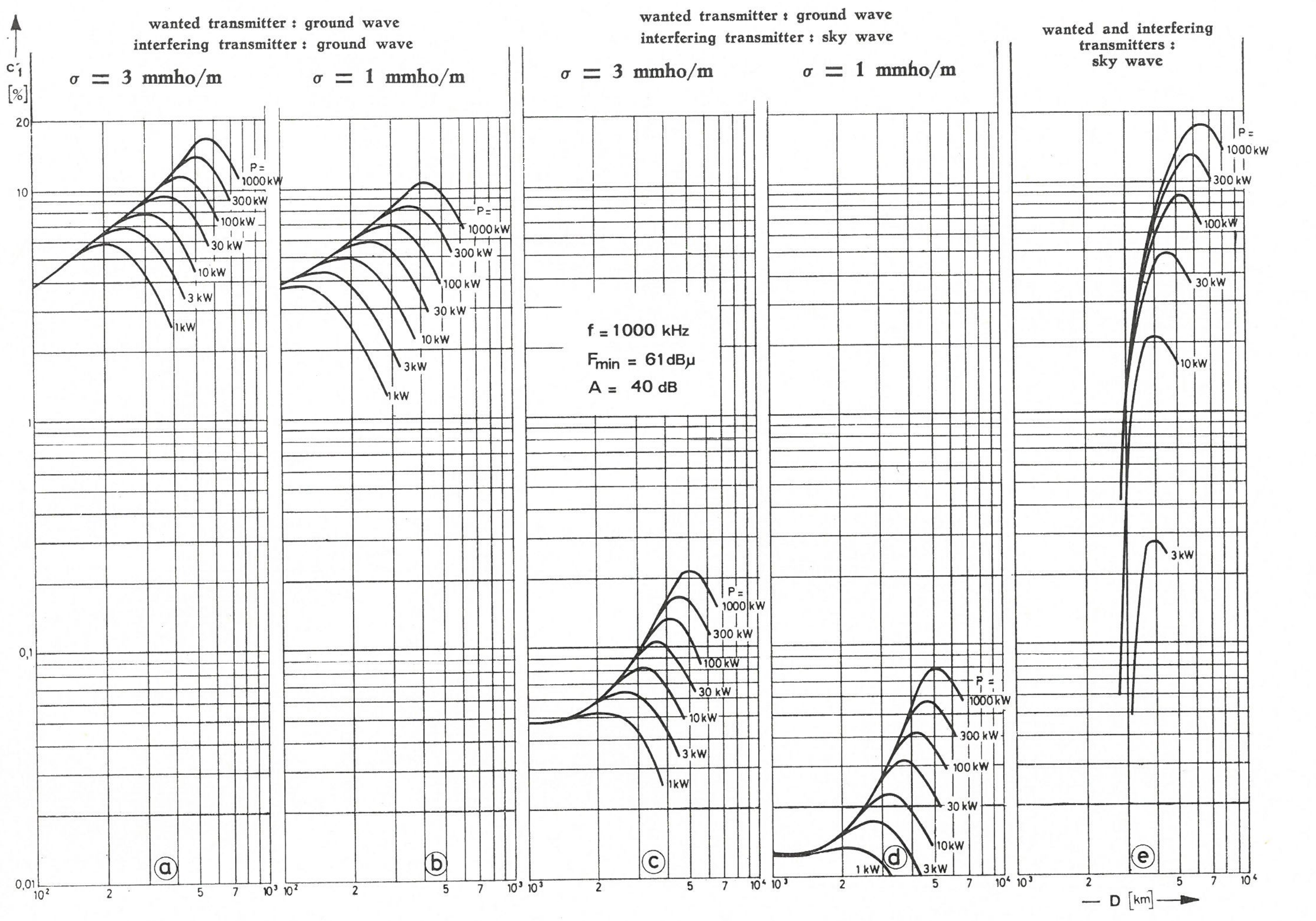


Fig. 1. — Coverage for plane ground, a frequency of 1 000 kHz and a protection ratio of 40 dB. On the ordinate scale is plotted the coverage factor c'_1 (as a percentage) with a single channel, as a function of the distance D between the transmitters in that channel. The parameter of the curves is the power P for each transmitter. The distances on the abscissa scale range from 100 to 1000 km for curves *a* and *b*, from 1000 to 10 000 km for curves *c*, *d* and *e*.

regular network, it suffices for the covered area or the coverage factor to be determined according to equations (5) and (6) by integration over an angle of 30°. Further simplification is obtained when the power level within the entire network is so high as to justify disregarding atmospheric or industrial noise, as distinct from interference from other stations — this is a condition for obtaining optimum coverage [2].

As it is in general not possible explicitly to indicate $d(\varphi)$, in a practical calculation the integral may be replaced by a finite sum, or in its place the mean value $\overline{d_i}^2$ is utilised. It is now possible to evaluate $\overline{d_i}^2$ and thus to calculate a limiting value for the coverage factor in the MF and LF bands.

In the practical calculations, the results of which are discussed in the following paragraphs, the coverage factor c' obtainable with a single channel was determined, when not otherwise stated, by assuming $p = 3\sqrt{3}/2\pi$.

3. Evaluation of broadcast coverage over an infinite plane.

3.1. *Results of calculations.*

An important part of the results is depicted in *Figs. 1a* to *1e*. The coverage factor c' obtainable by utilising a single channel is given as a parameter for different transmitter powers P (of the wanted and of the most disturbing unwanted transmitters), as a function of the shared-channel spacing. For the purpose of calculating the coverage factors, use was made of the ground-wave propagation curves from [3] and of the sky-wave propagation curves from [4]. The coefficient p, which takes into consideration the overlapping of service areas that is unavoidable with complete coverage, was taken as unity, because, with coverage by a single channel, no double coverage is to be expected.

Figs. 1a and *1b* depict the coverage obtainable during the day with two different soil conductivities (3 or 1 mmho/m). The coverage by the ground-wave of the wanted transmitter during the night is depicted in *Figs. 1c* and *1d* (again for the two soil-conductivities

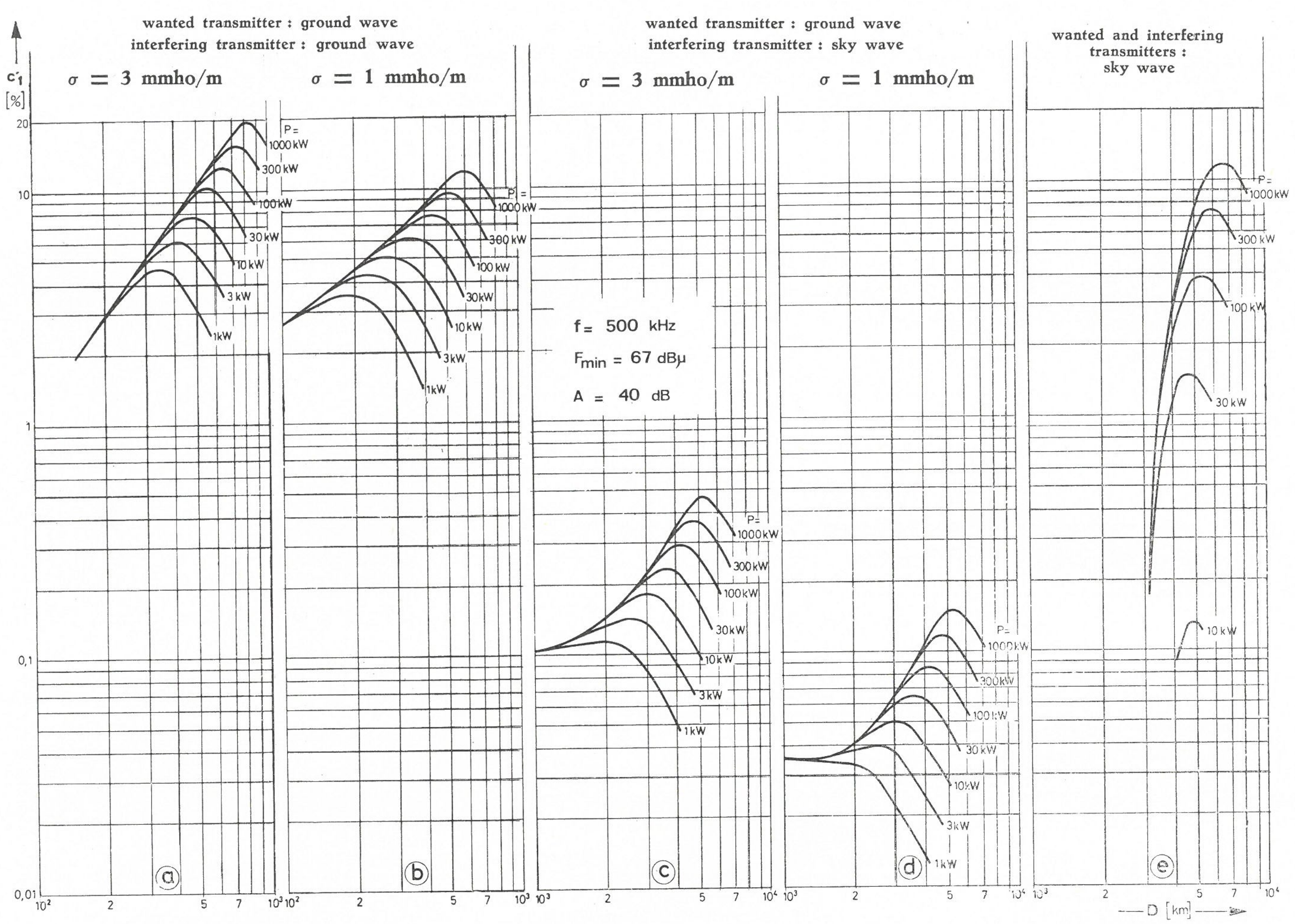


Fig. 2. — Coverage curves for plane ground for a frequency of 500 kHz and a protection ratio of 40 dB.
(These curves are plotted in the same manner as those of Fig. 1.)

mentioned), and the sky-wave coverage in *Fig. 1e*. In all these figures, the following parameters remained constant:

the minimum field-strength F_{min} = 61 dBμ *
the RF protection ratio A = 40 dB
the frequency f = 1000 kHz.

All the curves show a maximum of the coverage factor as a function of the shared-channel spacing. The maximum value of this coverage factor and the shared-channel spacing required to obtain this maximum coverage are, as shown in the figures, functions of the transmitter power, the soil-conductivity (only for ground-wave propagation) and of the type of coverage (ground-wave coverage during the day or during the night or sky-wave coverage). Furthermore, there is dependence on the parameters maintained constant in *Figs. 1a* to *1e*, namely, minimum field-strength, RF protection ratio and frequency, as well as on the shape of the space-wave propagation curves at distances exceeding 3500 km.

The maximum of the curve always occurs where the disturbing effects of interference and noise are equal. If the shared-channel spacing is smaller than corresponds to the position of the maximum, the transmitter interference is greater; if the spacing is wider, then the disturbance due to noise determines the size of the area having satisfactory reception. The envelope of the families of curves on the left-hand slope of *Figs. 1a* to *1e* therefore represents the limit of the coverage factor obtainable with a given shared-channel spacing, which limit cannot be exceeded even by an increase in power.

It should be repeated at this point that all the results thus calculated take into account only the effect of the most disturbing source of interference. Beyond this, it should be noted that the range of the wanted transmitter was always determined along the line connecting the wanted to the unwanted transmitter and was then considered to be independent of direction, and that, in the case of sky-wave interference, the field-strengths were calculated according to [4] (formula *1a*) even when the range of the interference, that is to say, the distance from the unwanted transmitter to the limit of the service area of the wanted transmiter, exceeded 3500 km.

* The dependence on frequency of the minimum field-strength [5] was taken into account in calculating the coverage for $f \neq 1000$ kHz.

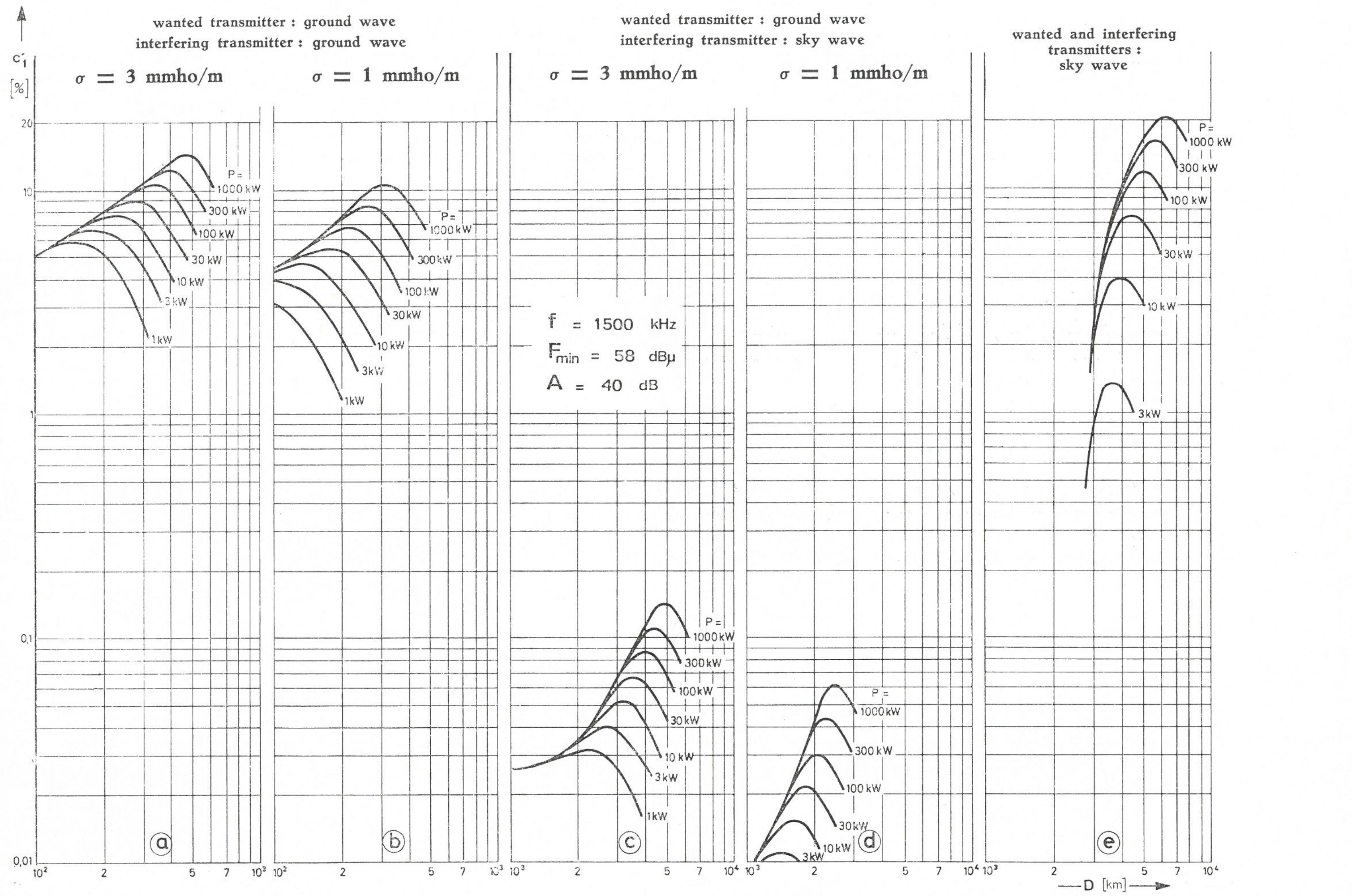


Fig. 3. — Coverage curves for plane ground for a frequency of 1500 kHz and a protection ratio of 40 dB.
(These curves are plotted in the same manner as those of Fig. 1.)

All the above requirements and assumptions naturally reduce the reliability and significance of the results. If one considers more than one unwanted transmitter, the range of the wanted transmitter is reduced through the effect of additional sources of interference, with the same shared-channel spacing. This effect is particularly important when the service radius is very small compared with the shared-channel spacing. When the range of the wanted transmitter is very small, the distances to the additional sources of interference and thus also their field-strengths are of the same order of magnitude as in the case of the first source of interference. However, because $c = 3\ (d/D)^2$, a small ratio of the service radius to the shared-channel spacing is equivalent to a small coverage factor. This therefore particularly affects nocturnal ground-wave coverage (*Figs. 1c* and *1d*). However, in the other cases, too, one must always reckon with a considerably smaller coverage owing to multiple interference when the coverage factor is less than 4% ($\Delta d > 0.1\ d$). With an increasing coverage factor, the influence of the additional sources of interference taken into consideration becomes almost completely negligible, for example, for c = 16 %, Δd is only about 0.02 d.

Moreover, in reality, so long as noise is of no importance, the service area of a transmitter, under the influence of a single unwanted transmitter, is in no way circular. If, on the other hand, one takes into consideration not one, but the six nearest sources of interference in the regular triangular network, the service radius of the wanted transmitter changes only slightly as a function of the angle of azimuth, the deviations being the greater the wider the shared-channel spacings. In reality, the average service radius is greater than the service radius in the direction of a source of interference. This is clearly visible in *Fig. 6*, when one examines the limits of the service areas for omnidirectional radiation patterns (*full lines*).

The influence of the shape of the sky-wave propagation curves at distances exceeding 3500 km was indicated for the first time in [6]. The fact that at present there exist no authoritative curves for sky-wave propagation at the distances mentioned, distracts further from the reliability of *Figs. 1c, d* and *e*. Should the field-strength fall off less steeply, as it would appear, than is to be expected according to [4] (formula 1*a*), then all the coverage factors given for shared-channel distances exceeding about 3500 km are reduced.

3.2. *Significance of the results.*

The coverage factors for the three possible cases, namely,

ground-wave coverage during the day,
ground-wave coverage during the night,
sky-wave coverage during the night,

were calculated in order to obtain fundamental data for frequency-assignment conferences and to indicate the limits of the possibilities of coverage that exist in planning.

However, before the results (which have already been indicated and discussed) of the calculations for f = 1000 kHz are utilised to forecast the possibilities of coverage for a variety of conditions, it is necessary to discuss the effect of the frequency on the coverage factor.

Figs. 2a to *2e* and *3a* to *3e* give the curves for 500 and 1500 kHz corresponding to *Figs. 1a* to *1e*. A comparison of corresponding figures indicates a steady decrease in the coverage factor with rising frequency in the case of ground-wave coverage, but a steady increase in the coverage factor in the case of sky-wave coverage. The dependence on frequency of the coverage factor is particularly marked with ground-wave coverage during the night; at the same time, the shared-channel spacings associated with the maximum values of the coverage factor are little dependent on the frequency.

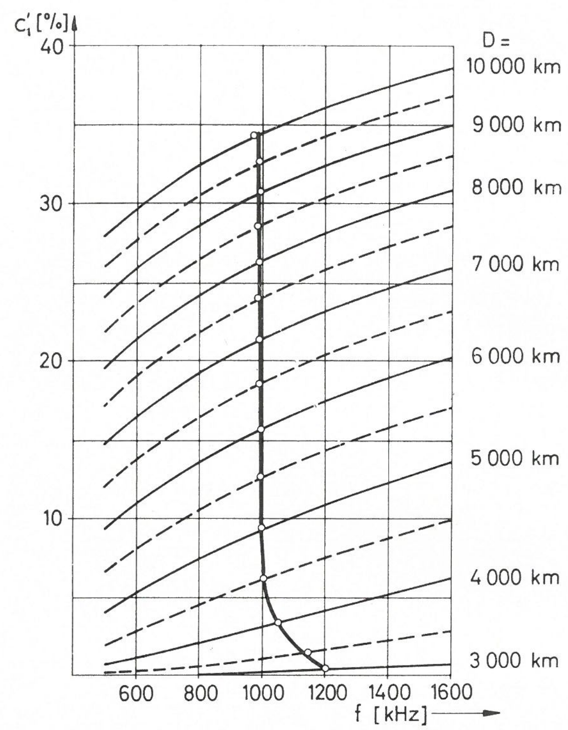


Fig. 4. — Coverage factor c'_i for plane ground as a function of frequency. The paramater is the spacing D between transmitters in the same channel. The protection ratio is 40 dB.

As the results given in *Figs. 1* to *3* cannot claim very high precision on account of the omissions and simplifications indicated, a further simplification intro-

TABLE 1

Overall coverage in the MF band as a function of the AF bandwidth

AF bandwidth (kHz)					10	7.5	5	4.5
channel width (kHz)					20	15	10	9
number of channels available					54	72	108	120
Type of coverage	**Time**	**σ (mmho/m)**	**D_{opt} (km)**	**d (km)**				
Ground wave	day	3	500	100	6.15	8.17	12.28	13.63
Ground wave	day	1	370	55	3.77	5.03	7.55	8.38
Ground wave	night	3	4500	100	0.075	0.100	0.150	0.167
Ground wave	night	1	4900	60	0.025	0.034	0.051	0.057
Sky wave	night	—	6000	1150	5.95	7.90	10.88	13.20

p = 300 kW
f = 100 kHz
$p = 3\sqrt{3}/2\pi \approx 0.827$

D_{ont} = optimum shared-channel spacing
d = service radius of wanted transmitter
σ = soil conductivity

duced was to consider the coverage at 1000 kHz as representative of the coverage throughout the MF band. The admissibility of this simplification was merely examined by means of the example of nocturnal sky-wave coverage. For this purpose, for each shared-channel distance a frequency was chosen in such a way that the corresponding coverage factor was exactly the average of all the individual coverage factors resulting along a parameter curve for D = constant.

The frequencies chosen are marked in *Fig. 4*, and it becomes apparent that for shared-channel spacings $D \geqslant 4500$ km, the average coverage factor is always attained with great accuracy at the frequency f = 1000 kHz.

If the entire MF band is sub-divided into channels of equal width, according to equation (*1a*), and using the double-sideband technique that is usual nowadays, one obtains for each desired AF bandwidth the number C of channels.

With the foregoing it is possible, corresponding to *Figs. 1a* to *1e*, assuming service radii independent of frequency, to obtain the overall coverage factors for all these channels, indicated in *Table 1*. The coefficient, which takes into account the unavoidable overlapping of service areas, was taken as $p = 3\sqrt{3}/2\,\pi$, and the power was taken to be 300 kW throughout.

