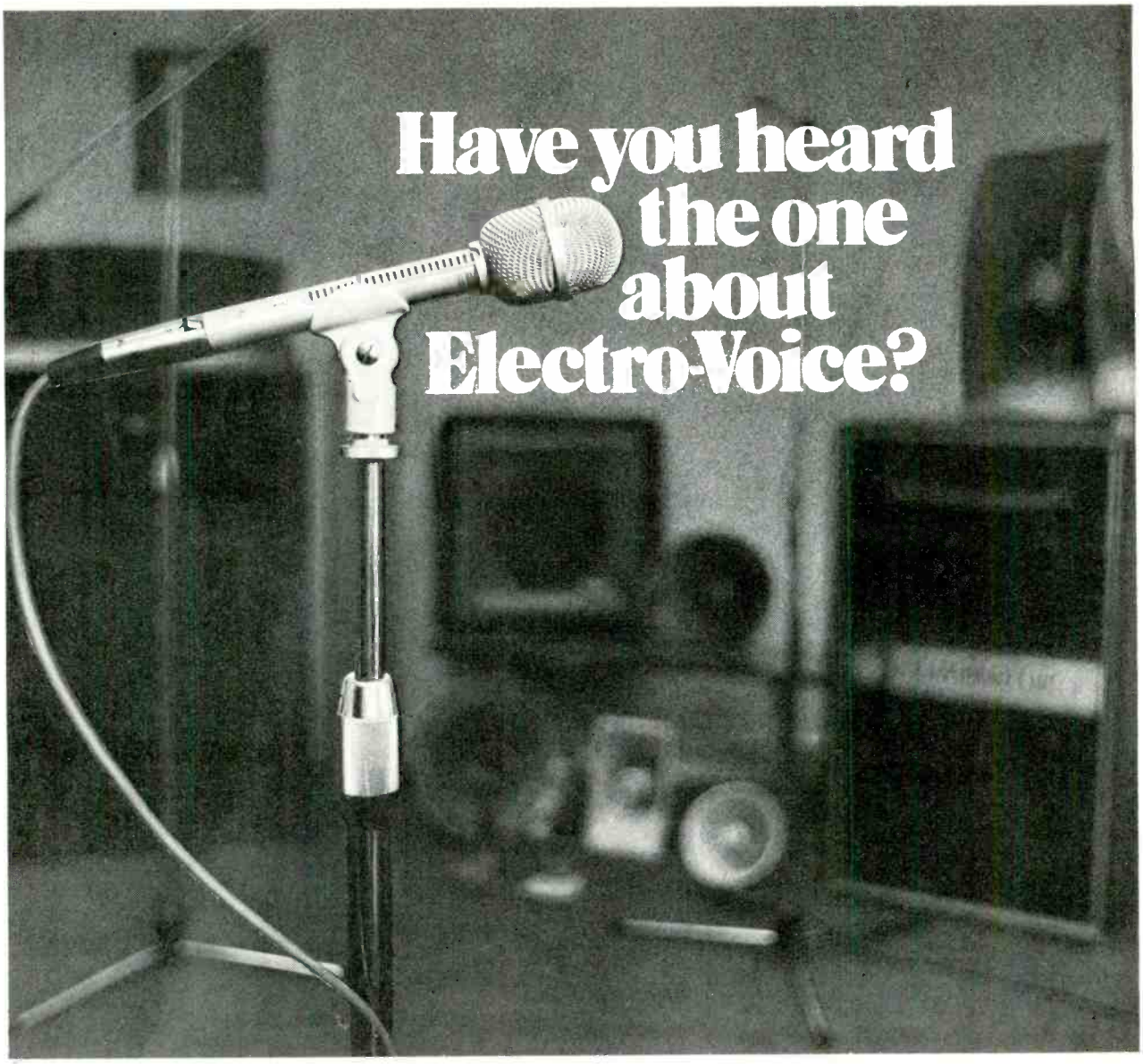
June 1972 25p

studio sound

EQUIPMENT HIRE



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studio sound
INCORPORATING TAPE RECORDER

JUNE 1972 VOLUME 14 NUMBER 6

EDITOR DAVID KIRK

CONSULTING EDITOR JOHN CRABBE

ADVERTISEMENT MANAGER TONY NEWMAN

AUDIO GROUP ADVERTISEMENT MANAGER ROBIN WELLS

Editorial and Advertising Offices: LINK HOUSE, DINGWALL AVENUE, CROYDON CR9 2TA. Telephone: 01-686 2599

FEATURES

COLUMNS

REVIEWS

SURVEYING AUDIO equipment hire services in this issue, we deliberately overlook the fact that almost the entire sound recording industry offers such a service. Virtually every commercial studio offers itself and its equipment for hire by the hour. Many of the companies in our survey provide back-up equipment to studios which in effect is rehired. Preparing the survey, we looked into the little matter of prices and found a decidedly complex situation. Two companies may offer similar equipment at widely differing prices. But investigate the concealed charges—for delivery, installation, collection, and in particular for insurance—and the basic prices become less meaningful. Further, certain companies demand a very substantial deposit to discourage irresponsible customers. This is understandable since more than its fair share of shady operators inhabit the fringes of the recording industry.

One factor which may discourage hiring is the imminent prospect of value-added tax on studio equipment. After 1972, the tax/no-tax distinction between domestic and industrial audio equipment seems almost certain to disappear. While many studios will be able to recover at least part of this tax, there seems a strong case for re-equipping this year rather than next—provided the option is open. The effect of vat on the vtr market will be watched with particular interest. Helical scan systems have hitherto been restricted to educational and industrial consumers, despite a noticeable reluctance to consume. One lecturer suggested to us that the educational use of videotape had been retarded by the unfavourable comparison students made between school productions and the previous night's broadcast television.

In the absence of that prohibitive 30 per cent purchase tax, domestic videotape has become a practical proposition. The last remaining obstacle was contrived by vtr manufacturers themselves when they decided there was room in the world for two helical videocassette standards.

A closing irrelevance. Have you checked your telephonist lately? We contacted one London recording emporium, when preparing the hire survey, and asked whether they supplied audio equipment for use off the premises. 'Audio equipment?' replied a girl. 'We haven't any audio equipment. This is a studio.'

CORRESPONDENCE AND ARTICLES

All STUDIO SOUND *correspondence should be sent to the address printed on this page. Technical queries should be concise and must include a stamped addressed envelope. Matters relating to more than one department should occupy separate sheets of paper or delay will occur in replying.*

Articles or suggestions for features on all aspects of communications engineering and music will be received sympathetically. Manuscripts should be typed or clearly handwritten and submitted with rough drawings when appropriate. We are happy to advise potential authors on matters of style. Payment is negotiated on acceptance.

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Annual UK subscription rate for STUDIO SOUND *is £3 (overseas £3.80, $8 or equivalent).*
Our associate publication Hi-Fi News *costs £3.24 (overseas £3.66, $8.64 or equivalent). Six-monthly home subscriptions are £1.50* (STUDIO SOUND) *and £1.62* (Hi-Fi News).
STUDIO SOUND *is published on the 14th of the preceding month unless that date falls on a Sunday, when it appears on the Saturday.*

PAST ISSUES

A small number of certain past issues may still be purchased from Link House, price 31p each including postage.

Photostat copies of any STUDIO SOUND article are available at 25p including postage.

BINDERS

Loose-leaf binders for annual volumes of STUDIO SOUND *are available from Modern Bookbinders, Chadwick Street, Blackburn, Lancashire. Price is 85p. Please quote the volume number or date when ordering.*

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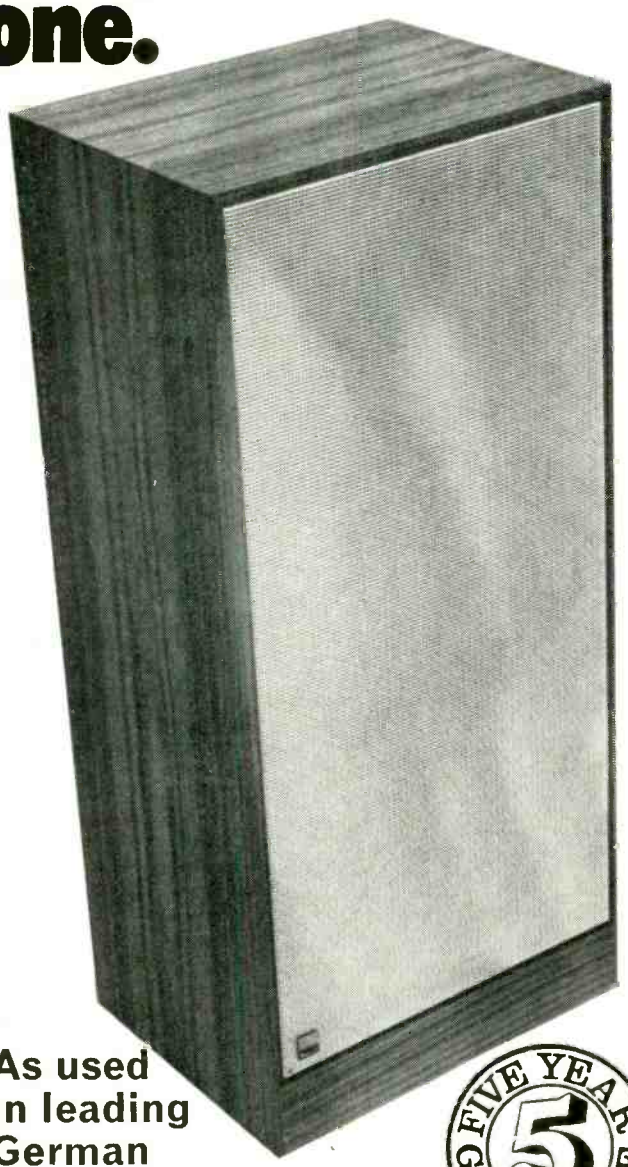

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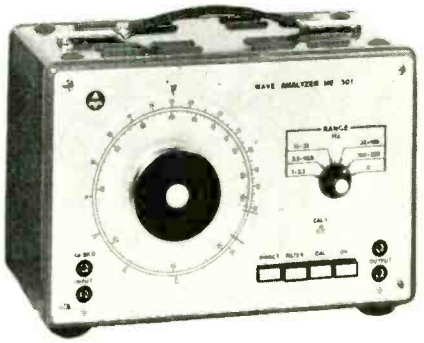

Illustrated is the ME301, a mains-operated silicon transistorized active Wave Analyser with constant "percentage" bandwidth, particularly suitable for narrow (width) band noise and vibration investigations in the 1-330 c/s range. Fuller details on application.

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SOUND SYSTEMS AND ELECTRONICS

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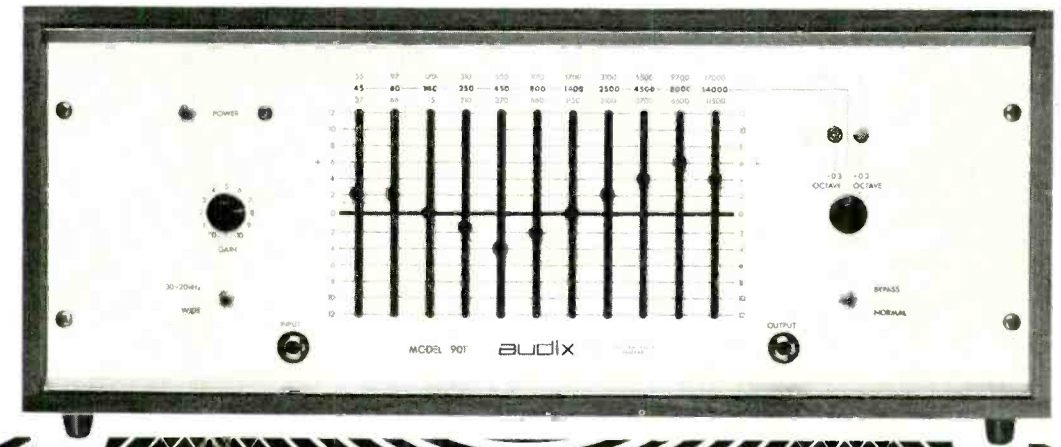

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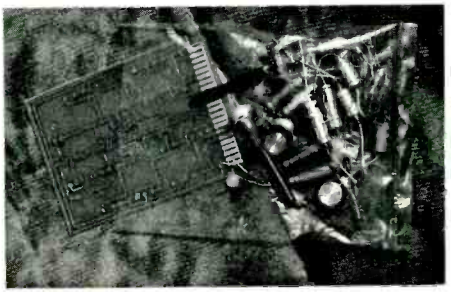

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News

JBL seminar in London

DISTRIBUTORS, PRESS and specialists in the audio world attended morning and afternoon seminars at the Inn on the Park Hotel, Park Lane, London on March 18. Organised by J. B. Lansing Inc, they were held in conjunction with the UK distributors, Feldon Audio Ltd. The sessions fell broadly into the categories 'high fidelity' (domestic) and 'professional' and were primarily held to acquaint the European distributors with the latest JBL philosophies on current and future trends in addition to discussing JBL products.

Larry Phillips (JBL sales manager, USA) was the speaker at both of the sessions, the first of which included an analysis of influences on the state of the audio market. Following a film which showed the manufacture of JBL drive units and enclosures, the importance of studying the audio market and buyers was emphasised by the fact that 80 per cent of US 'high fidelity' audio sales were to people in the 18 to 25 group, although the income is only five per cent of the US total. The influence of opinion in this age group was therefore very great, particularly regarding musical taste (only three per cent of the USA market is for 'classical' music) and audio system format, which is now predominantly packaged as against the previous popularity of the integrated console.

With the trend towards music of the close microphone variety, it was essential that singers' words and other subtleties were heard very clearly on replay and this aspect was a contributory factor regarding loudspeaker design. A demonstration was given of the type of 'assembly' used with multi-mic recording, with separation of the live instruments in booths and their rebalance, blend and integration by electronic processing, this being heard via two JBL *Century L100*, three-driver speaker systems.

Regarding speaker requirements for multi-channel sound, and with four channels in particular, Mr Phillips suggested that the rear channel speakers could be of relatively low performance and acoustic output. In Europe this viewpoint has been largely abandoned, since rear speaker coloration can be obtrusive. For recordings made in very reverberant surroundings without very close microphone techniques, the rear channel levels may be comparable with those needed at the front. However, a detailed description of JBL views on audio will be distributed shortly in a new publication.

Incidentally, JBL are now designing a four channel amplifier suitable for use with their speakers.

In the afternoon, a session on industrial matters was held, in which the three principal applications were covered. Concerning the purposes of auditoria, in which satisfactory sound should be the first requirement, Mr Phillips said that often only 0.1 per cent of the expenditure devoted to the building was available for pa and sound reinforcement. For example, the new Sydney Opera House had cost around $100,000,000, whereas the JBL sound equipment installed totalled $100,000. The number of firms well established in the field of efficient public address was very limited, the USA market being mostly handled by JBL and Altec. In the UK similar positions are held by Tannoy and Vitavox.

Some discussion of drive unit design was then given, including the concentric phase correctors used in JBL horn throats, these having to be machined to very close tolerances. Acoustic lens theory was outlined and its application to the hf section of line source units (sometimes called 'sound column') explained. The efficiency of horn loaded and directional units was emphasised by the JBL model *2356*, which gives 100 dB/W at 9m on axis. JBL horns are treated with a damping material having the name *Lanzaplas*.

The aluminium domed diaphragms used in JBL speakers are manufactured by a process using compressed air which allows their formation from flat sheets without the local stresses usually experienced with ordinary pressings.

Special features of JBL drive units include coils wound by hand with rectangular wire (giving 24 per cent more metal in a given cross-section), central magnet and low reluctance outer path, resulting in extremely low external leakage, and narrow air gaps, the pole surfaces being plated with 1.5 mm silver. This minimises coil inductance and gives 6 dB better drive at 10 kHz. Alnico magnets are employed, the largest being equivalent in useful flux to 37 kg of ceramic. Close tolerance crossover network components are used to maintain uniformity in production.

BBC order more EMI cameras

A REPEAT ORDER worth more than £50,000 has been placed with EMI by the BBC. This is for five *2001* four-tube colour broadcast cameras which will join ten similar cameras currently being delivered. The orders form part of a re-equipping programme to give regional BBC studios full colour broadcasting facilities. The Corporation now have some 120 *2001* cameras, representing 80 per cent of the colour cameras used for studio and outside productions.

Ampex mobiles for CSSR

TWO MOBILE recording units have been delivered to Czechoslovakian Television by Ampex. The blue and grey vehicles were custom-built by Dell Coachbuilders of Southampton and each contain a *VR-2000B* colour vtr plus test and monitoring equipment. The mobiles were dispatched five months after being ordered. Dimensions are 6.9 x 3.2 x 2.4m. A further two units have been ordered by CSSR.

Pyral form UK subsidiary

A BRITISH SUBSIDIARY of Pyral SA. France, has been formed with offices at Airport House, Purley Way, Croydon, Surrey CRO 0XZ (Tel. 01-681 2833). The premises include warehouse facilities for a complete range of studio audio tapes up to 50 mm wide. Pyral also produce 25 and 12.5 mm helical videotapes and a range of direct recording and process acetate discs up to 355 mm diameter. Managing director of Pyral (UK) Ltd is T. W. L. Perkins.

AES lecture on information conveyance

DR D. M. LEAKEY, remembered (together with Hugh Brittain) for some fundamental investigations into binaural hearing processes in the late '50s, and currently technical director of GEC-AEI Telecommunications Ltd, dealt with techniques of signal transmission at the AES lecture on March 14 at Imperial College. It was entitled 'Alternatives to frequency and time in audio system design and analysis', and covered the subject in an unconventional way.

The lecture commenced by emphasising that sinewave analysis did not bring to light the mechanisms of speech communication or even

continued 14

stereo perception, both of which are utilised to extract information under conditions described by the term 'cocktail party effect'. The communication process effectively reduced to an involvement of separable (or 'orthogonal') carriers, multiplexed in some suitable manner, and which showed several advantages over more familiar types of modulation, whether amplitude, frequency or phase. The benefits obtained included a smooth degradation of channel performance with increase of overall loading, adaption to instantaneous loading, gradual overload characteristics and improved fault and interference immunity and/or distribution.

To illustrate how these advantages arose, Dr Leakey first dealt with the cross-correlation characteristics of various types of signal waveform, going on to the use of 'matched' filters, both in the frequency and time domains as well as those showing selectivity to pulse coded waveforms. The properties of a selection of orthogonal functions were then described in straightforward terms, starting with pulses and progressing via Rademacher, Harr and Walsh functions to pseudo-random sequences, both digital and analogue. One interesting offshoot of this was the 'discovery' that telephone engineers in the late 19th century employed line crossings at support posts to minimise mutual crosstalk in precisely the manner demanded by the Walsh functions, first described in 1926!

Consideration of the pseudo-random sequences gave indications of how intelligibility was maintained despite conversation mixing. It involved pseudo-random 'carriers', whose modulations were selected by complex brain processing, including memory and matched detection.

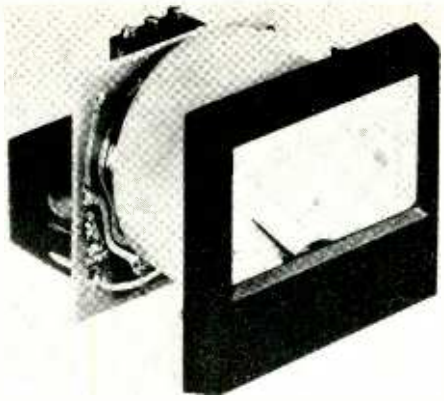
During the discussion it was confirmed that, with any type of transmission or recording system, the effective sampling rate must be at least twice the highest frequency of appreciable signal energy. On the possibility of extracting discrete source signals from a stereo pair, Dr Leakey thought this should be possible in due course, based on an understanding of the human hearing system which exhibits a 'time constant' of around 1 ms.

RCA develop miniature tv camera

AN EXPERIMENTAL television camera weighing some 2 kg has been announced by RCA. The unit is being developed for space research though suggested applications include domestic vtr and commercial surveillance. Future models could be as small as a wristwatch.

Logarithmic amplifier

FELDON AUDIO are now importing a logarithmic amplifier module manufactured by NTP, Denmark. The *M-900* operates from a 24V dc supply, consuming 20 mA, and is designed to work with a Müller & Weigert *D48PL* 0 to 1 mA meter (160 mS rise time). Fallback rate



may be adjusted up to 3s. Indication linearity is ±1 dB, stability 0.06 dB per C, input impedance 10 kΩ, and load impedance 2 kΩ maximum. The module without meter measures 25 (plus 20 mm leads) x 30 x 17 mm and costs £22. Other NTP items available from Feldon include a stereo ppm module, the *177-300*, at £378. Agent: Feldon Audio Ltd, 126 Great Portland Street, London W1N 5PH.

Stolen Uher 1200

A UHER 1200 battery tape recorder, serial number *01101*, was stolen recently from German Television (ZDF), 50 Charles Street, London W1. Any reader asked to service or buy this machine is requested to contact either the police or the German Television office (Tel. 01-499 1818).

