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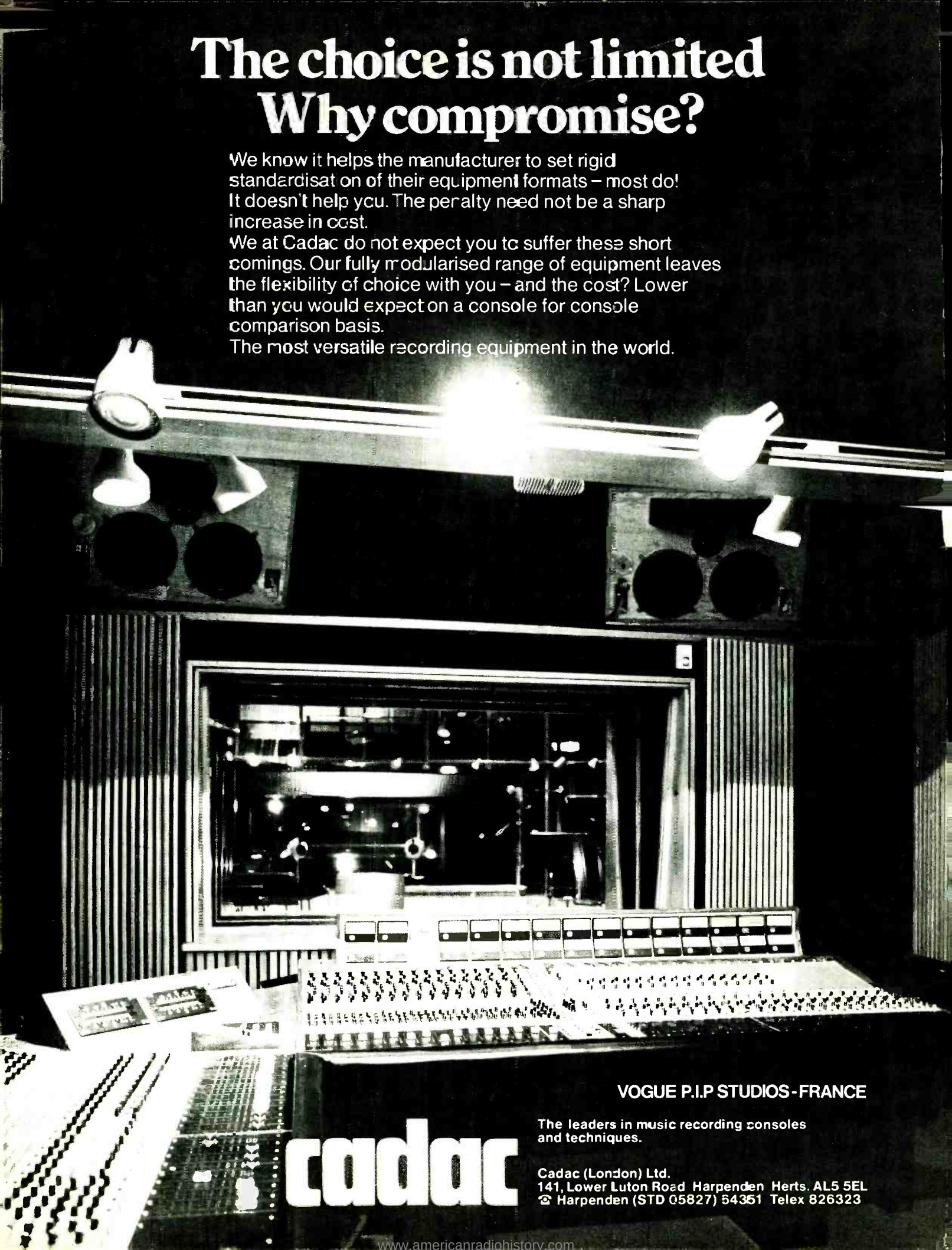

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Editorial and Advertising Offices:
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Telephone: 01-686 2599
Telex: 947709, EXCHMART CROYDON
Telegrams: Aviculture Croydon

STUDIO SOUND is published on the 14th of the preceding month unless that date falls on a Sunday, when it appears on the Saturday.

SUBSCRIPTIONS
All enquiries to: Subscription Dept, Link House, 25 West Street, Poole, Dorset BH15 1LL. Poole (02013) 71171.

DISTRIBUTION
STUDIO SOUND, published monthly, enables engineers and studio management to keep abreast of new technical and commercial developments in electronic communication. It is available without charge to qualified readers; these are directors, managers, executives and key personnel actively engaged in the sound recording, broadcasting and cinematograph industries in any part of the world. Non-qualifying readers can buy STUDIO SOUND at an annual subscription of £5.80 (UK) or £6 (Overseas). Express (air mail) as follows (extra charge over paid or free subscription): Argentina (B), Angola (B), Australia (C), Austria (X), Barbados (B), Belgium (X), Bermuda (B), Botswana (B), Brazil (B), Bulgaria (X), Canada (B), Chile (B), Colombia (B), Cyprus (X), Denmark (X), Finland (X), France (X), Ghana (B), Greece (X), Holland (X), Hong Kong (B), Hungary (X), Iceland (X), India (B), Indonesia (B), Iran (A), Israel (A), Italy (X), Jamaica (B), Japan (C), Kenya (B), Lebanon (A), Malawi (B), Malaysia (B), Mexico (B), Monaco (X), New Zealand (C), Nigeria (B), Norway (X), Peru (B), Philippines (C), Poland (X), Portugal (X), Rhodesia (B), Rumania (X), Singapore (B), South Africa (B), Spain (X), Sri Lanka (B), Sweden (X), Switzerland (X), Tanzania (B), Thailand (B), Trinidad (B), USA (B), Virgin Islands (B), West Germany (X), Yugoslavia (X), Zambia (B).

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Total average net circulation of 8899 per issue during 1975. UK: 5689, overseas: 3210. Total average net circulation of 10030 for January 1976. UK: 6003, overseas: 4027.

studio sound

AND BROADCAST ENGINEERING

Sound associated with film is nearly always considered secondary to 'the picture'. Sound is the poor relation. It starts that way and finishes that way; and for very good reasons it will probably always be so. Clearly there are exceptions: in the documentary field for example, no matter how well the cameraman catches a facial expression, it will be of little significance if the sound man loses the words—and furthermore there may not be an opportunity for a second take.

In a feature film, however, the director's concern is primarily for the visual aspect—the sets, the scenes, the costumes. Any microphones must now be placed unobtrusively within this context—on booms, in bushes, under clothing. It's very seldom that a microphone can be anything like optimally placed; such that sometimes a mic may be required solely to compensate for the bad acoustic positioning of another.

The problems which face a sound recording crew can be singularly difficult but if one of them yells 'cut' during a take, quite a few eyebrows are raised. In contrast, if the cameraman has to call 'cut' he may well be accredited by such whispers as 'It's really great working with this guy. He's such a perfectionist'.

At the 'output' the diversity of possible replay conditions is truly ominous. No two cinemas will be acoustically identical, but additionally there is a variety of replay equipment with a quality spread approaching that of a 'radio receiver'.

So there are those caught in the middle. For example, in order to achieve a respectable sound track, the dubbing mixer has to make corrections for the compromises in recording, and subsequently make compromises to compensate for the possible replay conditions—sometimes with the achievement of intelligibility as the only criterion. Some tighter form of standardisation would obviously improve matters, but something that obvious must imply colossal expense, otherwise it would have already happened.

All the same things are improving. Admittedly it's not so many years ago that people expected or at least accepted bad film sound; but no longer. With the recent rise of 'hi-fi' into the mass production market one of the saving graces of the situation is the fact that more and more people are hearing well-reproduced sounds. Some percentage of these appreciate the experience and subsequently use their improved (subjective) reference level to judge all reproduced sounds.

According to the usual rules of supply and demand the film sound industry is now tempering its traditionally based limitations by exploiting technique and technology to the full. It has become a very artistic, often creative, industry but paradoxically the greatest tribute to the ideas, skill and sheer effort of the film sound men is usually the fact that it doesn't show anway.

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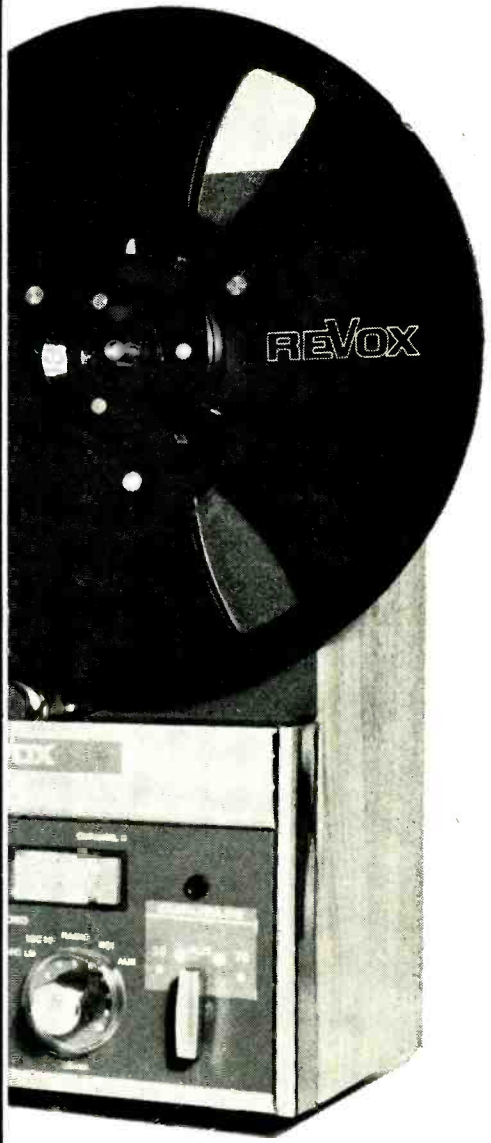

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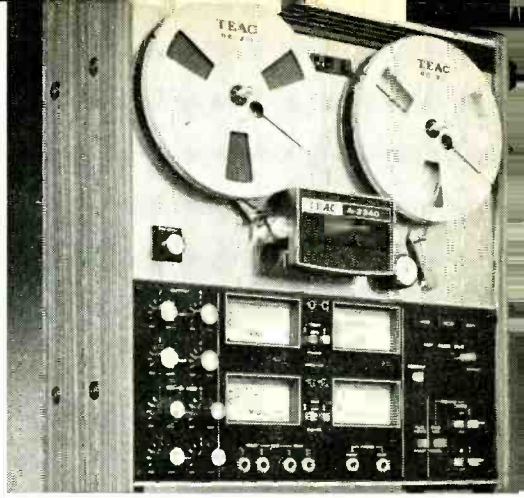