With the totality of the channels available, it is thus possible to obtain multiple coverage of the whole area, with the *ground-wave* during the day and with the *sky-wave* during the night, so that at any point of reception it is possible to receive at least the number of programmes indicated before the decimal points in *Table 1*.

Ground-wave coverage during the night, on the other hand, does not permit even approximately full coverage with only one single programme. In this connection, the inaccuracies in the results due to the simplifications and omissions assumed in the calculation should in no way be disregarded or forgotten.

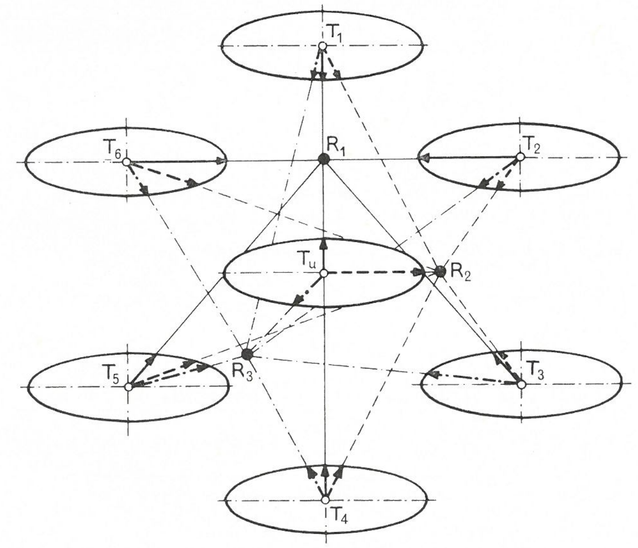


Fig. 5. — Arrangement of directional aerials in a regular triangular network.
T_u is the wanted transmitter and T_1 to T_6 are the interfering transmitters. For each of them, the power radiated in the direction of the three receiving points R_1, R_2 and R_3 is indicated.

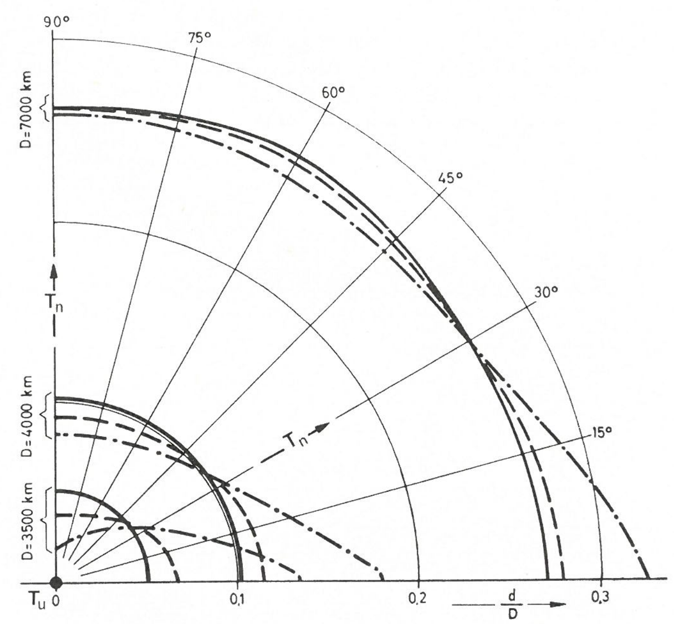


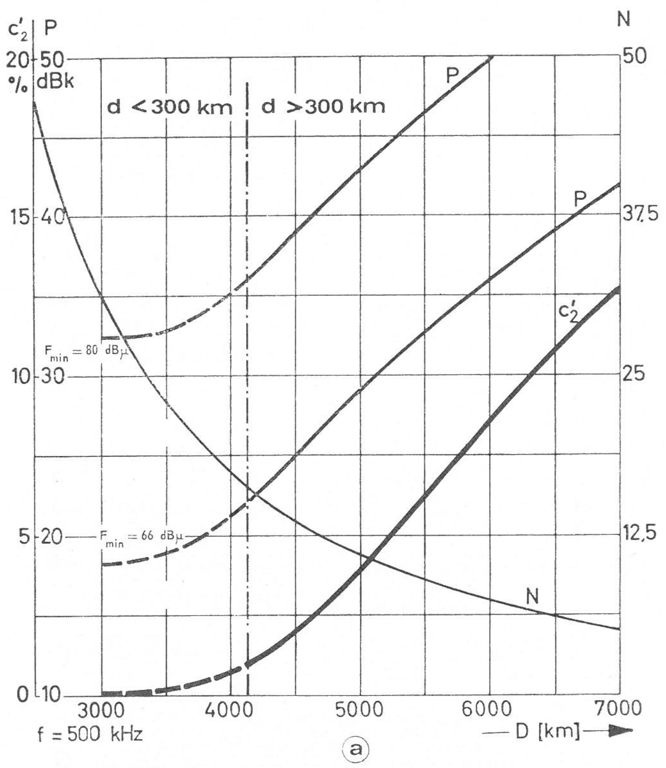
Fig. 6. — Sky-wave service by means of directional and omnidirectional aerials.
The relation between the coverage radius d and the spacing D between transmitters in the same channel is plotted for each direction.
Frequency : 1000 kHz. Protection ratio : 40 dB.
T_u is the wanted transmitter and T_n the interfering transmitter.
The horizontal radiation patterns are ellipses having the following ratios of axes :

————	1 : 1
– – – –	1 : 0.5
—.—.—.—	1 : 0.1

3.3. *General use of directional aerials.*

The question as to whether, through the general use of directional transmitting aerials, the coverage factor of a sky-wave service can be increased, was examined by means of the example of a geometrically regular network of transmitters, in which all transmitting-aerial radiation patterns have the form of an ellipse. The ratio of the lengths of the axes was varied, having successively the values 1:1 (omnidirectional radiation), 1:0.5 and 1:0.1. The position of the aerial patterns was the same for all the transmitters in the network, where all the minor axes of the ellipses were directed in such a way that they pointed exactly to two (opposite) of the six immediately adjacent transmitters (*Fig. 5*).

If the power throughout the network is chosen high enough for the limit of coverage also in the direction of the minor axis of the ellipse to be determined exclusively by interference, but not by noise, then there is little change in the size, and even in the shape of the service area, when the shared-channel spacing is wide. The service area will increase somewhat in those directions in which the power of the interfering transmitters, but not the power of the wanted transmitter, is reduced by their aerial patterns (direction of the major axis of the ellipse). In other directions it will decrease a little, where the effective power of the wanted transmitter is reduced by its aerial pattern to a greater extent than that of the unwanted transmitter because of its aerial pattern.



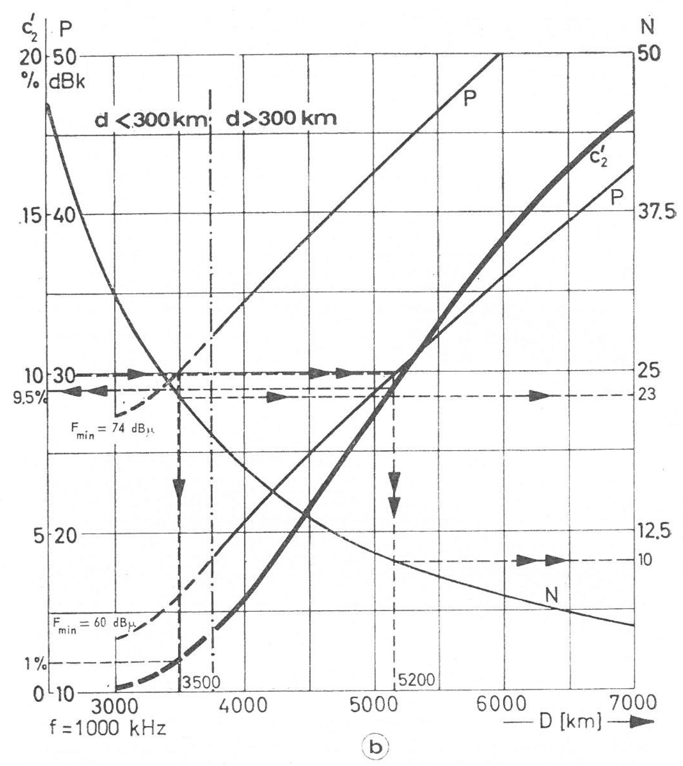


Fig. 9. — Coverage of a spherical Earth.

The relation between the number of transmitters N, the spacing D between transmitters in the same channel, their power P and the coverage factor c'_2. Protection ratio = 40 dB.

diagram a : f = 500 kHz
diagram b : f = 1000 kHz
diagram c : f = 1500 kHz

The vertical broken line corresponds to a coverage radius d of 300 km.

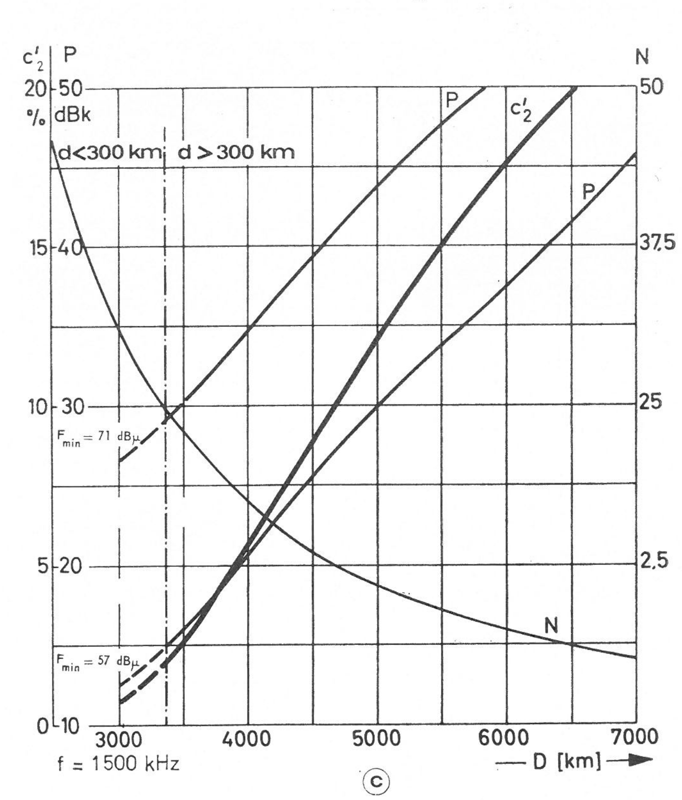
The number of transmitters N takes into account the part of the Earth's surface under water.

* * *

Fig. 9b demonstrates the utilisation of these diagrams.

Example : If the transmitter power is 1000 kW (= 30 dBk), the spacing between transmitters in the same channel must be:

- 5200 km if the minimum field-strength is 1 mV/m (= 60 dBμ), the preferred value for the European area. In that case, the number of transmitters sharing the same channel N = 10 and the coverage factor c'_2 = 9.5 % (for one channel).
- 3500 km if the minimum field-strength is 5 mV/m (= 74 dBμ), the preferred value for the tropical zones. In that case, the number of transmitters sharing the same channel N = 23 and the coverage factor c'_2 = 1 % (for one channel).



This reduces the number of utilisable surfaces and thus also the number of transmitters to be operated in the same channel, without there being a simultaneous change in the shared-channel spacing.

Owing to the reduced possibility of utilisation, there inevitably results a reduction in overall coverage. This loss in coverage is represented quantitatively in *Table 2.*

TABLE 2
Programme-coverage loss in %
for spherical surfaces

n	Tetrahedron	Octahedron	Icosahedron
1	50	25	40
3	33	25	26.6
4	37.5	25	22.5
7	28	21.4	20

A reduction of these losses of coverage is possible in individual cases, when on the "prohibited" triangular surfaces the groups of channels in question are utilised in their normal pattern, but rotated by 120° to the right or to the left. If it is decided to adopt such a solution, the linearity of the channel distribution will be disturbed, and therefore the determination of the coverage using the example of a single transmitter is impossible, but the overall coverage could increase. Further investigations in this direction should make it sufficiently clear as to how in such cases the coverage factor may be evaluated.

4.3. *Results of calculations.*

It may de deduced from the above consideration that the channel distributions that are possible for the case of a plane surface, may be utilised also for a spherical surface, subject to certain restrictions. Taking into account the required restrictions, it should then also be possible to evaluate the coverage to be expected on the sphere by means of the results for the case of a plane surface.

The coverage of a plane surface was calculated on the assumption that the six nearest shared-channel transmitters were the only effective sources of interference, and assuming the network to be regular. Owing to a lack of reliable data, the sky-wave field-strengths of the wanted and unwanted transmitters were determined also beyond the actual area of validity ($300 \leqslant d \leqslant 3500$ km) by formula *(1a)* in [4].

With ranges of the wanted transmitter of less than 300 km, in reality, the vertical pattern of the transmitting aerial also considerably affects the calculation. However, at such small useful ranges, sky-wave coverage may hardly be regarded as having a real advantage over ground-wave coverage, and, within the framework of the present study, it has therefore been neglected. In *Figs. 9a* to *9c,* the coverage-factor curve is shown as a broken line for shared-channel spacings giving wanted-transmitter ranges of less than 300 km.

Field-strength recordings at distances exceeding 3500 km show that (at least in individual cases) one must reckon with considerably greater field-strengths

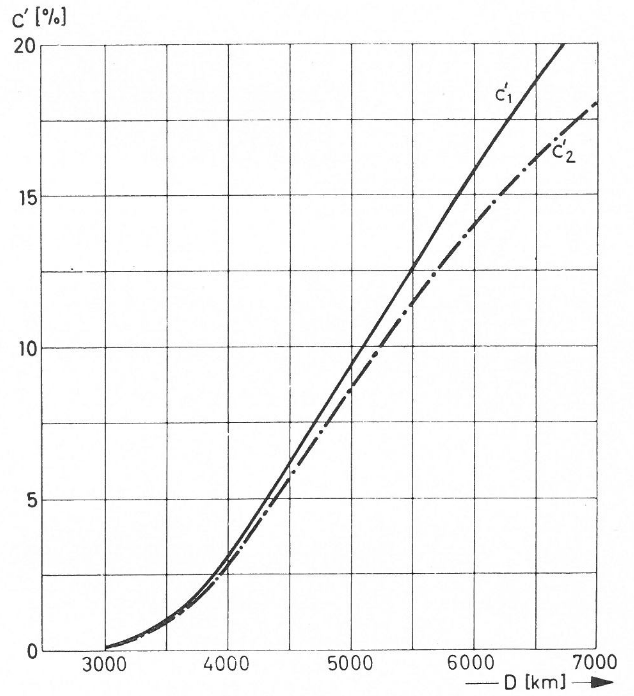


Fig. 10. — The coverage factor c' as a function of the spacing D between transmitters in the same channel.
(c', c'_2 for plane and spherical surfaces respectively)
$p \approx 0.827$ f = 1000 kHz

than those calculated according to [4] (formula *1a*). The deviation may become greater the greater the distances. For shared-channel spacings in excess of 4000 km, therefore, the results discussed here should be utilised with caution.

With the assumptions indicated above, the sky-wave coverage with only one channel is represented in *Fig. 10.* The figure of 0.827 was taken for the coefficient p. A usable coverage is evidently only obtainable when the planning is based on a shared-channel spacing of between 3000 km and 7000 km. It will be seen therefrom that great transmitter density, that is to say, many transmitters and small shared-channel spacings, can be obtained only with a loss in coverage. It is therefore necessary to seek a compromise between the number of transmitters and the degree of coverage.

In evaluating the coverage to be expected on a spherical surface, it is necessary with wide shared-channel spacings, to calculate the coverage factor from the ratio of the spherical surfaces. As with the same length of side, spherical triangles have a larger surface than plane triangles, and as this effect is all the more marked the longer the side of the triangles, there results on the sphere — as shown in *Fig. 10* — a coverage factor which, with the increasing shared-channel spacing, falls more and more below the coverage factor for the plane.

Beyond this, the restrictions indicated in *Table 2* should also be included in the considerations. However, if one considers that only about 30% of the Earth's surface, that is to say, the land areas, need to be covered, and if endeavours are made to let the losses in coverage, which are due to the transition to the sphere, occur only at places where no coverage is

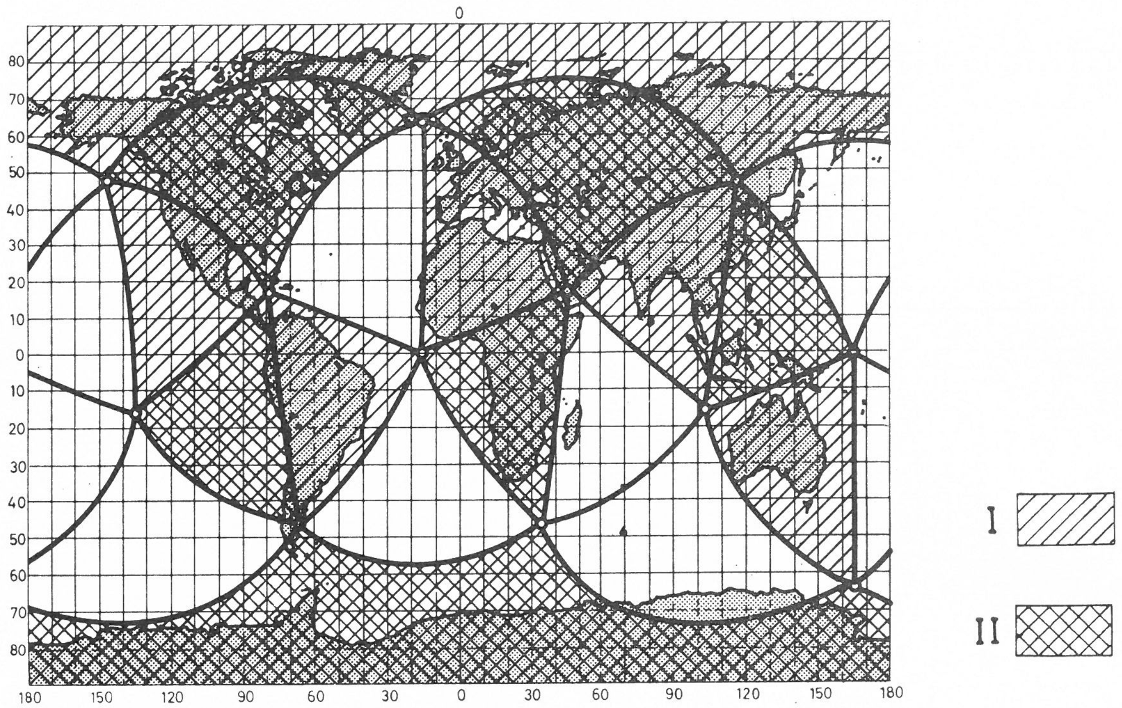


Fig. 11. — Example of a network constituted by representing the Earth's surface as an icosahedron.

required, it is possible to use the curve depicted in *Fig. 10* for the coverage factor over spherical ground for evaluating the broadcast coverage in the MF band.

An example, which is given only to illustrate the possibilities of planning, is shown in *Fig. 11* in the form of a spherical triangular network derived from the icosahedron and rotated into a suitable position. Twelve of the twenty surfaces, which in the illustration are hachured alternately in two different fashions, cover the continents almost completely. The channels available may be distributed six times each in a linear channel arrangement, in the development of the original icosahedron as in the plane. The loss of coverage remains ineffective, because when fixing the network, use was made of the fact that about 70% of the Earth's surface is covered by the oceans.

An adaptation even further to practical requirements — as in the UHF band [1] — is possible because, by suitable distortion of the lines of the network, the wish for irregular transmitter density can be taken into account. Beyond this, such a distortion of the basic network makes possible an adaptation to the shape of the continents.

4.4. *Significance of the results.*

The coverage factors that may be obtained with broadcast coverage in the MF band depend on the way in which the channels are distributed and how often they are used. Taking into consideration the fact that a given channel may be repeated only on every second triangular surface and assuming that all the Earth's continents may be covered with 50% of the triangular surfaces, the figure *N* of transmitters in each channel is exactly one quarter of the number *a* of triangular surfaces of the approximation body. However, from the number of triangular surfaces, not only the number of transmitters *N* that are possible in the same channel may be determined, but also the shared-channel spacing *D* and thus the coverage factor *c'*, as well as the transmitter power *P* required for a given minimum field-strength. Only *one* of these four parameters that are of importance in planning transmitter networks may thus be chosen freely*.

In *Figs. 9a* to *9c*, the relationship found between the separate parameters for the frequencies 500 kHz, 1000 kHz and 1500 kHz is represented. The curves may, however, be used only for assessing the general behaviour, as reliable propagation information for determining them was not available in all cases. On the other hand, the practical application of the planning method underlying the evaluation of coverage, appears to be proved. The flexibility of the method is deemed to be great enough to permit additional planning requirements to be taken into account to a large extent.

* *Example* : If a transmitter power of P = 1000 kW is chosen, the following figures are obtained with f = 1000 kHz:
for F_{min} = 60 dBμ : D = 5200 km, N = 10, c' = 9.5%
for F_{min} = 74 dBμ : D = 3500 km, N = 23, c' = 1%.

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THE TECHNICAL AND AESTHETIC ASPECTS OF STEREOPHONY
studied by the first "Sound Broadcasting Working Conference"

*by R. CONDAMINES **

Summary

On the occasion of the *International Festival of Sound*, there was held in Paris a Sound Broadcasting Working Conference, whose purpose was the theoretical and practical treatment of the awkward problems of sound studio operations and reproduction.

The agenda included the technical and artistic aspects of directional assessment in stereophony. The participants examined the several problems presented, and their influence on studio practice and the subjective quality of reproduction. A comprehensive discussion, illustrated by demonstrations, drew attention to the relative merits of intensity and phase stereophony. A detailed research programme for 1969 was organised, its subjects being the close-up and lateral movement in stereophony.

1. The Sound Broadcasting Working Conference.

1.1. *Introduction.*

An international festival of Sound, High-fidelity and Stereophony is held annually at the beginning of March in the Palais d'Orsay in Paris ; it is a key event for the sonic arts and the occasion of useful international discussions. Many broadcasting organisations present the more noteworthy of their productions, under conditions which enable the public to appreciate their quality to the full.