BBC ordered to increase music royalties

THE BBC have been ordered to pay two per cent of their income from television licences and government grants to the Performing Right Society. The Performing Right Tribunal, meeting in London on March 27, took the decision by a three to one majority after the BBC had resisted the society's claim for £3,000,000. In the financial year 1970/1, the society were paid £1,784,000 by the BBC. The 1971/2 payment will be £2,350,000, increasing to £2,550,000 in 1972/3. After that, the two per cent rate will take full effect.

BKSTS forum on objective and subjective acoustics

WITH CYRIL Crowhurst as chairman, the BKSTS held a forum on March 29 under the title 'Acoustics and Quality Judgement', the speakers being acoustic consultants C. C. Buckle and K. Shearer and BBC engineer R. S. C. Gundry.

Mr Buckle started with a general history of acoustic conditions for sound recording and particularly dealt with those used for film sound tracks. These were often highly damped at middle and high frequencies but surprisingly lively at lf. This sort of characteristic can give rise to an 'oppressive' effect due to residual rumble arising from outside noise, a phenomenon not experienced in truly quiet environments.

Mr Buckle then examined the traditional ways of measuring acoustic conditions in rooms and auditoria, such as the determination of reverberation time at fixed frequencies and also the steady state acoustic response. He showed that for some sound aspects, such as intelligibility of speech, the delay and magnitude of the reflected sound contributions arriving at the listener after the direct signal were of prime importance. Dealing with pulse testing, he said that this was not always relevant, since some auditoria or room modes may take several seconds to build up to the steady state condition. Pistol shots usually had maximum energy during the first millisecond and the measured reverberation characteristic could be quite different from that found using longer pulses, the 'delay distortion' degrading sound quality. He also pointed out that variations of loudspeaker polar responses with frequency could affect speech reproduction adversely under reverberant conditions.

Mr Gundry next spoke about problems of obtaining the required acoustic conditions in monitoring rooms. The average furnished sitting room has a reverberation time of about 400 ms and BBC listening cubicles were around 350 ms, rising to between 400 and 450 ms at lf, which was considered desirable. The ideal room size was quoted as about 6.1 x 4.9 x 3.4m high to stagger lf modes as evenly as possible. In contrast with the presence of much absorbtion at ear height in the home, most studios at this level housed reflective equipment. For stereo reproduction, some damping near the loudspeakers was said to be preferred, but the glass window of control rooms rendered this impossible except at the sides. Dealing with subjective compensations, Mr Gundry said that experienced operators could largely ignore listening room reverberation, flutter echoes and resonances, and so detect faults in the reproduced programme material. He maintained that realistic stereo was not obtainable with omni-directional loudspeakers and his preference was for concentric drive units with about ±45° polar distribution.

The last speaker, Mr K. Shearer (of Royal Albert Hall 'flying saucers' fame), confirmed the optimum reverberation time figure of 400 ms for recording studio listening rooms but thought it should not vary appreciably with frequency. He dealt with the problems encountered in measuring room isolation from outside noise, the effect of sound absorbents within and their distribution. For instance, absorbent material used in patches can give an apparent absorption coefficient of up to two due to edge diffraction effects. The employment of concrete floors and ceilings can reduce lf absorption but this is often offset by flimsy construction of the remainder! On studio monitoring rooms, he preferred, if possible, asymmetric surfaces and randomisation of absorption material. A small point sometimes forgotten by designers was that monitoring rooms often housed a number of people, with their consequent lowering effect on the reverberation time. He emphasised the value of initial listening tests and simple measurements to determine broad conditions, before taking elaborate measurements, and that even despite the latter being very favourable, it was the user's ear that gave the final judgement.

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Letters

Virtual earth mixers

Dear Sir, In his letter published in the March issue of STUDIO SOUND, J. E. Marshall makes the same point about Peter Levesley's virtual earth mixer design as I did in my letter of January 3. I also agree with the points he makes regarding the BBC microphone amplifier but I should point out that silicon transistors can give noise figures of less than 1 dB with a 1 kΩ source resistance, provided the right type is chosen (e.g. Motorola *2N4401* or *2N4403*). Flicker noise is a function of the source impedance, so it does not follow that a transistor with 200 μA collector current and a source impedance of 1 kΩ produces more excess noise than one running at 10 μA with a 50 kΩ source.

In his reply, Peter Levesley merely reiterates the proof that a virtual earth is created by shunt feedback, a fact which nobody is disputing. The point Mr Marshall is making is that the source impedance for noise figure considerations is not that of the virtual earth. If Mr Levesley is unconvinced, he should refer to papers such as 'The Design of Low-noise Audio-Frequency Amplifiers' by E. A. Faulkner (*Radio & Electronic Engineer*, Vol. 36 No. 1, pp 17 to 30). The consequence of the source impedance and also the effective input resistance being inversely proportional to the number of channels is not that mixer noise decreases with increasing number of channels, since the virtual earth amplifier is current sensing and Johnson noise current is inversely proportional to the square root of the resistance. Hence mixer noise is proportional to $\sqrt{n}$. So who's up a gum tree?

Yours faithfully, Hugh Walker, 91 Atheling Grove, South Queensferry, West Lothian, Scotland.

Noise and impedance

Dear Sir, I was very interested to see the letters in the March issue concerning transistor noise versus input impedance.

Several weeks ago I wrote to Mr Levesley because I was confused by the conflicting design optima I had come across. Mr Levesley's courteous reply convinced me to build some mic amps using the virtual earth technique and I found them rather quieter than the high impedance ones (Mullard) I had been using and I began to wonder why.

The first argument is that silicon transistors produced less noise at 20 μA than at 200. Now, according to data published by Miniflux Electronics, the noise power output of several small signal transistors (e.g. *BC109*, *BC114*, *BC150*) drops by around 3 dB at 100 Hz but the current gain drops by nearly 6 dB so have we gained much?

Secondly, it is said that the optimum Z_{in} is around 50 kΩ and again the Miniflux curves seem to support this view but a silicon transistor working at a normal Ic of say 0.5 mA has a Z_{in} of about 10 —25 kΩ and, if you drive it from a comparable impedance, you worsen the signal-to-noise ratios by 6 dB or so immediately. Therefore you have to reduce the collector current by a factor of ten to increase the input impedance to around 100 kΩ when signal loss will be insignificant. It seems a case of the Zanzibar Fallacy rearing its ugly head.

Finally Miniflux show that optimum head inductance is between 70 and 200 mH and noise is rather worse at 1 H, especially with an 'A' weighting.

Yours faithfully, D. H. Macready, 34 Trevor Crescent, St. James, Northampton NN5 5PF.

The ARP 2500

Dear Sir, I regrettably feel it necessary to comment on your field trial of the ARP *2500* synthesiser in the May edition of STUDIO SOUND. It is immediately obvious to anyone who owns, has used, or has been present at one of our lecture demonstrations, that the reviewer has not only completely failed to grasp the significance and practical importance to the musician of many of its functions, but has in addition totally ignored features peculiar to the ARP *2500*, possibly due to ignorance of their purpose or application.

The review begins by stating that there is no resemblance between the design of the ARP *2600* reviewed in the January 1972 edition and the ARP *2500*. Except for difference in their size, physical appearance and patching arrangements, the synthesisers are identical in their basic electronics, which provide the high standard of operational reliability for which these synthesisers are known. The presentation of the *2500* and *2600* is, as stated, different. One has been designed for the studio or more serious musician/composer; the other for more general use, particularly in the fields of education and live performance. The presentation of the *2600* is such that it enables sounds to be produced and noted with a minimum of effort —a necessity for educational or live performance work. The *2500* has unlimited flexibility which provides the more adventurous musician or studio with a system that can be arranged or re-arranged to any format of operation desired.

There are three basic methods for providing interconnections between the components of a synthesiser. These are patch cords, pin matrix and switch matrix. After careful consideration and investigation, the switch matrix was selected for use on the ARP *2500*. The patch cord and pin matrix methods were eliminated for many reasons, which include obscuration of panels, poor contact, loss, damage, earth loops, reliability of contact and the ingress of dirt. The reasons for the reviewer's mathematical comparisons between switch and pin matrix are puzzling. Does he wish to connect outputs to outputs simultaneously with inputs to inputs and, say, up to 89 components in *series?* Although it is possible to make a greater number of simultaneous connections with a pin matrix, the number of feasible connections during operation is similar for both systems. Operators of the many ARP systems in use have highly praised the patching system and we have no recollection of complaints relating to parallax confusion as suggested. The system is of a technically high standard and provided the equipment is used in the manner intended, problems such as cross-talk between matrix bus-bars are of no consequence.

Keyboards for ARP systems are available in many variations. The keyboard fitted to the test system consisted of a two octave single voice left-hand section and a three octave *two voice* right-hand section. The two voice keyboard enables any two notes to be played simultaneously, providing the musician with a keyboard of great flexibility. The reviewer has failed to appreciate the reasons for the three primary outputs of the keyboard. By separating the gate and trigger functions, it is not necessary (as on systems not using this principle) to release all keys to determine an operational cycle before operating the next key. This is obviously of tremendous importance to the keyboard musician and applies to all ARP keyboards whether single or two voiced.

The ARP vc voice *1045* was understandably skipped over in the review, due to its malfunction at that time. (Our apologies.) It contains a standard voltage controlled oscillator, voltage controller filter and voltage controlled amplifier complete with *two* envelope generators in one modular unit. These components are those most commonly used in the formation of a basic sound. As they are internally connected it is only necessary to connect the keyboard and output via the switch matrix to create a large variety of musical sounds. In this way eight connections on the switch matrix are saved as well as the setting up time.

It is general practice in ARP *2500* modules to package together and internally connect functions which, in normal usage, would be

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ALICE IS A BIG GIRL NOW

We started to build Mixers in 1968—small units specially built for customers and individually designed to specification. At first it was a part-time business—just a group of enthusiastic young men putting together equipment. By diligence, hard work and taking notice of the ever growing requirements for medium price mixers, the enthusiastic amateurs evolved from garden shed engineers to an efficient business machine.

An early stage in the evolution was the realisation that to build Mixers efficiently and to high standards, then a certain amount of standardisation in basic design is necessary. We spent considerable time developing a small range of original amplifier designs and immediately found that we had a particularly efficient microphone amplifier with consistently excellent noise performance. Hence "ALICE makes quiet Mixers"—our first advertisement heading.

By this time, our mixers were technically good and adequately reliable and, because of low manufacturing costs, excellent value for money. But the little Company was becoming successful, success breeds orders, and we were not equipped to build more than one mixer at a time. It was time for serious self-analysis. We decided that the answer was to take time out to design an entirely new mixer that was adaptable to different specifications and yet quick and efficient to build. The result of the development was the SM2 series with a complete complement of tooling, special printed circuit cards and production techniques. During this period we were also experimenting with modular techniques, building limited runs of channel amplifiers, mixer and line amplifiers, limiters and compressors. Production started to move, we took on more staff, moved premises and produced a product which is still the most efficient and reliable mixer of its type.

The introduction of standard tooling and electronics left the development staff free for other projects and soon a flood of ideas was aroused. We decided to fully develop 5 modular units—an equaliser, a limiter, a noise reduction system, a compressor and a power supply module. These are now in production.

And so to the present. Shortly to be delivered and installed is the first in a new line of sound mixing consoles. Bred from experience, study and hard work, this console represents new thinking in every detail. Modular, multi-track with in-built recorder, it is a complete recording machine new from microphone input to record head and monitor amplifier. Further details of these desks will be covered in editorials and later advertisements.

Developed in co-operation with Freehurst Ltd, of Wardour Street, W1, the ALICE/TRACKPLAN desk is the result of a design study into the probable requirements of future recording studios, engineers, musicians and producers.

And so, the Company grows. Already we have equipped a large number of West End theatres with 'quiet mixers' that never go wrong, including Her Majesty's Theatre, the Adelphi Theatre, the New Theatre, the National Theatre Touring Company, and latest, a 30 channel outfit at the Theatre Royal, Drury Lane. Our modules are in use at ORTF in France and at Pinewood Studios here. Equipment is installed from Reykjavik to Johannesburg. Westinghouse Broadcasting Corporation equalise with Alice and the heart of the telephone link-up system at Reuters, London, is an ALICE mixer. Jethro Tull feeds 17 microphones and effects tracks to Crown/JBL stacks via a 20 channel SM2 in Stereo, and 'Music for Pleasure' record all their classical material on an ALICE desk.

For the future, we are instituting a programme of research into new fields—electronic routing systems, audio delay lines, low-loss signal mixing, high speed amalogne to digital converters, and other projects.

Meanwhile, we continue to produce SM2 mixers in ever increasing numbers and variants, and send our modules all over the world.

We look back fondly to our beginnings in the garden shed—it seems so long ago.

Why ALICE?

She was the little girl who followed the white rabbit, met the caterpillar, the Hatter, and held the baby that turned into a pig. My choice of the name was part whimsical, part in admiration for the shy, stuttering mathematician whose mind conjured those incredible pictures.

The idea of the little girl seems a far cry from the real world of commerce, but doesn't the world of electronics get curiouser and curiouser?

Ted Fletcher

Alice (Stancoil Ltd) 15 Sheet Street, Windsor, Berks.
Tel: Windsor 61308

Alice/Trackplan
Modular Channel

connected by external means anyway. Naturally all individual components of 'package groups' such as the vc voice may be used separately and as with all other ARP *2500* modules input attenuators are available for each component.

The ARP *1047* vc filter/resonator is an extremely complex filter providing all the functions possible from one package. The resonant circuits are capable of attaining very high Q values (maximum 512). This facility can be utilised to produce oscillations and even percussive sounds derived from a single short pulse. To aid the practical use of this effect, the panel area to the top right-hand corner is devoted to 'keyboard percussion'. This enables maximum use to be made of the trigger pulse from the keyboard. Because of the high Q values obtainable, care has to be exercised during the use of this module. If during operation the Q control is advanced too much, the filter will veer towards self oscillation as one would expect, which will, under normal circumstances, cause an overload condition to result. A red light indicator is fitted to warn the operator of this condition, which is quickly rectified by a slight adjustment of the self-contained input level attenuator.

In addition to the facilities of the *1046* quad envelope generator described in the review, two of the envelope generators are fitted with delay controls, which enable the commencement of the envelope function to be delayed with respect to the command signal. This facility can, for instance, be particularly useful in synthesising double and triple string instruments.

The two slow random noise outputs of the *1016* noise generator are provided, for instance, to enable the musician to deviate from the normal 'mechanical' sound of synthesisers. By injecting a small amount of slow random low frequency noise into the control function of oscillators, a more 'human' texture is given to the sound. When a conventional instrument, such as a trumpet or cello, is played, the fundamental frequency is not absolutely stable, but varies slightly about the frequency of note pitched for. The insertion of slow random noise enables this human characteristic to be synthesised.

In conclusion I would refer to the point made about value for money. The system made available for the review was one compiled to demonstrate all aspects of music synthesisers and was not necessarily intended to be the ideal package for any particular individual requirement. A prospective purchaser must decide for himself if he will be content with a portable ARP *2600*, or start a *2500* system equipped only with those units which he understands or needs, to which he can add piece by piece as his expertise or application demands. To combine smaller systems, as suggested, could indeed be effective, but not only is one then confronted with a rather awkward total system to operate, but an expense proportional only to amount of equipment and not to amount of *required* or *necessary* equipment.

Above are some of the points I feel should have been mentioned in a serious review of the ARP *2500* synthesiser. Maybe the reviewer was suffering from a severe attack of 'synthesiseritus' at the time. I know what it's like—I've suffered myself.

Yours faithfully, John Bauch, F. W. O. Bauch Ltd, 49 Theobald Street, Boreham Wood. Herts.

David Kirk comments:

Not having been supplied with circuits of either the ARP 2600 *or* 2500, *I was in no position to know that 'the synthesisers are identical in their basic electronics' beyond the functional similarity of certain modules.*

While I concur that there are many reasons for eliminating patch cords in synthesisers, I dispute the implication that pin matrices suffer more than switch matrices from obscuration of panels, poor contact, loss, damage, reliability of contact or the ingress of dirt. Even the largest pin matrix I have tried (60²) was perfectly logical, though a left-handed operator might obscure the labelling if he really tried. As for poor contact, very occasionally a pin may break and become intermittent but this is hardly a criticism of the system since a pin may be repaired or replaced more easily and cheaply than a noisy fader or a faulty switch.

Regarding loss, at least one of the detachable coloured switch caps was missing from the 2500 —equally likely to suffer from light-fingered visitors. Dirt ingress might conceivably be a problem; I suggest using a separate ash tray. The main advantage of pin matrices is that they offer a simple, inexpensive, compact and rapidly programmed method of obtaining maximum flexibility from a given number of outputs and inputs. Perhaps Tonus are admitting partial defeat in choosing to prewire 'commonly used' facilities in the shape of the 1045 module.

I am aware that random noise may be used in vc synthesisers to reduce the 'mechanical' quality of these instruments in so far as human performers contribute unconscious variations in pitch, tonal complexity, loudness and tempo. This point was not mentioned since it applies more to vc techniques in general than ARP units in particular.

'Synthesiseritus' is indeed an occupational hazard for anyone using electronic musical instruments. I hope my continuing enthusiasm for vc techniques is proof enough that I was not suffering from musical indigestion when writing my report.

Tape head inductance

Dear Sir, Mr Marshall's letter (March issue) makes a number of valid points, but I would like to counter his proposal that the inductance of tape replay heads be increased. At low tape speeds, the amplifier hiss is worst at high frequencies. A 100 mH head has a reactance of 10 kΩ at 16 kHz and so matches well with a transistor passing about 50 μA.

At high tape speeds, the high frequency noise is relatively less important, so one might wish to increase head inductance in order to obtain the best match at a lower frequency. It is true also that an improvement in the noise factor at middle and low frequencies may be obtained by operating at a lower current a further increase in the inductance seen by the transistor then being necessary. However, if the first stage of the amplifier uses several transistors connected in parallel, it behaves as if each transistor 'sees' a higher inductance than the actual head inductance. It is not nowadays expensive to use several transistors, and the V_{be} consistency of modern transistors is such that it is not necessary to bias each one separately. It would be reasonable to feed a 100 mH head into ten *BC214LC* transistors passing a total of 100 μA. This will give the same signal-to-noise ratio as a 1 H head feeding a single transistor passing 10 μA but the output (current) will be 10 dB higher so the second stage will contribute less noise.

In practice though, ease of manufacture and the possibility of using longer cables with low impedance heads will probably weigh more heavily than mere arguments about noise!

Adrian Hope's article on the videotape to film process described an effect whereby the television line structure becomes visible in fast-moving sequences. This would indicate that the videotape is being made with the normal broadcast scanning system using interlace, which scans all the odd numbered lines in the picture before the even ones. Effectively, the odd numbered lines are exposed a fiftieth of a second before adjacent even numbered ones. Since the distinction between odd and even lines is lost in the transfer to film, it is not appropriate to use such a system for producing videotapes destined for this process. A simple non-interlace system (in which the lines are scanned sequentially from top to bottom) should produce better results.

Yours faithfully, Peter G. Craven, 100 Abingdon Road, Oxford OX1 4PX.

Microphone balance

Dear Sir, For a book that I am writing on microphone balance, I would be grateful for the fruits of your readers' practical experience in three fields:

(1) Microsound. The classical examples are the caterpillar eating lettuce, or the footsteps of a locust.

(2) The use of contact microphones for sounds that would be difficult to record by normal balance.

(3) Directional underwater microphones (omni-directional types pick up a lot of noise, which water transmits all too well).

Note that the quality and signal-to-noise ratio achieved are important. Would the results be usable in sync film, say, or only as a curiosity?

A certain amount has been written about these topics but they are fields in which individual ingenuity in design and experiment are at a premium.

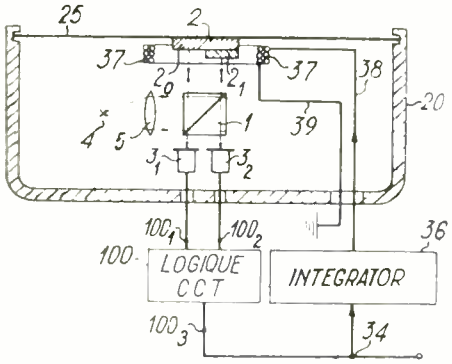
Yours faithfully, Alec Nisbett, 2 Oval Road, London NW1.

Alec Nisbett is the author of 'The technique of the Sound Studio' which has just been republished in its third edition—**Ed.**

Patents

A MICROPHONE for direct conversion of sound signal into pulse-coded electric signals. The title of Patent 1267632, filed by Patrice Bernard of Avenue Montaigne, Paris. His invention relates to a telephone handset microphone which employs optical and electronic techniques, in addition to a mechanical diaphragm, to produce a pulse-coded output. The diaphragm is coated on its underside with a mirror which forms part of an optical interferometer. This is energised by a light source propagated along two paths, one of which is fixed and the other varying in accordance with diaphragm motion. The light wave trains interfere to produce at least one sequence of images whose luminosity varies with changes in the variable path length. These images are received by at least one photo-diode. In **fig. 1**, microphone diaphragm 25 is secured to casing 20, mirrors 2_0 and 2_1 being seen on its bottom surface. The light source is shown simply by dot 4. These co-operate with the cube formed by two prisms and with photodiodes 3_1 and 3_2.