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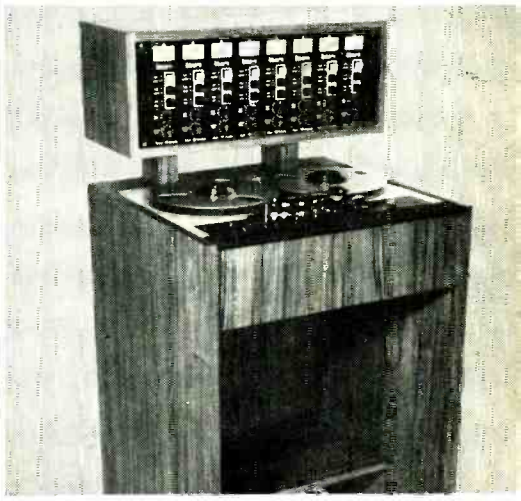

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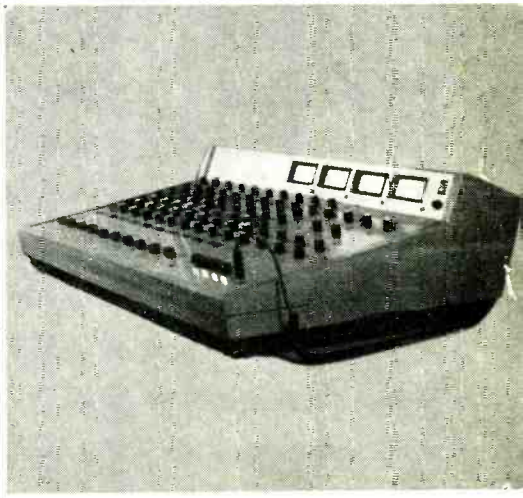

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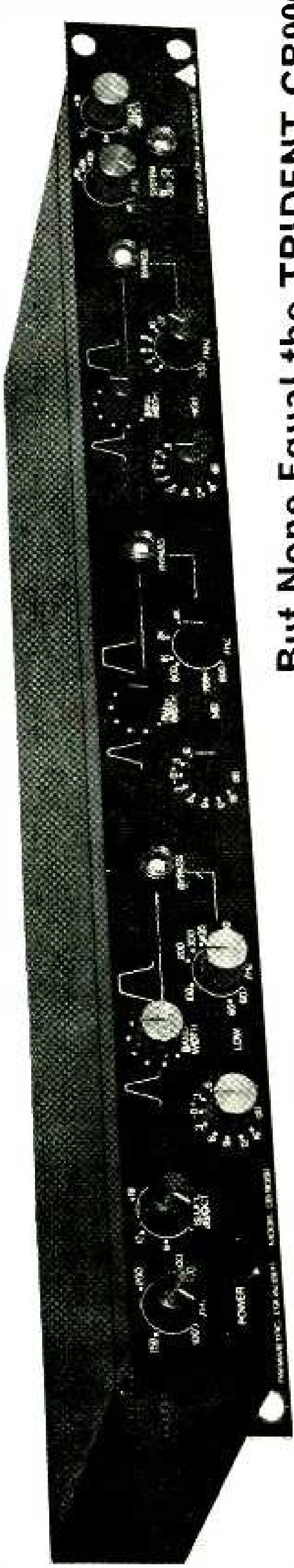

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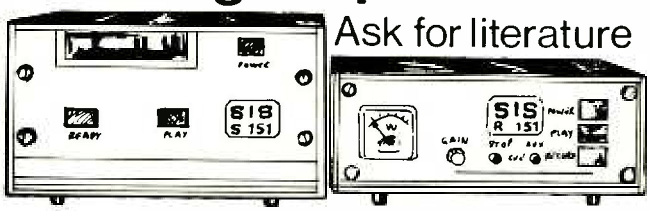

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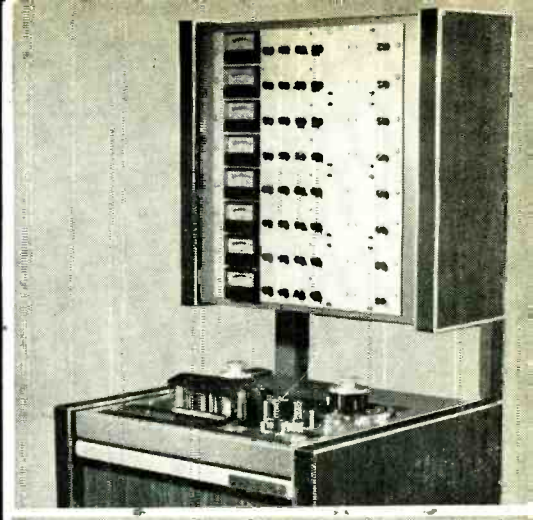

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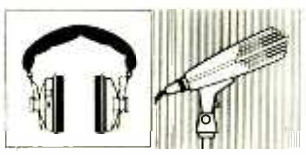

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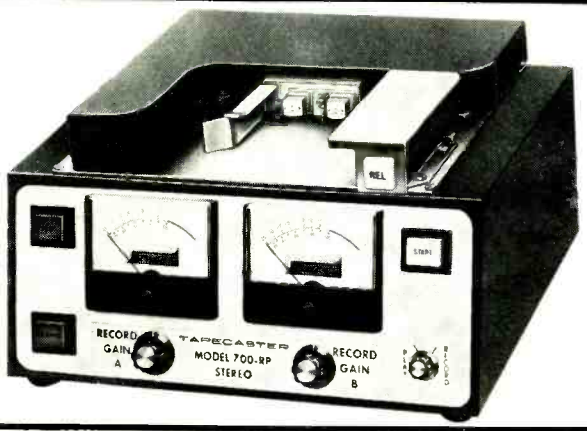

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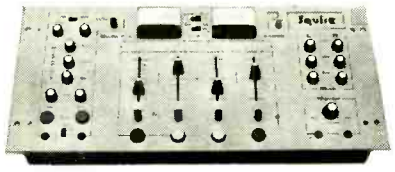

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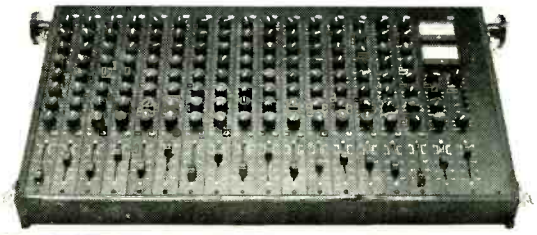

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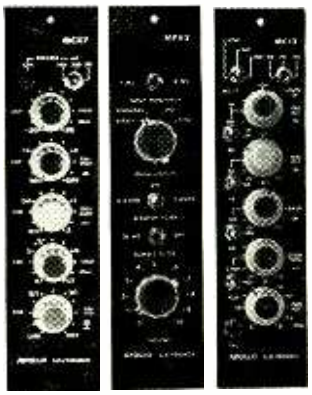

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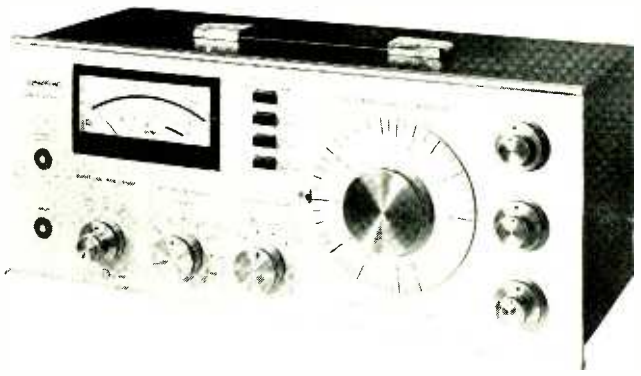

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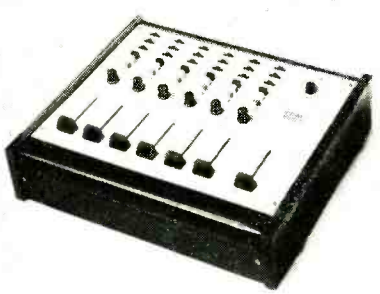

TEAC MODEL 2
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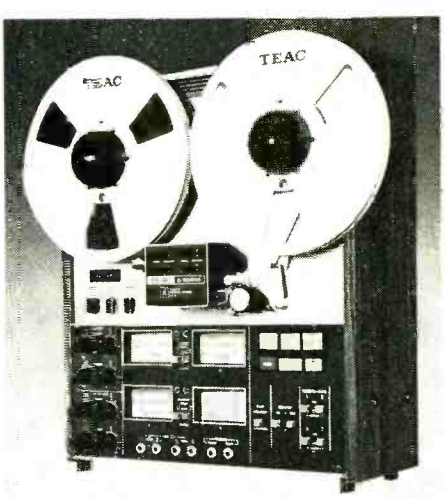

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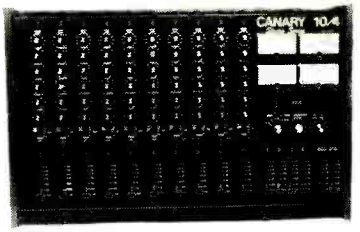

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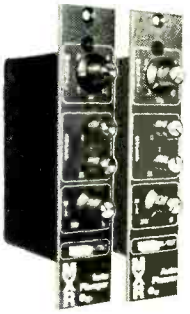