This year, it was found necessary to extend this essentially artistic festival by a working session for the specialists who were participating, the purpose being more specifically the theory and practice of sound studio operations and sound reproduction. This meeting, which was called the Sound Broadcasting Working Conference, was attended by representatives of the following European broadcasting organisations :–

Radiodiffusion-Télévision Belge (R.T.B./B.R.T.)
Ceskoslovensky Rozhlas
Office de Radiodiffusion-Télévision Française (O.R.T.F.)
Norddeutscher Rundfunk (N.D.R.)
Magyar Radio es Televizio
Radiotelevisione Italiana (RAI)
Sveriges Radio (S.R.)
Société Suisse de Radiodiffusion (S.S.R.)
British Broadcasting Corporation (B.B.C.)
Jugoslovenska Radio-Televizija (J.R.T.)

The technical part of the meeting was organised by the O.R.T.F. Acoustics Laboratory, but the conference itself was integrated into the more general context of the International Festival of Sound.

It is intended in this present article to analyse the problems raised and the consequent exchanges of views, together with the solutions or remedies proposed.

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1.2. *The subjects studied.*

The purpose of the meeting was to organise closer collaboration between research departments and operational departments ; it amounted to sharing the difficulties and finding constructive solutions to them.

To that end, the following general working procedure was adopted : a limited study theme was determined for treatment by each broadcasting organisation, depending upon its means, the results to be presented and discussed on the occasion of the next meeting. The term " means " was taken to include artistic and technical facilities, as the treatment of the theme might entail the development of special equipment.

For the first meeting, the theme proposed was the following : " The technical and artistic aspects of directional determination in stereophony ". During the first session, it was found possible to derive some general considerations, such as :

- the influence of the studio,
- the listening conditions,
- the production conditions,
- reverberation and echo-rooms,
- directional determination and the impression of space,
- diffusion and precision in music,
- the purpose and quality of stereophonic reproduction,
- drama programmes,
- compatibility.

The second session was devoted to the selection of subjects for future research ; a comprehensive discussion on the notion of the stereophonic sound-image took place, bringing out the following points :

- movements,
- the role of the imagination,
- some special problems.

2. Study of directional determination.

2.1. *The sound studio.*

The studio should, of course, be as good acoustically as possible ; the practical task can then be exclusively that of determining the best relative positions for the microphones and sound sources in the context of good technical quality, and not of trying to avoid the systematic shortcomings inherent in a badly-designed studio.

For stereophony, the requirements are not different from those for monophony ; the reverberation may not be much lower.

It should nevertheless be observed that the number of studios is limited and they cannot be specialised.

There results from this in any case a difficulty common to all forms of art : the microphone arrangements have to be adapted to reverberation conditions that are not ideal.

In order to obtain good quality sound when recording disks, it may be necessary — independently of the choice of the best studio available — to correct the bass in the recording process.

Mention was made also of the possibility of obtaining better technical quality for the " television listener " than for the audiences in the studio itself. Such a result might be caused by a lack of acoustic homogeneity in the studio, but such a judgement of value is too absolute in the present state of the technique. It would be necessary to determine in advance what one ought to hear, and also the ideal sensation for a listener in the studio. It would also be necessary to take into account the role of sight, and observations behind a curtain might perhaps make it possible to improve more effectively the "blind" nature of pure listening.

2.2. *The listening conditions.*

The problem of the listening area is very important in stereophony, but it needs to be postulated properly : does the listener place a high priority on precise directional determination, or does he place it rather on the effect of space or just pleasant listening ? In this latter case, the listening area is fairly wide, although always less than for monophony.

The RAI presented a system using four loudspeakers, which made possible a substantial increase in the stereophonic listening area, as was demonstrated by means of recordings made by the Turin Symphony Orchestra.

It was also pointed out that, for a listener to a drama programme, the effect of spatial distortion is extremely important. It is less evident in stereophonic listening, partly because man is conditioned to hearing "naturally" under a wide variety of conditions, with the result that the mind tends to compensate to a large extent the objective shortcomings.

It was suggested that, in the control cubicle (and for demonstrations) the precise evaluation of the listeners' conditions should be effected by listening using ordinary receivers on the market.

2.3. *Production conditions.*

A stereophonic programme, irrespective of whether the preferred objective is directional location or the impression of space, requires a rather large number of rehearsals, and this requirement is not always met.

In order to build a composite programme of disk-recordings and live items, it is often necessary to plan the live items in a similar style to that of disks and, in such cases, intensity stereophony has to be employed. Generally speaking, it is necessary to allow a certain flexibility of approach *vis-à-vis* the theory and preconceived ideas., and to adopt operational methods which enable each case to be treated individually.

2.4. *Reverberation.*

A very interesting exchange of views led to the question of the use of natural echo-rooms, which provide much better facilities than reverberation plates, which have a characteristic *timbre* that is not always desirable. The plate method has been improved (by the R.T.B.) by the use of a first " reflection " delayed (by 35 ms) and isolated ; the feed to the plate itself is delayed by 50 ms. In this way, the impression of space, which results to a large extent from the first reflections, is obtained.

There is also a great deal to be done to improve natural echo-rooms , the positions of the microphones and loudspeakers could be specified definitely, but an alternative technique would be to treat the echo-room as an appendage to the studio and to arrange the lay-out of the microphones and loudspeakers for each individual utilisation. This practice would necessitate a close spacing of the studio and its echo-room, which would not always be possible, although very desirable.

Proper echo-rooms are expensive, but it is not necessary that they should be very large, provided that the sound is well diffused in them (helped if necessary by suspended rigid plastic sheets).

The use of reverberation in stereophony makes it possible artificially to give the impression of movement, which leads again to the question of directional location.

2.5. *Directional location and the impression of space.*

What should be understood by the term " directional location " ? One may have recourse to a parable. Imagine a well-trained rat which, under the influence of a stereophonic stimulus, detects the directional bearing of a group of musical instruments, and translates this impression, for the benefit of the observer, into some conventional signal as a result of previous conditioning. Such a " listener " will, needless to say, not appreciate the aesthetic nature of the music, but will nonetheless perceive from afar the directional stereophony. This parable is intended as a warning against improper use of the angular distribution which was commonplace in the earliest days of " stereo ". It was also mentioned that Berlioz himself conceived his Requiem primarily as a complex of sound volumes, the localisation of orchestral groups being the means, rather than the end.

Some participants at the conference considered that the production of an effect of space was more important than the purely directional effect, but these two sensations are in no way mutually exclusive, and the resolving power of good stereophony should not be under-estimated. Examples given by the N.D.R. showed that an excellent compromise between the two concepts can be achieved.

2.6. *" Woolliness " and precision.*

The value of a certain degree of " woolliness " should not be disregarded ; the sound sources may succeed in filling the whole of the space, but one must be able to distinguish simultaneously several of them.

In stereophony, it is necessary to avoid confusion due to incorrect editing, and to work on the basis of the following precept : " the listener is blind, but he must be made to forget that he is ". In other words, woolliness and precision must be combined so that the resulting sensation, to the ears alone, is equivalent to those that would be experienced in other circumstances through the ears and the eyes.

2.7. *Objectives and qualities of stereophonic reproduction.*

A solution has to be found for the dilemma " space or direction ", and these two groups of sensations have to be used as best they can, depending upon the objective chosen.

Musical programmes were discussed to begin with, but the problem of dramatic programmes is also an interesting one (it will be discussed further later). From general considerations, the listener perceives sources of sound and he ought to be able, if he so desires, and if that was the intention of the producer, to determine their directions. However, in no case must this possibility become an obligation.

Stereophony in itself provides an improvement in listening, which can be recognised even outside the conventional listening area, for example, in an adjacent corridor when the listening-room door is open ; it gives an illusion that the sources are really physically present in the room itself with the listener. These several sensations may, furthermore, have different values for different persons, whether they be producers or listeners; it is preferable, in order to give stereophony the widest possible field of action, to consider it as a technique using two transmission channels and multiplying, in various fashions depending upon the circumstances, the possibilities of monophony.

2.8. *The case of dramatic programmes.*

The problem of directional location appears to be much more important for dramatic programmes than for musical programmes ; in other words, one approximates more to the rat than to Berlioz. A dramatic work does not have to be designed as a succession of " more or less spacious moments ", but as a whole. Thus there arises a problem of notation.

The listener must not be misled. It is necessary to give him the necessary and sufficient directional information, and to avoid confusion between two well-defined directions. One may also (according to the S.S.R.) go and mark guide lines which the actors have to follow on the studio floor, after rehearsal, as the sound perspective changes.

2.9. *Compatibility.*

This is the requirement that the monophonic listener should not be displeased; it is necessary to provide him with programmes of good technical quality, notwithstanding that they are produced for broadcasting stereophonically. It is very difficult to achieve the best possible quality for both monophony and stereophony at the same time, but it is not necessary to attempt that. Priority has to be given to stereophony in order not to restrict its progress, taking whatever precautions are needed to achieve *practical* compatibility.

It was stated that the compatibility is less good to the extent that special effects are utilised. In natural stereophony, the compatibility is good.

A distinction ought really to be made between technical compatibility and aesthetic compatibility. By recreating the relief, internal conflicts and realistic programmes, indeed all those subjects whose appreciation would be more difficult in monophony, and even difficult to accept, can be handled without fear of confusion.

All these considerations show that it is essentially a question of proportion and experience ; in practice, sufficient compatibility can be provided.

3. **Determination of new subjects for study.**

3.1. *Movement.*

The problem of the use of movement of sound sources derives from that, more general, of the art of broadcasting the spoken word. Everything on the dramatic plane has yet to be discovered : the method of notation and the creation of a sound-universe. In the first place, one should deal with very simple sound sources and determine to what extent various movements can have renewed interest. The microphones, too, might be moved relative to the sound sources such as the actors.

Rising and turning movements may already be simulated, sometimes by the use of certain frequency tricks. The O.R.T.F. demonstrated a sequence constituting a " travelling " sound shot, using as the source a kind of rotary rattle. The heavy footfalls of a man climbing a staircase gave, without any modification of the frequency response, a very clear impression of rising. It may indeed be an exclusively subjective effect, as sounds of this kind are in our mind inseparably associated with going up a steep staircase. The change of height was perceived differently, depending upon the position of the observer, but in all cases quite unmistakably. The same applied to circular movement, except for observers located well to one side.

In order to simulate the desired movement, it is necessary to take into account the proximity distortion of the pairs of microphones ; much work has yet to be done in this field, and special attention will have to be given to the following point.

3.2. *Role of the imagination.*

The role of the imagination seems probably to come into play in the perception of height, although the physiological theory is far from having reached a state of advancement such that this or that interpretation can be chosen at will. However, the theories of sensation and perception are one thing, putting them into effect is quite another, and the imagination is certainly involved in the latter. A movement perceived " physiologically " takes on a particular meaning as a function of the context.

It may be mentioned that stereophony, although offering wider possibilities for programmes, does not restrict the imagination ; on the contrary, it increases its possibilities.

The considerations might make it possible to deduce a law, namely that the imagination should always be applied beyond the limits of the technical facilities available. Stereophony having presented new possibilitics, the imagination must itself make progress in order to keep ahead. The application of this continuous advance of the imagination to the problems of the art of broadcasting is a continuing task for those responsible for sound research ; working conferences such as the one under discussion provide a very useful occasion for outlining the successive phases of that task.

3.3. *Special problems.*

The discussion then focused on the selection of the next theme for study, and this brought to light a number of extremely interesting problems, precisely at the boundary between technique and imagination.

a) *The " point of sound ".*

This concerns the treatment in space of a point source of sound as a function of its subjective impact. Can a " point of sound " be moved across the stage ? Can a voice play with an object that is imagined in space ?

b) *Penetrating movements.*

This concerns objects which approach the observer at high speed, such as the yellow lines painted on the road, which fly past when one travels in a car.

c) *Rapid movement.*

Hitherto most work has been done on slow movement, but rapid movement towards the loudspeakers is also of great interest. It is necessary to discover its aesthetic implications.

d) *The listening area.*

It is necessary to eliminate to the greatest possible extent the necessity for the observers to arrange themselves in Indian file in order to appreciate the stereophonic effects of the movements of the sound sources. The perspective, resulting from the impressions of width and height, must not be wrong.

e) *Balance of the directional and space effects.*

It is necessary to find examples of programmes wherein one or the other of these effects is predominant, and to study the variations of this balance as a function of the place of observation and of the quality of the loudspeakers.

f) *Close-ups.*

What is the emotional value of the close-up in stereophony ? It is necessary to study the different dramatic intensities of the close-up, to determine how to avoid spectral modifications of the voice and to study its possible applications in music.

4. **Conclusion.**

This working conference of broadcasting specialists provided the occasion to determine the situation of stereophony, a new mode of expression, and to sketch the outline of its study. With a view to the efficacy of the discussions and the exchange of experience, the participants adopted a very precise theme, namely : " To deal thoroughly, on the basis of each organisation's own technical and artistic facilities, with these two items :–

a) sideways movement at various speeds,

b) the problem of the close-up in stereophony. "

Close contact is to be maintained between the organisations that can collaborate in this work.

LIST OF LF/MF BROADCASTING STATIONS

The twenty-second edition of the List of LF/MF Broadcasting Stations published annually by the E.B.U. has just been printed. This document, printed by a mechanographic process, contains data about the stations, some 1469 in all, in service in the European Broadcasting Area on 1st May, 1969, obtained from official sources and from observations by the E.B.U. Receiving and Measuring Station at Jurbise. The List also gives details of the 1140 LF and MF stations, entered in the Copenhagen Plan and in the I.T.U. International Frequency List.

As in the previous edition, this document contains a list of the frequencies of all the transmitters in the spectrum and is classified by country, the station in each country being listed by order of frequency, with an alphabetical index. The frequencies of the transmitters are given to the nearest kilohertz. The List includes a chart reproduced opposite page 138, showing the situation in the spectrum.

Orders for this List, which is priced at 200 Belgian francs, including postage by surface mail, should be addressed to the E.B.U. Technical Centre, 32, avenue Albert Lancaster, Brussels 18 (Belgium). The price covers the cost of a map and six supplements sent out every two months.

INTERNATIONAL NEWS

INTERNATIONAL TELECOMMUNICATION UNION

International Telegraph and Telephone Consultative Committee (C.C.I.T.T.)

Meeting of Working Party 2 of Study Group IV (Maintenance). — This Working Party met at Geneva from 13th to 18th March, 1969, with Mr. D. Lindström (Sweden) in the Chair, for the purpose of dealing with Questions 10/IV, 11/IV and 13/IV. It had, in particular, to put in hand a study of the specifications for automatic transmission-measuring equipment and for automatic measuring equipment for sound programme transmission circuits. A further Question, 12/IV, was added dealing with automatic noise-measuring methods.

Specifications for measuring equipment (Question 10/IV)

The work undertaken in this fied concerned equipment for measuring group delay ; it was also necessary to find a compromise solution between the testing methods used in North America and Europe. Plans were made for further studies relating to frequency selection instruments, sweep-frequency variants of general-purpose instruments, noise generators, psophometric voltmeters for noise measurements other than for speech or sound transmission and instruments for measuring non-linearity distortion on sound programme transmission circuits.

Automatic transmission-measuring equipment (Question 11/IV)

The work at the meeting was concerned with a detailed specification of automatic transmission-measuring equipment, intended for the maintenance of automatic telephone circuits.

Automatic noise measurement (Question 12/IV)

In the case of automatic measurements, it is desirable that they should be made in as short a time as possible. This rule applies equally to the measurement of noise. It was therefore recommended that, on circuits of the types used for telephone traffic, measurements of steady noise should be made for a period of approximately 475 ms, using a detector having a time-constant of 200 ± 50 ms.

Equipment for the maintenance of sound programme-transmission circuits (Question 13/IV)

This question has, of course, a special interest for the broadcasting organisations. A small working party dealt with automatic measuring equipment for use on programme-transmission circuits ; there existed already a specification for equipment working on the analogue principle, and to this was added a specification for equipment working on the digital principle, as was requested by the Sound Sub-group of E.B.U. Working Party M at its meeting in Copenhagen in November, 1968. The report of a small working party, which comprised representatives from Italy (RAI), the Netherlands, Switzerland and the United Kingdom (B.B.C.), under the chairmanship of Mr. Gallenkamp (Federal Republic of Germany), set out in general terms the method of digital working to be adopted. The amplitude/frequency response is to be sampled at eleven frequencies and a small marker placed on the analogue representation of this response. The receivers will be slaved to the sender, and there will be optional provision for remote control over a telephone circuit.

The RAI submitted a working paper describing a novel method of measuring non-linearity distortion on sound circuits, using very brief signals of high level. The transitions of the test-signals are shaped before the signals are applied to the circuits, in order to reduce the risk of causing interference with other circuits. As an interim measure, it was decided to provide, in the automatic measuring equipment, for the non-linearity test proposed by the Federal Republic of Germany, so that further consideration could be given to non-linearity distortion measurements.

Although provision is made in the automatic measuring equipment for making measurements on stereophonic circuits, the details have not yet been settled. Discussions are at present in progress between the E.B.U. and the C.M.T.T. regarding the tolerances required for the characteristics of such circuits.

The details of the complete specification for digital/analogue working will be settled by correspondence between the members of the small working party during 1969, and a document will be issued in time for the next meeting of Working Party IV/2, in 1970.

CANADA

Problems of differences of local time. — As Canada extends over five time-zones, and all the television programmes of the Canadian Broadcasting Corporation in the English language are originated at Toronto, there has always been a problem connected with the timing of programme items for broadcasting at the same local time in all the zones. The problem was partially solved by the C.B.C. some years ago*, when a

* See *E.B.U. Review*, No. 48-A (March 1958), pp. 25-26.

Network Delay Centre was set up at Calgary (Alberta), where the television programme items received from Toronto were tape-recorded and replayed later at appropriate times for broadcasting by the stations in the western Provinces. To cover the eastern parts of Canada, whose local time is one hour ahead of that of Toronto, arrangements have recently been made for programme items to be transmitted from Toronto to Halifax (Nova Scotia) in advance of their broadcast at Toronto ; they are tape-recorded at Halifax and broadcast locally at the appropriate times.

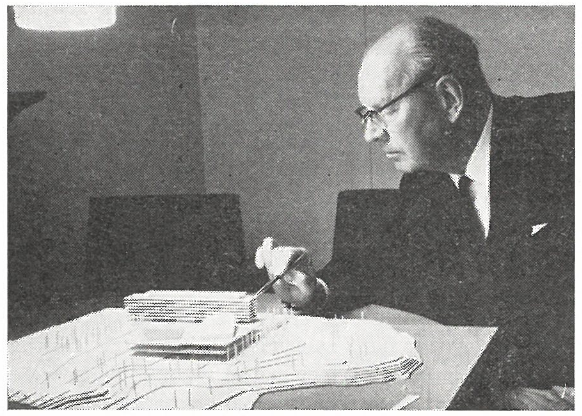
Colour-television production facilities. — The C.B.C. is at present engaged in systematically modifying or replacing its television camera chains, film-scanners and tape-machines in order to render them technically and operationally compatible when used in conjunction with the most recent colour equipment. Two colour OB vehicles are being modified to accommodate six cameras each, in order to provide more adequate coverage, in English and French, of national and international sporting and other events.

FINLAND

Sudden death of Paavo Arni. — We learnt with very sincere regret of the sudden death, on 28th May, 1969, of Paavo Arni, Director of Engineering of Yleisradio. He was sixty-four.

Born at Viipuri, Paavo Arni obtained his engineering degree in 1930. He joined Yleisradio in the following year and became Director of Engineering in 1964. He was one of the pioneers of acoustics research in Finland and he was personally responsible for the acoustic design of the many sound and television studios in that country, and notably those in Helsinki and at Pasila, as well as of the acoustics laboratory at Pasila, which was completed last year. In addition, he had a private consulting practice, and was the acoustics designer of, among others, the concert hall of Turku and that of the Helsinki Cultural Centre.

Paavo Arni took a great interest in all technical novelties. Thus it was that a demonstration which he organised on the occasion of an E.B.U. meeting in Helsinki in June, 1958, led the representatives of the E.B.U. and the C.C.I.R. to initiate the studies of stereophonic broadcasting. He also planned the tele-



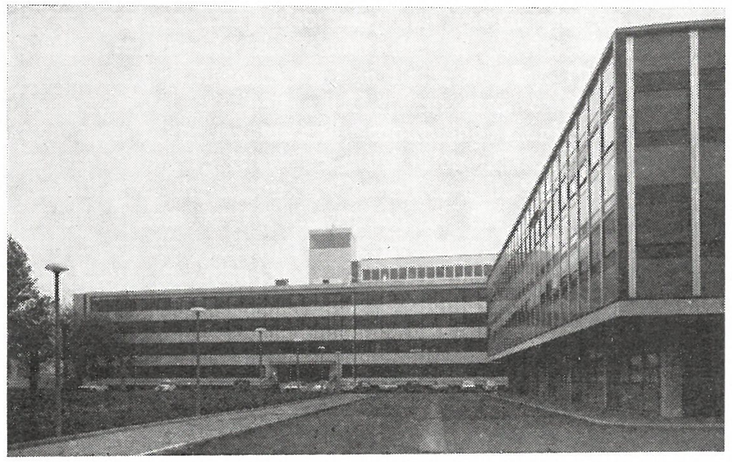
vision networks in Finland and more recently had been taking a keen interest in colour television.

He took part personally in numerous international movements and was a very valuable member of the E.B.U. Technical Committee, being a member of its Bureau for the term 1963-1966.

His cheerful disposition and enthusiastic collaboration will be sadly missed in E.B.U. engineering circles.

FRANCE

The new O.R.T.F. Broadcasting House at Lyons. — On 8th December 1968, the Office de Radiodiffusion-Télévision Française opened a new Broadcasting House at Lyons, built on a two-hectare site at Part-Dieu, formerly occupied by a barracks. It is intended that this district should become one of the cultural and artistic centres of the town. The new building, whose general appearance can be seen from *Fig. 1*, comprises two blocks :–



a) The *main block*, covering a site-area of 3 300 m², accommodates :

– the offices of the Regional Directorate (engineering, administrative and accounts departments) ; they occupy the west front on the ground floor and three upper storeys ;

Fig. 1. — General view of the O.R.T.F. Broadcasting House at Lyons. On the right foreground, is the annex ; in the background, the main block.
(O.R.T.F. photo)

– the sound-broadcasting production centre (on the right in *Fig. 2*).
– the television production centre (on the left in *Fig. 2*)
– the regional programme offices
– the regional news offices
– the outside-broadcast department (with garage for the OB vehicles).

b) The *annex* (to the right in *Fig. 1*) has a site-area of 966 m² and has two storeys. It accommodates certain technical departments, the reception desk, the welfare and first-aid departments, the restaurant, conference rooms and lecture theatres.