FIG. 1



The diodes deliver signals of varying amplitude which are applied to the logic circuit 100. A clock pulse feeds a time integration arrangement adapted to deliver a current to oppose the diaphragm movement. The microphone is claimed to lend itself to multiplex telephone switching systems using delta modulation and time distribution of channels, such as described in BP 1230927/8.

BP 1267142 describes a combined demagnetiser and cleaner developed for cartridges and cassettes by the Ampex Corporation. Cleaning and degaussing present particular difficulties with cassette equipment, where great ingenuity has been employed to conceal the heads and transport. **Fig. 2** shows the proposed Ampex compact cassette, loaded with a reel of cleaning tape. Degaussing is effected by a barium oxide magnet, 14, with diametrically opposed pole centres. A sprung arm, 53, is tensioned onto the periphery of the cleaning tape supply reel, 43, pulling the rotating magnet away from the replay head as the supply spool empties. The magnet diameter is 8 mm while its width is described in the imperial manner as 'about 1.125 inch', which would be a tight fit in compact cassettes. This is evidently 0.125 inch, or about 3 mm.

An arrangement for processing music is the subject of BP 1268820. Prepared by Matsushita Electrical, it details improved methods of obtaining vibrato and tremolo effects in electronic musical instruments. It is usual in electronic organs to produce vibrato by simple frequency modulation and tremolo by amplitude modulation. In a pipe organ, a tremulant effect is obtained by fluctuating the air pressure applied to the pipes. This produces both amplitude and frequency variation. The celeste or ensemble effect is achieved by causing beats between slightly detuned pipes. **Fig. 3** is a block diagram of the Matsushita processing system. Loudspeakers 141 to 144 are ideally arranged to surround the listener 'or in such a way that they produce reflections of the sounds'. Units 122 and 123 are phase modulators in which the modulation depth or frequency increase with any increase in the input audio frequency.

FIG. 2

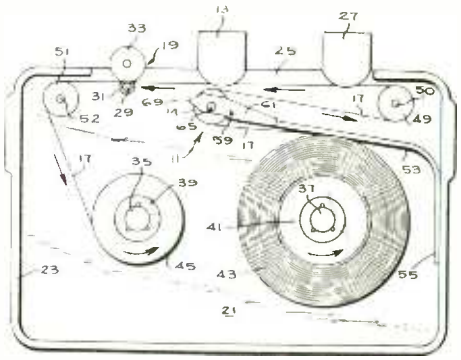
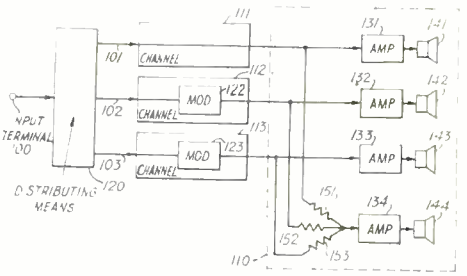


FIG. 3



THE FOLLOWING list of Complete Specifications Accepted is quoted from the March issues of the Official Journal (Patents). Copies of specifications may be purchased at 25p each from The Patent Office, Orpington, Kent BR5 3RD.

March 1, 1972

1269968
Siemens AG
Microphone preamplifiers

1269981
Plessey Co Ltd
Protection circuit arrangements

1270004
Tyco Instrument Division Inc
Analog to digital converter

1270032/33
Nippon Gakki Seizo KK
Loudspeaker

1270064
Mitsubishi Denki KK
Magnetically operable semiconductor device

1270113
English Electric Co Ltd
Phase-responsive circuits

1270128
Pitney-Bowes Inc
Acoustical sensing system

1270145
Philips Electronic & Associated Industries Ltd
Magnetic beam-focusing system

1270167
Philips Electronic & Associated Industries Ltd
Television picture display arrangements

1270178
Varian Associates
Camera tube having a target formed by an array of phototransistors

1270181
Westinghouse Electric Corporation
Tuning device for integrated circuits

1270210
Tavis Corporation
Magnetic core for variable-reluctance transducer

1270243
Dunlop Holdings Ltd
Acoustic elements

1270264
Marconi Co Ltd
Telecine equipment

1270282
Pioneer Electronic Corporation
Magnetic recording and reproducing head

1270293
Compagnie Generale D'Electricite
Television camera device in which scanning is effected by a laser beam

1270369
Columbia Broadcasting System Inc
Record reproducers

1270431
GABR, S Z M
Electro-acoustic transducer apparatus

1270512
International Business Machines Corporation
Transistor delay circuit

1270519
Amp Inc
Apparatus for exposing the core of an insulated wire

1270528
EMI Ltd
Modulated oscillators

continued over

PATENTS

continued

1270564
Philips Electronic & Associated Industries Ltd
Controllable electric oscillator
1270686
Time/Data Corporation
Digital to log-analog converter

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1270849
Philips Electronic & Associated Industries Ltd
Playback of recorded video signals
1270940
Marconi Co Ltd
Switching circuit arrangements for switching video or radio frequency signals
1271042
King Instrument Corporation
Tape winding machine
1271049
Motorola Inc
Frequency discriminator circuit including piezolelectric resonator providing coupled resonant circuit
1271058
International Business Machines Corporation
Noise rejecting circuit
1271088
Mullard Ltd
Magneto-optic body
1271089
Lucas (Industries) Ltd, Joseph
Electric storage batteries
1271109
Siemens AG
Synchronisation of oscillators in telecommunications systems
1271154
Philips Electronic & Associated Industries Ltd
Integrated capacitor memories
1271243
Texas Instruments Inc
Integrated circuit arrays utilizing discretionary wiring and method of fabricating same
1271286
Ever Ready Co (Great Britain) Ltd and Knight G P
Rechargeable electric cells and sealing devices therefor
1271297
Solartron Electronic Group Ltd
Mark-space analogue to digital converters
1271307
Philips Electronic & Associated Industries Ltd
Phase discriminator for synchronising a local oscillator
1271355
RCA Corporation
Transistor variable gain circuits
1271383
Prosser Scientific Instruments Ltd
Linear voltage controlled phase shifter for triangular waves
1271422
Matsushita Electric Industrial Co Ltd
Tape machine
1271441
Telefunken Patentverwertungs GmbH
Band pass filters
1271465
Fuji Photo Film Co Ltd
Magnetic recording material with nickel alloy surface
1271495
Defence, Secretary of State for
Application of acousto-electric oscillators
1271509
Imperial Chemical Industries Ltd
Polymeric compositions
1271517
EMI Ltd
Differential amplifiers
1271528
Compagnie Industrielle Des Telecommunications
Digital frequency receiving device
1271539
Foster Electric Co Ltd
Diaphragm for loudspeakers and method of making the same
1271591
Memorex Corporation
Epoxy binder for magnetic coating composition
1271604
Canadian Patents & Developments Ltd
Anti-clutter signal processing
1271618
RCA Corporation
High resolution electron gun
1271641
EMI Ltd
Electrical signal amplifiers

March 15, 1972
1271667
Sony Corporation
Phonograph pickup cartridges
1271673
Jines, J E, and Jines, J W
Means for shielding and unshielding permanent magnets and magnetic motors utilising same
1271693
Jarvis, W H, and Garton G
Musical tuning aids
1271730
Fuji Photo Film Co Ltd
Magnetic recording medium
1271751
Telefunken Patenverwertungs GmbH
Logic circuit with one pair of transistors
1271789
Kunststoffwerk GEB Anger GmbH & Co
Sleeve for joining electric cables
1271933
Alexander, R C
Rerecording aid
1272149
International Business Machines Corporation
Manufacture of magnetic record devices
1272216
Crow Hamilton & Co Ltd
Personal listening apparatus
1272224
Marconi Co Ltd
Discriminator circuits
1272345
Hammond Corporation
Musical instrument rhythm system having provision for introducing automatically selected chord components
1272347
AMP Inc
Lossy radio frequency ferrite filter
1272415
Philips Electronic & Associated Industries Ltd
Element supporting a record medium
1272447
RCA Corporation
Automatic frequency control
1272482
General Cable Corporation
Electrical cables

March 22, 1972
1272594
Communications Patents Ltd
Wired broadcasting systems
1272603
International Business Machines Corporation
Time division multiplex communication system
1272637
Matsushita Electrical Industrial Co Ltd
Multichannel magnetic head
1272655
RCA Corporation
Wideband amplifier
1272701
Mohawk Data Sciences Corporation
Tape handler with anti-hunt control
1272760
European Atomic Energy Community
Circular calculator for the solution of problems connected with electromagnetic radiation penetration
1272924
Tsugami, T
Cooling device for film-projector light-source units
1272926
Siemens AG
Electrodes for fuel cells
1272962
RCA Corporation
Audio processing equipment
1272970
Marconi Co Ltd
Colour television cameras
1273051
Matsushita Electric Industrial Co Ltd
Semiconductor resonant circuit oscillator devices
1273057
International Business Machines Corporation
Manufacture of magnetic head assembly
1273062
Mitsubishi Denki KK
Stereoscopic television system
1273171
Matsushita Electric Industrial Co Ltd
Magnetic tape recording and reproducing device
1273220
Fuji Photo Film Co Ltd
Magnetic recording medium

March 29, 1972
1273310
Moog Inc
Control mechanisms
1273331
Baldwin Co D H
Plastics piano action
1273338
Philips Electronic & Associated Industries Ltd
Single-tube colour television camera
1273341
Compagnie Generale De Telegraphie Sans Fil
Sound wave radiator devices
1273360
Matsushita Electric Industrial Co Ltd
Colour reproduction system
1273410
Siemens AG
Arrangements for reproducing holograms
1273442
Muller, J
Collapsible stands for musical instruments
1273476
Bobb L J and Pond C C
Electrostatic loudspeaker
1273536
Smiths Industries Ltd
Frequency dividing circuits
1273549
Girling Ltd
Frequency sensitive circuits
1273613
Hell Dr-Ing Rudolf
Method for obtaining electronic colour correction signals
1273630
Matsushita Electric Industrial Co Ltd
Turntable apparatus for phonograph records
1273749
Sanyo Electric Co Ltd
Slow motion picture reproduction in video tape recorders
1273790
Solartron Electronic Group Ltd
Mark-space analogue to digital converters
1273794
International Computers Ltd
Magnetic recording systems
1273816
Akai Electric Co Ltd
Head block assembly for a video magnetic tape recorder
1273821
RCA Corporation
Sequence switching circuit
1273829
Nippon Columbia KK
Disc record injection moulding machines
1273870
Mullard Ltd
Signal averaging systems
1273888
Raytheon Co
Frequency deviation modifier
1273891
Suwa Seikosha, KK
Driving circuit for a brushless motor
1273904
BTR Industries Ltd
Printed circuits
1273917
Autocue Ltd
Prompting devices
1273928
National Cash Register Co
Protective circuit for a field effect transistor
1273934
Commissariat A L'Energie Atomique and Compagnie Internationale Pour L'Informatique
Method and device for obtaining a contact between reading heads and circulating magnetic memory systems
1273981/2
Robertson-Aikman, A J
Pickup arms
1274056
Institut Kibernetiki An Ukrainskoi SSR
Magnetic storage arrangements
1274080
Boliden AB
Method of agglomerating fine-grain iron oxide
1274101
Matsushita Electric Industrial Co Ltd
Dry cells
1274123
Xerox Corporation
Frequency modulation signal demodulator
1274145
Mobay Chemical Co
Polyurethanes which have been stabilised against microbial deterioration

Diary

BY KEITH WICKS

FOR many of the medium and small-sized studios, business was rather slack around April, when this diary went to press. However, most of the larger studios appear to be doing as well as ever and George Pastell claims that his **Nova Sound Studio** near Marble Arch are the busiest studio in London. A new group, Ro-Ro, have been completing an album for Carlin Music with John Alcock producing. Neil Reid and Jade Warrior also completed albums, and Unit Four Plus Two made a single with German producer Tommy Moeller. Jackie Rae produced a Kim Jones single for GL Productions and Mike Leander has been in with Marianne Faithful, dubbing and mixing album material. Neil Reid, whose Nova-recorded Decca album *Neil Reid* reached the top of the British charts, has completed another album with producer Dick Rowe. Neil is soon to record a single follow-up to his current release *Mother of Mine*.

Nova have had such heavy bookings that they are installing more equipment and have recruited extra staff. In June, the reduction room will be equipped with a 16 track machine and the Neve desk modified accordingly. Twenty more Dolby units have been purchased and, when the installation work has been completed, the reduction room will offer virtually the same facilities as the control room.

Studio engineer Adrian Ibbetson and maintenance engineer Mick Glossop both joined Nova in early April. They are two of the four people who recently left Wessex Sound Studios.

The remaining engineers at **Wessex Sound Studios** have been busy with Flying Machine, Wooden Horse and also the Fantastics, who have been in several times with producer Tony Macauley. The band of the Royal Life Guards have made another lp, and several Chapter One artists have used the studio recently.

Piccadilly's **Command Studios** have been losing directors. After a period of strife, managing director John Mosely resigned in February, though he remains connected with Command in a consulting capacity. At the end of March, Dennis Comper announced his own resignation: 'I have resigned from the board and left the Company in order to devote full-time effort to my record production, music publishing and videocassette interests'. Dennis states that his connections with Command were 'severed quite amicably'.

A number of technical changes are being carried out at Command under the direction of Jack Davis. I understand that, at vast expense, all the monitoring speakers are being replaced and that alterations are being made in the disc cutting room.

At **IBC Studios**, Andy Bown, John Baldry, Tony Cole and Leslie Duncan have all been working on album material. Mike Leander has been in with Marianne Faithful adding instruments to some lp tracks and carrying out reductions. Other work has included the recording of theme music for *Budgie* and disc cutting for Festival Records and York Records. The Bee Gees have just started another album with producer Robert Stigwood, and Atomic Rooster are just starting work for Gass-Masters.

Towards the end of the year, IBC will have installed a new mixer in studio A, and transferred the existing one to studio B. The studio engineers have specified their requirements for the new desk and the IBC technical team are building it.

If all goes according to plan, **Mayfair Studios** will be opening their new control room at about the same time as this issue is published (mid-May). The new control room is about 4.5 m square, and has an adjacent vocal booth measuring 4.5 x 3 m. The studio is above the control room and visually linked to it by cctv.

While the finishing touches are being applied, work continues using the studio and old control room. Lionel Bart has been producing some more songs he has written, and Gary Glitter recorded a single, *Rock and Roll*, which has now been released.

Air Fiesta, recent BBC award winners, recorded an album at **Pan Sound Studios** for the Pearl Connor Agency. Studio manager Vic Hawley was favourably impressed by the exciting sounds produced by this Kenyan group. Cliff Bennett has made a single at the studio and Cat Stevens has been in for many sessions. How the theme from *Exodus* could acquire an Ink Spots flavour is hard to imagine but I am told it did when recorded by a steel band called the Carribean, who come all the way from sunny Grimsby. Pan are still searching for new talent and potential superstars should telephone Vic Hawley on 01-328 7222.

At **Maximum Sound**, the Equals have been recording an album produced by Eddie Grant, a member of the group. Manfred Mann has completed an album for release on Philips in England and Polydor in the States. Manfred has also been co-producer with John McGuinness on an album featuring Dennis Coulson singing previously unrecorded Dylan songs for Dick James's DJM label. After about a year, Mike Hugg has finished writing and recording material for an album. In total, about 18 titles were recorded, and from these the final album tracks were chosen. Brewers Droop and Middle of the Road have been in, and McGuinness Flint, having made a single, are about to start work on another.

The rehearsal room at Maximum has proved very worthwhile. For about £1 per hour, groups can make as much noise as they like in this soundproof room.

At **Majestic Recording Studios**, Mike Morton continued work for his successful series of *Non Stop Hits* albums. Mixing was completed on Phil Trainer's album tracks. Songwriter Larry Stott, whose *Chirpy Chirpy Cheep Cheep* sold so well, recorded his *Doggy*. It is said that Larry Stott was much influenced by Bach when composing this number.

Viking Sound Studios, formerly the Tooting Music Centre, recorded a performance by the Manfred Mann group at the Round House. The material will probably be used on one side of an lp.

A production company is being formed by Viking in conjunction with Gordon Smith, and one of its first projects is an album featuring engineer Steve Vaughan, who has already recorded some of the numbers. He sings, plays guitar, and has also added drums and bass on some of the numbers. Steve is soon returning to Canada where he hopes to continue working in the recording industry, as engineer or artist.

Up in the **AIR Studios** overlooking Oxford Circus, many well known artists have been laying down tracks. Cilla Black, Procol Harum, Tom Paxton, Alan Clarke, Mary Hopkin, the Fortunes, and Osibisa have all been in. George Martin's group Parrish & Gurvitz are recording an album, and Spike Milligan is recording a Serious song.

AIR are now beginning to experiment with quadraphonic equipment and techniques in anticipation of future demand. One of the control rooms has been enlarged, loudspeakers are going to be built into the walls and Neve pan pots into the desk.

Sarm have been doing freelance engineering for Rescue Company Number One, Eddison Lighthouse, Butterscotch, Irma Routen, Beggar's Opera, and Sands. In the cutting rooms, the Sarm partners Gary Lyons and Barry Ainsworth have cut masters for Dave Cassidy, Fifth Dimension, Roger Greenaway, Joe Brown, Garry Glitter and the Bay City Rollers. Sarm have also made up promotional cassettes for Jam Records and Bell Records, and have continued their tape duplicating work for various companies. Members of the Nationwide Singers Variety Club were recorded at the Horseshoe Hotel. Bob Antony, who runs the club, once held the record for the longest duration of non-stop singing. His record was recently broken so now he plans to regain his title and have Sarm record his achievement.

Although Sarm have not been in existence for very long, their achievements have been so

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An example of the Midas modular system mixers.

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good that they have been able to obtain financial backing to take over a London Studio. Negotiations are still in progress but they hope to have, within a few months, a fully equipped 16 track London studio with Dolby and quadraphonic facilities.

Sales of the Sarm *Stop Smoking* record by hypnotist Edwin Heath have ceased as a result of action by an EMI publishing company called Ardmore & Beechwood. This company objected to the Beechwood label used by Sarm on the grounds that people might think it is associated with EMI.

The name Beechwood was chosen by Sarm because their offices are located in Beechwood Avenue. Sarm's solicitor advised that it would be unwise to enter legal battle with EMI because of the possibility of having to pay extremely high costs. Hence the Beechwood label has vanished and records have been withdrawn.

I have received a letter from a person who wishes to remain anonymous concerning the Richard Harris tour in February for which Sarm engineer Barry Ainsworth did the sound balancing. It has been pointed out that the equipment was supplied by **Granada Recordings,** apart from the loudspeakers which were supplied by David Martin. Bob Auger was the official sound supervisor at three of the venues. Granada equipment supervisor was Chris Hollebone and transport of equipment was by Churton Services. The writer of the letter acknowledged that Barry and Gary did their job well but did not consider it 'humanly decent' that no one else was given credit. However, Sarm were simply reporting the events in which they had been involved and did not claim credit for anything but the sound balancing.

The **Roger Squire Studio** had its busiest period ever with disc jockeys from all over the country making demonstration tapes and programmes. I dropped into the studio recently to see the new remote start facilities that have been installed and was most impressed by the ease of operation of the equipment. Any turntable can be started by pressing a pushbutton situated in front of the dj, and the record attains full speed almost immediately. For a fast start, these turntable units by Russco of California are the best I have seen. I am told that the fast start is achieved simply by virtue of very large motors. The BBC, on the other hand, use mechanically-operated fast start mechanism. A heavy turntable rotates continually and a lighter plate carrying the record is brought into contact with it. This system provides a reliable fast start if the disc is set up about a quarter turn from the start of the modulation. However, the Russco turntables at Squire Sound are, I estimate, at least twice as fast in getting up to speed. Dj Johnny Walker who used both BBC and Squire equipment has found the latter much easier to operate.

Business is now so good that Roger Squire has found it necessary to appoint a studio manager. Bill Foster, who has been an engineer with CBS for the last four years and was in the business for five years before that, will take up this post on June 1.

Gooseberry had planned to go eight track in February but were still waiting for their Brenell-Richardson machine in April. Jimmy Olin, a freelance engineer at the studio, explained there had been a series of production problems. Meanwhile, four track demo work has continued and a music backing track was recorded for a play called *The Collector*.

At **Intersound,** regular clients Avenue Recordings and Pickwick International have been recording more cover versions of hit records. Crown International Productions worked on an Emerson, Lake & Palmer film track. Ian Cuthbertson, who was in the *Budgie* series, recorded album tracks for Standard Music. Carlin Music made some demo tapes of a group called Hate.

Orange Recording Studios are concentrating on completing a 24-track recorder which they plan to exhibit at the APRS exhibition. Following this, they intend to produce a 32-track model.