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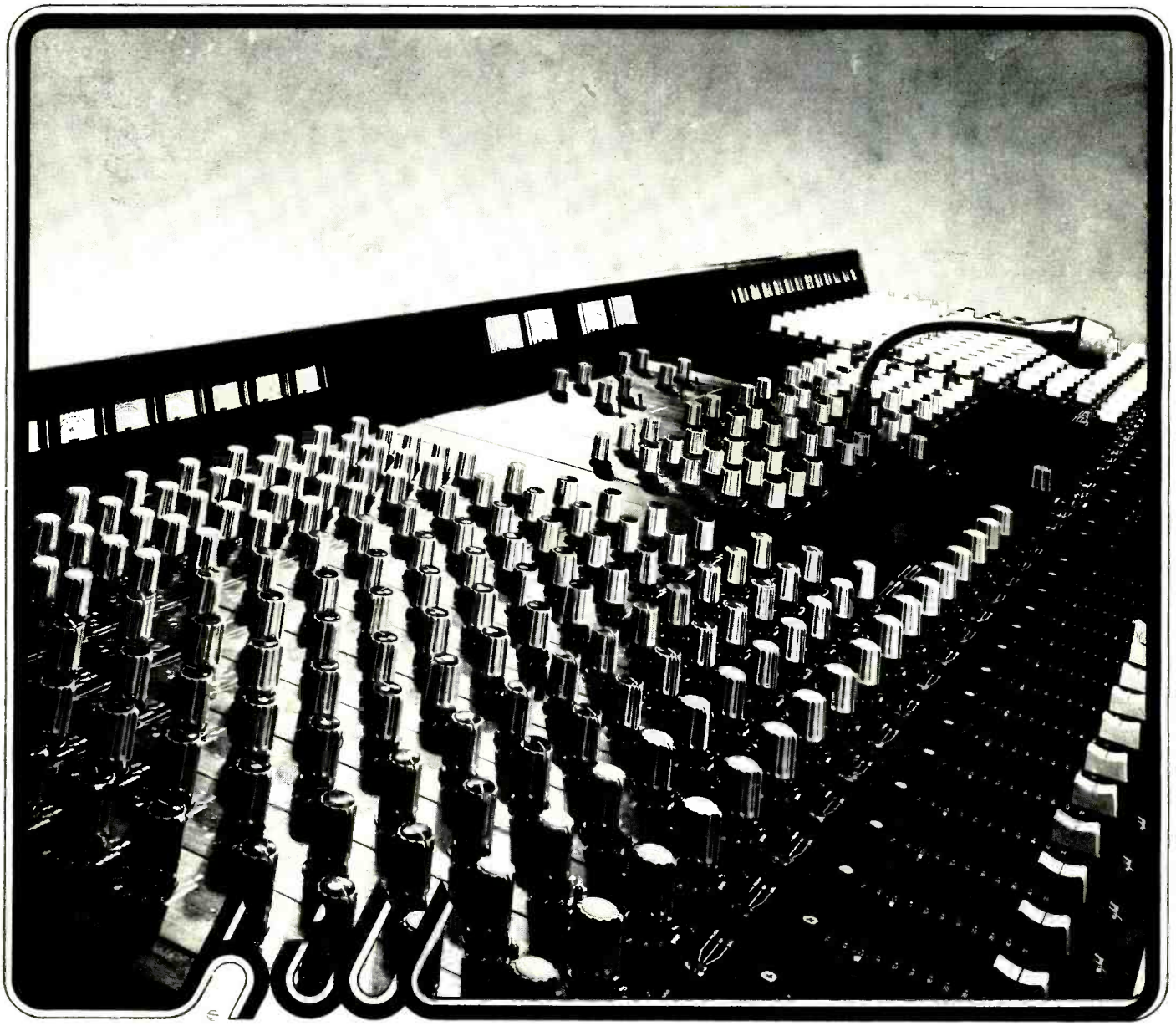

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revised specification.

Illustrated: Series II original format

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AUSTRALIA.	Klarion Enterprises (Pty) Ltd., P.O. Box 379, South Melbourne, Victoria 3205. Tel: 61 3801. Cables: Klarionmelb.
SOUTH AFRICA.	Tru-Fi Electronics S.A. (Pty) Ltd., P.O. Box 31801, Braamfontein, TVL 2017. Tel: Johannesburg 838 4930.
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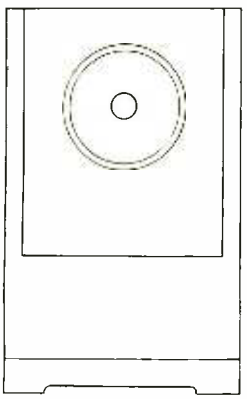
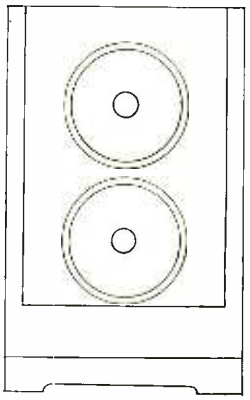


MAJOR



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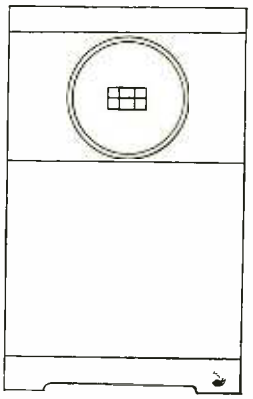

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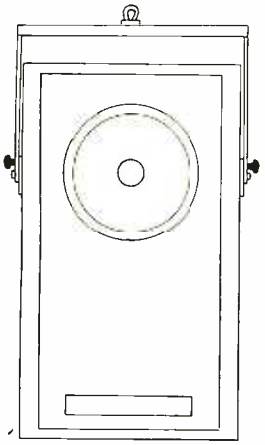

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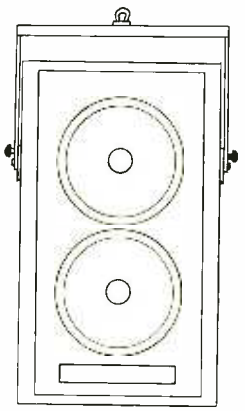

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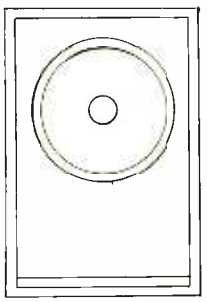

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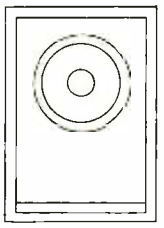

ACADEMY
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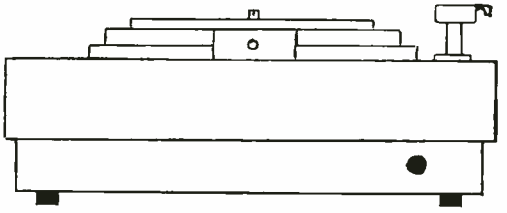
LOUDSPEAKER



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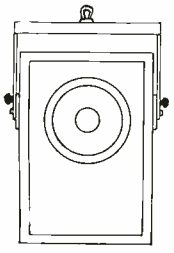

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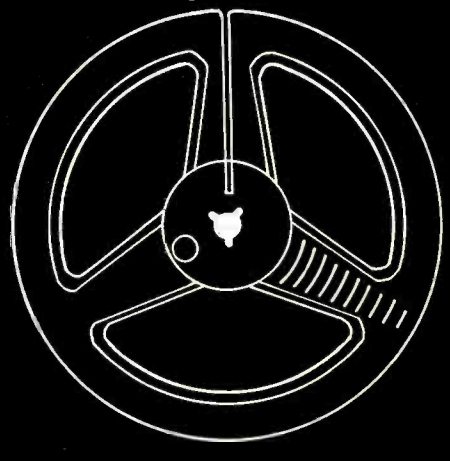

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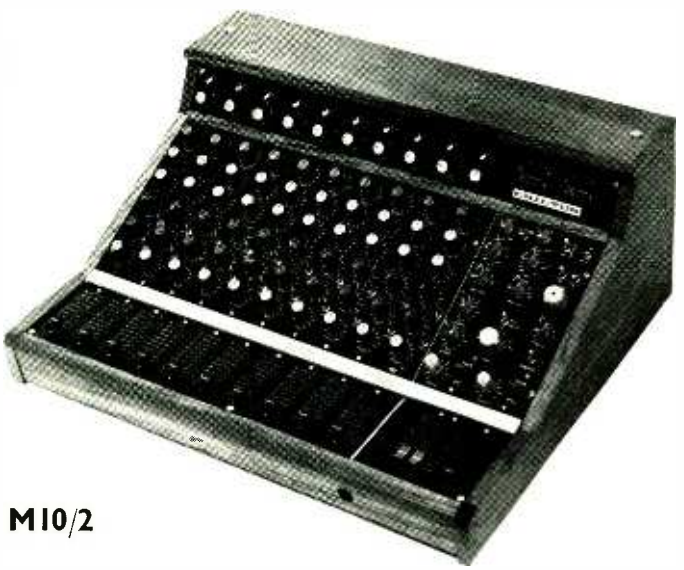

M10/2

The new Mk.5: 10 in 2 out on Stand 34 A.P.R.S.

Basic Price: **£410.**

16 input version **£585.**

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Is it meticulous attention to detail on the Teak case or the Black anodised control panel—maybe the shape?

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You can add at any time to Example 1 to convert to Example 2.

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news

Sound at NAB

At first glance a visitor to the enormous 1976 NAB Convention/Exhibition in Chicago might be excused for thinking that this was very much a video show, with sound the poor relation. All those colour cameras—including the new generation of ultra-compact, ultra-lightweight cameras for electronic news gathering—video tape recorders, video tape editing systems, video switchers, telecines, circularly-polarised television aerials . . . who had even heard of sound for television, let alone 'steam radio'.

But first appearances are often misleading and it soon became apparent that sound is indeed alive and, if not always flourishing, is very much of the broadcasting scene—and still producing a steady stream of innovation and new products.

All-solid-state am transmitters of 1.5 kW rating; am stereo; quadraphony; better pattern optimisation of vhf transmitting aerials; improved limiters for fm broadcasting; multi-channel radio microphones for use in television; the influence of all-news stations on radio-communication networks (it's no good getting the story if you can't get it back); the long and often vehement debate about how far to automate . . . but to continue this list would be to pre-empt the report. Another pointer is that almost as many papers were presented on radio topics as on television including the inevitable panel session on 'Automation for radio—boom or bust' or such radio-television worries as 'What the world administrative radio conferences 1977 and 1979 mean to you'; a comment (not particularly enlightening as it was judged premature) on the 'Report of the National AM Stereo Committee' —it is not due to report until next Spring; such nitty-gritty subjects as 'Antenna Q versus Audio Response'; and for all who have ever suffered breakthrough of unwanted radio signals on sensitive equipment: 'Achievement of rfi immunity in audio equipment'.

'What to do until the doctor comes' seemed to hint at non-engineering programme presenters trying to keep transmitters running by such methods as having 'a card posted near the transmitter listing the normal indication for various circuits' or using a transistor portable 'to check whether the oscillator is operating properly' and 'don't allow yourself to rationalise that a component is probably okay just because it's located in a spot that's hard to reach'. But before we allow a fleeting European smile to our lips, it is worth emphasising that American radio engineering is competent, cost-effective and well planned (particularly compared with the European medium-wave chaos). Though one hesitates to recommend, as the speaker did, that 'if the antenna tower is down, any length of wire can be made to radiate something'!

Harris Corporation were the first to obtain FCC approval for a 1 kW all-solid-state am broadcast transmitter (type *MW-1*) although Sparta (Cetec Corporation) have 2.5 kW units and RCA have announced a 10 kW design (suitable for 20 kW operation by using two in parallel). American am transmitters are designed for 125% modulation on positive peaks which is achieved by asymmetric modulation. The main advantages of going all-solid-state include reliability (due to the use of multiple power devices some can fail without putting the station off the air) and the lower power consumption—about 15 to 35% lower than can be achieved with power valves. It may seem strange that so much weight is now given in the States to saving the relatively few kW-hours of an am transmitter compared with uhf television, but for stations running throughout the 24-hours, power represents a significant part of their operating costs.

AM stereo?

The basic techniques which are being proposed for am-stereo have been around quite a long time but there is doubt that interest has been fanned by the setting up of a National AM Stereo Committee of the Electronic Industries Association. So far five proposals have been submitted and a major task of the committee is to define mathematically what each transmission would represent rather than to compare their merits.