Fig. 2. — The east front of the new Lyons Broadcasting House. *Left :* Television Block. *Right :* Sound Block.
(Yves Godard, Lyons, photo)

With the entry into service of these new buildings, the Lyons Region has at its disposal the following production facilities :–

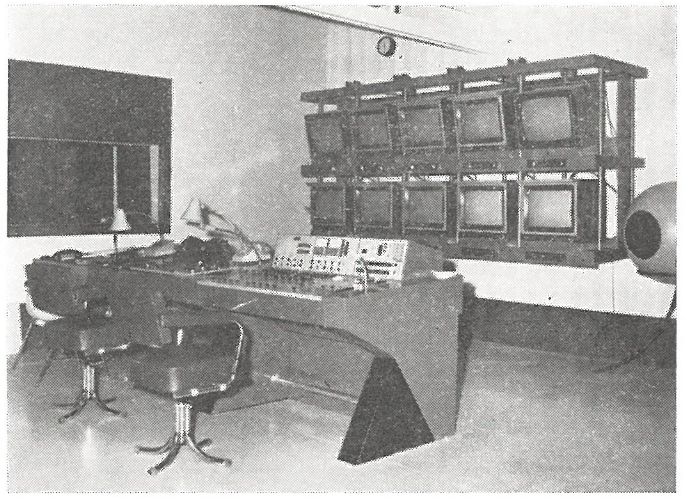


Fig. 3. — The Television News control cubicle.
(O.R.T.F. photo)

a) *Sound Broadcasting :*

– a 500-m³ studio for dramatic and variety programmes
– two 100-m³ studios, with recording and editing rooms, for the spoken word
– outside-broadcasting units.

b) *Television :*

– a studio with a working area of 300 m², with two camera channels
– a vision studio of area 100 m²
– a post-synchronising studio
– facilities for filming : 16-mm and 35-mm film-scanners, developing machine, sub-titling desk, copying unit, cutting table etc.
– an OB vehicle with two camera channels.

In anticipation of the expected expansion of broadcasting activity in the region, a parcel of land has been acquired for future extensions.

IRELAND

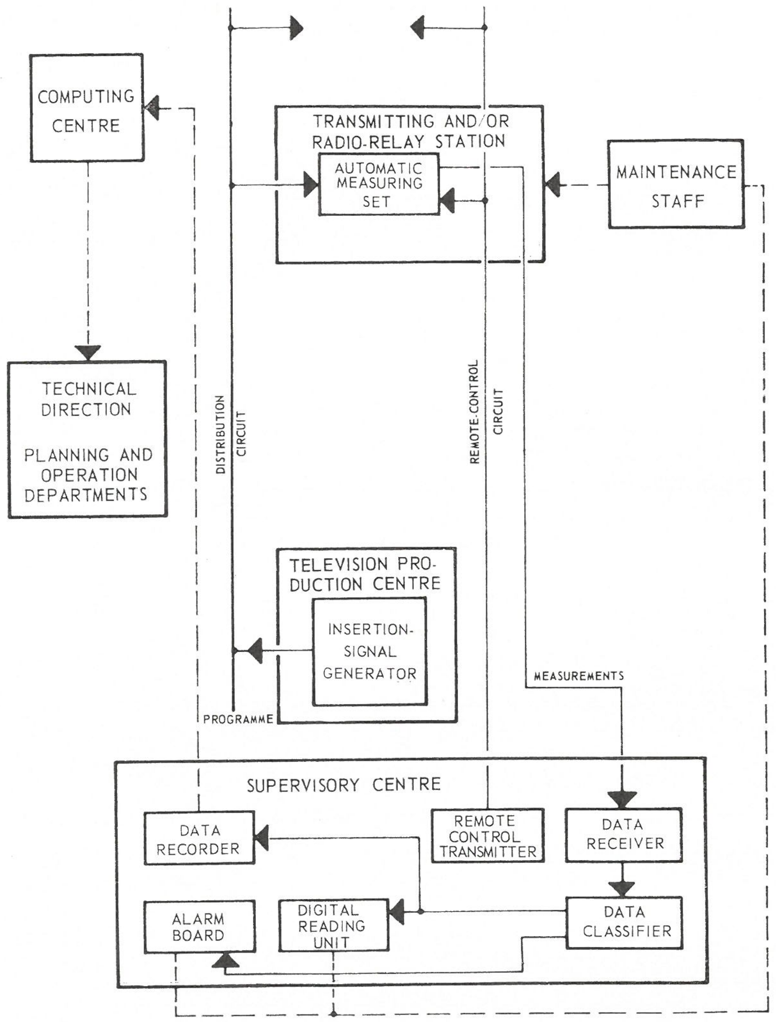
Increase in sound-broadcasting hours. — On 2nd November, 1968, Radio Telefis Eireann increased the total duration of programmes broadcast on its single national sound network to 114 hours weekly, corresponding to a rise of over 18 %. The expansion provides uninterrupted listening from 0730 to 2345 daily, and involves an increase in programme production of approximately 33 %, because at the same time the duration of transcriptions obtained from external sources was reduced by 5 hours 45 minutes weekly.

As no additional studios were available, a number of changes aimed at increasing the productivity of the existing facilities had to be introduced. In particular, the rehearsal time allotted to certain programmes was reduced, and the central tape-recording facilities were replaced by individual installations in each studio control-room, controlled from the mixing desk. The latter arrangement has been found to give an additional benefit in the form of increased operational flexibility.

Start of stereophonic transmissions. — The first stereophonic programmes in Ireland were broadcast from the R.T.E. VHF/FM transmitting station at Kippure, near Dublin, on 13th April, 1969. These programmes, which took place during the normal transmission schedule, consisted of recordings and lasted one hour. Similar test transmissions are being broadcast every Sunday in order to determine the effective service-area and the extent of public interest. The pilot-tone system is used, with encoding at the transmitter.

ITALY

Automatic monitoring of the RAI's distribution network. — The Research Laboratory of the Radiotelevisione Italiana has designed and built a prototype installation for automatically monitoring its television distribution network. The principle of the system consists in transmitting special insertion signals in the field-blanking intervals of the television waveform — in lines 19, 20, 21, 332, 333 and 334 — in measuring automatically the distortion suffered by these signals during their propagation and in transmitting the results of the measurements back to a supervisory centre by means of a data-transmission system.



Block shematic of the RAI's automatic monitoring system for television radio-relays and unattended transmitting stations.

The automatic control system may be described briefly as follows : the special insertion signals are inserted in the television signals at the point of origin of the distribution network, that is to say, the RAI Television Production Centre in Rome. At each station on the network — whether it be a radio-relay repeater station or a transmitting station — the arriving insertion signals are analysed by an automatic measuring set which indicates directly, in binary form, the degree of distortion suffered by the signals. The digital signals thus obtained are transmitted by a data-transmission system at a speed of 50 bauds back to the Supervisory Centre in Rome.

The measurements are made continuously on the whole of the network, at each station in turn as it receives its particular starting signal, these being sent over a telegraph circuit from the Supervisory Centre.

The data arriving in Rome are applied to processing units which cause coloured lamps on a mimic diagram to indicate whether or not certain characteristics are within pre-determined tolerances. It is also possible to obtain a digital display of the actual value of any characteristic which may have actuated an alarm signal by exceeding the fixed threshold value. The data can also be fed into a computer, if it is desired to effect a statistical study of the behaviour of certain circuits or components.

At present, the RAI has a prototype installation undergoing service-trials ; it comprises the equipment necessary to control and supervise five key-points on the network, as well as the data-processing equipment and the mimic diagram.

We hope to be able to publish in the near future an article describing this interesting development in greater detail.

Changes in the Management of the RAI. — The RAI Administrative Council has recently elected Professor A. Sandulli as Chairman, Mr. U. delle Fave as Vice-Chairman and Mr. L. Paolicchi as Director-General. Mr. Paolicchi was hitherto Vice-Chairman. These appointments resulted from the resignation of Messrs. P. Quaroni and G. Granzotto, who were respectively Chairman and Director-General.

JAPAN

Television with double sound. — For several years, the transmission of two sound signals simultaneously with a single vision signal has been the subject of joint research by the Nippon Hoso Kyokai, the National Association of Commercial Broadcasters and the Japanese Ministry of Posts and Telecommunications. Such a system would make it possible, for example, to televise foreign films with at the same time the original sound and a post-synchronised Japanese version, and dramatic programmes with the voices of the actors and commentaries, as well as stereophonic orchestral concerts. In the light of this research, wherein SSB/FM, DSB/FM, AM/FM and FM/FM methods were investigated, the FM/FM method was concluded to be the most suitable.

Service-trials are shortly to be begun from one of the N.H.K.'s educational-television stations in Tokyo, suitably adapted for this purpose. The questions to be settled during these service-trials are the following :–

a) the compatibility of the reception of the principal and secondary programmes

b) the functioning and installation of the adaptors (the design of a device suitable for the general public)

c) the extent of the principal and secondary service-areas

d) the cross-talk between the two sound channels.

The N.H.K. intends to introduce the system in the transmitting stations of its General Television Network in Tokyo and at Osaka, where an experimental double-sound service should begin in 1970. Foreign visitors to the " Expo-70 " in Japan in that year will thereby be able to enjoy the television programmes thus broadcast, by using receivers equipped with the appropriate adaptors.

NETHERLANDS

Band-limiting filter for AM transmissions. — The continuous increase in mutual interference between AM sound-broadcasting transmitters in the MF band is only too well known. It is, of course, evident that there is no means of improving the situation as far as transmitters sharing the same channel are concerned, but the situation can be improved in a comparatively simple fashion for transmitters in adjacent channels, by using a filter to reduce the spectrum of the modulation and, as a result, the bandwidth occupied. As 112 of the 121 channels in the MF band are spaced at intervals of 9 kHz, and as most of the receivers at present in service have passbands that are no wider than that figure, the restriction of the maximum modulation frequency to 4.5 kHz may be considered.

The Research Laboratory of the Nederlandse Omroepstichting has designed an active solid-state filter whose frequency response (*Fig. 1*) is that recommended by the A.R.D.*, the attenuation at 4.5 kHz being 3 dB, thereafter increasing by 66 dB per octave. The first transmitter in the Netherlands to be equipped with such a filter was Hilversum III, working in Channel 81

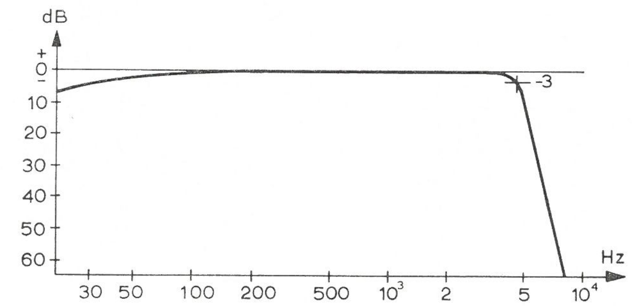


Fig. 1. — Frequency-response characteristic of the band-limiting filter designed by the N.O.S.

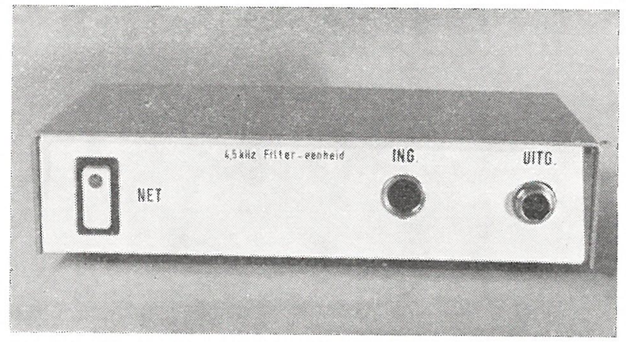


Fig. 2. — The band-limiting filter unit.

(1250 kHz). *Fig. 2* (above) shows the external appearance of the filter.

New Broadcasting Act. — A new Act of Parliament relating to the broadcasting service came into force in the Netherlands on 29th May, 1969. The immediate effect of this was the winding-up of the Nederlandse Radio-Unie (N.R.U.) and the Nederlandse Televisie Stichting (N.T.S.), and their replacement from that date by a single organisation, the Nederlandse Omroepstichting (N.O.S.), which is now responsible for both sound and television broadcasting.

The two former organisations — the N.R.U. in the case of sound broadcasting and the N.T.S. in the case of television broadcasting — had been set up with the function of providing the necessary production facilities

* See Netzband, R. and Süverkrübbe, R. : " The effects of appropriate bandwidth limitation on the transmission and reception of AM sound broadcasting ". E.B.U. Review No. 109-A.

for the several organisations holding licences for broadcasting. They also represented the Netherlands on the international plane, insofar as broadcasting was concerned. Henceforth, all these tasks will be the responsibility of the N.O.S.

The new Broadcasting Act was in fact passed by the Netherlands parliament in the Spring of 1967, but its entry into force was postponed until now, in order to allow the necessary time for a number of preliminary measures to be put into effect.

PORTUGAL

Expansion of E.N.R. facilities in Lisbon. — The site for the new Lisbon Broadcasting House, the plans for which will be finished in 1970, has now been finally selected, at the northern extremity of Avenida da Liberdade, the principal axial street in Lisbon.

Recent expansion of the facilities of the Emissora Nacional de Radiodifusao has made it necessary to adopt a temporary solution until the new Broadcasting House is built, and for this reason the E.N.R. has acquired a building in Avenida Duarte Pacheco, where accommodation has been arranged for the Directorate General and the Directorates of Engineering and Programmes, together with the central library, the electronic computer, staff-training department, staff-welfare department, a restaurant and storage.

* * *

The E.N.R. is at present continuing the installation of the new MF transmitters mentioned in E.B.U. Review No. 110-A (p. 194). One of these regional transmitters, having a power of 100 kW to serve the northern part of Portugal, was taken into service near Oporto in February, 1969. It is working on a frequency of 719 kHz.

On the left : The building recently acquired by the E.N.R. as its Lisbon headquarters until the new Broadcasting House is built.

Below : The Computer Room in the new E.N.R. building in Lisbon.

UNITED KINGDOM

New I.T.A. transmitter for the London area. — The first of three new television transmitters, which will replace the equipment installed originally when the Independent Television Authority began its transmissions in the London area in September, 1955, was recently delivered to the I.T.A. station at Croydon. This station, operating in channel B9, serves an area containing more than 4 million homes, representing a potential maximum audience of between 13 and 14 million viewers. The new equipment is expected to become operational in mid-1969.

The new transmitter units will comprise three 5-kW Pye vision transmitters together with the associated sound transmitters, combining units and aerial-switching

units. At any given time, two of the pairs of sound and vision transmitters will be connected to the directional aerial on the existing 150-m tower, with the third pair available in reserve. The ERP of the Croydon station will remain unchanged at 350 kW.

The new building in which the VHF transmitters are now being installed will also house a Colour Control Room, from which the I.T.A. channel-23 625-line UHF transmitter shortly to be installed at the near-by B.B.C. Crystal Palace station and several rebroadcast transmitters will be remotely controlled.

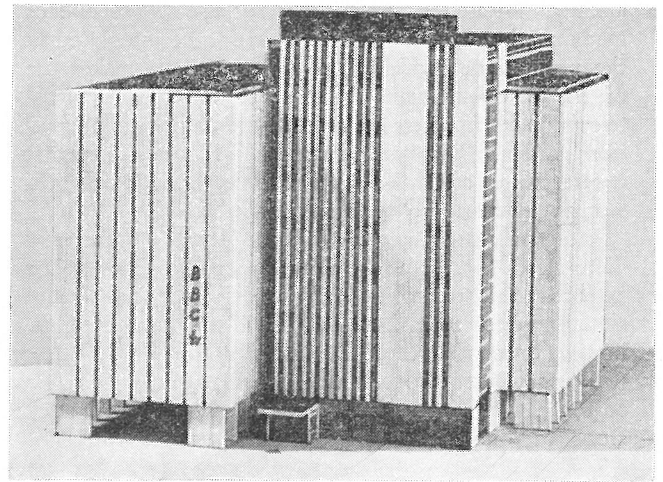
Work at the I.T.A. Croydon station has thus now reached the second phase of a three-phase operation ; phase 1 consisted of the erection of the new building, phase 2 concerns the installation of the technical equipment, and phase 3 will cover the demolition of the old building and the restoration of the amenities of the site.

B.B.C's new Television Rehearsal Centre under construction. — Work on the site for the B.B.C.'s new Television Rehearsal Centre in West London, not far from the Television Centre, began in the autumn of 1968. It is due to be ready for operational use in the late Spring of 1970 and will help to solve the problem of rehearsal accommodation for the Television Service which, at the present time, is provided in miscellaneous halls, clubs and churches throughout the Greater London area. The intention is to provide eighteen sound-proof rehearsal rooms of sizes which simulate, as economically as possible, average Television Studios, and to include producers' offices, " green rooms " and catering and toilet facilities for some 400 persons, together with rehearsal property storage having easy access to all rehearsal rooms, as well as parking for 140 cars.

As inquiries in Europe and the United States suggested that no " purpose-designed " building for this use has previously been built, the new premises, which will have a total area of 9000 m², were designed by the B.B.C.'s Building Department in the form of an eight-storey building. The ground floor comprises entrance hall, administrative offices, cloakrooms, boiler house, oil store and a partly covered car park, in addition to the large rehearsal property store. The last is connected to the rehearsal rooms on the upper floors by means of a goods lift centrally placed in relation to them. A main staircase and two passenger lifts rising from the entrance hall provide access to the upper floors for staff and performers.

The plans of floors 1 to 6 are identical, each level containing one 24 m x 15 m rehearsal room, two 21 m x 15 m rehearsal rooms, three 8-m² producers' offices and one 45-m² green room. A large sound-absorbent lobby and a small individual lobby give access to all rehearsal rooms and provision is made at each level for cleaning, painting of floors, telephone facilities and refreshment services.

In general, the floors are to be finished in a manner similar to those of television studios, but the rehearsal rooms on the first floor will have hardwood-strip flooring on battens to provide a more resilient surface for ballet and similar rehearsals. The seventh floor will be devoted entirely to the restaurant, kitchen and ancillary areas, with a large open-air terrace on the south side. Provision has also been made at this level for the possible future addition of a review theatre and a club. Double-glazed windows with an opening section will be provided for all rehearsal rooms, thus maintaining a reasonable degree of sound insulation from external noise, as no rehearsal-room windows overlook the adjacent main road.



A photograph of the model of the Television Research Centre, being built near the B.B.C.'s London Television Centre.

(B.B.C. photo)

The building will have a steel frame, supported on ninety-three concrete piles bored to a depth of 16 m, and ground beams. The floors will be of precast concrete having a floor-loading capacity of 400 kg/m² and are spaced to allow a clear working height of 3.5 m in the rehearsal rooms. The finish of these areas will, in general, be fair-faced brickwork, and cavity construction will be used on common internal walls between them.

The flush false ceilings of all rehearsal rooms will be faced with fissured mineral-fibre tiles in an exposed metal grid carrying recessed lighting fittings to give 30 lumens at 1 m 20 above floor level.

The external facades will be dark blue brickwork from ground to first-floor level, above which will be a combination of smooth-finished concrete ribs infilled with metal windows and exposed sand-coloured concrete panels contrasting with similar panels, of a different colour, on the unperforated external walls.

Synchronisation of colour outside broadcasts by broadcast insertion signals

by R.J. BUTLER *

The National Broadcasting Company is using, on an experimental basis, a novel method of synchronising for colour-television outside broadcasts taking place within the effective service area of a television broadcasting station. Complete system experiments have already indicated its practicality for use where one or many nearby outside broadcasts have to be integrated in the programme produced in the studios. It makes use of the wideband transmission path provided by local television transmitters and takes advantage of the insertion test-signals in current use in the United States. It is referred to as VICG (Vertical Interval Color Genlock-*vertical interval* = *field blanking*).

Insertion test-signals on lines 18 and 19** are now distributed along commercial network routes, and may be extented to the transmitters. *Fig. 1* depicts special control signals for insertion in lines 18 and 19 of both fields, in the place of the present test-signals.

Normal burst-recovery units separate the eight cycles of the chrominance sub-carrier frequency (3.58 MHz) from the line back-porch, in order to lock an oscillator at the OB point. In the field-blanking system, approximately 180 cycles of sub-carrier are extracted from either line 18 or 19 of each field to supply locking information. The block diagram (*Fig. 2*) illustrates the method by which the sub-carrier is added and recovered from the field-blanking interval. The synchronisation of the vision signals arriving at the control centre are compared with the station synchronising signal ; if the error is small (less than one line), the VICG control-switch introduces an offset sub-carrier in place of the original reference (3.58 MHz) on what is called the *phasing line* in the field-blanking interval. This signal is added to the video signal feeding the television transmitter. At OB points within the coverage area of the transmitter, the RF signal is received and demodulated, recovering both the picture signal and the insertion control signals. A special VICG gate derives an appropriate control signal from the sync. recovered from the broadcast signal. Separation of the correct line in the field-blanking interval is accomplished in the line-selector circuitry. Receiving the 180 cycles of sub-carrier from the line selector, an AFC circuit integrates the information and applies it to shift the OB oscillator slightly off nominal frequency. Since the time-base of the OB signal is then no longer equal to that at the control point, displacement in the line sense will occur ; the frequency offset (either higher or lower than the nominal), will determine the direction of this displacement. At the precise instant of time when the OB sync. signal coincides with that of the locally generated pictures, the VICG switch will re-establish reference sub-carrier on the phasing line. Both local and OB points will remain locked in phase unless the insertion signals are interrupted.

* Mr. Butler is with the National Broadcasting Company, New York.

** Lines 18 and 19 (in both fields) of the 525-line waveform are allocated to " national transmission testing " in the United States of America.