Manchester's recently opened **Indigo Sound Studios** have been heavily booked by Radio 70's, whose engineer used the studio to lay down four track masters of ads and jingles for a new commercial radio project. Actor Peter Adamson has joined the studio and plans close ties with the Northern Theatre. Peter is also enthusiastic about using the studio's *VCS3* synthesiser in the theatre. The experimental drama company Loophole Productions used this device for all 'noises off' in their recent University Theatre series.

Indigo have replaced the control desk built by their own engineers with an 18-channel four-group Sound Techniques desk, built and installed in only two weeks. I am told that the original desk will be reserved for location work. The rate for editing, reducing or copying stereo tapes is £6 per hour, not £3 as they quoted in error last month.

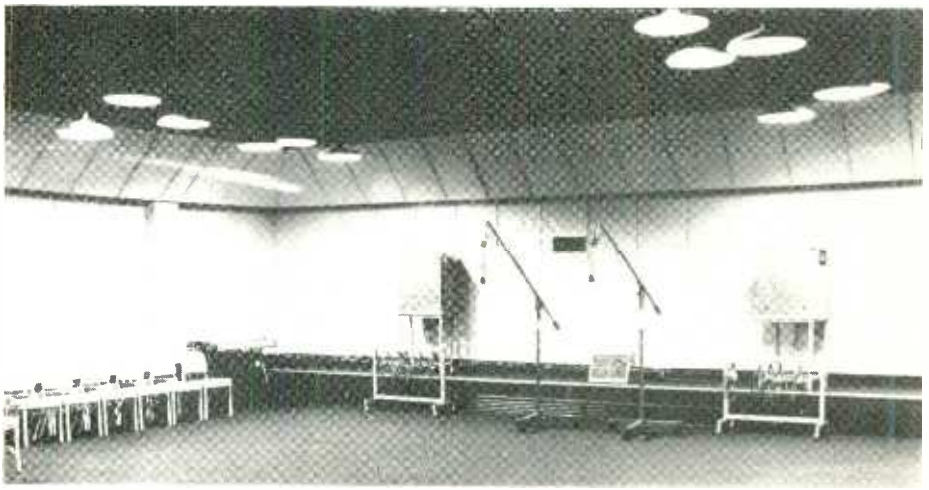
Rickmansworth now has an eight track studio. The **Jackson Recording Company** have acquired an eight track 3M machine, an EMT stereo reverberation plate, and an engineer called Chris Williamson who used to be at Advision. The charge for eight track recording is only £12.50 per hour. Pickwick have recorded tracks for a Clockwork Orange album featuring Nick Condron on synthesiser and produced by Bruce Baxter. Country and western star Charley Pride recorded an album, and Guy Fletcher, Alan Hawkshaw and Equity did demo work. Presentation material was prepared for Glaxo and Smiths Industries.

A Jackson recording of organist Keith Beckingham playing a reggae version of *Women in Love* is currently in the Italian charts. An organ album has now been made for release in Italy on the Adrhythm label.

Trident's many recent customers have included Elton John, Byzantian, Thirty Days Out, Gilbert Montagne, Marty Wilde, Nazareth, Atomic Rooster, David Bowie and Nilsson.

Theatre Projects recorded music to picture for a Buster Keaton film to be shown in the BBC *Golden Silents* series. The Settlers recorded material for a show, and the Polka Puppets recorded voices and effects. Other work included music recording for Richard II at the National Theatre, and a number of demos for various artists.

Peter Self is a recording engineer who used to work for Angus McKenzie. At the moment, Peter is doing mobile recordings, transporting the equipment in his car. A Peter Belamy folk album he recorded received many good reviews and resulted in his obtaining more work from folk companies. A Jacqui and Bridie album for Galliard has just been completed, and a lot of work has been carried out for various music publishers. Peter is now recording documentary albums, one on motor racing and the other on British canals. His main task, however, is the building of a mobile 16 track studio based on a large truck. Details to follow.



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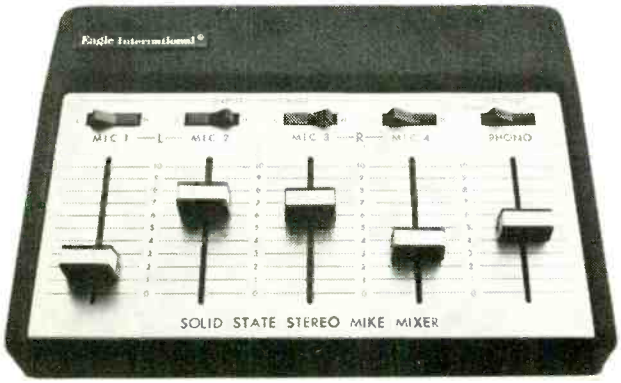

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Recording Studio Techniques

BY ANGUS MCKENZIE

CBS AT WALTHAMSTOW

I WAS very pleased to be asked by Paul Myers and Bill Newman of CBS Records to attend a recording session at Walthamstow Town Hall late last year. The session, recorded quadraphonically, was of Khatchaturian's *Piano Concerto* with the New Philharmonia Orchestra conducted by Ozawa, and with Philippe Entremont as soloist.

Bob Auger, the recording engineer, and his colleagues had filled the control room with a superb array of equipment and a number of chairs had been arranged so that guests could listen to the session. In the centre of the control room was Granada Recordings' Neve desk. The inputs were mixed down to eight tracks, which were recorded via *A301* Dolbys to an eight track 25 mm Scully. At the same time, a four track reduction for quadraphonics was recorded without Dolbys on a four track 12.5 mm Scully. For most of the session, we listened to the Dolby playback of the eight track machine and almost all the monitoring was done on the front two loudspeakers only, the ambience on the back two speakers normally taking care of itself. Bob Auger prefers the sound of the older 15Ω Tannoy *Red* monitors and four of these were positioned round the room. They were in Lockwood cabinets and were driven from Quad *303* stereo amplifiers capable of delivering approximately 40W per channel to the speakers. The tape machines were loaded with Ampex *434* tape and NAB recording equalisation was used.

Paul Myers, CBS producer, explained to me before the session that his intention when making recordings was to translate the musical score directly into reproduced sound and he felt that it was partly his responsibility to decide the nature of the sound that would ultimately be heard in the home. Paul Myers regards a simple concert hall sound as outmoded and does not like to try to reproduce the orchestra in such a way as to place the listener back in the concert hall. He prefers to take the listener directly to the musical score and interpret the score to give the most exciting or appropriate effect.

All engineers have different ways of working and all competent engineers and producers whose records sell are obviously catering for a demand. In the United States, the demand appears to be very much for this type of sound, but it seems that in Europe a sound halfway between the American sound and a concert hall sound is more popular. Here he aimed at this halfway stage although I felt the result was more American than European. I once compared the different approaches to balance with the difference between a colour photograph and a painting. It would perhaps be fair to suggest that American recording technique be compared with an oil painting, which reproduces the artist's interpretation, in this case the artists being jointly the conductor, the music producer and the balancer.

The microphones used were all Neumanns, an *SM2* stereo capacitor being used for overall sound pickup, with many other microphones on different sections of the orchestra pan potted into various positions. Three *M49* faced the back of the hall and supplied ambience for the rear quadraphonic channels. A single *U87* (1.5m up and thus fairly close) was used for the piano, but since an appreciable amount of piano tone was also picked up from the *SM2* at a height of 3.3m the piano spread a little, giving extra depth to the tone and making it rather more realistic. However, the close microphone did introduce a little hammer noise.

In the hall itself the orchestra was laid out more or less conventionally with the first violins on the left, the violas and second violins central, and cellos and basses on the right, the piano being centrally in front. The percussion and horns were behind the first violins at the back and the woodwind section was at the back with the brass on the right. The timpani were placed behind the cellos. The first violins were covered by two *U87* approximately 3.3m up on booms. The percussion mic was an *M49* 2.4m up. Two *U87* at a height of 3m picked up the horns, woodwind and brass, while another two 3.3m up picked up cellos, violas and second violins. The double brasses and timpani were picked up by another *U87* and an *M49* respectively, both 2.4m up. The producer specifically requested that the orchestra be seated at the opposite end of the hall to the stage. Although not normally used, this positioning was chosen here with quadraphonic sound in mind.

Overall sound picture

The balance was obtained by listening to the output from each microphone separately and, after equalising and panpotting, an overall sound picture was obtained. A proportion of *SM2* was then added to the general sound to give the required amount of ambience on the front channels. The ambience tracks were mixed down from the three *M49* backward facing microphones to give the two rear channels, the outputs of which were also used to feed two of the channels on the eight track recording for the subsequent stereo reduction.

I listened very carefully to the CBS system to decide how effective the quadraphonic sound was. While I found that the back speakers contributed additional realism, I noted a lack of information from the two side walls of the room because the quadraphonic sound was not obtained from coincident or near-coincident microphones. I can see, though, that the method of working was justified, for it is important on sessions such as this that a good balance be obtained quickly and reliably.

Vus were used throughout the system. The meters were set such that 0 vu equalled +4 dBm out of the control desk, and equivalent to Dolby level on both the Dolby units and the tapes. I was also informed that 0 vu on the Scully recorders was equivalent to the same level. My colleague and I were interested to note that the vus were frequently allowed to run fairly high on climaxes. Since it is reasonable to assume that all the vu meters acted normally, this would indicate quite a high recording level. Bob Auger explained to me that he was primarily interested in achieving the highest possible signal-to-noise ratio on the tapes, and although I would work at an appreciably lower recording level, nevertheless it is a fact that any distortion theoretically present on the tapes sounded considerably less noticeable than one might imagine. Since a NAB recording curve was used, treble and transient squashing was no more noticeable than middle frequency compression. The Scully recorders used are capable of low tape distortion at high recording levels because of their use of predistortion techniques; at middle frequencies these in theory allow a third harmonic distortion of three per cent to be achieved at 2 or 3 dB higher level than would be possible without predistortion circuits operating. The sound produced in the control room was in fact very exciting but I found it a little difficult to compare the balance with reproduced sounds as played back under normal monitoring conditions. It is perhaps a little daring to monitor at such a very high level, since a false impression of balance can be obtained as there is a tendency to put insufficient bass on the tape. Although the acoustics of the Walthamstow control room are not too bad, the room is a little over-reverberant. I have found in practice that when balancing under such circumstances an engineer is liable to add too much extreme top, particularly from percussion and brass, in order to make the sound clearer in the control room. I have been guilty in this respect on a number of occasions, and have sometimes regretted a slight excess of top on a master tape, or possibly too close a sound. One should therefore not criticise a balance engineer too much

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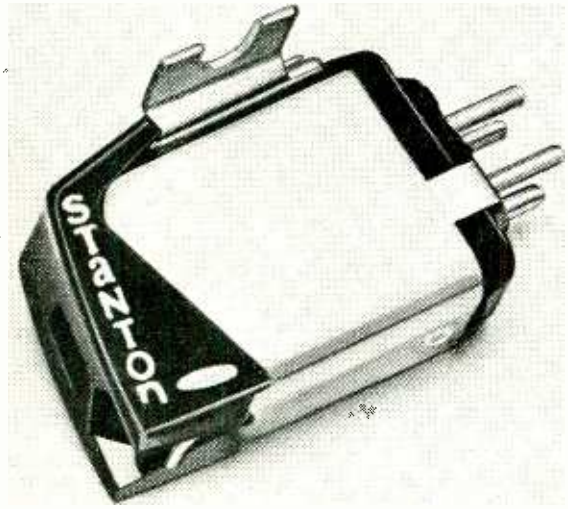

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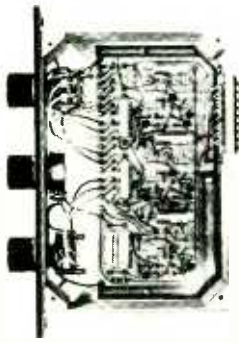

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Flesh and Blood Electronics

By Adrian Hope

IT is rather hard to know how to start writing an article on what Basil Kirchin is doing with tape. One could kick off with the rhetorical question 'Why is Basil Kirchin out on Hampstead Heath every morning at dawn with Nagra *4D* and Sennheiser "telephoto" mic?'. But that smacks of gimmicky journalism which is a bit out of place in the present context. Probably the best way out of the problem is to give a very brief run-down on Kirchin's recent history and follow on from there.

Basil Kirchin is best known as a writer of music for tv and films. The name crops up all over the place—like on the composer credits for the films *Negatives*, *I Start Counting*, *Assignment K* and, most recently, *The Abominable Dr Phibes*. Soon to be released is *The Freelance* and the list goes on and on. His musical writing for tv includes moneyspinners like the theme music from the Ronnie Barker series. Really all this should be irrelevant to what Kirchin is doing today but, by the very nature of the business he's in, a well established musical pedigree is obligatory for anyone to be taken seriously.

In mid 1971, EMI released an lp credited to Basil Kirchin under the title *Worlds within Worlds*. The disc carries the first two movements of a four movement work that Kirchin is producing. Kirchin is working with a heavily edited mass of live animal recordings. Over the years, there have been all kinds of trick methods of persuading dogs to sing *Auld Lang Syne*. Kirchin differs from this in that he goes out at dawn on Hampstead Heath and tapes reel after reel of live, natural sounds. Birds, land animals, amplified insect noises, all go down on tape. When I saw him, he had just returned from Switzerland recording sounds which he prefers for the time being to keep secret. But he did admit to extending his subject not only to simple animal environments but also to mixed environments like the docks at Hull, where he has picked up the sound of everything from seagulls to rattling anchor chains.

The editing work for his first lp was done at Denham where old friends in the film recording world, Ken Cameron and Eric Tomlinson, gave him all the studio facilities he needed.

'Who paid for all this?' I asked, being inquisitive about the economics of doing something at least initially uncommercial.

'We did,' said Kirchin, gesturing to his Swiss wife, Esther. We had help from friends and quite often Cameron and Tomlinson would let us have time in the studio free when they could manage it.

Another reason for using a film studio was that Kirchin next wanted to mix the animal sounds with his conventionally orchestrated music. In all this, his experience of film writing was invaluable. To obtain the split-second timing necessary, Kirchin resorted to the film technique of transferring his animal sounds to film and rerecording with the use of click tracks. From then on, the musicians came into the studio and played exactly what was written for them in just the way they would record for an ordinary carefully timed and synchronised film track. Kirchin now believes he can save time and money by recording in an ordinary sound studio without the use of film and with more straightforward use of tape. He also believes there may be room for live spontaneous exchanges between the musicians and the animal sounds, rather in the manner of jazz musicians swopping fours, eights and twos.

Sitting in Kirchin's work room at his Hampstead home and listening to the finished results (you can hear these on EMI *SCX 6463*) was quite an experience. Coincidentally, or characteristically, he had the speakers positioned with a stereo image spread across a picture window opening out on a garden. Squirrels ran up occasionally to poke their heads through the bushes and blink. I rather like to think they could hear what was going on. It's not often a squirrel hears the sound of a lion *and* a marimba on the edge of Hampstead Heath.

A lot of animal tracks were recorded at London Zoo. Some sounds are clearly recognisable, like the lion that duets with the marimba. Others are less easily recognisable like the ominous rumble that turns out to have been produced by a cello reduced an octave and mixed with the mating calls of two hornbills dropped by three octaves. At the end of one track, Evan Parker (well known as an avant-garde sax player) duets with a canary, blackbird and robin. But the canary has been dropped two octaves to bring into saxophone range the 'figaro, figaro, figaro' phrase it sings all day above a leather shop in Hampstead.

At the time of writing, Kirchin is composing a score of this type ('flesh and blood electronics' seems for the time being the best way of describing it) for a modern production of Richard III to be put on at Nottingham by Peter McEnery, and starring Leonard Rossiter.

RECORDING STUDIO TECHNIQUES

continued

for producing a certain sound on an occasion since this sound may be balanced exactly as the music producer requires. Furthermore, it may be regarded by the majority of listeners as highly commercial. This is, after all, a most important aspect in determining a balance. Some music producers restrict themselves almost entirely to the general running of the session and to points of musical interpretation whereas others, like Paul Myers, take an active part in deciding not only finer points of balance but also frequently instruct the engineer in the amount of equalisation and microphone placing required. I observed this in particular on this session.

I have explained previously that the quadraphonic tape was made from an overall stereo balance on Tracks One and Two and mainly ambience on Tracks Three and Four. The eight track machine was fed with the outputs of channels such that it could later be balanced to achieve both satisfactory stereo and quadraphony. Track One contained the outputs from the left section of strings, Tracks Two and Three the left and right ambience, Track Four the right group of strings including violas, cellos and basses and the timpani, Track Five the left-hand section of the woodwinds, French horns and some brass, Track Six percussion, Track Seven piano, and Track Eight wind section and brass. Tracks One and Four also had some output added from the stereo microphone, thus adding a contribution from the entire orchestra and soloist.

Some readers who prefer the use of a basic coincident mic technique may be surprised at the large number of microphones employed, but there are considerable difficulties in the use of a coincident technique in some halls. Walthamstow may well be an example of a hall that gives disappointing results with such a technique. However, the acoustics are such that many fine recordings have been made there. It would be most interesting to record quadraphonics independently in this hall, using a pure four microphone technique, at the same time as making a normal multi-mic commercial balance.

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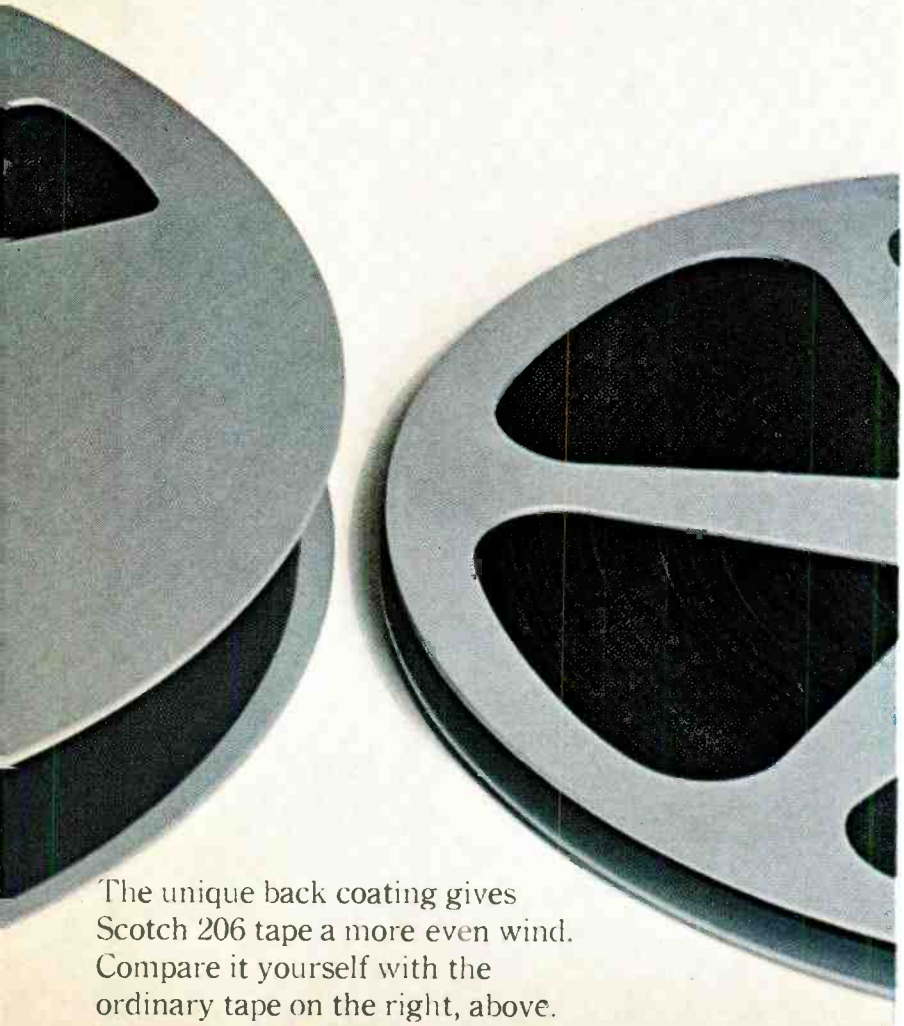

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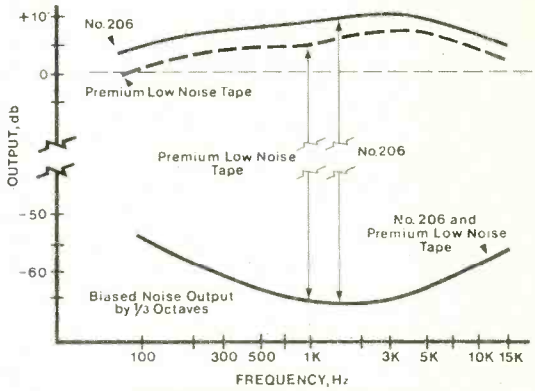