At NAB, RCA provided demonstrations of their fully compatible am-fm system in which the audio difference channel is transmitted by narrow-band-frequency-modulation of the carrier which is simultaneously amplitude-modulated in the conventional way with the sum channel. Sansui Electronics (two different systems, one of them am-fm), Communication Associates and Kahn Communications all have systems, the Kahn independent-sideband system having been tried experimentally at Baltimore in 1975, and which when used with a special decoding system provided some 35 dB separation.

Some American broadcasters see a brighter future for am-stereo than for quadraphony—though the fm operators are clearly worried at the prospect of losing the advantage they hold at present of being the only service with stereo.

There was little evidence at NAB of any rapid advance towards 4-channel discrete quadraphony following some disappointment that the laboriously produced report of the National Quadraphonic Radio Committee makes it difficult for an outsider to determine the relative advantages and disadvantages of each proposal. Meanwhile around 100 American stations are using quadraphonic matrix encoders; more are playing matrix-encoded records.

Automation

Automated broadcast systems are available from a number of firms, a further twist to the debate stemming from the use of microprocessors in this application. For example one finds Systems Marketing Corporation with a *DP-2* digital programmer which is an integrated combination of microprocessor with digitally controlled audio switcher and processor. The manufacturers provide the software programmes which are stored in plug-in units. Options to such systems read like a computer bureau with video displays, selective dumping, automatic logging. There is a basic 1000-event subroutine and models with up to 8000 programmable events are offered by this firm, which also has a *Ras-Pro* lower cost model.

Harris has a *System 90*; Collins the *A7600 Auto-Pro*; considerable use is made of Schafer (Cetec) systems by the networks—and some of the West Coast programmes are automated from New York with distribution via satellite. The jargon of automation: 'walk away time', 'flag disaster events'; the fear of what happens when an automated system really 'crashes'; the feeling that semi-automation can sometimes combine the advantages of 'live' and automation: these were the messages coming through to this rather bemused

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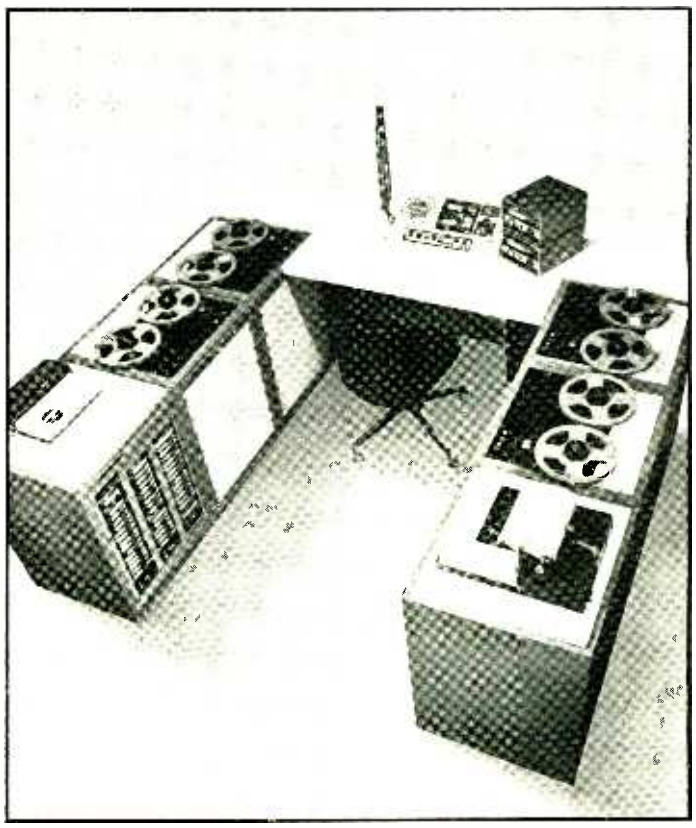
Schafer 903E (console version)



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Uses only ⅓ of a watt of power.
Weighs less than 3lbs.
Interfaces to the Nagra in seconds.
Available in the UK for less than £400.

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or a demonstration of the dbx 192 two channel noise reduction unit
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Scenic Sounds Equipment, 27-31 Bryanston Street, London W1H 7AB
Telephone: (01) 935 0141

observer. Schafer is currently introducing an all-new Model *903E* radio automation system with 'three-day' control system and permitting full manual control. It features one-button bulletin insert, four-way entry lock and dual alarm system and will be available in both low-profile and rack-mounted presentations. NBC incidentally are using 12-bit pulse code modulation techniques for the audio in a large video/audio switcher with 100 inputs, 300 outputs.

Signal processing

An area of considerable interest to local vhf/fm stations in the UK is the subject of audio processing to increase modulation levels while retaining high signal quality: something which is not easily achieved with conventional compressors and limiters. Orban/Broadcast has recently introduced a new *Optimod-FM* system in which the compressor, limiter and stereo generator are engineered as a single package, using fets to provide fast, cleanly controlled attenuators. For the American 75 μS pre-emphasis system it is claimed that average modulation levels can be raised by 2-3 dB with extremely low distortion (unless one views any form of compression as distortion).

Although not a new product, it was interesting to see the Garron Electronics *STE-100* stereo phase enhancer, designed to act on common-mode signals above 3 kHz to minimise the cancellation that can occur when the common-mode signals are out-of-phase, degrading the encoded stereo and particularly the mono-sum signal. This is done by analysing the phase relationship between 'left' and 'right' signals and dynamically shifting the phase of the 'leading' signal to put it in phase with the 'lagging' signal.

Better ob communications

The emergence of 24-hours-a-day, seven-days-a-week, all-news radio stations has resulted in the need for better radio communications to link news teams with studios. The buzz-word here has become 'satellite receiver voting systems' (eg Motorola's *Spectra-TAC* equipment). In effect these are the use of an area-coverage radio network using multiple 'base' receivers scattered throughout the area, each linked to the studio by line. The receiver receiving the strongest signal locks on to the transmission which may be a hand-held transceiver and relays the channel to the studios; all other receivers remain quiescent. If conditions change a signal comparator will cause a switch to another receiver, as in diversity reception. A similar elaboration of communications can be found in a multi-channel long-range radio-microphone system developed by RF Technology for Thomson-CSF. This 950 MHz system permits the operation of up to five radio-mike channels in the same studio, each with diversity reception: in open air a range of about a half-mile is possible.

Many other new products could be seen—from new tape cartridge equipment by Audio-Cord to the biggest air-cooled tetrode for fm and tv by RCA (55 kW output), to Delta Electronics digital systems for monitoring the parameters of directional aerials and telemetry and supervisory systems for unattended transmitters.

Pat Hawker*

**Independent Broadcasting Authority. This report represents solely the view of the author, not necessarily the IBA.*

Live sound award

Vitavox, the UK pa equipment manufacturer, has announced the sponsorship of an annual award specifically aimed at up and coming bands resident in the UK. With the full title *The Vitavox Live Sound Award*, the winning group will receive a sculptured silver trophy which will be kept for a year. More tangibly, each finalist from one of three categories of music—pop, progressive and reggae/soul—will receive a pair of the *Thunderbolt* loudspeaker systems, worth £1500, manufactured by the sponsors.

Basically the rules are:

1) Only British groups are eligible.
2) The group must be resident in the UK.
3) The group must have had a commercial recording contract within the 12 months prior to August 1, 1976 (closing date for Award entry).
4) The group has never gained a place in the Top 30 as produced by *Music Week* in their album and singles charts to April 8, 1976.
5) Of the three categories of entry, progressive, pop or reggae/soul, competitors and their record company must decide in which category they want to be judged.

Initial judging will be based on a five minute tape from a live gig played by the competing band. Judges include three radio djs and presenters. Second stage of judging will be by committee listening to 15 of the tapes selected at the first stage.

Six finalists will be chosen, two from each category, who will compete for the various prizes in front of a panel of judges at a public venue.

Rules, regulations and entry forms may be obtained from: Vitavox Live Sound Award, c/o 27/28 George Street, Richmond, Surrey TW9 1HY. Final date for receipt of entries August 1, 1976.

Ilr broadcasts QS

An historic, although perhaps not earth shattering, event occurred to mark the second anniversary of the Manchester, England, independent radio station Piccadilly Radio. They were the first UK station to broadcast ordinary material in a quadraphonic format on an experimental basis. The 43 hour trial ran from 5 am, April 2 until midnight, April 3 using QS encoded records—principally those on the Pye label since these are the only ones generally available in the UK—and ordinary stereo programmes put through a Sansui QS synthesiser.

About the only thing that will surprise the Japanese, Americans and the rest of the world concerning this experiment in broadcasting is the recalcitrance of the British Broadcasting authorities — both public and private—underlined by the first time nature of the broadcast in the new medium (sic). Naturally, Corporate caution prevailed. The most obvious facet of the quadraphonic programmes was the frequent announcements identifying them 'as being of experimental nature'. Just in case listeners thought that there might be a fundamental policy change within the subsequent 43 hours, ten years or whatever. It will come as no surprise, therefore, to learn that there are no plans for final adoption of a particular four channel system, or even an overall concept of multi-dimensional sound broadcasts. This trial was undertaken purely through the initiative of Piccadilly Radio although production was closely monitored by two teams of IBA engineers.

■Silesian State Radio recently celebrated its 2nd anniversary of quadraphonic broadcasting processed through 25 μS Dolby encoders.

Stereo compressor limiter

The dbx *162* compressor limiter offers stereo operation from, what is effectively, a pair of ganged *160* electronics sections housed within a single unit. The basic *160* mono complimiter performs demonstrably well—see review STUDIO SOUND, February 76. Both channels, which feature rms level detection and feed forward compression control circuitry, share a common control line sensed and summed from both channels to preserve stereo image stability. Connections at the rear of the instrument enable interconnection between two units for quadraphonic operation.

The twin panel meters are switchable to read input or output level over a continuous 60 dB range. A rear mounted trim control enables zero dB to be set at any nominal line level between ±10 dBm. An additional switch position displays gain change on one meter while the other shows the sum of the output levels of both channels.

Manufacturer's specification:
Compression ratio: 1:1 to infinity.
Input and output level: to +26 dBm max.
Equivalent noise: —78 dBm from 20 to 20k Hz.
Frequency response: within 1 dB 30 to 20k Hz.
Distortion: .075% 2nd harmonic at infinite compression and +4 dBm output. 0.5% 3rd harmonic at infinite compression.
Attack time: dependent on programme dynamics; 1 kHz tone burst, maximum rate of change 100 dB/ms.
Release rate: up to 120 dB/s.
Dimensions: 8.9 x 48.3 x 26.7 cm (whd).
Weight: 4.6 kg.

dbx Inc, 296 Newton Street, Waltham, Mass 02154, USA. Phone: (617) 899 8090.