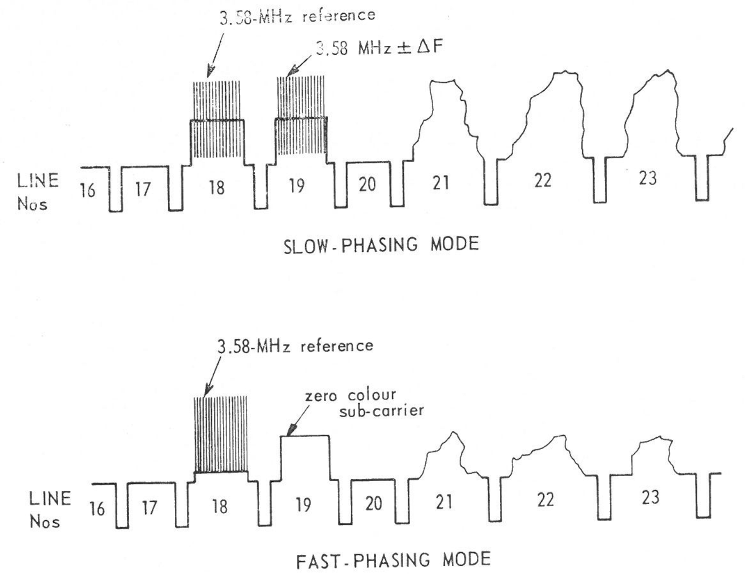


Fig. 1. — Modified insertion signals used by the N.B.C. for synchronising television outside broadcasts.

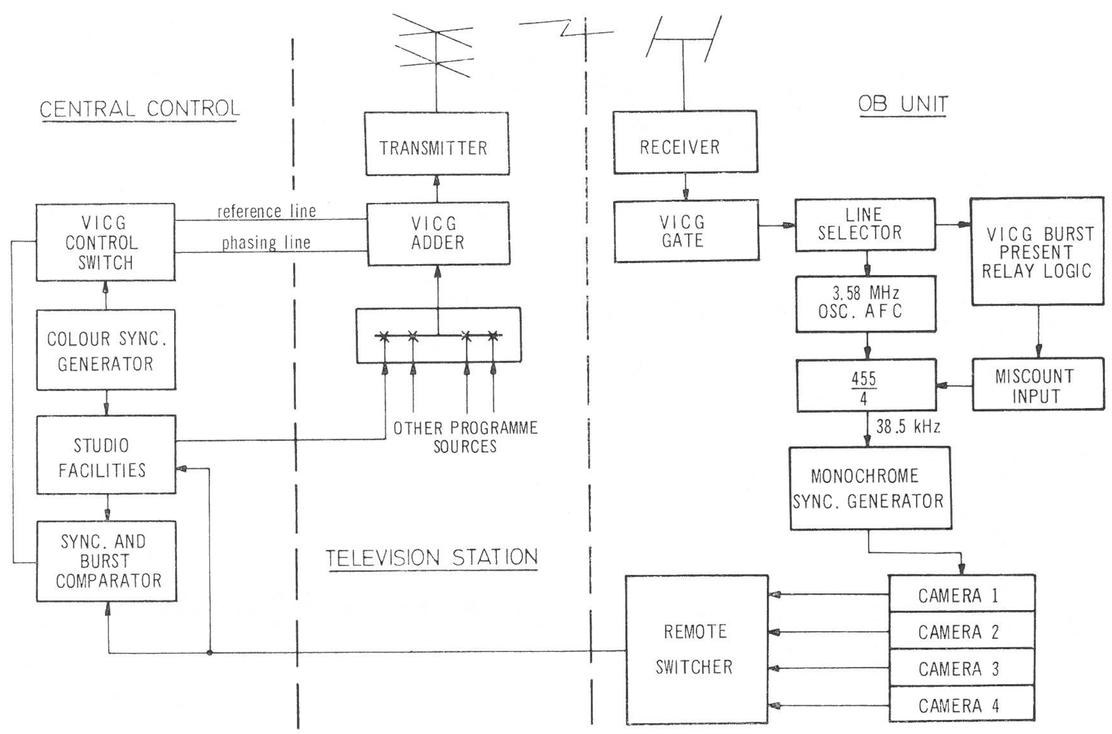


Fig. 2. — Block schematic diagram showing the functioning of the VICG system for synchronising television outside broadcasts by means of broadcast insertion signals.

Corrections of this type are very slow. If the offset is 1 Hz, it will take 3 minutes and 45 seconds to shift by one complete line. A device called the Burst Present Relay Logic associated with the line selector and miscount-input circuits provides for the fast correction of errors exceeding one line. If, on comparison, a large error of the remote signal is detected, all sub-carrier is removed from the transmitted phasing line. A Burst Sensing Relay at the OB unit, changes its state causing a miscount in the chrominance countdown circuits. The direction this miscount takes with regard to the field phase is arbitrary ; reversal can be accomplished by re-applying the burst to the phasing line and then removing it again. When proximity to coincidence is achieved, the offset burst is re-applied to the phasing line by the VICG switch, thereby producing a slow approach to perfect synchronisation. Upon coincidence the reference sub- carrier is re-applied to the phasing line and all displacement stops.

The line selector at the OB point is then switched from phasing line to reference line. The transmission of two lines in the field-blanking interval is necessary in order to phase two or more OB units. Each OB is switched in turn to the phasing line and then reconnected to a reference sub-carrier which never changes.

The VICG system was first tested in October, 1967 between the Brooklyn studios and the NBC Radio City station, New York. Results over a four-hour test-period indicated a total phase drift of the chrominance sub-carrier frequency of 20°, with a short-term instability of 10°. Much of the short-term instability seems to have been due to crosstalk between the broadcast signal and the insertion reference signal. Improvements in the field-blanking interval gate circuitry, it is believed, will reduce this error to 2°.

ABSTRACTS AND REVIEWS

Under this heading we shall mention, in each number, recent publications and a selection of articles published in technical periodicals which seem to us to be of real interest to sound and television broadcasting engineers. We shall restrict ourselves to giving, in a very concise form, an idea of the contents, at the same time indicating its technical level by means of the following symbols.

Level A : articles requiring a knowledge of advanced mathematics or considerable other specialised knowledge on the part of the reader.

Level B : articles corresponding in technical level to the average engineer's training.

Level C : articles that do not call for any very special technical knowledge on the part of the reader.

It must be emphasised that this classification refers uniquely to the degree of difficulty of understanding the articles, and in no way the value of the articles as such. The mention of an article under this heading should not be taken as indicating in any way the E.B.U.'s opinion on the matter in question.

(Editor)

Some noteworthy articles

Gilbert, J.C.G. and Driscoll, R.C. (Northern Polytechnic, London) : **Acoustic absorption materials.**
Wireless World, No. 1402, April 1969, pp. 171-174.

Level C.

Survey of the influence of the acoustic properties of rooms on sound reproduction in them, and methods of modifying these characteristics by the use of absorbent materials. Discussion of various materials in common use; description of treatment applied to the Albert Hall in London to eliminate unpleasant resonances.

* * *

Radjer, A. (O.R.T.F.) : **La prise de son dans les grandes émissions extérieures de télévision** (Sound techniques for major television outside broadcasts).
Télévision, No. 191, March, 1969, pp. 39-42.

Level C.

Conditions under which the sound component of interior and exterior scenes is produced. Equipment and techniques used in various cases : light entertainment, demonstrations (effects and commentary), Eurovision transmissions.

* * *

Kononovich, L.M. and Polbennikova, R.G. : **Some statistical properties of a stereophonic signal.**
Telecommunications and Radio Engineering, No. 7, July, 1968, pp. 102-105.

Level B.

Article translated from Russian. Experimental analysis of the distribution of the volume of stereophonic signals A, B, M and S in various types of programmes. Conclusions from the point of view of the compatibility of recordings on magnetic tape and of monophonic reception (reduction of the mean volume of the M signal), as well as the distortions occurring at high volumes with decoders for the polar modulation system.

* * *

Ilmonen, K. (YLE) : **Loudness of sound broadcasting programmes from the viewpoint of listeners.**
Radio Television (O.I.R.T.), No. 1, 1969, pp. 34-39.

Level B.

Conclusions drawn from the inquiry made into the preferences of the listeners to Finnish radio regarding the volume of different types of programmes under various listening conditions. These experiments and the results obtained have already been the subject of two more detailed articles by the same author published in the E.B.U. Review, Nos. 87-A and 106-A.

* * *

Rezvyakova, Z.N. (Radio & Television Broadcasting Committee — USSR) : **The dynamic range of sound broadcasting signal and its evaluation.**
Radio Television (O.I.R.T.), No. 2, 1969, pp. 22-35.

Level B.

Definition of the dynamic range of a signal and a survey of methods enabling it to be evaluated. Comparison of the characteristics of meters utilised and indications given in various cases. Study undertaken by the O.I.R.T. with the intention of developing a method of evaluation giving useful results with a broadcast-programme signal : characteristics of a standardised meter meeting these requirements. Graph showing results of measurements of the dynamic range obtained for a large number of different types of programmes, obtained with a quasi-peak meter, and with the proposed method.

* * *

Boïanova, M. (Bulgarian Radio) : **Analyse critique des méthodes de mesure des distorsions non linéaires dans les systèmes dépendant de la fréquence** (A critical analysis of methods for measurement of non-linear distortions in frequency-dependent systems).
Radio Television (O.I.R.T.), No. 2, 1969, pp. 36-40.

Level B.

Comparison of methods of measuring three types of non-linearity distortions : harmonic distortion, intermodulation and cross-modulation. Relationship between the measured values for the three coefficients in the case of a studio amplifier, whose operating conditions are defined by the load characteristics. Conclusions on the validity of the methods of measurement used, according to the range of frequencies.

* * *

Kiefer, D. (I.R.T. Munich) : **Ein Entzerrersucher zur experimentellen Bestimmung der Dimensionierung von Allpassnetzwerken** (An equalisation indicator for the experimental design of all-pass networks).
Rundfunktechnische Mitteilungen, No. 2, 1969, pp. 64-72.

Level B.

Description of an instrument in which up to ten variable phase-shift elements can be incorporated. Construction of the phase-shift elements. Examples of the utilisation of the corrector.

* * *

Meier, F.P.H. (N.D.R.) : **Zur Farbwiedergabe im Farbfilm** (Colour reproduction in colour film).
Rundfunktechnische Mitteilungen, No. 2, 1969, pp. 77-81.

Level B.

Study based on the physical and chemical problems affecting the production of a colour picture on film : density, colour saturation. Measurements performed on currently available types of film.

* * *

Peth, H. (Fernseh GmbH) : **Un transcodeur SECAM-PAL produit industriellement** (A commercially-manufactured SECAM-PAL transcoder).
Radio-TV-service, n° 111/112, pp. 4730-4739.

Level B.

Descripion of an all-electronic transcoder intended to convert 625-line colour television signals from SECAM to PAL. Design, based on work by the Deutsche Bundespost and others; separation of chrominance and luminance by a 2.7 MHz low-pass filter; decoding of SECAM with matrixing to produce R G B for monitoring and U, V for PAL coding; automatic selection between PAL sub-carrier derived from incoming line frequency or from local oscillator, dependent on line frequency; internal calibration and test facilities. (Bilingual text in French and German.)

* * *

Funk, H. and Grüning, D. (I.R.T. Munich) : **Der Einfluss der Ausgleichsimpulse auf die Vertikalsynchronisation von Fernsehempfängern** (The influence of the equalising pulses on the field-synchronisation in television receivers).
Rundfunktechnische Mitteilungen, No. 2, 1969, pp. 82-88.

Level B.

Origin of the study : British proposal to utilise a single equalisation pulse one half-line before the start of the vertical synchronisation pulse of the first field. Consequences of such a signal on the correct field synchronisation of television receivers with a long integration time.

* * *

Mishev, D.N. and Konov, K.I. : **A method of electronic display of caption on television picture tube screen.**
Radio Television (O.I.R.T.), No. 1, 1969, pp. 21-25.

Level B.

Method consisting of the reconstitution of each sign (letter, figure, etc.) by the combination of a certain number of basic elements. Example of a system utilising 41 individual elements each formed from a grid of 7 x 5 squares and scanned by 42 lines of the television picture. Operating principles of a generator producing such symbols electronically.

* * *

Chakhparouniants, G.R. : **Quelques problèmes de l'éclairage en télévision** (Problems of television illumination).
Radio Television (O.I.R.T.), No. 1, 1969, pp. 26-33.

Level B.

Theoretical and experimental study of the following problems influencing the quality of pictures produced in television : establishment of the optimum level of illumination of the subject for transmission, specification of the permissible variations in the luminance of the subject, influence of the angular dimensions of the transmitted details, evaluation of the spectral characteristics of luminous sources and of the objects to be reproduced in order to solve the problem of the reproduction in monochrome of details in colour, and shadows created by the lighting installations.

* * *

Centre de production de télévision René Barthélémy construit aux Buttes-Chaumont (The René Barthélémy television production centre at Buttes-Chaumont).
Revue française de radiodiffusion et de télévision, No. 8, 1968, pp. 33-70 and No. 9, 1969, pp. 21-54.

Level C.

This issue is devoted to a description of the buildings, the equipment, and the method of operation of the O.R.T.F.'s René Barthélémy television production centre in Paris. It contains an editorial by L. Conturie (O.R.T.F.) followed by a foreword and the following articles :

- J. Bernhardt (O.R.T.F.) : The Buttes-Chaumont, the largest television programme factory.
- M. Bezie (O.R.T.F.) : The René Barthélémy television centre : site, construction and buildings
- M. Morel (O.R.T.F.) : The technical installations-General.
- M. Remouit (O.R.T.F.) : The sound facilities
- G. Hemart (Schlumberger) : The studio sound installations
- M. Morel (O.R.T.F.) : The studio vision installations
- M. Bouillon (O.R.T.F.) : The recording and reproducing equipment : tape-machines, film-recorders and film-scanners.
- M. Trelluyer (O.R.T.F.) : Programme production at the Buttes-Chaumont
- E. Delfau (O.R.T.F.) : Scenery... a happy medium
- M. Bourdon (O.R.T.F.) : Making the scenery
- A. Paris (O.R.T.F.) : Scene setting
- M. Taton (O.R.T.F.) : Scene dressing
- M. Cosme (O.R.T.F.) : Managing the scenery and property by computer

— M. Barry (O.R.T.F.) : Scene lighting
— M. Demarque (O.R.T.F.) : Rehearsal rooms
— M. Aubin (O.R.T.F.) : Productivity.

* * *

Smalling III, E.E. (Tele-Tape Productions, New York) : **Designing a television theater.**
Journal of the SMPTE, No. 1, January, 1969, pp. 34-38.

Level C.

Various requirements which must be satisfied by a theatre intended to accommodate a large audience as well as to be suitable for large-scale television production. Comprehensive plans and the architectural design of a television studio of this type. Particular emphasis is placed on two characteristics: on one hand, the arrangements for the spectators, and the construction of the removable seating, on the other hand, the design of the control rooms and the equipment necessary for production supervision.

* * *

Flaherty, J.A. (C.B.S. Television Network, New York) : **Fernsehprogram - Produktion in den U.S.A.** (Television programme production in the U.S.A.).
Rundfunktechnische Mitteilungen, No. 2, 1969, pp. 73-76.

Level C.

Brief survey of the present situation and trends in the future development of production methods : the increase in the proportion of programmes recorded on film in relation to those recorded on tape, advantages and disadvantages of the two methods.

* * *

Nikl, J.K. (F.T.Z., Darmstadt) : **Die Entwicklung der TV-Schaltstellentechnik bei der Deutschen Bundespost** (The development of television switching-centre technique in the D.B.P.).
Fernmelde Praxis, No. 5, 10th March, 1969, pp. 161-179.

Level B.

The principles adopted for routing television programmes produced in numerous centres, from the studios to the transmitting stations : by " chain ", " star " and " lattice " distribution networks. Description of the facilities used : simple and cross-connecting switches, switching at IF, monitoring, equipment, future developments.

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Krivosheyev, M.I. : **Monitoring and measurement automation in television channels.**
Telecommunications and Radio Engineering, No. 7, July, 1968, pp. 25-32.

Level C.

Article translated from Russian. General survey of the possibility of the automatic operation of television links utilising test signals and insertion signals. Automatic optimalising of the transmission parameters, fault diagnosis and reliability predictions.

* * *

Apotheloz, M., Schütz, A., Schwarz, E. and Walter, W. (Swiss P.T.T.) : **La télévision au Val Bregaglia et au Val Posschiavo** (Television in the Bregaglia and Posschiavo valleys).
Bulletin Technique des P.T.T. suisses, No. 3, 1969, pp. 107-114.

Level B.

An article in four parts (introduction and general, radio-relays, transmitters and rebroadcast transmitters) dealing with the special problems arising out of the mountainous nature of the region.

The first part is in French. The second describes in particular the passive relay station used for transmitting the Italian-language television programmes originating in Tichino.

* * *

Meyer de Stadelhofen, J. and Bersier, R. (Swiss P.T.T.) : **La pince absorbante - une nouvelle méthode de mesure pour l'antiparasitage en ondes métriques** (The absorbent clamp - a new measuring method for VHF interference suppression).
Bulletin Technique des P.T.T. suisses, No. 3, 1969, pp. 96-104 (in French and German).

Level B.

Detailed description of the method proposed by the Swiss Telecommunication Administration and adopted by the C.I.S.P.R. in 1967; principle, measuring equipment, construction, special problems encountered when using the " absorbent clamp ".

* * *

Stöhr, W. (Siemens AG) : **Satelliten-Hörrundfunk** (Satellite Sound Broadcasting).
Rundfunktechnische Mitteilungen, No. 2, 1969, pp. 58-63.

Level B.

Characteristics of systems for the broadcasting of VHF/FM sound programmes directly to domestic receivers in the 100 MHz band : power supply for the satellite, aerials, attenuation, coverage. Brief mention of systems in the 12 GHz band.

* * *

Rydbeck, O. and Ploman, E.W. (S.R.) : **The European broadcaster's attitude toward satellite technology.**
Telecommunication Journal (I.T.U.), No. II, February 1969, pp. 72-78.

Level C.

General discussion of the various applications of telecommunication satellites to broadcasting. Necessity for international collaboration between television organisations, taking the European Broadcasting Union as an example. Conditions for the production of programmes intended for transmission by satellites, and problems raised by the broadcasting of such programmes. Difficulties encountered in the use of satellites. Problems which the extension of transmissions by satellites will cause in future in the legal and operational fields.

TELEVISION SATELLITES

We give below a summary of the present situation of the telecommunication satellites used for television, either for point-to-point transmissions or, in the future, for the distribution of programmes. The exposé brings up to date the information given in E.B.U. Review No. 109-A.

A. Point-to-point telecommunication satellites

The Intelsat system.

After the failure of the launching of the first Intelsat-III satellite on 18th September, 1968, two further launches have been made successfully. One Intelsat-III satellite (Flight 2) was put into position over the Atlantic Ocean on 19th December, 1968, and another over the Pacific Ocean (Flight 3) on 6th February, 1969. These satellites are each equipped with two wide-band transponders, they have an output power of 10 W and mechanical " back-spin " aerials covering the whole of the Earth's surface visible from the satellite.

A second Intelsat-III satellite (Flight 5) is to be put into position over the Atlantic Ocean towards the end of July, 1969. The circuits between Europe and the Americas will then be as indicated in *Fig. 1* ; the adaptation of the Canadian Earth-station Mill Village 1 should be completed during June, 1969, and it is expected that Pleumeur-Bodou 2 will be ready by January, 1970. Goonhilly Downs 2 and Pleumeur-Bodou 1 will work with Mill Village 2 and Andover. A second Intelsat-III satellite (Flight 4) was put into position over the Pacific Ocean on 21st May, 1969, and the previous satellite in that region (Flight 3) is to be moved to a position over the Indian Ocean, probably towards the end of July, 1969. Single-hop television transmissions will then be possible in both directions between Australia and Japan on the one hand, and Europe, on the other.

There were, at the beginning of 1969, eighteen satellite-Earth-stations, in fourteen countries, capable of transmitting or receiving television signals ; their sites are indicated in *Fig. 2*. By the end of 1969, some twenty further Earth-stations will have been integrated into the Intelsat system. Goonhilly Downs 1, Raisting 2 and Fucino 2 will work with the satellite over the Indian Ocean ; the first-mentioned station is due to become operational by mid-June, 1969, the second in September, 1969 and Fucino 2 in December, 1969. The Japanese Earth-station at Yamaguchi, which will also work with the Indian Ocean satellite, should be finished in June, 1969, and the Australian Earth-station at Ceduna has to be ready by November, 1969. Among the other Earth-stations which will in due course work with that satellite, will be Bahrein, Kuweit and a station in Thailand, while in August, 1969, an Earth-station in the Lebanon, and in November one in Morocco, will be working with one of the Atlantic Ocean satellites.

The contract for the manufacture of the Intelsat-IV satellites has been let to the Hughes Aircraft company. These satellites will have a mass of 488 kg, which will make a launcher of the Titan-Agens class necessary. The Intelsat-IV satellites will each have twelve 6.3-watt transponders and a mechanical " back-spin " aerial system covering separately the whole of the visible part of the Earth's surface and two small areas illuminated by beams of aperture 4.5°.

The telecommunication capacity of satellites has undergone a spectacular development ; it will be recalled that the first Intelsat satellite — Intelsat 1 or " Early Bird " — could provide 240 telephone circuits in the two directions and had an expected life of a year and a half, that is to say, a capacity of 240 x 1.5 = 360 circuit-years. The Intelsat-II satellites have a capa-

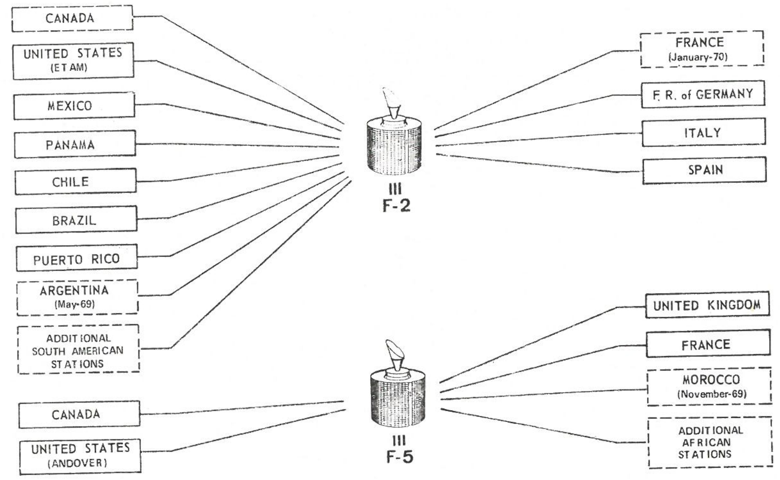


Fig. 1. — Transatlantic connection effected by means of Intelsat-III satellites.