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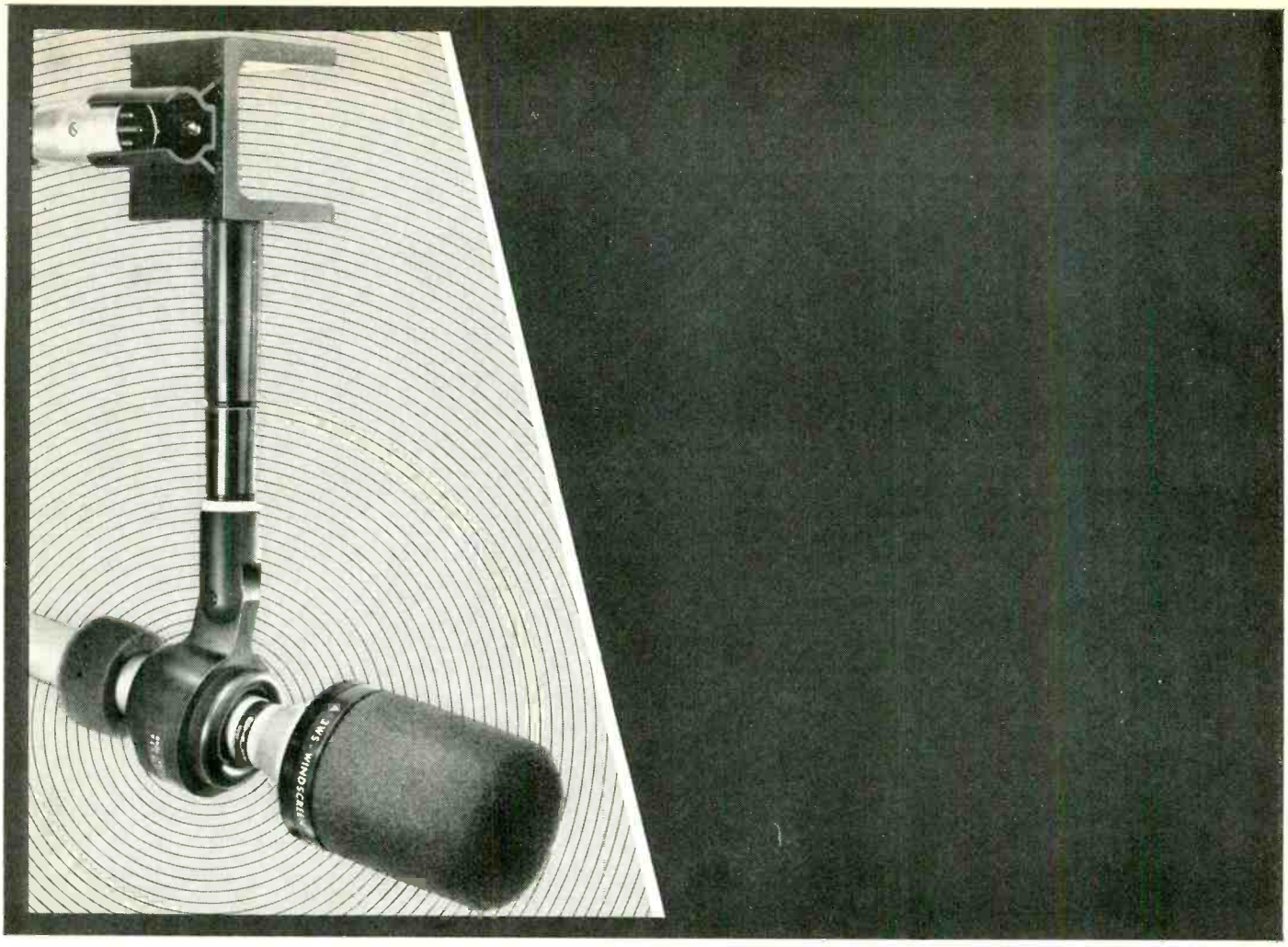

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Kudelski Revisited

By John Shuttleworth

AFTER recently reviewing the Nagra *4S*, I was invited to visit the Kudelski factory in Lausanne to discuss some of the points raised.

The factory is a newish building, pleasant and modern, a large percentage of the space being given over to design and research, with what appeared to be Mr Kudelski's own private research lab next door to the boardroom. This lab is equipped with all the test equipment needed to evaluate a recording chain and must be one of the best in existence.

The factory is currently producing various versions of Nagra recorder and new products on the way are a mixer of modular construction and high quality turntables and pick up arms for studio use.

The points (arising from the Nagra *4S* review) were the widely differing amounts of flutter detected on unweighted rms measurements using different brands of tape, the rather restricted range of bias adjustment, and the higher 40 Hz distortion figures than those obtained from the *4D*.

Kudelski recently investigated the characteristics of various currently available tapes. These have been found to divide into three distinct groups within which the bias requirement of each tape is almost identical. Because of this, it was felt adequate to supply a five position bias adjustment switch assuming the customer would use the Nagra with tapes from the recommended group.

Bias control

Unfortunately this philosophy does not take into account some users' favourite brands of tape. Many users prefer sufficient control of bias to be able to set up the machine in the way they like. Finally, of course, the extreme likelihood that there will be considerable advances in tape production long before the Nagra has completed its useful life: it would be useful to be able to take advantage of future improved tapes without having to return the recorder to the factory for further adjustments.

These points were taken by Kudelski and all *4S* recorders will from now on have modified bias controls to give the customer complete control. It should be noted, however, that alteration of bias affects the adjustment of the anti-distortion circuit and that any change in bias must be followed by an adjustment there.

Some time was spent in discussing how best to provide bias control as some users will obviously prefer fully accessible controls while others would rather have them inside the machine to discourage knob twiddlers. The likely solution which seemed to meet both requirements is a three-position switch on the deck for quick adjustments to suit tapes from one of the three groups, plus a variable control inside the machine for accurate setting up in the lab.

With regard to the flutter measured (rms unweighted), it must be remembered that other factors than fast variation in tape speed will affect the readings. While the figures obtained are perfectly meaningful in comparing the performance of different recorders used with different brands of tape, they do not give the complete answer, particularly when they are as low as those obtained on the Nagra. Kudelski research into tape characteristics has shown that different brands of tape have widely different levels of modulation noise. A tape with a higher modulation noise will give a higher reading of unweighted rms wow and flutter. Modulation noise depends on the intimacy of contact with the recording head as well as on the properties of the tape. As the head geometry can only be made optimum for a particular type of tape running at a given tension, this can cause some of the differences.

Cleanliness and evenness of oxide coating play a big part in reducing modulation noise. I was shown a 'tape cleaner' which produced a dramatic improvement when introduced before the erase head. Measurements of wow and flutter using the Kudelski meter, which has been designed to eliminate the effect of modulation noise as far as possible, showed that readings with different types of tape were very similar and that further alterations to the tape path or guides would not be justified on these grounds.

The final point discussed was the rather high (for a Nagra) distortion figure at 40 Hz. Distortion at this end is closely linked with the recovery time of the limiter. As the Nagra was designed with the film boys in mind, a very short recovery time was arranged so that rifle and pistol shots would not upset the recordings.

In practice, however, people are so used to the sound of a shot which has overloaded a tape that they find the undistorted signal dull and inadequate. For this reason the 'record without limiter' position has been provided on the *4S* and a larger recovery time on the limiter might now be acceptable.

While we were discussing this possibility, one of the Kudelski engineers modified a *4S* in the way suggested and distortion measurements on the modified machine gave results as remarkable at 40 Hz as at other frequencies. Kudelski want to investigate the change in recovery time further but it is certain that a modification will be introduced later. Hayden Laboratories will, of course, be able to modify existing machines to the new standard when this has been decided.

Readers may wonder how machines like the *4S* can give distortion readings lower than the theoretical tape distortion. The principle behind the anti-distortion circuit is ingenious and simple. The idea is to predistort the signal in a manner directly opposed to the distortion that will be produced by the tape. The two distortions should thus cancel, leaving less residual distortion than would otherwise be possible.

It has been found that a pair of diodes used back to back give almost the opposite curve to the hysteresis curve of the tape and a circuit based on this is used in the Stellavox. A slightly more elaborate one is found in the Nagra. Since the hysteresis curve of the tape changes with any variation in bias, it follows as stated earlier that any change in bias must be followed by an adjustment of the anti-distortion circuit.

I was interested to note that my opinion of the rough relationship between weighted and unweighted figure was confirmed yet again. In my review of the *4S*, the unweighted s/n ratio was measured as 64 dB. Measurements of the weighted figure at Kudelski gave 74 dB, exactly the 10 dB I always subtract mentally from the weighted figures given in specifications. It is interesting to note that these quite remarkable figures are obtained on a stereo machine using a very wide guard band.

Cassette problem

I asked if Kudelski had any plans to produce a cassette machine either for interview or domestic use but was told that the problem of azimuth with cassettes precluded their use for compatible mono and stereo recordings, as the two channels keep going in and out of phase. A machine was developed at the factory which maintained azimuth automatically by a signal recorded on the tape, but tapes made on this recorder would not be compatible with other cassette machines. The project was abandoned in favour of the higher quality and reliability associated with the various Nagra recorders now in production and under development.

I was most impressed during my visit to Kudelski by the amount of research done before a new product is launched and the care taken in every stage of manufacture.

The modern spacious and well equipped factory is ideally situated and seems to have an unusually large staff of highly qualified engineers. Led by Mr Kudelski, this team still search after perfection and it is little wonder that the Nagra is such a superb recorder. I would like to thank Kudelski and Hayden Laboratories for their kindness and hospitality and for what proved to be a most instructive visit.

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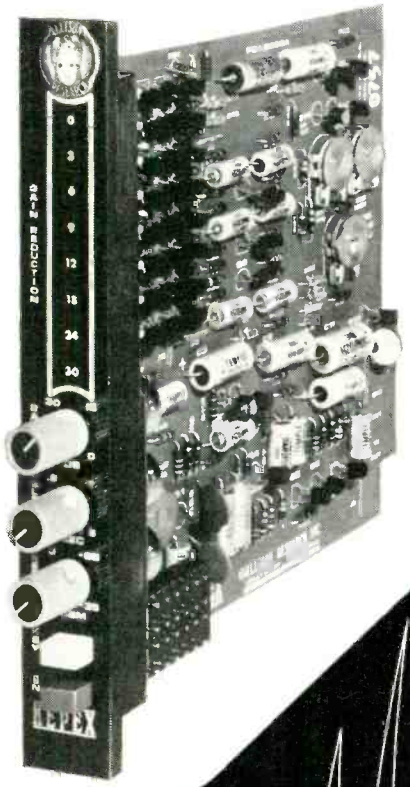

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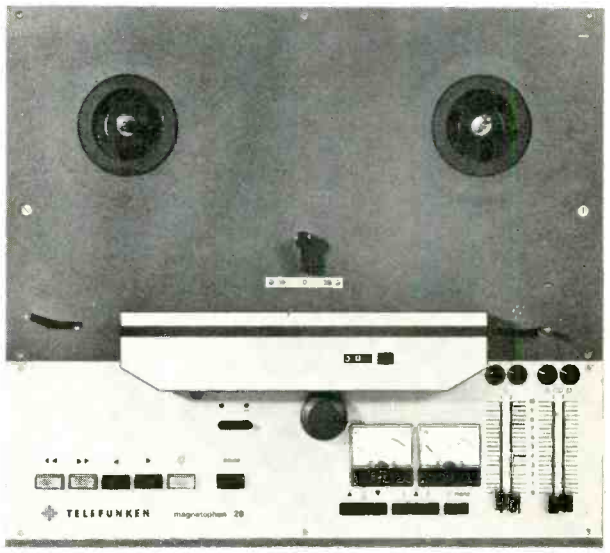

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Report on the AES Munich Convention

By John Dwyer

ARCHITECTS are a race apart, it would seem. The opening address of the second convention of the Central European section of the AES, held at the Holiday Inn on Munich's Leopoldstrasse, was brilliantly lit from the large windows on each side of the conference hall. The early morning sun filled your eyes from a tall rectangular window behind the chairman.

So when the first lecturer called for the first slide there was a great deal of shuffling about to pull curtains shut. The window at the front remained; architecturally right, perhaps, but without curtain or blind. On subsequent days, and with the doubtful benefit of many litres of Bavarian beer still saying their goodbyes from the night before that window could become a problem.

More whispering, more shuffling, much coloured paper, much sticky tape, and the offending window ceased to offend. All this while the first lecturer delivered what was probably the most nerve-racking lecture of the session.

The lecture programme began at 9.00 on Tuesday March 14 and the closing address was held at 17.30 on the following Tuesday. Forty-one papers were presented by speakers from 14 countries and for this reason it was necessary to arrange the lectures in two concurrent sessions per day. Each of the six sessions considered various aspects of a theme.

As well as lectures, there was an exhibition at which 25 firms were represented. Visits to studios and factories in the Munich area were also arranged.

The convention was well organised apart from one or two things; one lecturer I spoke to complained about the audio visual facilities. The overhead projector used in the larger hall, he said, was too small. The slide projector at the back of the hall was too near head height so that, as people entered or left (as they did constantly), the screen was obscured. In the smaller lecture hall, the ventilation noise was irritating and the mild sunny weather seemed to have taken the heating engineers by surprise, for the heat was stifling the whole time. Going round the exhibition you often got a shock when you touched equipment.

The first session was about sound recording. In the opening lecture of the session, J. W. Remouit told of some of the problems encountered in relating sound television pictures to sound. Cinema films seem particularly difficult in this respect. Mr Remouit said that, in reducing the size of the screen and the room in which the film is presented, the relationship between sound and picture became unbalanced. The position of the loudspeaker in a television affected the intelligibility of the signal. 'The main criterion for judging the position for the speaker seems to be the space available when everything else has been fitted.'

The second, third and fourth lectures in this first session were in German. 'The use of support microphones in head-related stereophony' discussed the possibility of using a third microphone to simulate direction and distance in binaural stereo. Some of the equipment relating to this lecture was on show on the Neumann stand at the exhibition.

In the third lecture, research was outlined into the connection between musical style and acoustic ambience.

The fourth lecture, 'Sound recording and acoustics in the new dance-music studio of the Hessische Rundfunk,' concerned the use of short reverberation times, the avoidance of first reflections, and the reduction of sound levels with increasing distance to produce a certain acoustic. This was connected with the previous lecture in that there was some discussion of the effect of acoustics upon the playing of musicians. It would seem that the idea that musicians are affected by the sound of their own instruments is belatedly coming home to some producers and engineers.

The fifth lecture in the first session concerned the use of stereo with television pictures and discussed the problems raised by the use of zoom lenses, switching between cameras, studio acoustics, control board design, microphone placement, and the use of 'Off Camera' sounds.

While these lectures were going on in the main hall, the smaller room (which holds about 150) was the scene of six lectures concerned with instrumentation and measurements. The first two were concerned with designing a high power cutting amplifier and with circuit design for the reduction of transient intermodulation distortion in amplifiers. In the third, N. V. Franssen of Philips Research Laboratories delivered a lecture on 'Tempered tone scale generation from a single oscillator'.

His circuit uses digital techniques to obtain an output frequency related to that of the input by the twelfth root of two, which relates adjacent notes of the equal temperament scale. Twelve notes are obtained in this way and octaves are derived by frequency doubling.

Predistortion

Following this, Michael Gerzon gave a lecture on predistortion techniques. Signals are distorted by transmission systems and, to avoid this, a compensating distortion is added to the signal before it is transmitted. Gerzon suggested using a feedforward loop instead of the more usual feedback loop. He gave examples with reference to the multiplexing of FM transmissions.

The following lecture of the session, in German, was a report of tests to find the best transmission frequencies for radio microphones under given conditions. Following this came one of the most memorable performances of the convention. The public relations officer for the convention, Hermann Wilms, gave a talk entitled 'Stop using the ambiguous dBm'. Herr Wilms is a lecturer in electro-acoustics at the National Radio & Filmtechnical Institute in Belgium.

His 22-page paper began with a short historical survey of the development of the dB to remind us that the dB, unlike its neighbour the neper, is defined only as a power ratio. Thus, if we are comparing two powers, it is only legitimate to use voltage ratios if the two impedances across which these voltages dissipate power are equal. His point is that, since the two impedances are very rarely equal, we have no right to go on using the dBm as we have been doing unless we are prepared to compensate for the change in impedance. If the dBm can be used to define either a power or a voltage output level, then the statement 'Output level equals +12 dBm into 30 ohms' could refer to either an output *power* of 12 dBm or an output *voltage* of 12 dBm and these are two different things.

Herr Wilms points out that the IEC recommendation 268-2 of April 1971 suggests that the dBm be discarded in favour of the dB(V), for which voltage ratios are defined as dB with reference to 1V. If engineers were prepared to drop the 0.775V reference in favour of 1V, or if the 600 ohm impedance could be abandoned in favour of one of 1 kΩ, then all would be well.

As Herr Wilms points out in his paper, these are somewhat Utopian dreams and we must adopt a new proposal for the dBm. What he suggests is to annotate the 0.775V reference as follows: 0 dB ref 0.775V = 0 dB (V.7).

Members of the audience reacted swiftly to these proposals. John Mosely, late of Command Studios, remarked that, if these proposals were adopted, then he feared the vu meter would become obsolete (*Not before its time*—**Ed**).

Another gentleman stood up and informed those present that the IEC recommendation which had been referred to (268) was in fact published in a different form to that agreed upon by the international committee nominally responsible for the document. Doubtless you have your own views on the subject. We shall see what becomes of Herr Wilms proposal for the dB (V.7).

The first three lectures of the third session were conducted in German or Dutch. They were: A studio cassette system for a tape speed of 9.5 cm/s; a Unipot—a device for distributing sound sources into the four channels of a

continued 35

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continued

quadraphonic console—and a metal foil reverberation unit with extremely small dimensions.

The fourth lecture was called 'Voltage controlled gain in the audio channel'. In this, J. Mellis gave details of a circuit arrangement which can be used in mixing consoles and synthesiser amplifiers. The design uses a long-tailed pair at the input which functions as a variable gain differential amplifier. The control voltage which determines the gain is applied to the constant current generator connected to the two emitters. There is a variable law switch in the emitter of the constant current transistor. The control voltage is supplied from an amplifier with a linear fader at the input. This fader controls the audio output and eight or 16 channels can be ganged to it if necessary.

The third session concluded with two papers entitled 'Long term programme attenuator', and 'Volume control equipment with discrete display, variable dynamic properties and signal processing output'. The first describes a level controller which does not compress or expand the input but affects the overall programme level. In theory, a constant or nearly constant output level is obtained for use in broadcasting. The other lecture, unfortunately in German, advanced a new form of level control meter which will give information about the amplitude distribution or pulse distribution of the signal.

Session four, the first on transducers, started with a paper on unidirectionally radiating loudspeakers. This involved presenting various approaches to the design of loudspeaker enclosures. Following this, H. D. Harwood of the BBC presented two papers on Doppler distortion in loudspeakers. Unless the crossovers are correctly arranged, a high pitch signal in a loudspeaker may be frequency modulated by low frequency movement of the cone. Mr Harwood outlined the basis on which he had conducted his tests and indicated that the subjective effect of Doppler distortion was nothing like as serious as measurements suggested. This is qualified by Mr Harwood's initial premise that he was only interested in tests made on programme which, according to his definition, excludes any form of pure tone.

The next lecture was given by A. V. Siniscal of Spectra Sonics. In it he described his company's latest high power public address equipment, which will supply up to 3 kW. As Mr Siniscal said, the sound 'will kill anyone within the first 50 rows'. This output, it was claimed, is made possible by cascading a number of amplifier modules and supplying the loudspeaker units separately. Thus the low frequency, mid range, and high frequency units will each have one or more amplifiers connected to them, the crossover networks being at the input to the amplifiers. The claimed power output only applies, therefore, if the sound produced is apportioned equally among all four units.

Mixer on the Schlumberger stand

There was some dispute about the mathematics by which the power output figures were obtained. The voltages across the loudspeaker units were added in series but for some reason the impedances of the units were not though a correct figure was arrived at.

The fifth session was entitled 'Music, Speech and Hearing' and most of the lectures, conducted in German, concerned acoustic physics. The first two lectures of the sixth session, in German, concerned electret microphone capsules and couplers used in headphone measurements. In the third lecture, a comparison was made between line sources and discrete sound source arrays. It was concluded that continuous radiators have higher frequency range and better directivity. A horn design was shown for use as a continuous radiator and a method was given for improving the directivity by using an acoustic lens.

The fourth lecture of the session featured methods of calculating the directivity of these continuous arrays by using what the authors called an abacus. The three lectures of the first forum were in German. The first concerned the impulse testing of loudspeakers and equipment. The second was about non-linearities in the interconnection of transmission elements. The last asked whether the distortion factor measurement was relevant. It was pointed out that there was a discrepancy between perceptible distortion and measured total harmonic distortion. Suitable weighting networks were proposed.

The second forum, held on Wednesday afternoon, concerned digital techniques in audio. The first paper explained a method of encoding and decoding audio signals digitally. A demonstration of the results obtainable with the equipment followed. The second paper of this forum covered digital delay apparatus.

The final lecture was entitled 'A fader with digital control'. The fader consists of a chain of matched resistive T attenuators with attenuations in a binary sequence in dB, starting from 0.75 dB. The attenuators are switched by fets. Circuit details were shown and the effect of future developments of this kind on console design was discussed.