UK: Scenic Sounds Equipment, 27/31 Bryanston Street, London W1H 7AB. Phone: 01-935 0141.

Stereo reverb

Orban/Parasound, manufacturers of the mono *106CX* spring line reverb, now market a two channel version featuring all the controls

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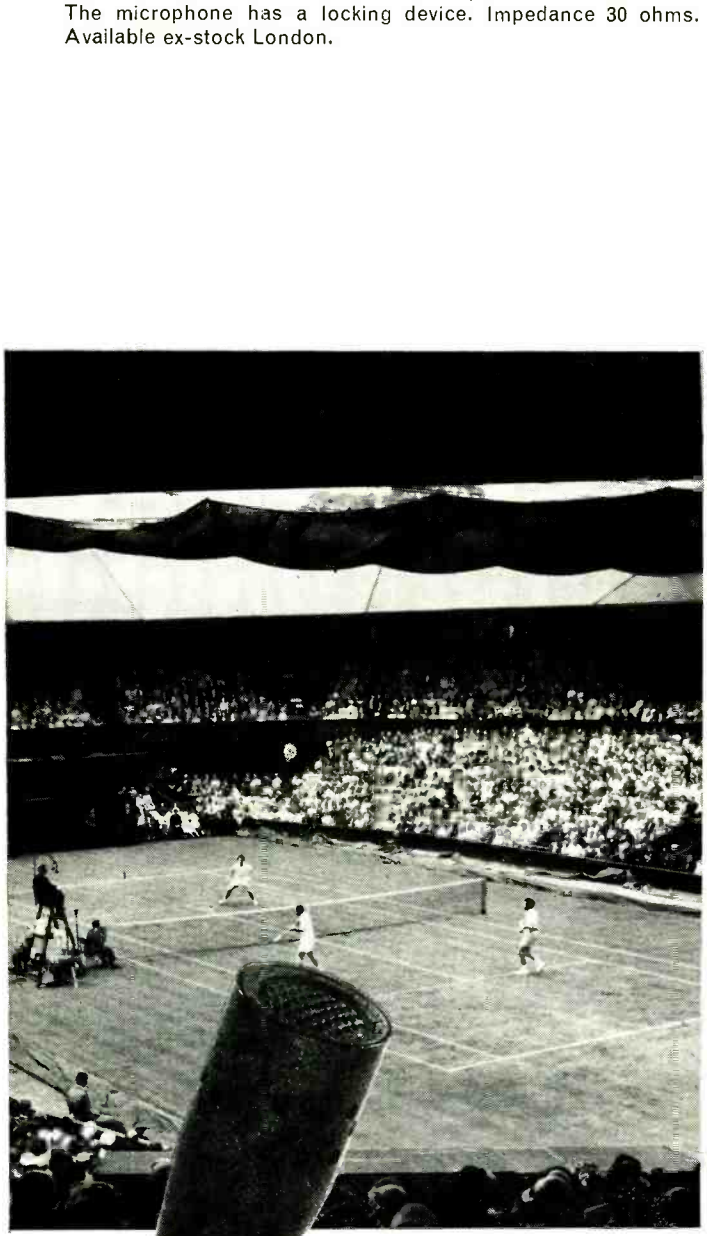
The dbx 162 compressor/limiter

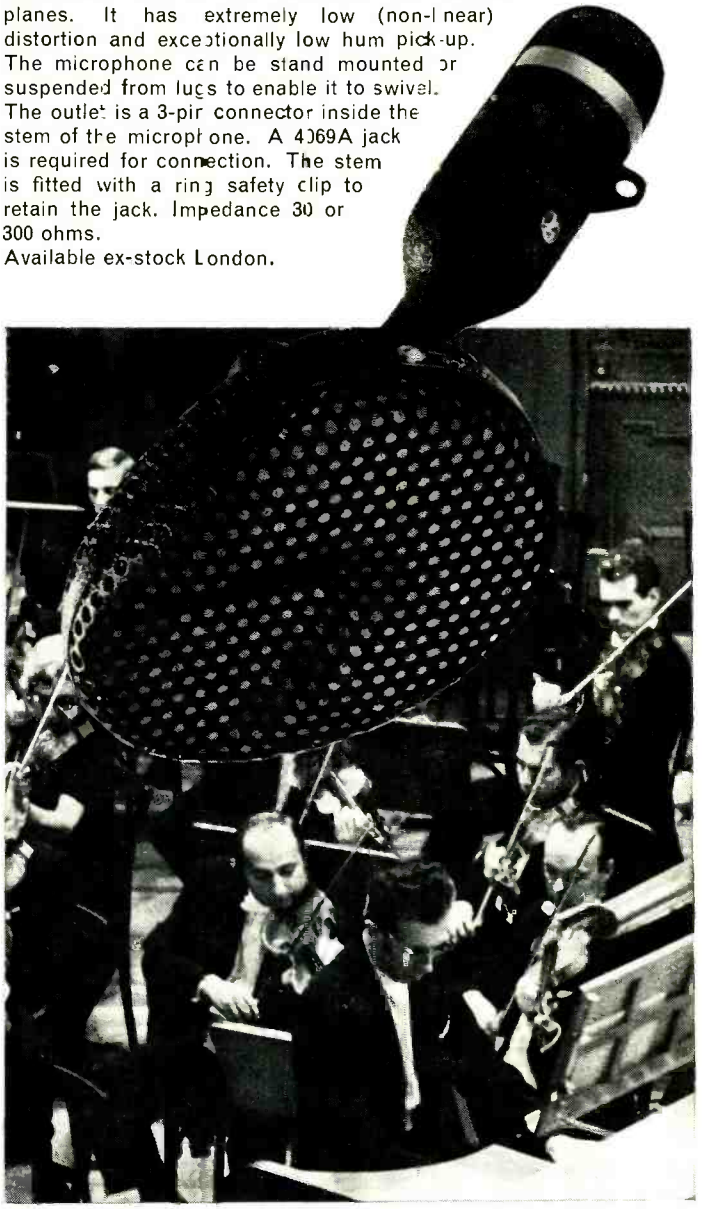
Tennis to Telemann performance plus

Hampstead High Fidelity Studio and Outside Broadcast Professional Microphones

4105 Lightweight Cardioid Moving Coil Microphone
This small and lightweight robust microphone is ideally suited to Public Address and Sound Reinforcement work. It is compact and unobtrusive in design. The directional response makes this microphone particularly suitable for high quality sound reinforcement systems where a high degree of intelligibility and a good feedback margin are required. The microphone is virtually distortionless at all normal sound fields. The electrical impedance rises from about 25 ohms at the mid frequencies to approximately 35 ohms to 100 c/s. The outlet of the microphone is a shrouded 3-pin connector. A 4069A jack is required for connection. The microphone has a locking device. Impedance 30 ohms. Available ex-stock London.

4038 Broadcast Quality Studio Ribbon Microphone
The 4038 ribbon microphone is a pressure-gradient transducer and presents the very highest standard of fidelity for ribbon microphones. It is manufactured by agreement with the British Broadcasting Corporation Patent 738,864 and 742,006. Because of its smooth wide frequency response, absence of transient distortion and relative high sensitivity it is an outstanding choice for the orchestral concert hall as well as the Broadcast and Recording Studio. The frequency response is exceptionally flat from 30 to 15,000 c/s and throughout this range the shape of the bi-directional (figure of eight) polar response is accurately maintained both in the horizontal and vertical planes. It has extremely low (non-linear) distortion and exceptionally low hum pick-up. The microphone can be stand mounted or suspended from lugs to enable it to swivel. The outlet is a 3-pin connector inside the stem of the microphone. A 4069A jack is required for connection. The stem is fitted with a ring safety clip to retain the jack. Impedance 30 or 300 ohms.
Available ex-stock London.





HAMPSTEAD HIGH FIDELITY LIMITED
63 Hampstead High Street,
London NW3 1QH
Telephone 01-435 0999/6377

and floating threshold limiting of the mono model. In addition, the new *111B* incorporates a bass control and a 'quasi parametric' midrange control which permits stepless adjustment over a ±12 dB control range.

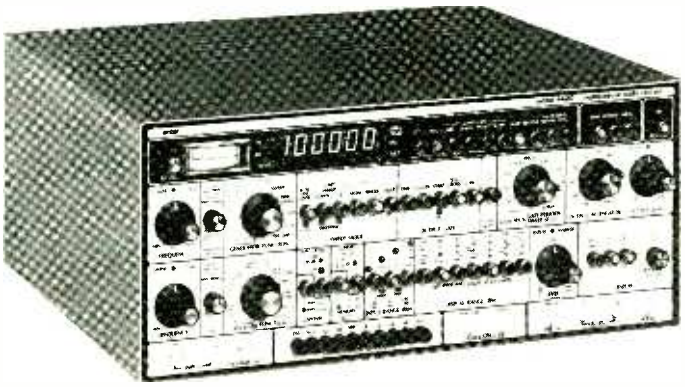
The most surprising feature of the new reverb, which measures 8.9 x 48.3 cm, is the price. It costs the same as the erstwhile mono unit at $695.

Parasound Inc, 680 Beach Street, San Francisco, Ca 94109, USA. UK: Helios Electronics, Browells Lane, Feltham, Middlesex. Phone: 01-890 0087.

Comprehensive test set

The latest product from the Canadian company, Amber, is the *4400* multipurpose audio test set. Its organisation is divided into two sections: the generator comprises a multiwaveform function generator, pink noise source, log sinewave sweeper and comb generator. It has facilities for tone bursts and a balanced output capability of up to +30 dBm. The receiver section contains an autoranging digital frequency counter, a spectrum analyser, a wave analyser, a bandpass, band reject, highpass, lowpass filter and a four channel digital memory to store response plots.

The instrument has been designed for use with a good quality display oscilloscope to measure gain, noise, crosstalk, distortion, frequency and phase. The four memories permit plots of amplitude or phase versus time or frequency. These functions and features enable calibration and measurement of eq and filter networks, desk and tape recorder line up, room equalisation, production testing, microphone and speaker response testing, spectral analysis and transmission line testing. The *1100* costs under $3000 with production units available now.



Amber 4400

Amber ElectroDesign Ltd, 1064 Chemin du Golf, Montreal, Quebec H3E 1H4, Canada. Phone: (514) 769 2739.

UK: Scenic Sounds Equipment, 27/31 Bryanston Street, London W1H 7AB. Phone. 01-935 0141.

Altec servicing in UK

From April 20, service facilities for Altec professional gear have been transferred to the UK distributors, Theatre Projects, from the independent company, Audiotek. When Altec first set up distribution in the UK, the latter company provided a caretaker function until suitable facilities were set up. The new service address is: Theatre Projects, 10/16 Mercer Street, London, WC2. Phone: 01-240 5411.