UNION EUROPEENNE DE RADIODIFFUSION
CENTRE TECHNIQUE
AVENUE ALBERT LANCASTER, 32
BRUXELLES

EUROPEAN BROADCASTING UNION
TECHNICAL CENTRE
AVENUE ALBERT LANCASTER, 32
BRUSSELS

Stations de radiodiffusion en ondes kilométriques et hectométriques
(Situation du spectre au 1ER mai 1969)
Zone européenne

LF and MF broadcasting stations
(Conditions in the spectrum on 1ST May, 1969)
European area

LEGENDE

PUISSANCE
- Egale ou supérieure à 100 kW
- Inférieure à 100 kW
- Inférieure à 10 kW
- Inférieure à 1 kW
- Puissance inconnue.

S=Stations d'un même pays utilisant la même fréquence et souvent synchronisées.

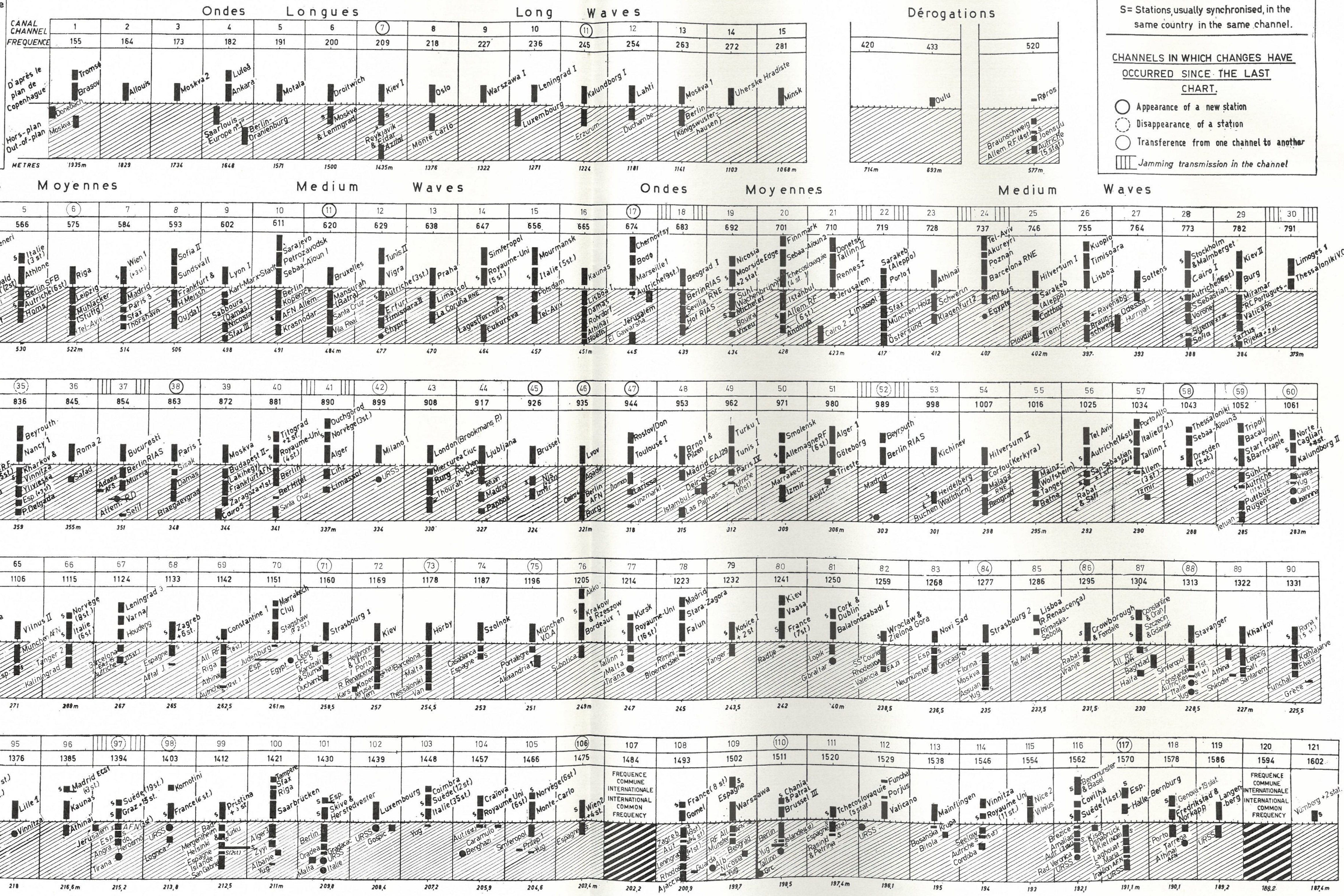
CANAUX DANS LESQUELS UN CHANGEMENT S'EST PRODUIT PAR RAPPORT AU TABLEAU PRECEDENT.
- Apparition d'une nouvelle station
- Disparition d'une station
- Passage d'un canal à un autre
- Emission de brouillage dans le canal

LEGEND

POWER
- Not less than 100 kW
- Less than 100 kW
- Less than 10 kW
- Less than 1 kW
- Unknown

S= Stations usually synchronised, in the same country in the same channel.

CHANNELS IN WHICH CHANGES HAVE OCCURRED SINCE THE LAST CHART.
- Appearance of a new station
- Disappearance of a station
- Transference from one channel to another
- Jamming transmission in the channel



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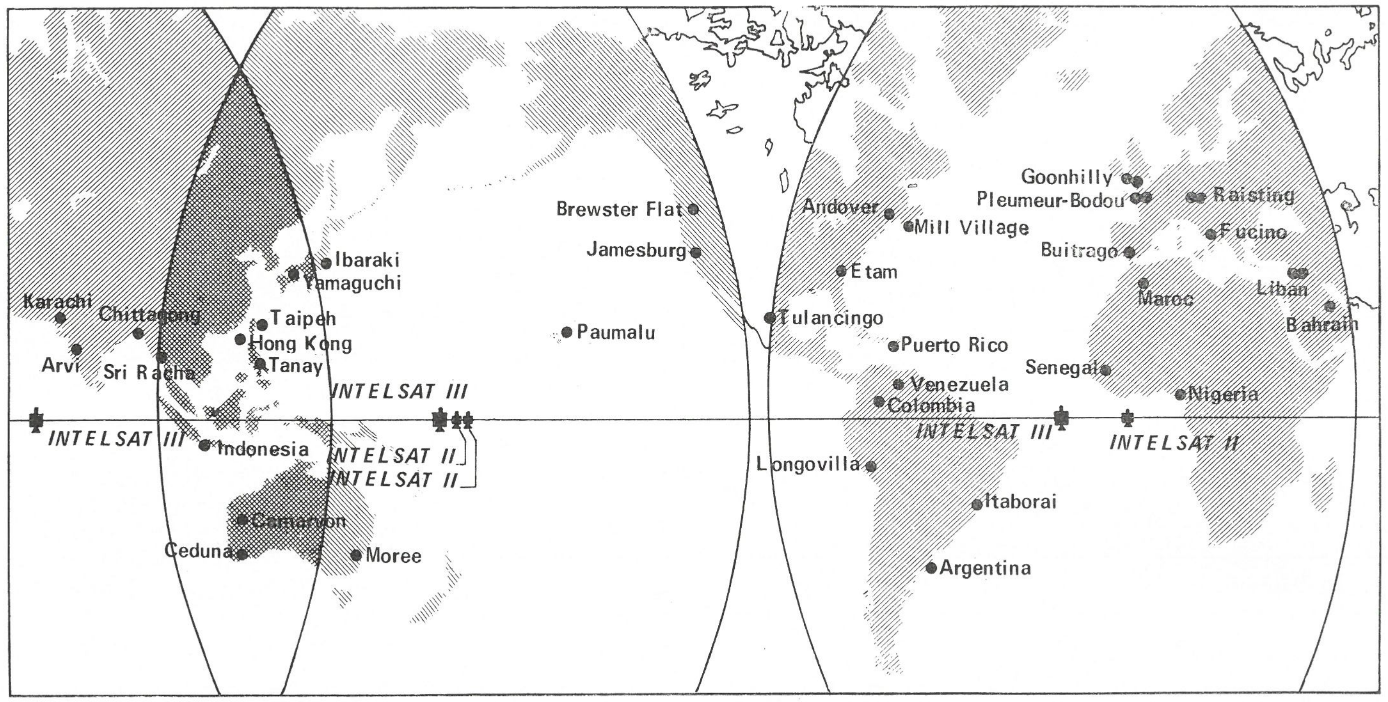


Fig. 2. — Sites of Earth-stations suitable for television transmissions, as at the end of 1969.

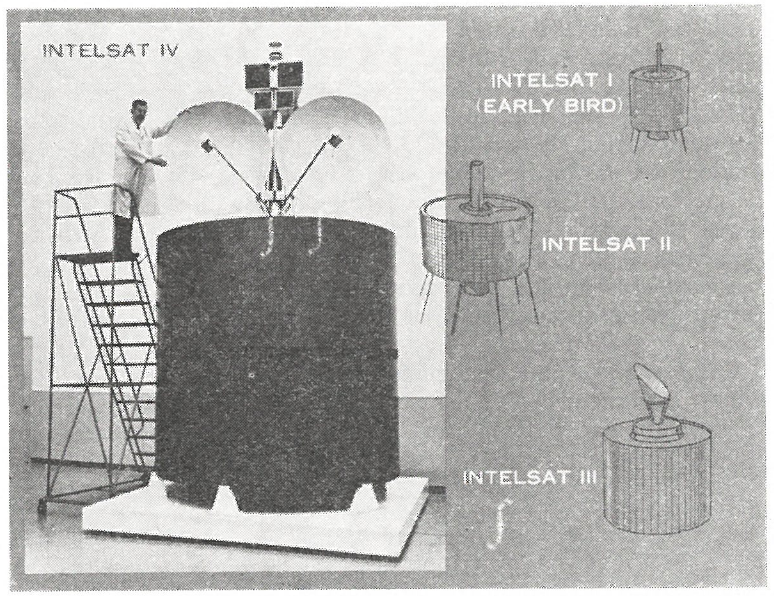


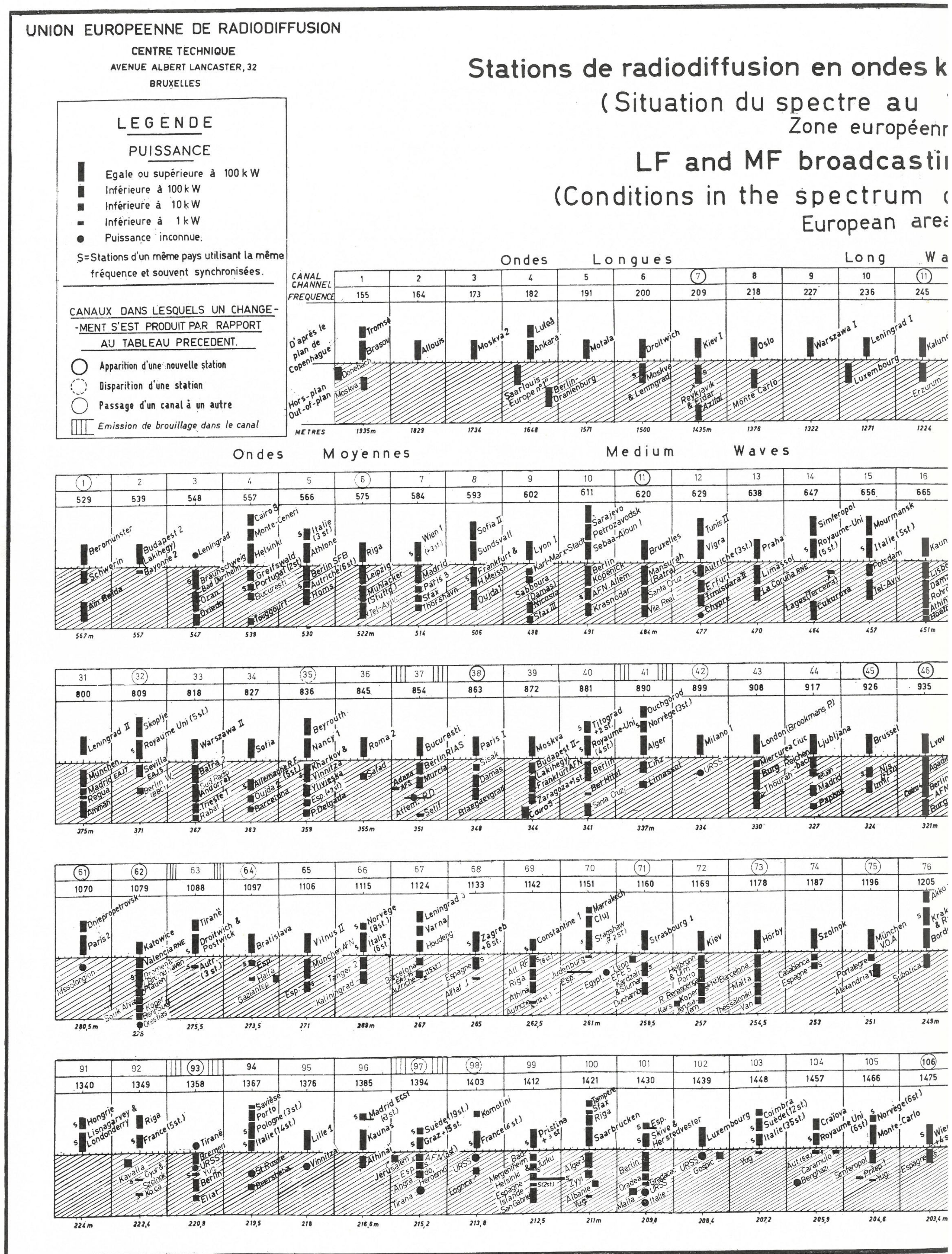
Fig. 3. — An Intelsat-IV satellite. The drawings of earlier Intelsat satellites are to the same scale.

city of 720 circuit-years, the Intelsat-III of 6000 circuit-years (1200 circuits for 5 years). The Intelsat-IV satellites, which will be launched from 1971 onwards, will have a capacity of 42 000 circuit-years (6000 circuits for 7 years). Over five or six years the capacity has thus increased nearly 120 times, whereas the cost of a satellite in orbit has increased by only five times.

B. Distribution satellites.

1. The CETS-C project.

It is well known that, in 1967, the European Conference on Satellite Communications (CETS) assigned to the European Space Research Organisation (ESRO) the task of preparing a specification of a European telecommunication satellite project, intended to bring about a technological renascence in Europe and to mark the starting point of a series of " application " satellites in the fields of meteorology, navigation, the study of terrestrial resources and the like. From the variants proposed by the ESRO, the CETS chose the project known as CETS-C or " Eurafrica ", which not only effected the technological exercise demanded, but also constituted a prototype of the operational satellites contemplated by the E.B.U. as a replacement for the international terrestrial circuits used for distributing the Eurovision programmes. The objective of that satellite is in effect specifically that of the E.B.U., and for that purpose it would be provided with the following facilities :–



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- two aerials of beam-width 7° and 12°, covering respectively Europe (with Iceland and the Middle East) and the whole of Africa ;
- two transponders of output power 14 W and 28 W, the last-mentioned being intended for serving Africa. Each transponder would transmit the vision, the international sound and twenty commentaries ;
- an auxiliary transponder transmitting the signals for remotely switching the Earth-stations, as well as four service-telephone circuits ;
- a system for attitude stabilisation and orbit correction to ensure a useful life of five years.

The CETS-C project was submitted to the Ministers at the European Space Conference in Bonn in November, 1968. The Bonn Conference approved the project and invited the countries that wished to participate in it to announce their intention officially, so that a final decision might be taken by a CETS ministerial conference. That conference has not yet been convened, because of the financial difficulties encountered by the ELDO in the development programme of the Europa-I and Europa-II launchers. Complete agreement was reached by the countries which are members of the ELDO in April, 1969, and it is expected now that the CETS conference might take place in September, 1969. If a favourable decision is taken then, the first CETS-C satellite might be launched in 1975.

2. The Symphonie project.

The consortium for building this satellite was chosen at the end of 1968. The technical characteristics of the Symphonie satellites are not yet definitively fixed ; nevertheless, this satellite now seems to be of substantially more advanced design than was the case of the initial project. It is to be equipped with two 13-watt transponders and an aerial system comprising two parabolic reflectors and two horn exciters ; thus, two elliptical coverage areas will be obtained, comprising, on the one hand, Europe and Africa as far south as Madagascar and, on the other hand, the eastern part of the Americas. The effective isotropic radiated power will be 30 dBW, which will make it possible to use for the Earth-stations either aerials of 14 m diameter with uncooled parametric amplifiers, or aerials of 10 m diameter with cooled parametric amplifiers. A novel apogee motor has been adopted, bringing the " payload " to 200 kg and the expected life to five years.

SOUND AND TELEVISION BROADCASTING STATIONS in the European Broadcasting Area

Changes observed in the spectrum during March and April, 1969

LF and MF.

The changes in these bands observed during March and April, 1969, concerned low-power transmitters only. Monitoring stations, including that of the E.B.U., have reported the introduction of new transmissions in Albania (on 1422 kHz), Bulgaria (1299 kHz), Greece (1333 and 1507 kHz), Morocco (1079 kHz), Poland (1115 kHz), U.S.S.R. (1193 kHz) and Yugoslavia (1331 kHz).

In addition, and as in previous years, two low-power transmitters broadcasting " holiday " programmes have been taken into temporary service in Eastern Germany on 602 and 1052 kHz.

VHF/FM.

Two transmitters of ERP 100 kW were recently taken into service in Yugoslavia, at Krvavec (98.9 MHz) and Vlasic (89.3 MHz).

The power of each of the three transmitters at the Austrian station on the Pfänder (89.7, 93.3 and 98.2 MHz), has been increased from 50 to 100 kW ERP.

The following medium-power (3 to 15 kW, ERP) transmitters have also been taken into service during the period under review :

Austria : Pyramidenkogel (101.2 MHz)
France : Longwy (88.3, 91.0 and 98.1 MHz) and Sens (93.8, 96.25 and 98.5 MHz)
Germany (F.R.): Coburg (93.5 MHz) and Büttelberg (99.3 MHz).

As for lower-power transmitters, there were three 1-kW ERP transmitters taken into service at Cherbourg (France), as well as several rebroadcast transmitters of power less than 100 W ERP, notably two in Austria, four in Norway, two in Switzerland and four in Yugoslavia.

Television.

Several high-power transmitters working in Band IV/V were taken into service during the past months :

Amiens (France)	Channel 47	ERP 500 kW
Angelburg (Germany, F.R.)	24	500 kW
Schnee-Eifel (Germany, F.R.)	30	250 kW
Stuttgart (Germany, F.R.)	39	276 kW
Saarbrücken (Germany, F.R.)	42	430 kW
Angelburg (Germany, F.R.)	52	450 kW
Osnabrück (Germany, F.R.)	56	138 kW

The other stations opened are all only low-power rebroadcast transmitters, of which the number taken into service is rather higher than usual : one in Austria, fifty-five in Germany (F.R.), one in Iceland, two in Italy, four in Norway, five in Sweden, ten in Switzerland and five in the United Kingdom.

* * *

Detailed characteristics of all changes in the broadcasting band are published in two-monthly supplements to the following E.B.U. publications :

- Annual List of LF and MF Broadcasting Stations in the European Broadcasting Area, the last edition of which has just appeared, brought up to date to 1st May, 1969 ;
- Annual List of VHF Sound Broadcasting Stations in the European Broadcasting Area, the latest edition of which is dated 1st January, 1969 ;
- Annual List of Television Stations in the European Broadcasting Area, the most recent edition of which is dated 1st March, 1969.

The List of LF and MF stations is based essentially on observations made by the E.B.U.'s Receiving and Measuring Station at Jurbise-Masnuy, near Mons (Belgium) and by monitoring stations belonging to E.B.U. Members. It is completed by information obtained from official sources and has this year been brought up to date by questionaries sent to all the broadcasting organisations concerned, individually.

The list comprises, as an appendix, a chart giving the situation in the LF and MF broadcasting bands as on 1st May, 1969, which is reproduced on the previous page. It cancels and replaces that published in No. 109-A. The chart retains its usual presentation, which distinguishes between the stations effectively operating in the channels assigned to them in the Copenhagen Plan, on the one hand, and those exploited outside the terms of the Plan, on the other (indicated on the hachured part of the chart). Each station is designated in the chart by its name, except in the case of a group of stations on the same nominal frequency in the same country, when only the name of the country or of the principal station is given and the letter *S*.

E.B.U. ACTIVITIES

Twenty-first Plenary Meeting of the E.B.U. Technical Committee

Vienna, 14th to 18th April 1969

The E.B.U. Technical Committee, whose members are the Technical Directors and Chief Engineers of the Members and Associate Members of the Union, is one of the four main Committees set up by the Administrative Council ; its mandate is to advise the Council on all questions of broadcasting engineering and to direct and coordinate the technical activities of the Union as such. It holds its annual plenary meeting in the Spring each year, on this occasion from 14th to 18th April, 1969, in Vienna, at the invitation of the Österreichischer Rundfunk ; more than eighty persons participated, including representatives of Associate Members from all parts of the world, of Telecommunication Administrations and of international organisations which have technical interests in common with the E.B.U. Mr. G. Bacher, Intendant General of the O.R.F., was unable to open the meeting formally, and this was done on his behalf by Dr. G. Skalar, Technical Director ; happily, Mr. Bacher was able to come to greet the participants during the course of the meeting. Mr. E.L.E. Pawley, Chairman of the Technical Committee, was in the Chair, assisted by Dr. H. Rindfleisch and Mr. C. Mercier, Vice-Chairmen. The plenary meeting was preceded, as is now customary, by a short preparatory meeting of the Bureau of the Technical Committee.