The third forum was concerned with the reproduction of four channel stereo. In the first paper, Duane Cooper of the University of Illinois advanced the theory that three channels were really quite sufficient. The fourth channel makes little or no difference, but the addition of a third channel to the basic stereo pair radically alters the perspective or depth sense afforded to an off centre listener. Further, Mr Cooper contends that this third channel can have a bandwidth as low as 2 kHz. 'The listener cannot tell the difference between a top-boosted 2 kHz and a full width third channel.'

Following Mr Cooper's discourse, Michael Gerzon leapt to the microphone to advance his own theories on periphony. What he had to say complemented Mr Cooper's work and was a natural extension of it, said Mr Gerzon. He was good enough to mention that certain problems might be encountered using the tetrahedral arrangement in the home, not least that of arranging the furniture. He made the point that the periphonic setup was inclined to show up the smallest fault in loudspeakers and should have high fidelity, good channel separation, should be compatible, economic and standardised.

Following this, T. Inoue presented a paper through an interpreter explaining improvements that have been made in the JVC carrier system, which include improvements in the disc cutting equipment, the pickup stylus itself (a newly developed device called the Shibata stylus) and the use of a newly developed noise reduction system. Each groove wall of a JVC record, which cannot be played with an ordinary stylus, has two signals impressed upon it. One groove wall has the sum plus the

continued over

The NTP stand. NTP are currently represented in the UK by Feldon.

Ortofon displayed disc-cutting equipment and a light-beam vu meter.

continued

difference of channels one and two, the other has the sum plus difference of channels three and four. The difference signals are modulated on a 30 kHz carrier. A combination of phase and frequency modulation is used, the former for frequencies between 80 Hz and 6 kHz and the latter for frequencies to either side. The noise reduction system is applied to the difference signals only, low level signals being emphasised above 700 Hz in the record mode and de-emphasised in playback. High level signals are recorded and played back flat. The high point of the lecture was the covering of a JVC disc in french chalk. It appeared to make little difference.

The last lecture of the session was a paper presented by John Mosely for R. Itoh of Sansui. It was described in the programme as an introduction to the quadraphonic QS system.

During the convention there were opportunities to hear some of the systems working in domestic listening conditions. The JVC demonstration, held in a room on the hotel's fifth floor, was impressive apart from the rather intrusive surface noise. Part of the demonstration was a cathode ray display in front of the listener which indicated the instantaneous amplitudes at each of the four speakers; it told you, in fact, where the sound was coming from. I thought the sound convincing enough without the aid of this device, which seemed an unnecessary admission of defeat.

The exhibition was held in what is normally the ballroom. Two exhibitors had to show their wares on the stage, accessible only from behind a curtain. I was told that there were more applications for space than could be accommodated. Names familiar in Britain included AEG, Beyer, Helios, Sansui, Spectrasound, AKG, Staar SA, NTP, Klein and Hummel, Neumann, Ortofon, EMT, Philips, Neve, Studer, Dolby, Nortronic, and Spectra Sonics.

Schalltechnik of Karlsruhe were showing, with the aid of a large mechanical model, their *CMT36* capacitor microphone. The model showed how the microphone can be switched to any of three polar diagrams. Only one diaphragm is used and the switching is done mechanically. A French firm, Schlumberger, were demonstrating their range of programmable equipment. Elements include comparison matrices, addressable memories, remote control modules, switching grids, and automatic fader logic units. The latter can blend two programmes in any of eight ways, selectable by switch. All the units use modular construction. The firm manufactures a wide range of sound and vision equipment and has installed many of ORTF's studios in France. Their products should find a supplier in this country before long.

There were a number of firms demonstrating light beam signal level meters. Typical of these was one manufactured by Hans Weissert of Berlin. This has two separate channels operating on the same scale and is very expensive, particularly if you are thinking of installing one in each channel of a mixer. Peter W. Wolfert, a Hamburg firm, were also showing a twin beam peak level meter. The price is 620 DM, about £78. They also had on show a number of amplifiers, some items of test equipment and correlation measuring instruments.

A Munich firm, Echolette, displayed a portable mixer. This had ten inputs (two per fader), two outputs, echo send and return, and bass and treble equalisation on each channel. The mixing circuits were constructed using operational amplifier ics. A built-in spring reverberation unit gave a maximum reverberation time of two seconds. They were also showing a tape reverberation unit which is not yet in full production. You could listen to this by putting on headphones and speaking into a microphone. It was good, so good that I expressed disbelief. I asked how it worked and began to receive a potted course in tape recording and reproduction. I said I didn't mean that—it just didn't sound like a tape delay system.

'Ah, that's because we have put a spring under the table, ja?'

Ja.

Nearly 350 delegates attended the convention and one of the most impressive features was the enthusiasm with which the various lecture topics were discussed during the coffee periods. Especially memorable and by no means uncommon was the sight of groups of people, wrestling with Europe's many languages, trying to express points of view about some aspect of audio engineering. Had the convention had nothing to do with audio this would have been impressive. As it was, what took place in Munich this year can do the recording industry nothing but good.

Survey: Audio Equipment Hire Services

THERE are three basic reasons for hiring equipment. First, because it may be considered economically justifiable. Second, to overcome a temporary shortage of equipment, whether due to a peak in the work load or failure in the main equipment. Third, to evaluate a specific type of equipment prior to possible purchase or where longer term capital requirements are uncertain.

The second and third instances occur quite frequently in recording studios but the first reason is not often considered by engineers as meriting serious consideration. Most engineers like owning equipment because it is always available when required. Furthermore it is usually considered that hired equipment is not as well looked after or maintained as if they owned it themselves. This may well account for the relatively undeveloped state of the electronics hire business. There are few organisations specialising in the hire of electronic and recording equipment, the majority consider hire equipment as a subsidiary part of their business. The recording industry is, of course, a hire business in itself, hiring out studio space and equipment for the duration of a recording.

Most artists would not consider owning their own studio since it would be hard to justify economically. How does one therefore set about deciding which equipment to own and which to hire? The higher the initial cost of the equipment, the more difficult it is to justify purchasing. Hence ownership should normally be restricted to good 'value for money' items, the remaining items being hired unless in continuous use. Contract hire of equipment is particularly advantageous where equipment has a fast depreciation or requires frequent maintenance. Hiring is attractive here since agreements normally place the onus for maintenance on the owner. For example, many companies have taken advantage of contract hire facilities to obtain all their cars and vans. This is made even more attractive since rental charges are eligible for tax allowances in the UK.

It is unfortunate to see firms run into liquidity problems, not because of poor sales or inferior products, but because far too many of their assets are tied up in capital equipment. A firm may appear to have ample assets on its balance sheet and yet be unable to pay its creditors. It was traditionally regarded as a sign of strength to have only very limited cash reserves available at any one time. This thinking was based on the concept that money in the bank ('current assets' or 'near cash') was not earning its keep. While this may be true, a firm with only very limited cash reserves is in a very vulnerable position when it comes to an

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expansion programme or meeting increased sales. The only solution is to borrow cash (usually at high interest rates) or increase liabilities (a sure way to bankruptcy).

The simple solution, particularly for a small or medium-sized firm, is to keep its fixed assets to an absolute minimum. This is where the hire business merits serious consideration. By hiring as much equipment as possible, it is possible to minimise fixed costs. Take for example the case where one is attempting to determine a policy for the ownership of microphones. The type of conclusion that one might come to is that it is cheaper to hire a top quality capacitor microphone than to buy one. One would then evaluate the number of occasions when only a first-rate capacitor microphone is adequate for the job. For 80 per cent of the time, a high quality moving coil microphone of one-fifth the cost of a capacitor might prove sufficient. Therefore a sensible policy would be to purchase the moving coil microphone and hire the capacitor microphone on the one in five occasions for which it is required. Hence the capital outlay has been reduced by four fifths. For the other occasions, the hiring cost can be directly attributed and charged to the individual occasion. Thus the really expensive items of equipment only appear as a cost when they are actually earning revenue. This should be the aim of every firm —to ensure that all its equipment is earning revenue for as much time as possible.

The above arrangement also holds true for development work. Precise measurements on equipment are usually only required in the final stages of development. Therefore a policy for a small company would be to buy good low-price equipment and hire very accurate instruments when the occasion arises. This method is particularly attractive since it is possible to purchase good quality oscillators, millivoltmeters, distortion meters, and oscilloscopes at very reasonable prices. Then there are very reasonable hire facilities for hiring top quality test equipment. By adopting such a policy for test equipment, development programmes can be undertaken at reasonable cost and one can avoid tying up valuable capital which could probably be better used in other directions.

The other side

On the other side of the counter, a firm specialising in hire equipment has to contend with a number of problems. Maintenance costs on hired equipment are inevitably high. Damage to connection plugs and sockets and the frequent recalibration necessary due to careless transportation are the most obvious problems. If a good service is to be offered, it is necessary to have a maintenance team available to do the work. Maintenance costs can be reduced by hiring out only the more rugged (and usually expensive) equipment. A firm can reduce rough handling to a minimum by running its own delivery service. The multiplicity of plugs and sockets on audio equipment presents a problem, especially as Phono and some types of DIN sockets are not suitable for frequent connection and disconnection. Some hire organisations in fact modify these sockets to more rugged and reliable types.

Another problem that faces the hiring organisation is that hirers wish to use the latest version of equipment. Hence a frequent replacement policy has to be adopted. Livingston Hire have attempted to overcome the problem by running a separate company which specialises in hiring out the older equipment at very attractive rates. Even so, the working life of a piece of equipment may not be much more than four years. The buying policy is critical and requires careful handling if one is not to finish up with a lot of obsolete and unprofitable equipment.

The cost of hiring is based on the purchase price of the equipment and on its expected utilisation. A hire company would not normally purchase an item of equipment unless they could envisage a fairly high utilisation. For a one-week hire period, the charge would probably be about one twenty-fifth the purchase price. A car hire firm, on the other hand, would typically charge about one-fortieth of the purchase price for a one-week hire period. The difference is accounted for by the much higher utilisation of a car compared with an item of electronic equipment. To put it another way, the potential market for the hire of a car is much larger than for electronic equipment. Even so, to be able to hire £1,000 worth of equipment for a week for about £40 must be considered a very attractive proposition.

Anthony Eden

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Electret Microphones

By John Fisher

THIS must be the most frustrating and tantalising review I have undertaken. It has certainly taken the longest, or has seemed to, and I am still not sure what my final conclusions are. Let me explain. The whole business was my own fault anyway. I had heard of these electret microphones being imported from Japan, some at relatively modest prices considering they were potential competitors for the conventional capacitor microphone with its power supply complications. True, even electret microphones need a power supply. But, because they do not need an ht supply to polarise the diaphragm, the power supply can be very simple. In fact it *can* be a small low voltage battery inside the microphone case. Not so long ago, capacitor microphones did away with the need for a heater supply when semi-conductor amplifiers took over from valves and nuvistors. The permanently polarised diaphragm takes the process a stage farther, and only a low voltage low current supply for the amplifier is required. The millennium appeared to have arrived. But had it?

The theory . . .

The idea behind the electret microphone is that it is possible to produce the electrostatic equivalent of the permanent magnet. Opinion appears to differ as to how long an electret will persist: as yet there is little practical evidence as far as microphones are concerned, but 'many years' seems a likely guess, though it is rumoured that some may only last about three years before losing their polarisation, and others are said to 'die' temporarily.

I understand that one way of inducing a permanent and uniform charge between the two faces of a polymer diaphragm is to bombard it with an electron stream. The charged diaphragm is mounted in front of a back plate, as with a conventional capacitor microphone capsule. The outer face of the diaphragm and the back plate are held at the same potential by the input resistance of the head amplifier, and a potential is induced between the inner face of the diaphragm and the backplate. Vibrations of the diaphragm cause small changes in capacitance between the diaphragm and backplate, in the conventional way. Given a high resistance amplifier and constant charge on the diaphragm, the changes in capacitance are reflected in small changes in potential between the inner face of the diaphragm and backplate, which induces a signal in the amplifier (**fig. 1**).

The capsule itself can be and is made quite small, in the order of 12 mm diameter. This smallness in size makes for a neat microphone and, more important, for potentially good acoustical performance. The microphone supplied for examination (Sony *ECM-22P* and Eagle *CO-96*) were both cardioids, having a pattern of holes drilled through the backplate and free access of sound to the rear of the capsule to provide phase-shift operation. The capsule is coupled to a solid-stage amplifier with a high input impedance. In the case of the Eagle this is a bootstrapped fet source-follower (**fig. 2a**), in the Sony a fet-ic amplifier driving a transformer with taps for phantom powering (**fig. 2b**).

. . . and the practice

Ah, the crunch; this is where the problems begin. I suppose I should begin with my first impressions. Those of the Sony, in its nice padded plastic travelling case, with stand mount, adapter, wind shield and Cannon plug, were all very good. The instruction book said the microphone could be phantom powered (it couldn't quite decide on the lower operating voltage) up to 54V (**fig. 3**) and made helpful suggestions about connections, including consulting your dealer (this is called a professional microphone). It also said the microphone could be powered by an internal 9V battery, which appealed to me no end as I don't normally phantom power anything and don't have the appropriate Sony power supply unit. Snag? No battery supplied. It's a pen-cell (*HP7*) size 8.4V to 9V, mercury cell or dry battery at choice, but neither was enclosed in the package, and I have found neither a Sony agent nor a hearing aid battery seller who could supply one from stock. One can, in fact, leave off half the microphone case, wedge a *PP3* battery in place with its +ve terminal against the spot where the battery positive should go, and use a flying croc lead from the negative terminal of the battery to the spring contact holding the *PP3* in place. But this is hardly worthy of a microphone costing over £60 in this country. The alternative is to rig up a phantom supply. I did both in the course of tests. The mic is intended to feed balanced inputs, but one side of the transformer output can be earthed for domestic or unbalanced-input recorders and equipment.

continued 43

FIG. 1

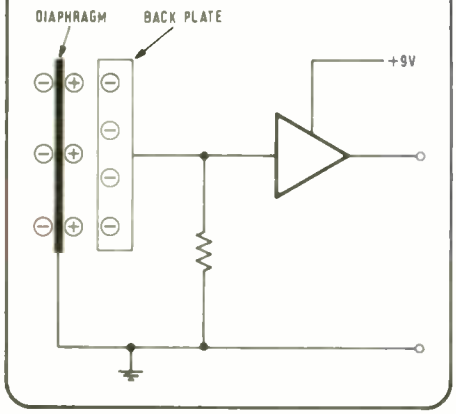


FIG. 2

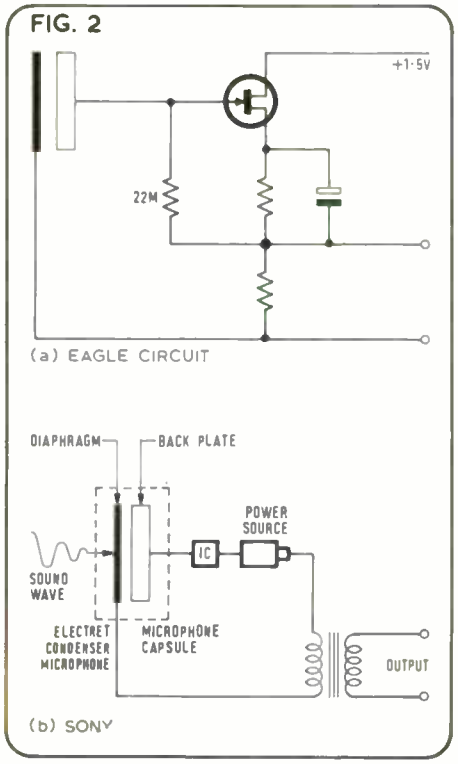
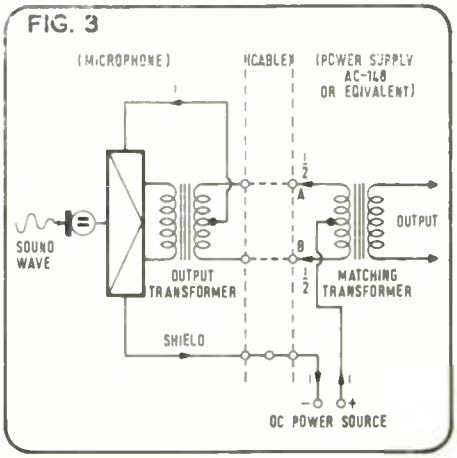


FIG. 3



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Sony 366D 3 sp. 4 Tr.
Sony 266D 3 sp. 4 Tr.
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*Grundig TK.248 2 sp. 4 Tr.
Grundig 146 4 Tr. Mono Auto
Philips 4303 2 Tr. Mono
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Philips 4308 3 sp. 4 Tr. Mono
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*Telefunken M207 2 sp. 4 Tr.
Telefunken 203 2 sp. 4 Tr.

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continued

The specification of the Eagle is more modest and more ambiguous, basically quoting an output impedance of 600Ω and a tolerance-free 50 Hz to 15 kHz frequency response, with minimum operating voltage 1.1V (standard 1.5V) and a consumption of 800 μA.

Sony warn against keeping their microphone in temperatures over 40°C, the Eagle against temperatures above 60°C and in conditions of high humidity. Presumably the electret deteriorates.

The anodised finish of the Sony is attractive and the case nicely built, though I get the impression it wouldn't stand up to as much maltreatment as a Calrec, and the little off/music/close-speech switch looks distinctly fragile (though I must admit that in some months intermittent use there has been no hint of trouble from it). The impedance selector (inside the portion of the case detached to replace the battery) is a slide switch, another of my pet aversions though it may only be used a few times in its life.

The other microphone, the Eagle *CO-96*, aimed clearly at the domestic market, lacks any frills beyond cardboard and polystyrene foam packing (inconveniently arranged packing at that, designed to give minimum protection to the mic while being a pest to pack the cable back into). There is no cable plug, the cable being simply glued into the case, and there is a single on/off slide switch in the body of the microphone. Like the Sony, it is an end-fire, lightweight, quite attractive and not oversized microphone. At least the battery is the common *HP7* type, and one can easily get an alkaline or mercury replacement. The *CO-96* comes with a wind-gag, and simple instruction sheet. In the ordinary course of event this microphone, as a domestic item, would not be reviewed in these pages, but in view of its similarity in principle to the Sony, which claimed to cater for the professional, and the fact that its price compares with a number of ribbons for which professional use is found, it was interesting to see how it compared.

Specifications

Sony's claimed response curves indicate a general fall-off in the bass (−3 dB at 100 Hz and −6 dB at 50 Hz) while the spec gives no tolerance on the claimed 'response' figures of 40 Hz to 15 kHz. Effective output is quoted as −54.6 dBm at 250Ω and −54.8 dBm at 600Ω (0 dBm = 1 mW/10 μBar), with an open circuit output voltage corresponding to −54.8 dB at 250Ω and −51 dB at 600Ω (ref 1V/10 μBar, no frequency specified), with a deviation of ±3 dB in sensitivity. Signal-to-noise ratio is claimed as 64 dB at 10 μBar, 1 kHz, and inherent noise as less than 30 dB spl, with a maximum sound input level of 124 dB spl. It is somewhat difficult to relate the claimed response curves at 0/90/180° to the claimed polar curves (confined to the range 500 Hz to 6 kHz, presumably due to an unflattering shape outside this). Battery current is approximately 130 μA at 9V, giving a claimed life of 2,000 hours for the specified dry battery or 4,000 hours with the mercury cell; life of the batteries could not be verified as the batteries could not be obtained. The microphone can also be powered by the Sony *AC148* power supply, an optional extra, or by phantom powering from 4.5 to 54V supply. Output is balanced 250 or 600Ω.

Impressions

All said and done, it is how a microphone behaves in practice rather than its specification or even measured performance which determines its worth—which is not to deny the value of good measurement figures, simply to underline the fact that small traces of coloration and distortion at certain frequencies cause more unfavourable impressions than larger amounts at other frequencies, and various shortcomings sometimes tend to cancel out in the overall impression.

The microphones were tried out with a variety of material including speech, singing, guitar, piano, descant recorder, keys jangling and alarm clock ticking. The equipment used included Revox *H77* at 38 cm/s on BASF *LP35LH*, and Bowes & Wilkins *DMI* and Goodmans *Maxim* speakers. For comparison purposes, a Neumann-capsuled microphone of similar dimensions to those on test was kindly loaned by John Penty, and two of my own stereo cardioid microphones with larger diaphragms. The noise performance and frequency response of JP's microphone were aurally virtually indistinguishable from those of my mics, so his was adopted as the reference standard, being nearer in dimensions to the electrets and like them end-fire, which simplified comparisons. For interest, the amplifier of the JP microphone is his own construction using readily available components and is somewhere between the *C451* and *C12A* in noise performance, and therefore a good standard. This is not the place to review the JP; suffice to say on listening tests it was one of the nicest I have tried and with the B & Ws in particular gave a very realistic account of all the material tested, giving the least coloration to the sound.

By comparison, the Sony lacked bass and was considerably noisier; it also added a bit of presence. The Eagle was lacking in bass, very noisy, added definite presence with, I think, a lack of extreme top. Compared with the JP microphone, the electrets had relatively low outputs (the Sony's 6 dB up on the Eagle is the 600Ω setting), and required either very high settings of the Revox controls in the low-impedance mic mode of the machine or a matching transformer in the high-impedance mode.