IBC 76

The International Broadcasting Convention — a biennial event — will take place at Grosvenor House, London between September 20 and 24. Following the usual format, it comprises a paper presentation programme with an accompanying exhibition.

More than 60 papers will be presented during the 14 sessions of the technical programme. They cover new techniques, systems, developments and trends relevant to all aspects of broadcasting. In addition to conventional broadcasting, there will be two sessions devoted to the new information systems using the domestic television receiver as the vdu. Specifically, there will be papers on Teletext (*Ceefax* and *Oracle* are already in use in the UK) and *Viewdata*, the system using PO lines for information transmission. Qualifying for an international tag, there will be a paper on *Text Television*, the system devised and promoted by NHK of Japan.

A special session will cover 'Electronic Journalism'—man on the spot news reporting using lightweight camera, recording and transmission equipment designed specially for this purpose. This class of ob hardware is in heavy demand following increasing use around the world to cover news events for television.

The IBC is sponsored by the Electronic Engineering Association, the Institute of Electrical Engineers, the Institute of Electrical and Electronic Engineers, the Institution of Electronic and Radio Engineers, the Royal Television Society, the Society of Motion Picture and Television Engineers. Information and registration forms can be obtained from The Secretariat, International Broadcasting Convention, IEE, Savoy Place, London WC2R 0BL.

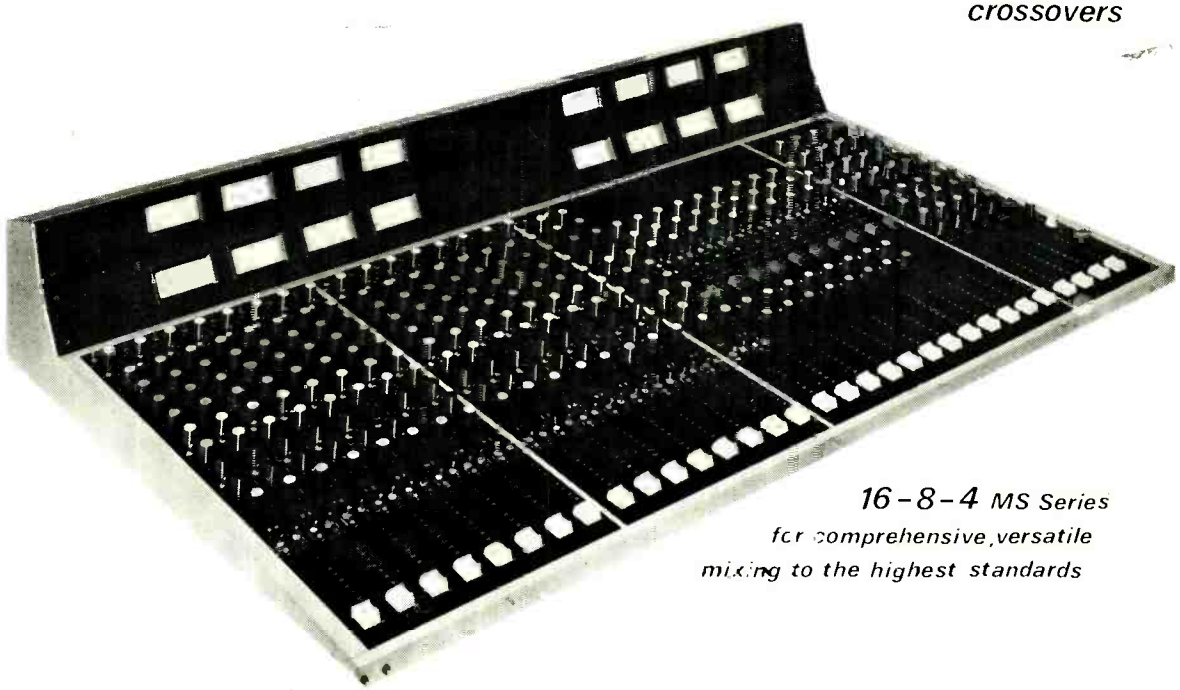
Ilr for N Ireland

The opening of Downtown Radio, the independent radio company servicing the Belfast area, brings the potential audience up to 24M for the combined service areas.

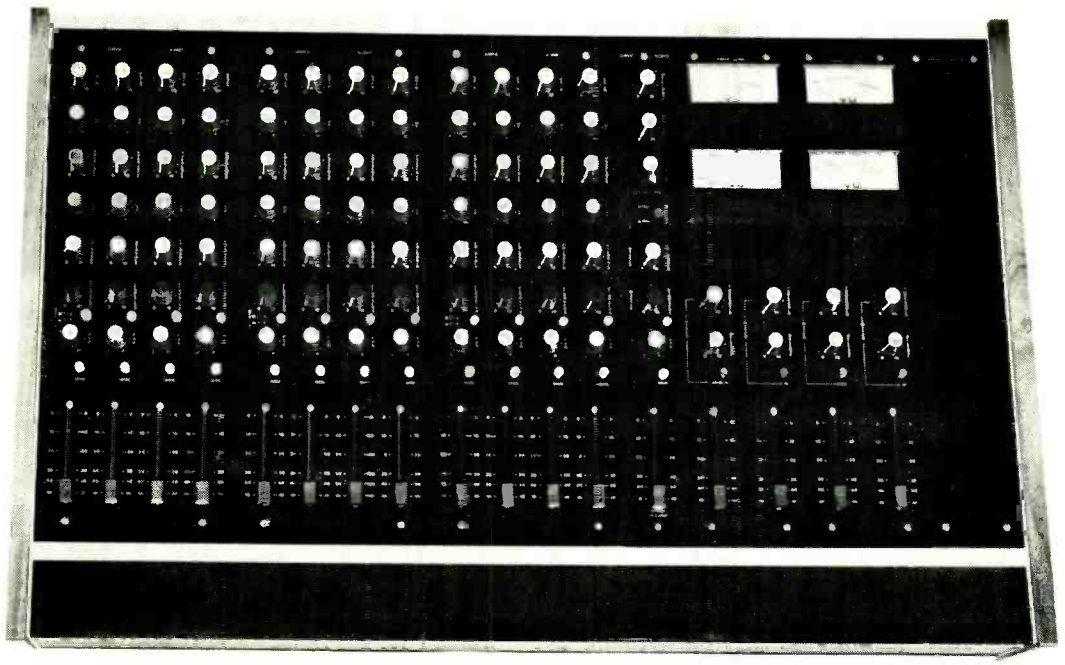
The new station started programme broadcasting on March 16 to an area of Ulster covering about 1M people: Belfast, Carrickfergus, Newtownabbey, Bangor, Newtownards, Donaghadee, Downpatrick, Lurgan, Portadown, Dungannon, Cookstown, Antrim and Ballyclare. Transmissions are made from Black Mountain to the southwest of Belfast on 96 MHz and from a site at Knockbrackan, due south, on 293m.

Downtown Radio is the eighteenth station to open; the seventeenth, Thames Valley Broadcasting, serving the Reading area started programmes on March 9.

Consoles for all applications; sound reinforcement systems; electronic crossovers



16-8-4 MS Series for comprehensive, versatile mixing to the highest standards



X Series: up to 24 or more in, 2 or 4 out; options include eight-track monitoring, two foldbacks and many others

London representation (P.A.) IAN JONES 16 Wallasey Crescent, Ickenham, Uxbridge, Middx tel Ruislip(71)73271

FRANCE: AUDIO-SERVICE 36 Rue de l'Abbé Carton, 75014 Paris tel 533 2960

AMEK SYSTEMS & CONTROLS Ltd 2nd floor Islington Mill, Salford M3 5HW Lancs, England tel 061-834 6747

Location recording of film sound

JOHN JORDAN

Location film recording often involves severe problems which can prevent the consistent recording of usable dialogue, recourse being made to dialogue post-synchronisation. Using existing techniques it is possible to record under almost any location conditions—but it can be a risky business!

'Stand-by please . . . Run sound . . . Run camera . . . Slate it.'

A sequence of instructions that film production crews respond to many times a day, every week of the year. Always the same starting point to their work. But what follows is always new and different, both in front of and behind the cameras—a challenge to each member of the team.

For the sound crew, which can vary between one and five in number, it is not only a challenge of technique but often of political skill as well, since sound men, although essential, are often thought of as a nuisance. For the director the key things are usually visual and dramatic: camera angles, actors' performance, lighting, props are of first importance. Recording a few words and sound effects, which can always be post-synchronised in the studio later, is not that vital. As a recording engineer who has also worked on the other side of the microphone and behind the cameras I agree with his priorities, but however hard the actors and director work at post-synchronising location dialogue, they can rarely match the ambience and feeling of the original performances. And the cost of doing this is now very great

So the film recordist has to be, or become, a politician of the most persuasive kind. Able to get good clean dialogue in situations where this depends on the co-operation of the actors, the camera crew, and other members of the team, for the sound man can rarely put his microphones where he wants them. He has to compromise continually to avoid the microphones (or their shadows) being seen, to hide cables, to cope with camera movement, and so on, and yet the dialogue he records must be crisp, free from background noise, and free from reverberation. As the camera angle changes from wide angle to close-up to medium shot to wide angle and so on within the scene, the microphones, if they are always placed on the edge of the camera frame, are forced to move as well. Unfortunately, the sound perspective changes which result from this are much more severe than are needed to match the change in visual perspective even when the directionality of the microphone is changed to attempt to cope with this. The resulting sound track can be very intrusive and disconcerting when the location is reverberant and noisy.

An outline of some problematical film settings is probably the best, and only, way to introduce the questions of techniques that can confront a sound recordist on location.

John Noakes is learning to fly a helicopter for the 'Blue Peter' programme. The director has asked for an air to air shot showing John Noakes and his instructor flying their helicopter over a simulated battle run on Salisbury Plain. The camera, in another helicopter, will be close enough to see the two pilots talking to each other, so the sound must be recorded in synchronisation with the film.

The Channel island of Guernsey. Fifteen metres underground in a German Military Hospital built by slave labour during the Second World War. Each 'ward' is a semi-circular tunnel about 15 metres long with concrete walls, roof, and floor. It is as silent and lonely as a tomb except for the distant drips of water echoing round the huge underground complex. Drop a pin and you hear it. Drop a stone and the sound echoes on for six seconds. Talk at normal volume to another person 1.5m away and the reverberation is so great that you cannot understand a word. Problem—record a film with Charles Aznavour, Peter Sellers and Jeremy Kemp, without any post-synchronisation, entirely underground.