After examining the activities of the Receiving and Measuring Station (CEM) at Jurbise, the Committee noted that the current quinquennial programme of re-equipping the CEM was coming to an end this year and fixed the annual credit which would be needed for the next few years for essential renewals and maintenance. Two further monitoring stations, Enköping and Châtonnaye, belonging respectively to the Swedish and Swiss Telecommunication Administrations, are now participating in the regular coordinated observations of the broadcasting bands.

The Committee next discussed the periodical and occasional publications of the Technical Centre. The circulation of Part A of the E.B.U. Review was increasing steadily, the sale of advertising space was being maintained and the Committee expressed its satisfaction with its contents and presentation. It was reported that the eighth Technical Monograph had been published — No. 3109, entitled " Technical advice for listeners and viewers ". In addition, the preparation of the monograph on " Radio-relays for television " was entering its final stages and it seemed reasonably certain that at least the English version would appear before the end of 1969.

Within the framework of the Administrative Council's encouragement of technical assistance to broadcasting organisations in developing countries, the Committee approved the help that had been given to the Radiodiffusion-Télévision Tunisienne in the planning of the new television production centre for Tunis, and also the arrangements being made to help the Cyprus Broadcasting Corporation to plan a VHF/FM network.

The Technical Committee noted the progress being made in coordinating the research and development work being undertaken by various Members' laboratories, whose Heads had held two further meetings ; as a first phase, reports and other documents were now being regularly exchanged on the basis of abstracts collected and distributed by the Technical Centre.

The Committee had a most informative discussion of the use of computers in broadcasting, ranging from the processing of data concerning the administrative and management problems to automatic methods of programme planning, production, presentation and distribution. Several papers on various aspects of this subject had been issued in advance to the Committee, and these were supplemented by interesting *exposés* by Messrs. Sansom, Ettlinger and Kuwata, describing the systems developed respectively by Thames Television, the C.B.S. and the N.H.K. This subject is of growing importance, and the Bureau is to consider the possibility of organising a Symposium on this subject, to be held possibly in February, 1970.

The Committee then turned to Eurovision. The scale of operations continues to increase ; 3233 transmissions were planned and supervised by the Technical Centre during 1968, representing an increase of about 55 % compared with 1967, but the increases in intercontinental transmissions by satellite, in transmissions in colour and in transmissions arranged at very short notice were even more remarkable. The Committee noted that the Eurovision Section of the Technical Centre had been reorganised, to separate the development of the technical facilities and the forward planning of the service from the routine handling of the transmissions themselves.

The Committee noted with satisfaction that the Technical Centre now had on secondment from the B.B.C. a communication specialist, whose task it was to improve the performance of the circuits constituting the Eurovision Network. The order for an automatic telephone installation for linking Members over the permanent-network circuits had been placed in February, 1969, but it would take at least a year to manufacture and install.

It was reported that the arrangement whereby the Technical Centre used the R.T.B./B.R.T. computer on very favourable terms would shortly terminate, because of the increasing use of the computer by the R.T.B./B.R.T. (it is already rarely available to the E.B.U. except in the late evening). It is therefore intented to hire a suitable computer and accessories for installation in the Technical Centre in 1970.

Next, the Technical Committee reviewed the progress made by the several Working Parties and their future working programmes*. Working Party A (AM sound broadcasting) has very important tasks in preparation for the I.T.U. Conference for re-assigning LF and MF channels in the European and African Broadcasting Areas and in parts of Asia, expected to take place in late 1970 or early 1971. Dr. von Rautenfeld and Mr. Mercier read papers on the immediate and more distant future of LF/MF sound broadcasting, explaining the seriousness of the situation and the necessity for a very thorough study of the technical possibilities, including the use of single-sideband systems, the restriction of the radiated bandwidth, the wider use of VHF for short-range services and the utilisation of the sky-wave. After a long discussion, the Technical Committee recommended that Members should not take at this stage any decision on a national plane that might jeopardise future international standardisation in these fields, and also formulated three unanimously agreed technical objectives, namely the standardisation of the characteristics of sound broadcasting as an integral transmission-propagation-reception system, the extension of Band II to 108 MHz and the restriction of the radiated bandwidth to about one-half of the carrier spacing. Finally, the Technical Committee authorised the despatch, to C.C.I.R. Study Group X, of six contributions prepared by Working Party A.

Working Party B (Ionospheric propagation on LF, MF and VHF) also deals with questions which concern the assignment of frequencies, and it was stressed that it was urgent to establish more reliable means of forecasting field-strength, especially for the shorter and very long ranges. The data resulting from the field-strength measurement programmes organised by Working Party B over nearly twenty years were at present being processed by computer and should provide essential information for the forthcoming I.T.U. Conference.

Working Party G (Recording of sound and pictures) comprises three Sub-groups : Sub-group G1 (Sound recording) had drafted three contributions to the C.C.I.R. and I.E.C., one of them relating to tapes in cartridges, and these were approved, although a proposal to delete the tape-speed of 38.1 cm/s from the list of preferred speeds for international exchange was deferred for further study. Sub-group G2 (Television tape-recording) is at present principally concerned with improving consultation between broadcasting organisations and manufacturers of tape-machines, in order to ensure that the equipment now being developed will fully meet the future needs of broadcasting ; the Committee approved a document prepared by the Sub-group and intended for issue to the manufacturers. The Committee approved also a contribution to the C.C.I.R. and I.E.C. on the definition and measurement of " drop-outs " and on the absolute reference level for the sound recording on television tapes, the latter prepared in collaboration with Sub-group G1. Sub-group G3 (Television film-recording) was engaged on a study of the assessment of the quality of films intended for televising in colour. It drew up a C.C.I.R. revised draft recommendation dealing with standards for the exchange of television programmes on film ; it is investigating with Sub-group G1 the possibility of adopting the same sound recording characteristics for 16-mm film as for 19.05-cm/s tapes and also the possibilities of standardising further types of films. An inquiry is to be made of the Members to determine their possibilities and preferences regarding film types. Sub-

* The principal activities of the Working Parties have in most cases been reported in these columns on the occasions of their recent meetings.

group G3 is also watching the development of the EVR recording process developed by the C.B.S., particularly its possible application to broadcasting. Finally, it was reported that, in compliance with the directive of the Bureau, closer regular liaison between Working Party G and the S.M.P.T.E. had been established.

The Technical Committee approved minor changes in the Terms of Reference of Working Party K (Television and FM sound broadcasting) and the creation of a third Sub-group, K3 (Direct television broadcasting by satellite), whose essential function will be to establish the Union's position in that field and to prepare the necessary contributions to the forthcoming I.T.U. World Administrative Conference on Space Radiocommunications and to other organisations working on this subject. A report was given of the meetings held in London in September and October, 1968, with the participation of the O.I.R.T., where a plan for the carrier offsets to supplement the Stockholm UHF Plan had been worked out ; the Committee decided that this plan could best be put into effect by the procedure indicated in Art. 4 of the Stockholm Agreement (1961).

Working Party L (International network operations and the Eurovision Permanent Network) had held a plenary meeting in Brussels on 19th and 20th March, 1969, its first since 1965. In all, eighty-three persons attended the meeting, whose primary purpose was to review Eurovision procedure and practice (most of which dates back ten or even fifteen years) to take account of intercontinental transmissions, transmission in colour and rapidly rising scale of operations over the period until the Eurovision Satellite Scheme is implemented. The meeting benefited from the attendance of a large number of delegates of N. American organisations (eighteen in all), which made it possible to reach an understanding on a large number of problems that have so far impeded the organisation and execution of transatlantic television transmissions. During the course of the meeting, an extremely interesting *exposé* was given by Mr. D.D. Karasik (Comsat) on the present situation and future development of the Intelsat world-wide satellite telecommunication system, with special reference to its television facilities.

Working Party M (International network transmission) now holds only meetings of its constituent Sub-groups, whose activities are organised by the Coordinating Committee. The Video Sub-group was engaged on studies relating to the standardisation of insertion signals, and planned to meet in Rome in May, 1969, when it would examine the RAI system, based on insertion signals, for automatically controlling, monitoring and correcting its television distribution network. Dr. Castelli gave the Technical Committee a brief *exposé* of the system and a description of the prototype installation now undergoing service-trials. The Video Sub-group also intended to draft certain contributions for the C.M.T.T.'s next meeting (September, 1969). The Conversion Sub-group had organised comparisons (London, January, 1969) of converters capable of converting from 525 lines (NTSC) to 625 lines (PAL), and the Technical Committee noted that, as a result, the Technical Centre was seeking the approval of the Television Programme Committee to treat the B.B.C. Mk-II converter and the D.B.P. converter as equivalent for planning purposes. The Network Switching Sub-group was making noteworthy progress in the design of the installations for remotely switching the Permanent Network from Brussels — an essential requirement for handling the increasing scale of operations — and service-trials of a pilot installation are due to begin in the autumn of 1969. The Sound Sub-group had produced a number of draft contributions to the C.C.I.T.T. and these were approved, subject to minor amendments, by the Technical Committee, as was also a Code of Practice for multiple-destination international sound programmes transmitted over the Network. There followed an interesting discussion of the " Sound-in-Vision " system, developed by the B.B.C., of transmitting the sound component in coded form on the synchronising pulses of the television signal, and the Committee directed Working Party M to undertake certain tests of the system and to prepare a communication to the C.M.T.T. regarding its utilisation on the international plane.

Working Party N (Eurovision Satellite Scheme) was keeping in close contact with the organisations collaborating on the several projects which might form the basis of a television distribution system in Europe ; at present the work was being directed toward the choice of frequencies for the circuits to and from the satellites and toward that of the sites for the Earth-stations. The Committee heard with great interest a statement by the Director of the Technical Centre on the latest developments regarding satellite facilities for Eurovision.

Working Party P (Collaboration with the C.I.S.P.R. and interference counter-measures) was continuing its studies in collaboration with other organisations, including the O.I.R.T.

Working Party S (Stereophonic broadcasting and multiple-modulation systems) had settled a number of questions on stereophony technique, including the listening conditions in control rooms, but further work was needed before a recommendation could be made regarding protection ratios.

The Technical Committee finally discussed the Union's relations with other international organisations on the technical plane, particularly the Union's technical representation at their forthcoming meetings.

In closing the meeting, the Chairman noted that, at the next meeting, which was to be held in Portugal in April, 1970 at the kind invitation of the E.N.R./R.T.P., it would be necessary to hold an election of the members of the Bureau for the period 1971-1972. The Committee learnt with regret that Mr. Pawley, Chairman since 1952, is retiring from the B.B.C. and will not offer himself for re-election on that occasion.

Second meeting of the Video Sub-group of Working Party M

Rome, 6th to 8th May, 1969

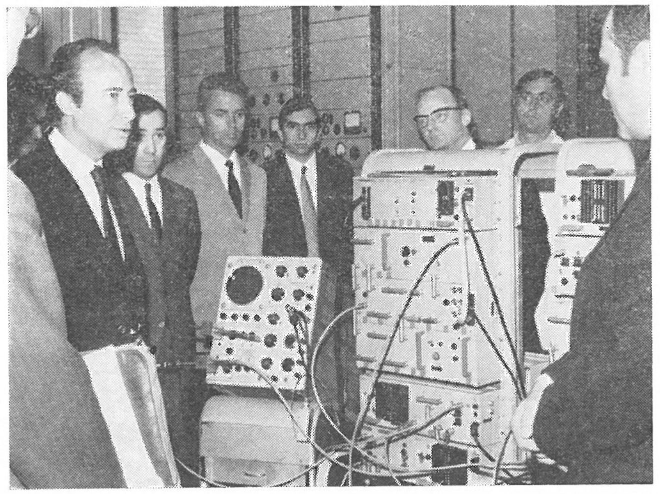
The Video Sub-group of Working Party M held its second meeting from 6th to 8th May, 1969, in Rome, at the kind invitation of the Radiotelevisione Italiana, under the chairmanship of Dr. E. Castelli, Chairman of the Sub-group and of the Working Party ; the meeting had been postponed from the latter part of 1968, because it had not then been possible to find a date suitable for most of the members.

On behalf of Dr. Orsini, Technical Director-General, who was absent from Rome, Dr. Castelli welcomed the members of the Sub-group in the name of the RAI. After dealing with the Terms of Reference and membership of the Sub-group, and other administrative matters, the Sub-group received reports on the activities of the Conversion and Network-switching Sub-groups.

One of the more important tasks now facing the Video Sub-group relates to the standardisation, on the international plane, of *insertion signals*. Earlier proposals by the E.B.U. regarding special signals inserted in the field-blanking interval of the television waveform, had stressed their utilisation for the rapid visual appreciation of the quality of transmission, but the evolution of the technology has resulted in their adoption also as essential elements of methods providing for the precise measurement of transmission characteristics, and several sophisticated systems, some of them including automatic correction of errors, have been developed in various countries. On the international plane it is therefore urgent to standardise insertion signals of wider application than that so far recommended by the C.C.I.R. The E.B.U. is collaborating with the C.M.T.T. to this end, and at its last meeting (September, 1968) the C.M.T.T. issued a draft report [E.5.m (CMTT)] and asked the Administrations and broadcasting organisations to comment on the proposals therein. The study of that document was therefore undertaken by the Video Sub-group in Rome; it decided that Mr. W.N. Anderson's ad-hoc group, which had prepared a contribution to the C.M.T.T.'s last meeting, should meet in the first week of June in the I.R.T. Laboratories (at Munich) to draft a further contribution based on the discussions that took place in Rome, and the Video Sub-group should meet again in mid-June, in order to finalise the contribution (which would include a brief statement of E.B.U. philosophy regarding insertion signals), before submitting it to the Bureau of the Technical Committee for authority to forward it to the C.M.T.T., which is to meet again in September, 1969.

Another important item on the Video Sub-group's agenda, was the international implications of the *Sound-in-Vision system* developed by the B.B.C. and demonstrated to the Sound Sub-group of Working Party M at its meeting in Copenhagen in November, 1968. In that system, the sound signal is inserted in the line-synchronising pulses, in the form of coded pulses*. At its Vienna meeting, the E.B.U. Technical Committee recognised that this constituted a significant advance in broadcasting technique and that it could provide a sound channel of considerably better quality than can be obtained otherwise over long distances in Europe, as well as having the inherent advantage of enabling the vision and sound signals to be switched at the same time and place, a requirement of the remote-switching system being introduced on the Eurovision Permanent Network. It had therefore seemed indicated to investigate the adoption of the system for the " international sound " in Eurovision and for the daily news-exchanges, for which rapid and precise switching is very important. The Video Sub-group was therefore requested to undertake this investigation, and an ad-hoc group led by Mr. G. Stannard was asked to consider whether any modification of the standard 625-line waveform should be envisaged, in order to facilitate the instrumentation of the Sound-in-Vision system. It was reported to the Video Sub-group in Rome that the B.B.C.'s current design, which applies to the waveform as now standardised, should be adopted. After a long and interesting discussion, it was concluded that, as the United Kingdom Administration would submit a technical description of the system to C.C.I.R. Study Group XI and the C.M.T.T., it was desirable that the E.B.U. submit at the same time a contribution setting out the views of the broadcasting organisations regarding the international implications, based on the Rome discussions and the opinions expressed at the Vienna meeting. The Technical Committee, however, had asked that tests be carried out to determine the behaviour of the system under certain conditions of distortion on the long-distance circuits ; it was initially intended that the Video Sub-group should conduct these tasks on the RAI radio-relay network, but the necessary equipment could not be made available in time, and it was decided to carry out the tests and draft the contribution in London, on the same occasion as the preparation of the contribution on insertion signals. It was emphasised that attention should be drawn to the essential difference between this system, wherein the sound signal is wholly accommodated in the video-frequency band occupied by the television signal, and those systems whereby an audio signal, not necessarily associated in any way with a vision signal, is transmitted on a sub-carrier in the same base-band, but at a frequency beyond the upper limit of the video band.

* The system was described in E.B.U. Review, No. 113-A, February, 1969, pp. 13-18.



Members of the Video Sub-group of Working Party M examining the prototype installation of the system developed by the RAI for the remote control and supervision of its radio-relay networks.

On the right : the data-processing units.

Below : the control desk.

(RAI photos)

At its plenary meeting, devoted principally to the problems arising out of intercontinental television transmissions and the expansion of colour broadcasting in Europe, held in Brussels in March, 1969*, Working Party L had asked Working Party M, as a matter of urgency, to specify the colour test signals to be used on the Eurovision Network, to approve suitable test-signal generators and to indicate provisional tolerances on the transmission characteristics. A detailed discussion of these problems indicated that the use of insertion signals appeared to be the best method and that, when repetitive test-signals were required, the elements of the standardised insertion signals should be repeated in all active lines, that no test-signal generator suitable for both applications was known, although several were in an advanced state of development, and their design might perhaps be modified to provide the features considered necessary by the Sub-group. Rapid action being necessary, both to satisfy Working Party L and also to be able to notify the C.M.T.T. in September, 1969, Mr. Anderson was asked to add to the tasks of his ad-hoc group that of drafting a specification for the approved test signals and a suitable generator, based on designs expected to come on the market early in 1970, it being deemed better to wait a few months for instruments exactly meeting the requirement, rather than acquiring generators at present available, which were not entirely suitable.

The morning of 8th May, 1969, was devoted to a number of demonstrations, the most important of which was that of the system developed by the RAI for remotely controlling and monitoring its radio-relay networks and unattended broadcasting stations. The system, which is briefly described on page 128 of the present issue, will be the subject of an article in the E.B.U. Review in the near future. It is at present in the service-trial stage ; a prototype control-unit is installed in the RAI Television Production Centre in Rome, controlling five distant stations. Special " national " insertion signals are the basis of the system, and provision is made for a continuous visual display of the interconnections (mimic diagrams), the conditions of transmission (digital readings) and automatic correction of certain characteristics (at present only the luminance/chrominance amplitude ratio), together with magnetic recording of all conditions (the taped data being subsequently processed by a computer). As well as serving for the service trials, this prototype installation is being used for staff training (in anticipation of its general installation) and for acquiring data needed for planning further extensions of the radio-relay networks. The members were also interested in a demonstration by the D.B.P. and I.R.T. of insertion test-signals with automatic correction, over a vision circuit from Munich to Rome. The afternoon was devoted to discussions of these demonstrations.

* See E.B.U. Review, No. 114-A, April 1969, pp. 99-100.

Camera cables
Video cables
HIFLEX®-cables
Waveguides

FELTEN & GUILLEAUME
KABELWERKE AG
KÖLN-MÜLHEIM
GERMANY

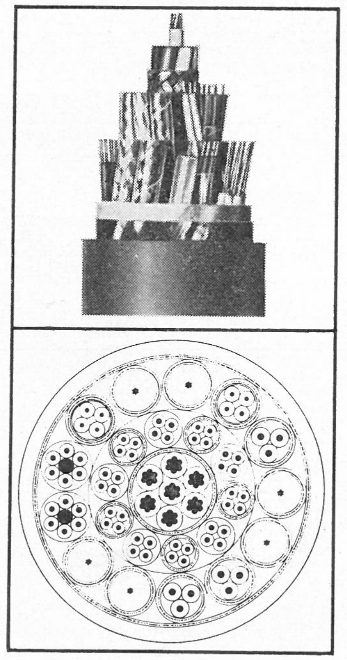
In collaboration with broadcasting corporations and camera manufacturers F&G have developed a colour television camera cable containing 84 elements, including 6 coaxials, the outside diameter being less than 26 mm.
The elements are grouped in bunches and arranged symmetrically. The cable has the high flexibility and stability required for studio and outside operation.
A second colour television camera cable with an outside diameter of 34 mm contains 90 elements, including 7 coaxial conductors, and has been designed on the same basis.
On request, both camera cables can also be supplied with attached 98- or 100-pole plugs (coaxial type).

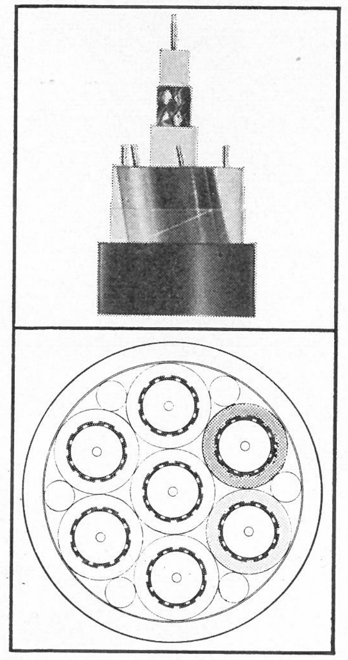
F&G manufacture video cables as coaxial cables with a characteristic impedance of 75 Ω (60 Ω in special cases) and solid or air-space insulation. The attenuation and distortion of these video cables are particularly low, because inhomogeneities are reduced to a minimum and the characteristic impedance deviates from the rated value by only ± 1%. Video cables are manufactured in many sizes with an outside diameter between 4.8 mm and 22 mm, the outer sheaths being marked by the colours standardised in colour television studios. These cables can also be supplied as multiple or combination cables.

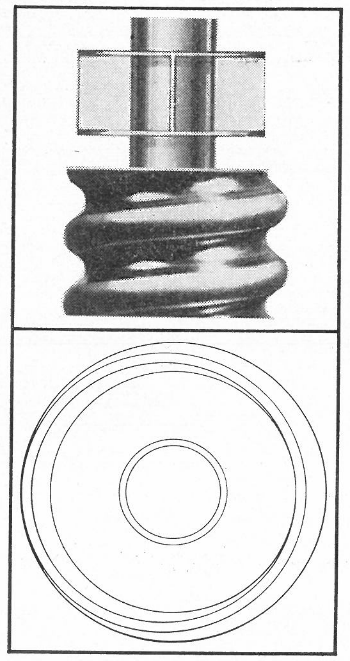
Our new HIFLEX cables represent a further advance in the field of high frequency power cables. They take into account the higher transmitter outputs and extension of transmitter stations in the UHF range. The design, precision manufacture and frequent inspections of the HIFLEX cables ensure that the following features are incorporated: high transmission power, high dielectric strength, low attenuation, low VSWR, low dielectric constant, high transverse stability, high tensile strength, high flexibility due to corrugated aluminium tube as outer conductor.
HIFLEX cables are available in sizes between 15 and 176 mm outside diameter with the standard characteristic impedances of 50 Ω and 60 Ω.