The Sony made speech crisp, intelligible and lacking in warmth, except at fairly close range where the rise in output due to the spherical wavefront compensated for the inherent bass loss in the mic. The bass-cut (voice) switch was only needed very close-to. Female voices tend to take on a sharp edge, not entirely attributable to microphone testing in place of washing up! Guitar lacked the characteristic warmth of the instrument except when close-miking, but there was a fair bite to the sound. Piano was thin and disappointing. Descant recorder sounded a bit hairy. Jangled keys clicked rather than rang at close range and were nearly inaudible behind the hiss when recorded at one or two metres range. Clock ticking was not wholly convincing.

The Eagle was more disappointing. Speech was over-crisp and lacked body, except fairly close and off axis, when it was acceptable though still rather noisy. Singing was a little harsh-sounding for a capacitor, guitar thin and (dare I say it?) 'wooden'. Piano was thin and harsh, recorder hairy, keys and clock definitely 'wooden'.

Both microphones showed reasonable front-to-back discrimination, within the limits of non-anechoic testing, and comparable with many moving-coil cardioids though apparently less good than JP's Neumann capsule. The Eagle appeared more directional at high frequencies than the Sony. The Eagle was aurally more acceptable at 45° to the axis than at 0°; the Sony was acceptable between 0° and 90° (speech tests). Both microphones were at their best 50 to 75 cm from the speaker, otherwise the sound lacked body. Used at 10 to 20 cm the Sony benefited from the bass-cut switch while the Eagle sounded slightly chesty. At this distance both microphones needed their windshields, which reduced breath effects substantially. The effect of its windshield was negligible on the Eagle's response: on the Sony it was subtle, a suggestion of less extreme top and, curiously, a very slight impression of chestiness on speech. Both microphones popped badly on close speech without windshields.

Another Eagle

I may have over-emphasised the response

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This is Indigo

By John Dwyer

TO be honest I was a bit put off. The building that houses Indigo Sound Studios is hardly new. As Dave Kent-Watson, one of Indigo's two managing directors, struggled with a recalcitrant lock at the front door he explained: 'The building is scheduled as an ancient monument. We're going to have the front done up.'

The door opened to reveal a thick, dark blue carpet and orange walls—the inside of the building was totally out of keeping with the outside. We went down some new wooden stairs to the studio itself. The control room resembled a lounge. Though, as I was told later, all the walls are sound treated, much of this takes the form of wood panelling. Against one wall was a leather settee.

I was introduced to Bob Auger (the other Bob Auger) who told me something about Indigo. Bob and Dave had met while working at Granada. They had similar technical backgrounds as both of them had spent some time working for the BBC before joining Granada TV in 1966. Both thought that there might be a future in opening a studio in Manchester.

'We were offered financial backing to start a studio in London,' Bob said, 'but that wasn't what we wanted to do. There are so many clubs in the north and yet no studios at which visiting artists can record. That is why Indigo started.

He went on to say that Indigo's present premises at 72 Gartside Street were at the centre of things in Manchester. Granada's studios are across the street and the Opera House and Free Trade Hall are not far away. For mobile work Bob and Dave use a portable mixer Bob has built.

So far they have spent about £16,000 on the studio, which has been in use since February, and they are still working on it. Malcolm Davies (also of Granada) helped them in the beginning by doing the wiring but he has since dropped out. They were looking for someone to take over his interest in the studio when Peter Adamson (Len Fairclough of Granada's *Coronation Street*), who is a friend of Dave's, asked if he could partner them.

The money was put up by Ian Fisher, former member of the Four Just Men group. He owns the wholesalers beneath which the studio has been built.

Bob Auger showed me the Sound Techniques desk. 'They built it in a fortnight and were the only manufacturers who came anywhere near our six-week time limit. Even then, they said they could have been quicker were it not for the power shortage.'

The desk has 18 input channels which can be switched into any or all of four groups. The input units can be routed to either of two speakers on either of two tracks. 'This facility is useful for adding vocals to backing music tracks while the vocals are being sung.

'Although the studio is only four track at he moment, the desk is designed to work with a 16 track machine. All the input units are constructed using ics apart from the electronics of the mic front ends. The units have a gain variation of between 20 and 60 dB, though normally the gain is set somewhere between 40 and 50 dB.'

'Sound Techniques have gone for a good overload margin and this is particularly important when you're monitoring with vus. The modules have the same gain and electronic characteristics to within 0.5 dB.'

I asked Bob if he preferred vus. 'No,' he said, 'it's just that the desk, which is a standard Sound Techniques model, is fitted with them. We have ppms on the tape machine and intend to put two extra ppms on the desk before long. We like to listen to things rather than look at meters.'

A 'solo' button on the desk enables you to hear any input by itself. They only use it if something sounds wrong.

There are 20 microphone lines from the studio and any line can be routed to any channel. Bob explained that, in his opinion, all monitoring should be done in stereo: 'Some people say you should use four speakers but we don't believe this. If you're making a stereo disc, you should monitor in stereo.'

I asked if they monitored off tape.

'No, we monitor off the desk output. We like to hear what's going on in the studio at the same time as it's happening.'

All the monitor units and input units are interchangeable. The mixed output is usually monitored on units one to four but other units can be used. There is a remix switch which puts the output of the tape machine onto the first four channels. The headphones in the studio are supplied by an auxiliary feed from the monitor unit, which has full echo and pan facilities.

Other features of the desk include a tone source with six frequencies, Penny & Giles faders, and two Kepex expander units. The studio is not yet equipped with Dolby units though this is another priority.

The studio is using a Brenell four track tape machine. The original intention was to buy a Brenell deck and have the electronics built. Why Brenell? 'For the money we had we could

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Left: Sound Techniques desk, EMS *VCS3* synthesiser, 38 cm/s Revox and bay-mounted Audio & Design compressor.

Right: Studio A.

continued

have bought an Ampex or the Brenell. We would love to buy a Studer *A80*, which I think is the best machine on the market, or a Scully. Anyway the deck logic of the Ampex was poor and the Brenell was a British machine. Brenell said they could do the electronics and we have the first of their series of electronics designed for studio use. I don't want to say too much about the Brenell except that the recordings we have made on it are up to standard.

Next to the Brenell were an Ampex *351* stereo master machine and Goldring Lenco *GL75* turntable, which they like because of the variable speed facility. Next to that was a slow speed Revox machine which is used for mobile work as well as general studio work. There was another Revox, a high speed machine, near the desk for use when there is only one engineer in the studio. All the tape machines could be operated by remote control.

In the compressor bay was an Audio Design *F700* stereo compressor. 'Most of the plugging is done on the miniature jack field here on the desk, which is linked to the compressors in the bay. We try to minimise plugging as much as possible by using "normalling", that is, we use GPO jacks, which have switch contacts on them: if no jacks are plugged in everything is still connected up via a "normal" route. We find that GPO jacks are more reliable than other types anyway.'

Dave and Bob explained that they wanted the studio to gain a reputation for its relaxed atmosphere. 'One thing that's important is to make it cosy,' Bob told me and explained that it was the reason why the decor and acoustics of the control room had been made close to that in the home. Those parts of the control room not covered in woodwork were swathed in a strange white material called 'Noise Control'. 'It's an American padding. We haven't seen it used here before and we think it's pretty good.' The walls behind the wood panelling had been specially treated.

The monitor speakers are JBLs, which handle 50W apiece. Bob Auger doesn't like monitoring at high levels but thinks it advisable to have a lot of power in reserve to handle peaks. The JBLs also have the advantage of small size.

Bob told me they found, quite apart from the sound considerations, that they preferred the sound of the *L100* to that of the bigger *L200*. Another reason for choosing the *L100* was that it was available in an indigo-coloured grille. Dave has built an artificial corner for one of them so that both are working in the same conditions.

Next I was shown the studio area. 'We have had 16 musicians in here but the limit is really eight.' The studio has four double power points and there are two distribution boxes which each contain eight microphone points, four foldback points, two tie lines, a master cue light circuit and a cctv socket.

Nearly a kilometre of wire has been used in the studio, with a consistent colour coding throughout. Thus all the microphone wires are orange, the programme sources purple, and other functions coloured white or grey. The wire was supplied by Future Film Developments.

There is a German *Noesk* piano in the studio which is capable of a good bass sound. Foldback cans are Koss *Red Devil*. Indigo have six *D202*, two *C451* and two Calrec *1050* microphones powered where appropriate by battery supplies.

I commented that the Eagle stands they were using seemed rather flimsy. Dave Kent-Watson replied that their flexibility made them less likely to break. They were light to move around and they were smooth to operate. The studio is also equipped with a 6m boom arm.

For talkback, Indigo use two Sinclair amplifiers. Altogether they have about ten Sinclair *Z50c* and often use two in push-pull.

'It's the only amp we know that's plug-in. We use them purely in the production side, for echo drive, foldback and monitoring, not in the actual recording chain.' Dave and Bob have paid special attention to the lighting of

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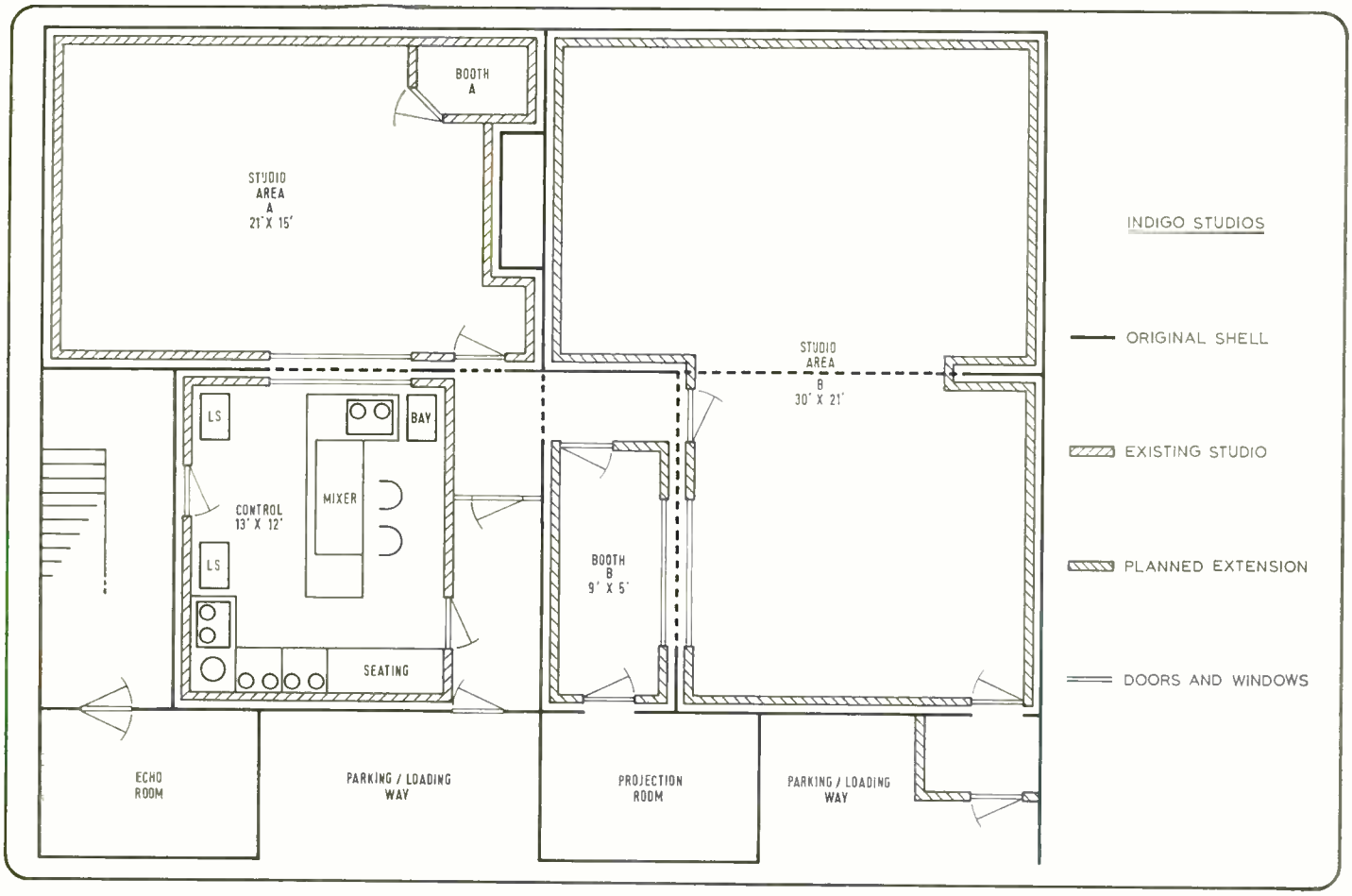


the studio, again with the aim of getting a relaxed atmosphere.

The studio was quiet even though there was a main road close by. Dave Kent-Watson told me that the noise of the lorries was loud when they started the studio. They counteracted this by laying the concrete floor, which is between eight and ten centimetres thick, on a cushion of fibreglass. The walls were then built on this concrete base. Because of this, they claim, the studio is virtually rumble free. The ceiling is 'Wood Cemair', a mixture of straw and cement, and this has been covered with a layer of the 'Noise Control' they used in the control room. The walls of the studio are lined with fibreglass and hessian, and they use blockboard and hessian screens which Dave made himself.

'I don't believe a sound should be too dry; at the same time musicians don't like playing in an echo chamber. We have gone for a live sound and tried to keep the resonances down. I think we've succeeded.'

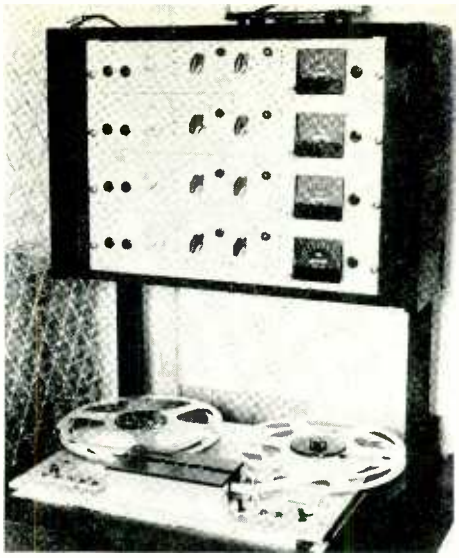
Dave went on to describe his approach to adjusting the acoustics. 'You've got to build the studio, listen to it and then put it right.'

All this, he explained, was to make musicians feel at home. 'If they don't know what's happening, they get very hung up and start screaming for more foldback. Jazz musicians particularly need to know what everybody else is doing.'

Relaxation may depend on other considerations than acoustics and, for this reason, they have a standing arrangement with the local pub to be supplied with large quantities of whatever is necessary at short notice.

Finally, in a corner of the basement, is a tiny room which they have turned into an echo chamber. It seemed to boom a bit but I was told that this was being fixed. In this they use an STC *4021* ball and biscuit microphone.

We started talking about microphone technique. Both Dave and Bob had been in sound for some time before they joined Granada Television so they have definite ideas on the subject. Bob recalled the story of one chap he had to work with who used white gloves and a slide rule when he placed microphones. He never actually listened to the results and the microphones always had to be placed again.



Four-channel Brenell

Dave Kent-Watson told me his views about microphones. 'There are no hard and fast rules,' he said. 'The only way to get a big band sound or group sound is to multimike. That way the engineer can control what's going on and before it goes on record the sound will need modifying for volume, treble, bass and so on.

'But multimiking can sound muddled. With a brass band, for example, a crossed pair is better.

'We're used to doing a balance as a one shot thing. You have to balance quickly in television and so we have tended to go for the simpler types of microphone set-up. For a big band front line, we use a single mike for each section. You can get rather strange results if you use a microphone per instrument. When we get our eight track machine, we'll need to multimike more than we do now.

'For drums, we usually use a minimum of three microphones: one on the bass drum, one on the snare, and one overall, or a crossed pair if we want stereo drums.

'Groups are learning how to play their instruments and experimenting with unconventional techniques. Now a group comes in to create something; they are thinking of sound in terms of a whole sound.'

I asked what work had been done in the studio so far. 'We have a tie-up with a commercial radio set-up. Radio 70s have used the studio a lot to record four track masters and jingles and we expect to do a lot more business with them. Loophole Productions have used the studio for theatre sound effects. We have done some work for Royds and Greendow, an advertising agency. The Northern Theatre have done music for their ballet presentations and we did a recording of the Dobcross Brass Band which has been issued on limited release.

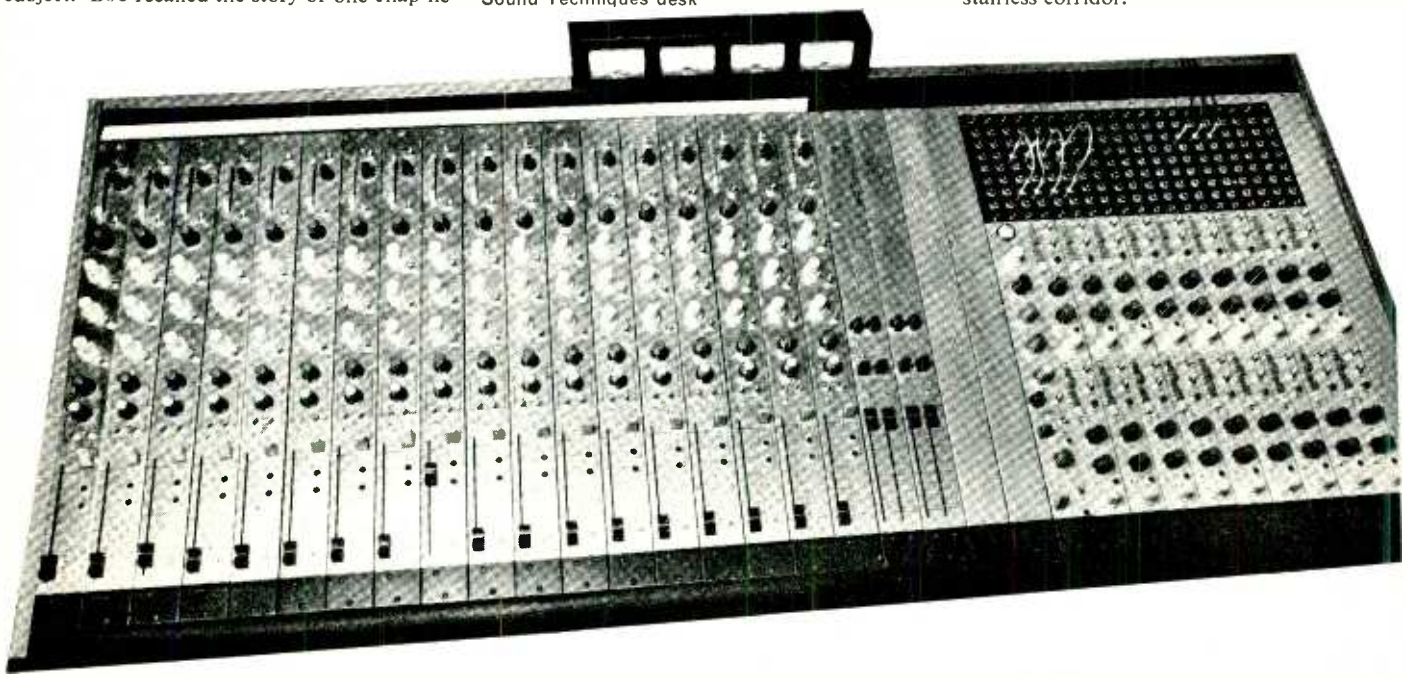
'One record we did was recorded on Sunday for release on Wednesday. We have also done some work for Chris Pye, a local record producer.' 'Recently George Best [a footballer] came in to record an advertising feature for a London agency and we had a mobile session at the Free Trade Hall recently to record The British Youth Orchestra doing Mahler's *First Symphony*.'

What do you charge?

'The basic rate is £6 an hour for a two track session. This includes editing and stereo or mono reduction. For four track the charge is £12 an hour. The reason for the difference is that we want to attract demo and theatre work. The VCS3 synthesiser can be hired for an unspecified sum and most instruments are available by arrangement with a local musical instrument shop. Our cutting is done by 'Twelve Grades Gramophones' in Leicester. They do most of the cutting for the MFP label.'

One of the most attractive features of the studio is that it is easy to get at. Parking is no problem and there is a loading bay connected to the recording room by a short length of stairless corridor.

Sound Techniques desk



Equipment Reviews

Shure M67 2E and M675

MANUFACTURERS' SPECIFICATION

Four input channels each with three pin XLR sockets. Channel one switchable microphone/oscillator, channel four switchable microphone/line. Output microphone level on three pin XLR male and banana sockets for balanced 600 ohm; up to +18 dBm nominal into 600 ohm. Vu meter on output switchable 0 vu ±4 dBm or +10 dBm. Bass cut switches on each channel. Four individual channel faders and separate master control fader. Headphone jack for 'phones of 8 ohms/1 kΩ impedance. Phono socket for direct access to virtual earth bus bar. Provision for 240V ac or 30V external battery operation with automatic switch over in case of mains failure.