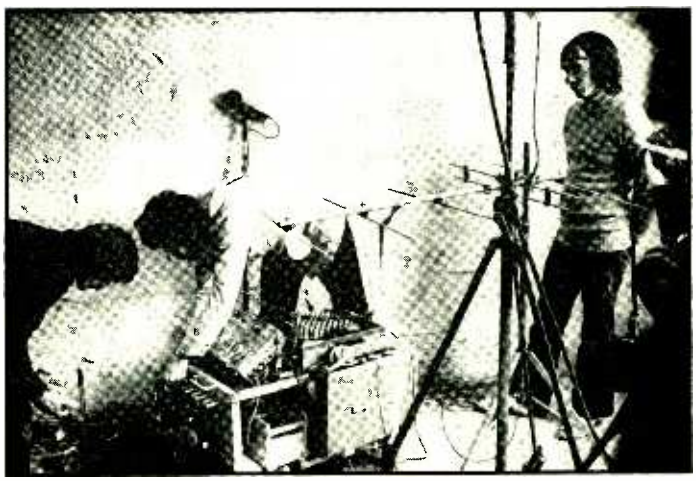
The quadrangle at Sherbourne School in Dorset. The set of the Peter O' Toole version of the musical *Goodbye Mr Chips*. The scene is full of schoolboys miming to the playback of the pre-recorded song. The camera starts on a close-up of a boy singing at the back of the crowd and zooms out to reveal him as only one of several hundred.

Vienna. The Theater an der Wien. A small opera house which is notoriously impossible to record music in. On stage is Lucia Popp, Gwyneth Jones and Theo Adam singing in Beethoven's only opera, 'Fidelio'; and conducting the opera, in exactly the same place as Beethoven conducted the first performance, is Leonard Bernstein. Problem—without any microphones being seen by the camera, film for ten days while the opera is being rehearsed, and record (onto one track only) in such a way that sections of the opera can be assembled from bits filmed each day, and at the same time, using the same equipment, be able at any moment to record the comments and discussions between the conductor and opera director and the artists in a suitable perspective to match the shot being filmed.

These are not everyday problems, but they serve to illustrate several of the techniques of film sound recording in the industry.

One underlying technical requirement, however, needs to be established before the various techniques are discussed. This is the synchronisation of film and sound track so that when the editor receives the developed film (called 'rushes') and the sound track (which will have been copied from 6.25 mm on to perforated 16 mm or 35 mm magnetic tape), the length of the picture

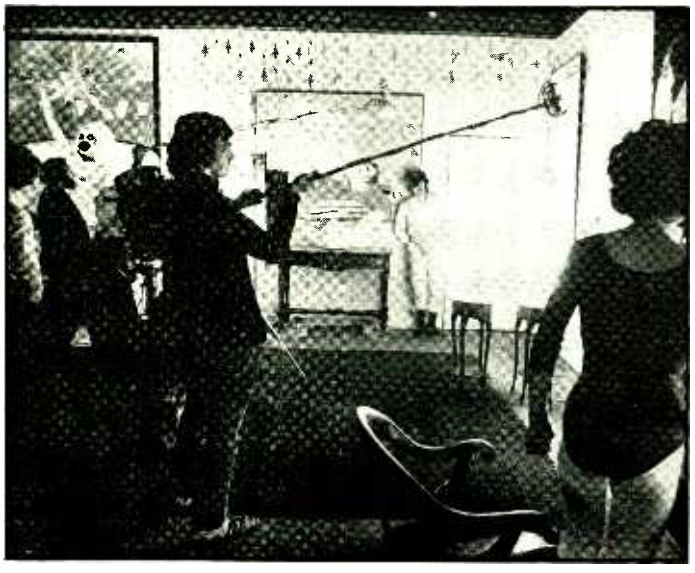
Below: *Location equipment in the Underground Hospital, Guernsey.*
Right: *Conventional mic techniques 'A Clockwork Orange'*



take and that of the corresponding sound take is precisely the same. As the camera and tape recorder are not driven by the same motor it follows that both camera and tape recorder speed can vary on location. So although the clapperboard gives a visual and an aural mark at the beginning of each take, by the end of the take there can be a considerable error of synchronisation between the lips on the screen and the words on the sound track. An error of 1/12th of a second (two frames) is noticeable, and on a ten minute long take this represents an error of 1 in 7,200 or about 0.014%. To achieve such tolerances calls for a method of continuously recording the relative speed variation between camera and recorder, and this is most simply achieved by recording a pulse which has been directly generated by the camera motor on to a second track on the tape recorder using a pulse lead between camera and recorder. When the audio track is copied on to perforated magnetic tape (which matches up mechanically with the film) this pulse is used to automatically vary the speed of either the playback machine or the record machine so that the relative speed variation between the camera and recorder on location is accounted for and the resulting sound track has precisely the same number of frames as the picture.

For cine-verite work the pulse lead from camera to tape recorder is a hindrance, and synchronous camera motors driven by a crystal controlled oscillator built into the motor itself are used: the tape recorder has a matched crystal which generates a pulse for the pulse track. The tape recorder almost exclusively used professionally is the fully portable Nagra which records full-track and records the pulse on to two identical tracks within the full-track width: the two pulse tracks are arranged to be 180 degrees out of phase with each other so that the resultant playback of pulse in the full-track audio head is zero.

Returning to the problems of techniques, most location recording is recorded in such a way as to allow the film editor and the dubbing mixer, who will eventually mix up to 36 simultaneous tracks, as much flexibility as possible. When he is shooting the film the director is seldom certain of the way in which he will assemble his shots, so the recording engineer can make no assumptions about whether the end of shot A will be joined to shot B or to shot C. Everything has to be recorded on the assumption that the director will want to use every word of every take, so the loss of a word or two due to a passing car or aircraft is of vital importance because there may be no way of re-recording those missing words in a matching ambience. Nearly all recording is done 'flat' straight into the microphone input leaving any equalisation until the final mix. There are however situations where neck microphones are used, hidden under clothing of course, and the results from these can vary in degree of muffledness according to the clothing. To give the 'edge' back to the sound a rifle microphone is also used at low level to put back the high frequencies. This technique gives excellent quality when trying to record usable sound in very noisy situations, or 'period' sound in the countryside



Listening to a take—'A Clockwork Orange'

when there is the inevitable distant roar of traffic. In situations where the background sound is so high that the use of the rifle microphone is out of the question then equalisation of the several neck microphones must be done on location. On the film 'A Clockwork Orange' extensive use of this technique was necessary and the resulting sound track was the first all-London location film to be made which required no post-synchronisation; in fact in several sequences the traffic noise was so low that more had to be added! 'A Clockwork Orange' was a very demanding film utilising virtually all the techniques at the disposal of a recording engineer both on location and during the recording of sound effects and music and during the final mix. Many of these techniques are discussed below in relation to the typical location problems outlined earlier.

'Blue Peter' posed the problem of How to Record Air to Air Without Really Trying. Radio microphones on John Noakes and the instructor, or a tape recorder in their helicopter pre-set for level were the two possible solutions. Actually the dialogue had to be recorded off the helicopter intercom system which used noise cancelling boom mics because the ambient noise is much greater than the human voice, so the choice was whether to plug the radio mic transmitter or the uncontrolled tape recorder into the intercom. Although radio mics are attractive they are inherently unreliable, especially in the presence of spark ignition engines, so the unmanned tape-recorder was used. This solved the dialogue recording problem, but introduced the problem of how to record the camera pulse on to the tape recorder in the other helicopter. Apart from a long lead between helicopters, the only choice was to either transmit the pulse (using a radio mic link with the same disadvantages mentioned above) or use a crystal controlled camera motor and crystal pulse on the recorder. We used crystal pulse. That left only one problem—how to operate a clapper board in mid-air to get a common start mark on the film and on the sound track. In practice we gave instructions to John Noakes to very obviously tap his boom mic with his hand when we told him to (by normal air to air radio). The camera filmed his hand hitting the mic, and the sound track received a big thump; the editor, having been told what to expect, used the microphone 'tap' as a clapper board. Because this is a common problem in news situations there are now several automatic clapper boards (called slating systems) which, as the camera starts, fog a certain pattern of frames on the film and simultaneously transmit by radio link to a receiver built into the tape recorder a pulse code which is recorded on to the audio track to identify it.

A similar situation to this arose when 'World in Action' were making a programme about Edward Heath when he was Prime Minister. We were filming the race from Cowes to Dinard, observing action on board 'Morning Cloud' from another boat piloted by Robin Knox-Johnson. In spite of concern that the weight of the Nagra tape recorder (about 10 kg) would upset the racing trim of the boat we were able to install it on board

38 ▶

'Morning Cloud' and monitored its output by radio microphone link to enable the camera crew to cover interesting situations as they arose.

The German underground hospital posed many problems. The silence was so intense and this combined with the very long reverberation time at low frequencies meant that the slightest sound became intensely audible. The only way to be understood was to whisper to each other so that most of the sound energy dissipated before it hit the concave roof and came reverberating back to confuse the original words. Everyone spoke quietly, both crew and actors, and in order to record the actors' words with a reasonable signal to tape noise ratio virtually maximum gain

On board 'Morning Cloud'

had to be used on the equipment. Talking quietly helped binaural humans to understand each other, but still made nonsense to microphones which were forced by picture composition to be up to a metre away from the lips. The only answer in such a situation is to use neck microphones on each actor. Naturally each of these must be concealed under clothing with the inevitable loss of high frequencies. This varies from actor to actor and consequently each microphone needed individual equalisation before mixing on to the one track. Using dynamic neck microphones on up to five actors at a time, at full gain, meant riding the gain of all channels simultaneously to keep the noise (both electronic and ambient) on unused channels as low as practical between actor's lines. This calls for very careful attention to the script to avoid missing the opening word of an incoming actor. Such an error on an otherwise perfect take for director, actors and the camera operator is intolerable, so mixing in a situation like this is quite a strain. Replace the cable between neck mics and mixer by radio mic links, as often has to happen on wide shots to avoid cables showing, and the dangers of a technical fault on the take are magnified.

Apart from the electronic noise introduced by the equipment the other main source of objectionable acoustic noise was from the cameras. Cameras are 'blimped' to reduce their noise so that it is almost inaudible about two metres in front of the lens in a normal relatively dead studio; in the reverberant silent situation camera noise being picked up through the neck mics was very noticeable in almost every shot, and would normally have meant post-synchronisation later. This was anticipated before the location started and equipment was designed to selectively reduce the camera noise and other low level background noise; this equipment was used during the copying process from 6.25 to 35 mm perforated tape. A pair of variable notch tunable dip filters, a graphic equaliser, and Dolby A units used as selective expanders with variable expansion in each of the four bands were used in the chain. As it was anticipated that several generations of a take would be needed to reduce the camera noise, which had many harmonics, all the original 6.25 mm tapes were Dolbyed. By subjectively 'compensating' for the removed components of the sound track by using the graphic equaliser an acceptable dialogue track was achieved.