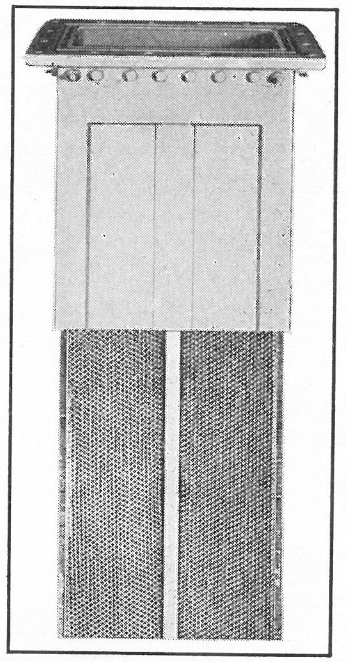
Waveguides are modern structural elements used in high-frequency engineering for transmitting HF power; they are distinguished by their particularly low transmission losses as compared with other line systems. F&G have developed aluminium waveguides of honeycomb sandwich plate construction for television bands IV and V.
This method of construction combines low weight with high stability. A special process permits manufacture with minimum tolerances and thus ensures extremely low VSWR and minimum pulse reflections.
F&G waveguides are installed in the following transmitters: Luttange, Nordheim, Limoges, Bordeaux, Sens, Paris Eiffel tower.

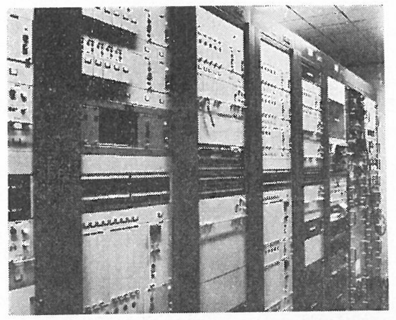
1641











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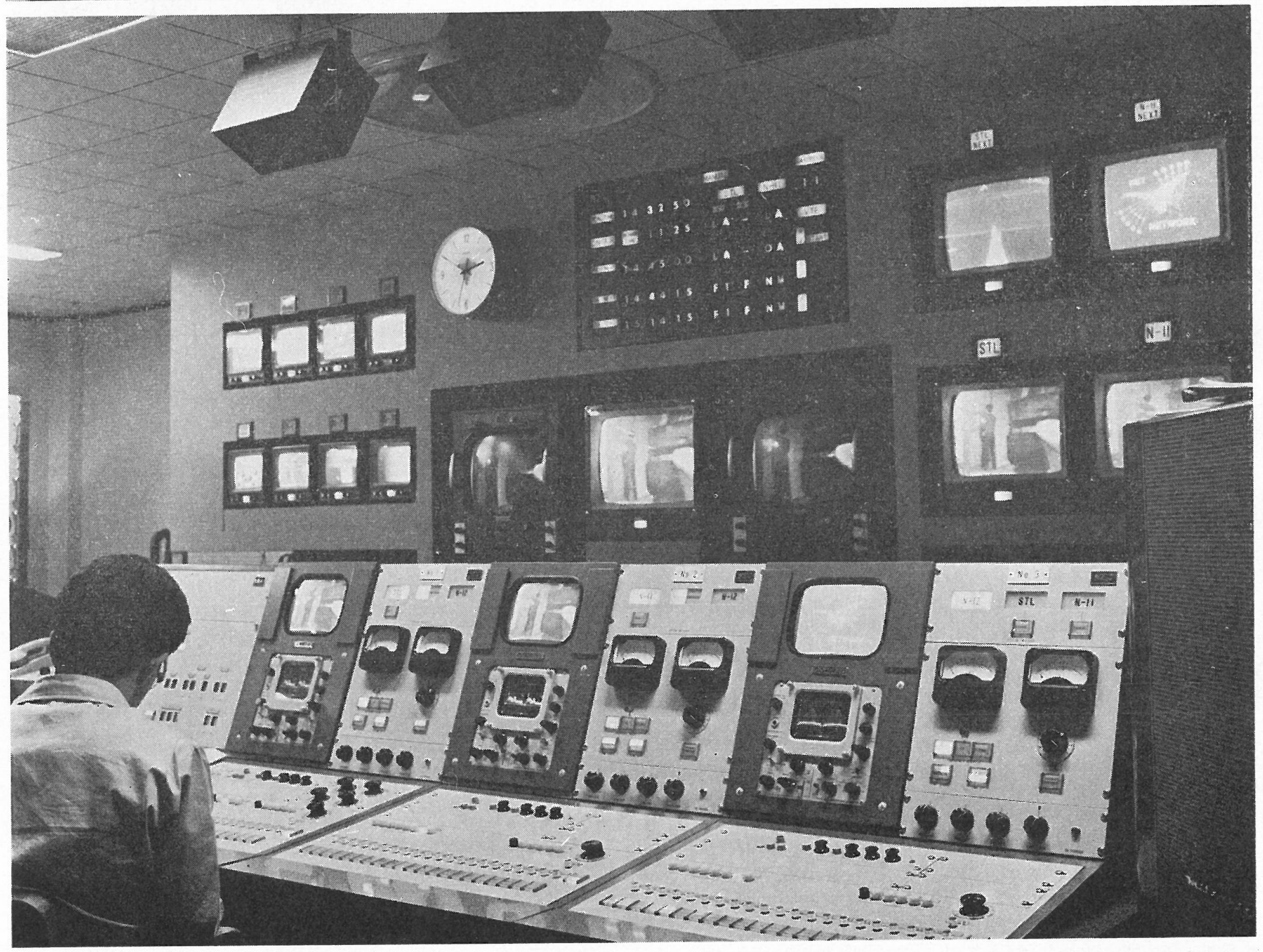

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NEC, a world leader in the field of telecommunications and electronics, manufacture everything needed for color and monochrome TV broadcasting from transistorized cameras, automated studio equipment, VHF and UHF transmitters, antennas, microwave relay systems to satellite earth stations. The keynotes of NEC systems are reliable operation and low installation and maintenance costs. NEC service includes site survey, installation, test operation and personnel training.

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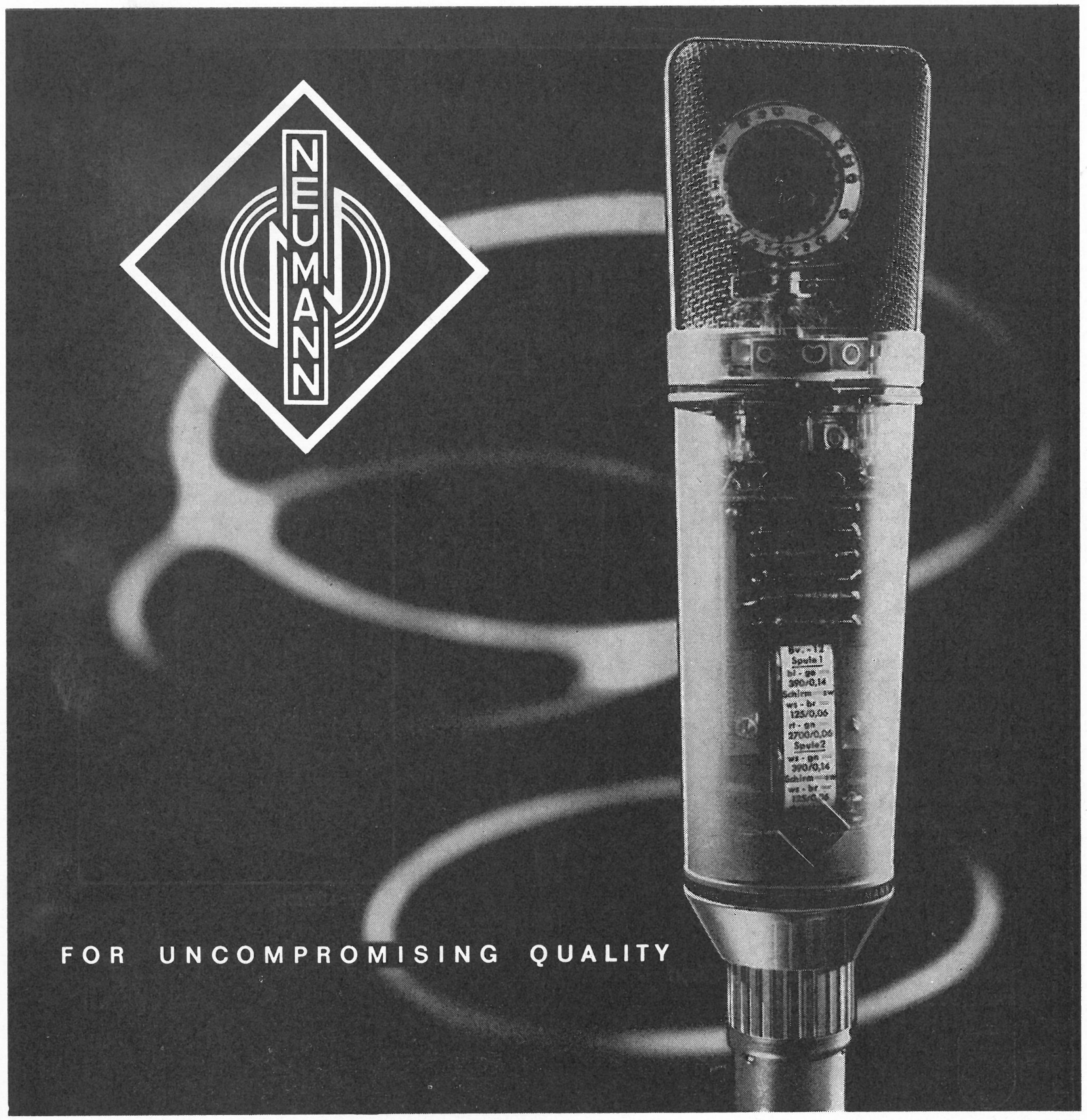

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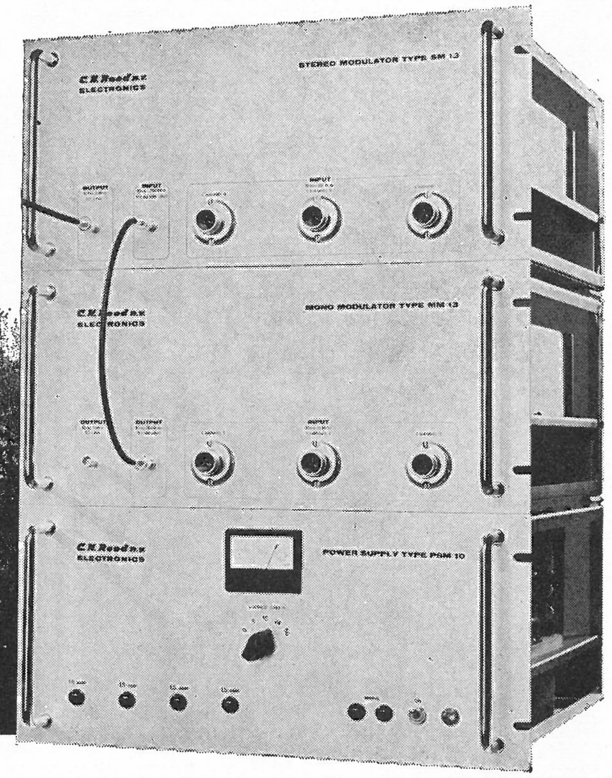
Advantages of the system

- Quality of the distributed signal is far superior than when distributed with any other system.
- Quality remains virtually unaffected by the distance over which the signal is relayed. No demodulation takes place at intermediate relay stations but only at the station from which the program is finally to be broadcast.
- System provides an excellent means for international exchange of programs via Eurovision and Intervision networks.
- Price of the system and cost of maintenance are lower than of any other system.
- Through modular construction of modulator and demodulator units, each unit is available with as many channel modules as required. Additional units can be quickly and easily installed.

The system concept was first introduced during the C.C.I.R. Assembly, Oslo 1966



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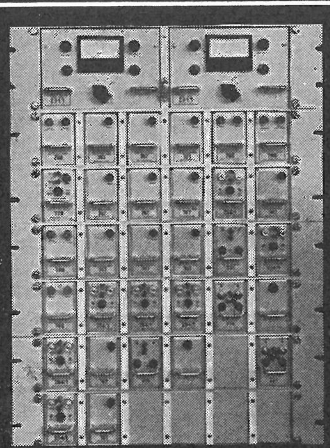
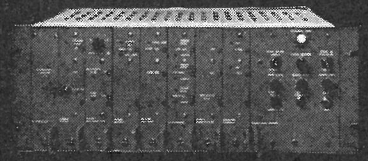
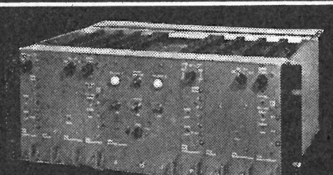


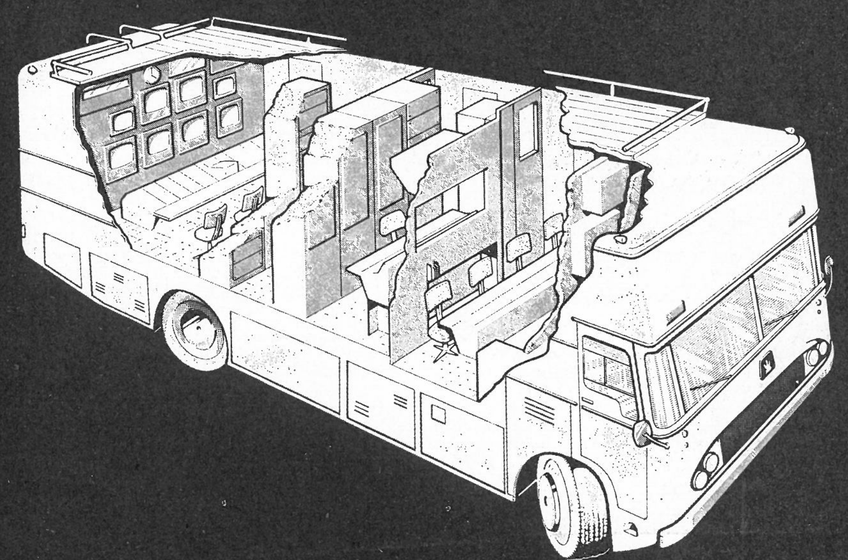
Solid State Video Switching & Mixing Equipment. A vital link in the colour fidelity chain. Proven high performance with respect to differential gain and differential phase. Accurate control of time delay within each module. Exceptional flexibility and reliability.



Stabilizing Amplifier. As well as the normal functions of removal of hum and the effects of noise on signals from a remote source, this equipment makes provision for a number of special facilities including the insertion of cue dots, test line waveforms, master gain and black level controls and peak limiters.



Colour Encoders. Modular solid state units to meet the requirements of both PAL and NTSC standards.



Colour O.B. Vehicles. These colour outside broadcast vehicles make provision for up to five Type 2001 Colour Cameras. Three separate air conditioned areas are provided for production, sound and vision control. Sound and vision mixers are of the **EMI** modular solid state construction and comprehensive communication facilities are provided by the **EMI** "Transcom" System.

Colour Camera Type 2001. Novel features include integral zoom lens, capstan arrangement of unique printed circuit scan assemblies and sealed four tube direct imaging optics. Optional aperture corrector unit provides "contours out of luminance".

EMI - complete colour TV capability

Everything that the modern colour television centre requires for studio and outside broadcast use is planned, designed, produced and installed by EMI. Heart of the system is the EMITELEVISION Colour Camera Type 2001 which has set new standards for colour registration and resolution. Many other unique features contribute to its compactness, ease of operation and servicing. A special version of this Camera, Type 2002, provides facilities for telecine, slide, captions, closed-circuit and other applications.

But EMI's colour capability is more than just an outstanding series of cameras. Ancillary equipment to match the colour fidelity and definition of the 2001 Camera includes encoders, vertical aperture correctors, telecine, switching and mixing equipment based on the EMI solid state modular system—together with a range of equipment necessary for complete colour studio installations or outside broadcast vehicles.

If you would like to know more about EMI's colour capability, contact us at the address below.

Colour Telecine Type 414. Produces high-quality R' G' B' colour television signals suitable for NTSC, PAL, or SECAM systems. Either simplex or fast-acting multiplex arrangements can be supplied, the latter comprising two film projectors (16 mm or 35 mm) with forward and reverse run, and a slide projector. Type 414 uses the high quality Colour Camera Type 2002 which is based on the 2001.

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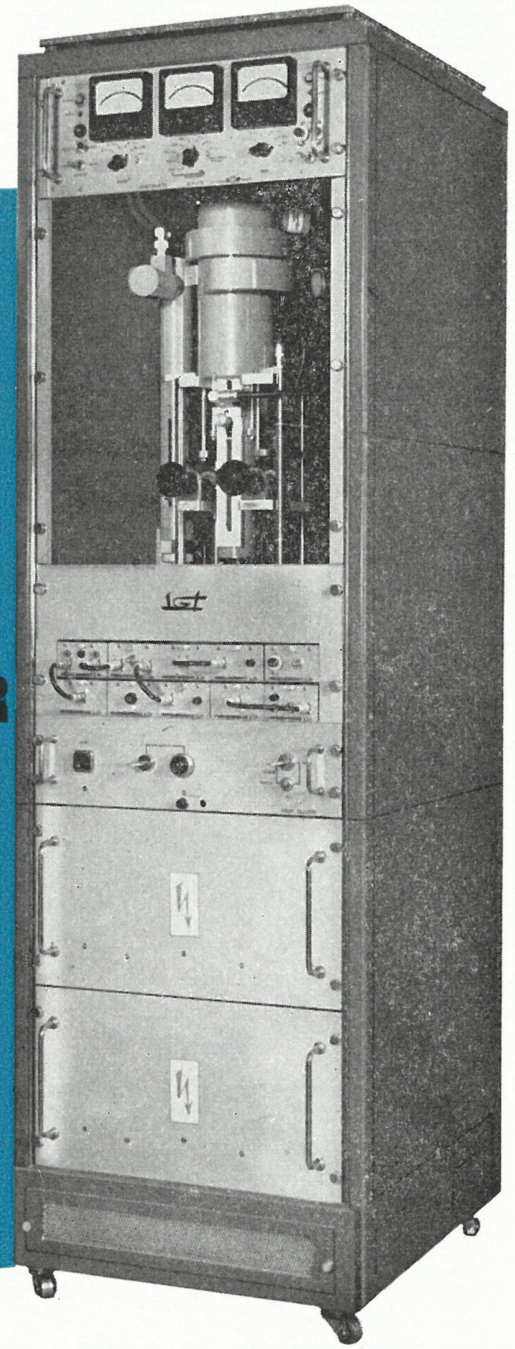
M. T. B. F. greater than 3000 hours including the power valve



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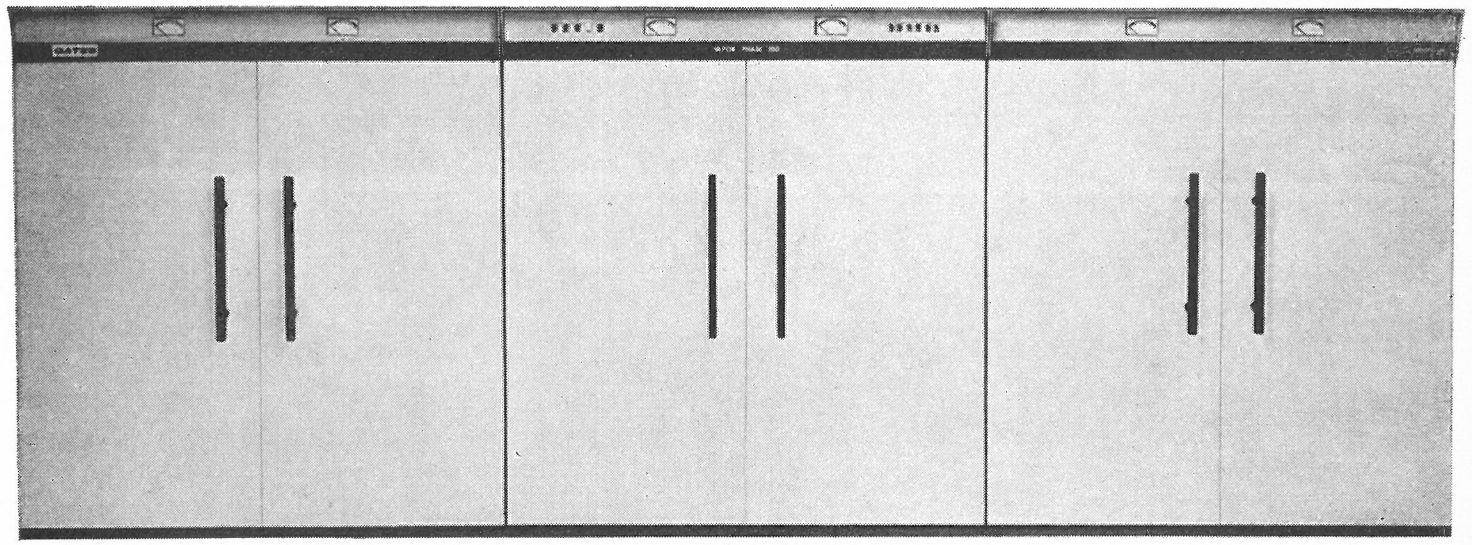

*Exclusive Gates "Pulse Duration Modulation", patent applied for.

This is the world's most advanced medium-wave broadcast transmitter.

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THOMSON-CSF, one of Europe's leading groups in the field of electronics, has earned world-wide fame through the success of its products.
For monochrome and colour television, the output of its BROADCASTING EQUIPMENT DIVISION constitutes a complete range of CAMERAS, RECORDING EQUIPMENT, PULSE GENERATORS, DISTRIBUTION AMPLIFIERS, MIXERS AND MONITORS, as well as all the other material required for equipping STUDIOS, OB UNITS AND TRANSMITTING STATIONS.
The BROADCASTING EQUIPMENT DIVISION, which is an important supplier to the O.R.T.F., exports all over the world ; it has recently secured contracts for equipping and installing television production centres and complete television-broadcasting networks in Iran, Chile, Algeria, Tunisia and Morocco. It has partially equipped the television networks of the U.S.S.R. and Mexico and the new production centre of the Radiotélévision Belge.
The incontestable technical quality of THOMSON-CSF colour equipment has ensured its success in most countries where the introduction and expansion of colour-television services are seriously studied.

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