Maximum gain, microphone input to line output: 90 dB

Maximum gain, line input to line output: 40 dB

Frequency response: 20 Hz to 20 kHz, ±2 dB

Equivalent input noise: —127 dBm weighted 300 Hz/20 kHz
—123 dBm weighted 20 Hz/20 kHz

Distortion: less than one per cent thd at +18 dBm out into 600 ohms typically 0.5 per cent at normal levels.

Dimensions: 289 x 63.5 x 177 mm

Weight: 2.4 kg

Price: M67/2E: £88.80
M675: £79.80

AGENT: Shure Electronics Ltd, 84 Blackfriars Road, London SE1.

A CURSORY examination of the specification for the Shure *M67/2E* mono mixer showed that the unit should perform satisfactorily if used as intended, and in general it worked quite satisfactorily. A reviewer, however, has to look for any snags in the design, be they electronic or ergonomic, which might affect a reader's decision as to whether or not the equipment is what he wants. So although I have a number of reservations about the performance of the equipment, including one serious one, it seems suitable for many applications, particularly those in which neither the very highest standard of noise performance nor a high microphone sensitivity is necessary.

The *M67/2E* can be used in conjunction with the *M675* to provide a compact and fairly comprehensive mono mixing system suitable for pa and outside broadcast work when feeding post office lines for example, or, as we have experienced recently, when balanced operation is desired during emergencies. The two units used together consume less than 10 mA at normal operating levels and yet can provide a post office line feed off batteries from three or four microphones and four or five line feeds, two of which line feeds can be switched to RIAA corrected gram inputs.

The front panel of the *M67/2E* includes, from the left, four input channel potentiometers, above which are their bass cut controls and to the right of which is the master gain control. Above this is the vu sensitivity switch and to the right of these the vu meter itself. At the bottom right end of the front panel is a combined on/off and battery check switch.

The back panel includes XLR sockets for inputs and outputs at mic level, and three terminal-type banana sockets for the balanced 600 ohm line output and earth. Also on the back panel are two special sockets with polarity markings for supplying external 30 volts dc from an external battery pack or for connection with the *M675*, whose internal batteries can supply both units. A phono socket on the back panel injects directly on to the virtual earth point of the mixing bus bar and can be fed from any external source of greater than 3.5 kΩ, the theoretical impedance at the virtual earth point. A captive mains lead is supplied including an earth wire, all with the new colour coding.

The microphone input circuit is basically a balanced input transformer driving a form of Darlington pair, the collectors of the npn transistors being in parallel and driving a 50 kΩ channel gain potentiometer. The input impedance is rated by the manufacturer as nominally 800 ohms, but in fact measured 950 ohms at 1 kHz and fell to only 320 ohms at 20 Hz and 20 kHz. At 40 Hz however the impedance was 500 ohms and at 10 kHz the impedance was 650 ohms. The response from a 200 ohm source from the mic input to line output of the mixer was ±1 dB from 40 Hz to 15 kHz, but a bass rise of 2 dB was noticeable at 20 Hz. From a 60 ohm source the bass rise at 20 Hz was 4 dB and a treble rise of 2.5 dB became apparent at 20 kHz. The response from a 60 ohm microphone is therefore just outside the specification but this is of no real consequence, especially since a bass cut is available on all channels.

The clipping level at the microphone input was found to be exactly as specified by the manufacturer, namely −28 dBm for one per cent distortion, although audible distortion on a tone was noticeable at −30 dBm. The gain of the microphone preamplifier with its transformer measured approximately 40 dB to the top of the channel gain control. The input clipping level is a function of the preamp gain, and the output capability of the preamp is determined by the available ht rail voltage, this being approximately 15 volts. Unfortunately the clipping level is totally inadequate to allow the mixer to be used with normal capacitor microphones on music unless external attenuator pads are available; for speech no pads should be necessary, unless someone is almost shouting into the microphone. Using moving coil or ribbon microphones with the mixer should cause no trouble unless the microphones are used close to loud musical instruments.

The virtual earth mixer amplifier, also a form of Darlington pair circuit, drives the 50 kΩ master gain control. The output from the master gain control is amplified up to line level by a line out amplifier having four transistors, the two output transistors being a complementary pair. The junction of the two emitter loads is fed via a capacitor to the primary of the output transformer. The same point also drives an ac only feedback loop to the first emitter of the line out amplifier. A small amount of feedback is taken from the collector of the first transistor to its base to decrease the input impedance of the complete line out section. In this way the noise level of the output amplifier does not deteriorate dramatically when the master gain control is 6 dB down from maximum and therefore at its highest output impedance.

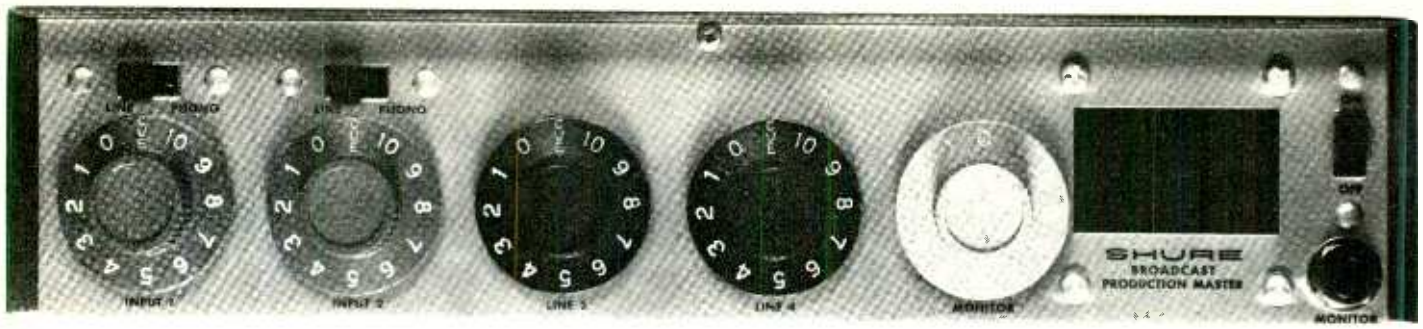
In my opinion far too much gain has been made available in this line out amplifier since it produces some 56 dB gain between the master gain control and the line out terminals. For this reason the noise level on the output when the master gain control is at minimum measures rather poorly at −56 dBm when the mains power supply is used, and −66 dBm when batteries are in use. As measured, the mains noise consisted mainly of 50 Hz hum but the 150 Hz component was more audible although it measured substantially less.

With the master gain control flat out and with all channel gain controls at minimum, the noise level was −39 dBm; the mixer cannot really be used in this position when powered from ac mains.

The manufacturers recommend that the master gain control should normally be used at about half way position, that is a five on the dial, and under these conditions the output noise with channel gains at zero measured −52 dBm. These very poor noise figures are due partly to hum pickup from the mains transformer and partly to the considerable hiss which results from the high gain of this stage. It is strongly recommended that 16 dB more feedback be applied around the output stage by the addition of an extra resistance of 18 kΩ from the top of the output transformer primary to the first emitter. This should reduce output stage distortion and increase its gain stability when the unit is used with batteries which are running down; I noted that the output stage alone lost 8 dB of gain when the battery voltage, normally just under 30 volts, was reduced to 20V.

The output clipping level was approximately +22 dBm into open circuit and +20 dBm into 600 ohms. This is more than adequate for any normal requirement.

The vu meter is driven from its own buffer amplifier and this also drives the headphone



M675

jack. Even when shorted, the jack only decreases the vu meter reading very slightly. The first microphone channel gain can be switched to an internal tone oscillator which applies a 700 Hz tone to the output terminals. When the mixer is in normal use however it is recommended that the tone oscillator is switched off since breakthrough can occur even if the channel gain control is at minimum. The fourth microphone input channel is provided with a switchable attenuator pad of 50 dB allowing the input to be used up to line input clipping level of +22 dBm, in which case the input impedance becomes 66 kΩ although an input load termination resistor of 600 ohms can be switched in.

The equivalent input noise level generated by the microphone preamplifier was checked and found to be better than specified, measuring −129 dBm with a bandwidth of 300 Hz to 20 kHz and −125 dBm from 20 Hz to 20 kHz. Once again the main noise consisted of 50 and 150 Hz hum, the latter being the most audible. When driven off batteries both noise figures measured −129 dBm, an extremely good noise figure for a front end. This noise measurement was done from a screened 200 ohm input source.

If the channel gain controls were set almost maximum and the master gain control was set as low as possible no clipping was audible on speech. As well as this, with the controls in these positions the overall noise level on speech from a moving coil microphone was subjectively very good because the slight hiss that was noticeable came from the front end and not from the line out amplifier. Therefore if the master gain was brought up to five—the normal recommended operating position—and the channel fader was then adjusted to give the correct output level, an audible hiss developed. I really cannot understand why so much gain has been made available in the output stage. I have never used more than 80 dB gain, even on speech from a 200 ohm mic.

The overall distortion of the mixer with controls in reasonable operating positions always measured less than 0.2 per cent with input levels at least 8 dB below clipping. It was noted that when the output level was driven up to 3 dB below its clipping point the total harmonic distortion actually improved to better than 0.1 per cent, showing distortion cancellation between the output stage and earlier stages. Although these distortion figures were satisfactory, more accurate biasing of the transistor could have improved them. Nevertheless the distortion measured was very considerably better than the manufacturer's claims.

Although the main ht rail is nominally 30V this voltage is only used in full in the output stage. For the remainder of the circuit the supply is halved by a dropping resistor of 6.8 kΩ. I feel that a higher rail voltage applied to the microphone preamps would substantially improve the input clipping margin without a significant increase in input noise. I would also prefer to see some 4 dB less gain in the preamps to allow an input clipping level of −20 dBm. With reduced gain in the line out amplifier the unit could be highly recommended, particularly for simple pa and broadcast set ups. It could also be used to provide extra mixing channels when these are required to be balanced as a group on a larger main desk. The low battery consumption will be found useful for film recordists working on location.

The *M67/2E* is very compact and my only other criticism is my personal dislike of the way the front outer case extends over the controls rather than being flush.

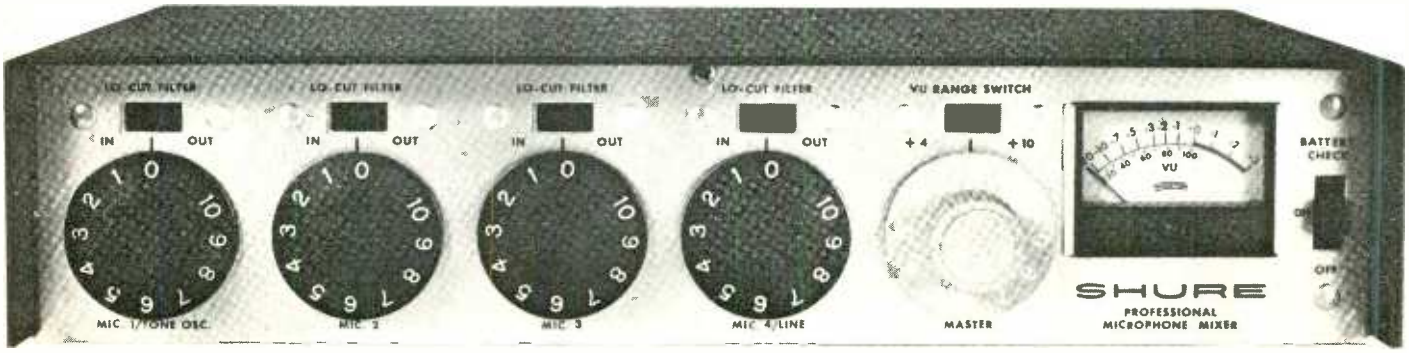
I notice that the guarantee contains the most extraordinary sentence: 'The Shure Mixer is guaranteed to be free from electrical and mechanical defects for a period of one year from date of shipment from the factory provided all instructions are complied with'. I cannot see how the manufacturers can dare to guarantee mechanical and electronic perfection of construction and performance. Although they must mean that they are prepared to effect a repair for one year under guarantee, this is not made clear and could lead to confusion.

The *M675* Broadcast Production Master is an ancillary unit to the mixer having two normal balanced line inputs and two inputs switchable line or gram, the latter having RIAA correction. The outputs after mixing feed the captive output lead, supplied with a phono plug, which can be inserted into the virtual earth mixing bus bar socket on the main mixer, considerably extending the latter's use.

The unit also contains a monitoring circuit with internal loudspeaker and with its own monitor gain control. This amplifier can either be driven via another captive lead with a jack plug which can be inserted into the headphone

continued over

M67/2E



ELECTRET MICROPHONES

continued

deficiencies of both microphones. There are many worse ones than the Sony about, from the response point of view, though not so many among the ranks of capacitor mics. But as far as the Eagle goes, there are few £14 capacitor mics with which to compare it. The chief drawback was the high hiss level. The quality of hiss in the Eagle was particularly objectionable even though it seemed to be concentrated in the lower frequencies. As far as I was concerned neither microphone merited a good report and, depressed, I sat down and wrote a stinker. I then rewrote *that* in the interests of fair dealing! I also contacted the Eagle distributors who arranged for a second sample of the *CO-96* to be sent to me for further trials. And another rewrite.

The second Eagle mic was still noisy (and again noisier than the Sony), but subjectively much quieter than the original sent for review. Its output was almost identical with that of the Sony, while its noise output was almost identical with that of the original mic. The signal output of the second Eagle *CO-96* was about 6 dB up on the first. Although the noise output was a fraction of a dB higher than that of the first, the absence of the tearing quality to the hiss made the difference in signal-to-noise ratio subjectively greater than 6 dB. It was, however, still not good enough for serious consideration as a professional or even domestic microphone.

The performance of the second *CO-96* seemed very similar in other respects to the first sample. They produced a curious form of stereo because of the difference in hiss levels in the two channels which I found very distracting. If you could tolerate the hiss, a pair would probably give reasonable stereo. Pairing the Sony and the second *CO-96* had the same drawbacks, except that the hiss was that much better. I would not expect the stereo to be particularly good. I did not try a pair of the Sony electrets for stereo. Incidentally, I think it is pretty pointless any manufacturer sending out single microphones for test purposes these days. Despite the widespread use of multi-mic techniques there are a large number of engineers around who will want to know how good the stereo from a crossed pair is.

Conclusions

Had the noise performance been better, the sound given by both microphones would have been acceptable for many purposes. Bass was lacking, particularly in the Eagle (something I have heard commented on by several other people who have tried these microphones), but they might have found use as close spot microphones. As it is, I consider the Eagle a write-off for any serious use, unless the manufacturers do something about the noise. There are several other microphones in the same general price bracket as the Eagle which would offer better sound quality and signal-to-noise ratio if carefully used, notably the Reslo or Film Industries ribbons, though they would be susceptible to wind damage out of doors. The Sony could just about find use as a close-in mic, for speech or instrument-spotting, but again, I would consider at the price that a *D202* or *D224* would offer much better value for money, giving a better signal-to-noise ratio, at least as good a response, and offering total freedom from power supplies. The Eagle gets unhappy at loud sound levels (probably not surprising in view of the very low supply voltage) and the rated overload level of the Sony is inadequate for many spot-mic purposes.

Obviously one Eagle was worse than the other, and may well have been substandard. With my luck that would have been the one I would have bought anyway! No microphone the price of the Sony should get through the screening process if it is substandard, so one must assume that an equally inadequate noise performance is to be expected. The fact that both designs have a fairly low output and are noisy suggests (and though obviously it is not conclusive, the relative performances of the two *CO-96* samples tends to reinforce this) that as yet there are a number of common shortcomings in electret microphones, including a capsule output which is inadequate for a good signal-to-noise ratio. Obviously, however, there is room for improvement in the amplifier design, both in reducing noise and ensuring an adequate input impedance to get a decent bass response. Some thought could also be given to raising the signal output with more gain in the head amplifier, as I found the Sony's output a bit too low to use satisfactorily with a portable. Otherwise it might have been useful for interviews under noise conditions.

A last little grumble at Eagle. They might at least point out on their instruction sheet that there is dc on the output, about half a volt in fact. This may not matter if there is a capacitor on the input of your amplifier, or even on some valve amplifiers without. But many fet inputs don't have a capacitor, and may not like having 500 mV dc stuck on the front of a high sensitivity stage to shift the dc working conditions. Nor will a low-resistance input transformer necessarily work best with several milliamps dc flowing through the primary, not to mention the effect on the battery and head amplifier. A tantalum capacitor and earthing resistor would have removed the problem at negligible increase in cost or bulk.

Sorry to cast gloom on the electret scene. I like the idea of electret microphones very much, particularly if the capsules are made rechargeable or cheaply replaceable. I understand that there are some promising omni electret mics around, one of them about the size of a cable jack socket, and I am convinced we shall hear much more about them in the next few years. For the moment, however, the samples I have played with for some months have not persuaded me that the millennium has arrived.

SHURE REVIEW

continued

socket of the main mixer, or can be driven from a prefade monitoring position on each of the unit's input channels. This useful facility allows the correct point on a gram or tape feed to be found whilst the main mixer is being used to feed programme. Then, when necessary, the appropriate channels can be faded up on to the main mixer. The line inputs have the same specification as those on the main mixer.

When the gram/line switch is changed to gram an RIAA compensation is applied and the input is switched to a separate phono socket. The RIAA curve is accurate to within 0.5 dB from 40 Hz to 15 kHz. The input clipping level on the gram inputs is -20 dBm at 1 kHz into an input impedance of 330 pF in parallel with 47 kΩ, being designed specifically for Shure's own cartridges. For other makes of cartridge it will probably be necessary to lower in value, or even remove, the 330 pF capacitor in order to achieve a flat response. The capacitor is present to resonate with Shure cartridges to achieve a flatter response at the extreme top end; otherwise, under certain circumstances and particularly with short input leads, a shelf down from 6 kHz to 12 kHz of up to 2.5 dB can sometimes be noticed. The phono input has a gain of some 35 dB at 1 kHz to allow for the lowest output cartridges. This input is not suitable for ceramic cartridges unless a further equaliser network is added.

The distortion at 1 kHz for a level of -40 dBm into the input phono socket with +8 dBm output from the mixer measured 0.5 per cent. I found that the gram/line switches were not at all reliable and one channel was intermittent. I would therefore prefer to see a better quality switch.

The monitor amplifier will give up to 40 mW output into 8 ohms at a relatively low distortion although up to 70 mW can be obtained if a somewhat higher intermodulation and harmonic distortion can be tolerated.

At clipping point the ht consumption of both units was only 27 mA, but in normal use the consumption is only one third or so of this, since all the output stages are working in class B. The monitoring unit includes three *pp3* batteries giving a rail voltage of 28.5V from fresh batteries, and an interconnecting lead can supply this voltage to the mixer. This same lead can also be used to supply 30V to the monitor amplifier unit when the mixer itself is being used off mains.

The styling of the *M675* is identical to that of the *67/2E*, with a small monitor speaker taking the place of the vu on the front panel and separate headphone and external monitor loudspeaker jacks being provided on the rear panel. All input XLR sockets on both units are in phase when interconnected and the output sockets are phase identified to correspond with the inputs. The mixer line output transformer incidentally can have up to 100 mA dc passing through it from an external landline without affecting performance. Thus sufficient dc to drive both units can be supplied from the landline if appropriate extra connections are made.

In operation I particularly liked the pre-fade listen facility on the *M675*, and the combined unit provides an extremely useful and efficient emergency mono mixer. **Angus McKenzie**

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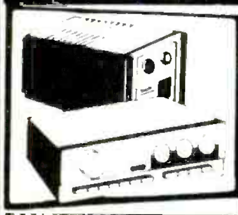

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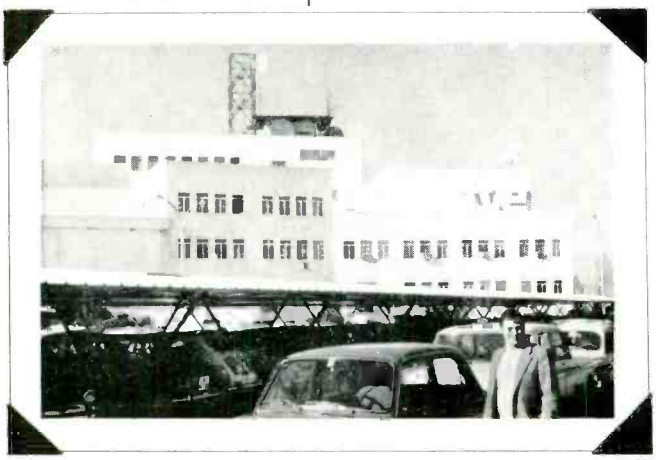

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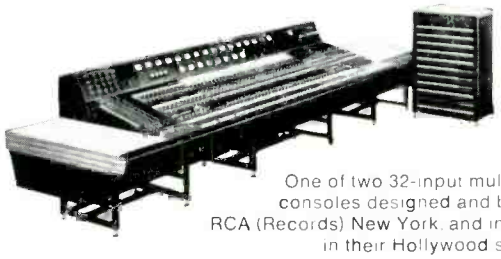

One of two 32-input multi-track consoles designed and built for RCA (Records) New York, and installed in their Hollywood studios

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