Neck microphones were essential, but unfortunately produced a constant perspective whatever the angle of the camera shot, and although this can be adjusted during the final mixing it would have been impossible to reproduce the magnificent reverberation of the tunnels. To provide the dubbing mixer with this echo so that it could be used when required it was decided to record a second track using a stereo Nagra and a conventional 'open' microphone. The two audio tracks, one very reverberant, the other dry, were transferred simultaneously to two tracks on the sprocketed magnetic tape, the dry track being cleaned up as above. So much for underground technology.

Musicals, such as *Goodbye Mr Chips*, present in many ways a much easier location job, as the pre-recorded music just has to be played back on location. There are however two simple points which are easy to overlook. The first is the need to ensure that the pre-recorded music has a pulse recorded on to it when location copies are made so that when it is replayed on location the pulse from the camera can be used to directly control the speed of the recorder being used to play back the music. Severe camera speed changes therefore appear as wow, but this is immaterial provided the actors who are miming keep in time with it! The other important point is related to the speed of sound, the speed of light, and loudspeaker placement. If the playback loudspeaker was placed close to the front row of boys in the quadrangle at Sherbourne School, they would of course mime in synchronisation to it. The boys at the back, about 60 metres away from the loudspeaker, would also mime in time to the sound as they heard it—60 metres or about 1/5th second later than the boys at the front, with obviously disastrous consequences on the screen! In a situation like this several speakers placed throughout the group must be used.

In the middle of a song it often happens that while the orchestra continues to play, the actors talk to each other in normal dialogue. The use of a loudspeaker in this instance would require the orchestra to be faded out before the dialogue and faded in again whenever the song had to be mimed. This is not always practical, and so the actors and director are issued with miniature hearing aids with loop induction facility. The music is played only into the loop; nobody, microphones included, hears the music except the actors, and so their dialogue can be recorded in the normal way.

Live music recording for film almost invariably has to be recorded on the same single track system as dialogue. In fact the basic film sound kit is very limited, being composed of two neck microphones, three other mics (one of which is a rifle mic), a Nagra recorder, headphones and a hand held mic boom; hardly the ideal, but practical for carrying by one man anywhere in the world. The 'Fidelio' recording kit was a little better off. Nine mics and two Nagras to permit continuous recording. We had been assured that there were multitrack facilities available in the Theater an der Wien, and that we only needed our equipment for some of the rehearsals which were to take place in another auditorium. When we arrived there were no suitable facilities and so we deployed our equipment as best we could. The acoustics of the auditorium were such that a single mic balance could not be obtained—once again a compromise had to be reached. The stage area over which singing and dialogue took place was about 10 metres deep so one mic was set about half way back rigged in the flies, two mics on front of stage, two neck mics on radio links on conductor and director, and the remaining three 'covered' the orchestra in an enforced close mic balance to avoid the mics being seen when filming the stage from the auditorium. The ninth mic, the rifle mic, was used hand-held in conjunction with the neck mics to brighten up the otherwise muffled sound. The final result, which should have been disastrous, was liked and the film got a nomination for an Emmie, the television Oscar!

In no way has this been an exhaustive list of location recording techniques. Much more could be written, especially regarding the everyday life of the film unit, briefly touched on in the opening paragraph. More could be written about the relationship between the location sound recordist, the editor, and the dubbing mixer; a relationship which rarely exists, the location recordist hardly ever following a production through to the finished film. And more about the everyday routine, often monotonous. But, as we have seen, location dialogue recording is a little different. Occasionally tedious, often challenging, and sometimes risky, especially when the next job always depends on how well you did the last. ■

Dolby Noise Reduction

The First Successful Decade 1966-1976

**Dolby noise reduction has staying power.
It has been around for ten years.***
If you have read our technical papers and otherwise followed our progress, you are probably familiar with the reasons for this success. Here are ten quick reminders.

1 The Dolby system works like a constant-gain amplifier in two critical dynamic regions—low levels and high levels. Error-free signal handling is thus ensured at the dynamic range extremes. Compression and expansion occur only at easy to handle mid-levels, between −20 dB and −40 dB.

2 The system employs a simple adding and subtracting scheme which automatically results in mathematically exact complementary compression and expansion. There are no approximations, so the signal must come out the same as it went in (just check the Dolby Level now and then).

3 Compressor overshoots with high-level transient signals are suppressed without audible distortion, because of the basic system layout (dual signal paths). Since there are no overshoots to be clipped by the recorder, there is no impairment of even the most extreme transient signals.

4 The freedom from overshoot is a result of system philosophy, not an ultra-short attack time. Relatively gradual gain changes are used, yielding a compressor output which is remarkably free from modulation distortion. There is no need to depend upon cancellation of modulation products by the expander (thereby relaxing recorder performance requirements).

5 The reproduced dynamics of low-level signals are essentially immune to rumble in the input signal and head bumps and other frequency response errors in the recorder—the system has a solid low-level 'gain floor' below −40 dB.

6 The system gives a pre-determined amount of noise reduction which is realistically useful.

7 The noise that remains has a subjectively constant level. Noise modulation effects are almost non-existent.

8 The principles and parameters used in the Dolby system result in a high margin of safety. The system works well with all types of audio signals—speech, music, effects—and with practically all types of noises. High noise levels (from multi-generation copies, for example) do not impair performance.

9 The system functions reliably on a day in, day out basis, with real workaday recorders and other equipment.

10 All of the above have been proved in ten years of dependable service to the industry—25,000 professional channels in use by well over a thousand studios in more than 50 countries around the world.

The first five A301 units were delivered to the Decca Record Company, London, on April 14, 1966.

Dolby noise reduction now looks forward to

The Second Successful Decade 1976-1986

Dolby Laboratories Inc

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San Francisco CA 94111
Telephone (415) 392-0300
Telex 34409
Cable Dolbylabs

346 Clapham Road
London SW9
Telephone 01-720 1111
Telex 919109
Cable Dolbylabs London

AUTOMATION

The MCI automation system for the JH500 AUDIO MIXING DESK will be released by late 1976. The circuitry and the controls needed for full automation are built into the standard desk. Advanced design, coupled with the extreme flexibility of the JH500 desk allows the WRITE and UPDATE controls to be reduced to just three simple pushbuttons per channel for ALL FIVE AUTOMATED FUNCTIONS. *When CHANNEL GROUPING is used, three buttons can control the whole group.* These buttons are already built into the modules and are labeled VCA WRITE, VCA UPDATE, AND MUTE WRITE. The buttons are momentary pushbuttons with latching circuits. An LED located beside each button lights whenever the circuit is active.

Two other features of the AUTOMATION SYSTEM contribute greatly to ease of use:

FIRST, a design breakthrough has achieved AUTOMATIC NULLING of all automated controls. This is accomplished electronically and results in an additional feature:
When VCA WRITE or VCA UPDATE is activated, the mechanical position of the fader is taken as a ZERO, or NULL POINT. *(WHATEVER THAT POSITION MAY BE)*. When updating, changes are read as differences from that assigned ZERO position. Therefore the faders can be used in the upper *(and more sensitive)* portion of their range when updating - REGARDLESS OF THE LEVEL BEING UPDATED.

SECOND, when the UPDATE or WRITE function has been completed, return the fader roughly to the vicinity where the NULL WAS ESTABLISHED *(NORMALLY AROUND 0 DB)*. An EXPONENTIAL RAMP built into the NULLING circuit will AUTOMATICALLY **RAMP OUT** any difference of setting. No sudden level change will occur.

MUTE WRITE – is treated as a seperate function, and may be easily added either before or after writing the VCA program. **NOTE** – that the MUTE FUNCTION in the MCI desk is **NOT** the usual reduction of VCA gain to minimum, but is accomplished by shorting the output to ground through relay contacts. *THIS ASSURES A* **TRUE CUT-OFF OF CIRCUIT NOISE** *AS WELL AS PROGRAM MATERIAL.*

The VOLTAGE CONTROLLED AMPLIFIER (VCA) automation has four modes:

WRITE – This is accomplished by pushing the VCA button and going through the recording with the controls set as you wish them to be.

PLAYBACK – None of the desk buttons are used. Going through the recording with the automation activated will cause the controls to faithfully follow whatever you have written into the program.

UPDATE – This function is essentially a playback with CONTROLS ACTIVATED. NO REWRITING OF THE PROGRAM occurs in this mode. If you wish to test a different combination of control settings, use this mode. The originally programmed control settings will be reproduced. YOU CAN ADD OR SUBTRACT from any programmed control setting merely by moving that control.

REWRITE If you decide that you like the new settings, you may **THEN** rewrite the program by pressing BOTH the VCA UPDATE and the VCA WRITE buttons.

SPECIFICATIONS JH-500 SERIES

MIKE PREAMP

Input impedance		1.2K ohms
Output impedance		2 ohms
Nominal output		−6 dBm
Maximum output *1 kHz @ 0.5% THD – into 600 ohms*		+29 dBm
Distortion		
0 dB input – +28 dB output to 600 ohms (50 Hz)		.03% THD
IM measurements with 60 Hz & 6000 Hz at a 4:1 ratio		
−40 dB input – 0 dB output		.005% IM
0 dB input – +28 dB output		.03% IM
Equivalent noise	*44 dB gain*	−126 dBm

CHANNEL CIRCUIT *(TO MASTER TAPE)*

Signal to noise	*Better than*	75 dB
Input impedance to Fader		4k ohms
Output impedance of Channel output		100 ohms
Nominal output		+4 dBm
Maximum output into 600 ohms @ 0.5% THD	*(1 kHz signal)*	+27 dBm
Distortion	@ Nominal output	.07% IM
Distortion	@ +24 dBm output	.09% IM
Separation – *Between adjacent channels*		
assigned to adjacent Busses	*1 kHz*	85 dB
Mike input to Line output	*15 kHz*	65 dB
Internal Head Room of Equalizer	*Above +4 dB*	25 dB

MIXDOWN MODE

Input impedance to Fader		4k ohms
Nominal output		+4 dBm
Signal to noise	*Better than*	75 dB
Distortion	*@Nominal output*	.06% IM
	@ +24 dBm output	.08% IM
Maximum output into 600 ohms @ 0.5% THD	*(1kHz)*	+27 dBm
Separation of QUAD MIX Busses	*1kHz*	75 dB
	15 kHz	65 dB
Maximum Fader attenuation (FDR KILL)	Better than	80 dB

Patch panel	528 – *up to*	504 Jacks

LIGHT METER OPTION

Range *(SCALE) Switchable from VU to Peak*	
VU *(log scale)*	+3 dB to −20 dB
Peak *(linear scale)*	+10 dB to −40 dB
Integration time	
VU ballistics	per ASA Standards
Peak ballistics – Rise time	10 ms to full scale
Fall time – Adj. from 1 sec. to 7.55 sec. FS	
Frequency response	20 Hz – 20 kHz ±1/4 dB
Input impedance *(resistive – unbalanced)*	10k ohms
Overshoot	*Less than* .1 dB
Display	*length* 127 mm (5")
	width 2.54 mm (.1")
Number of segments	100 per display

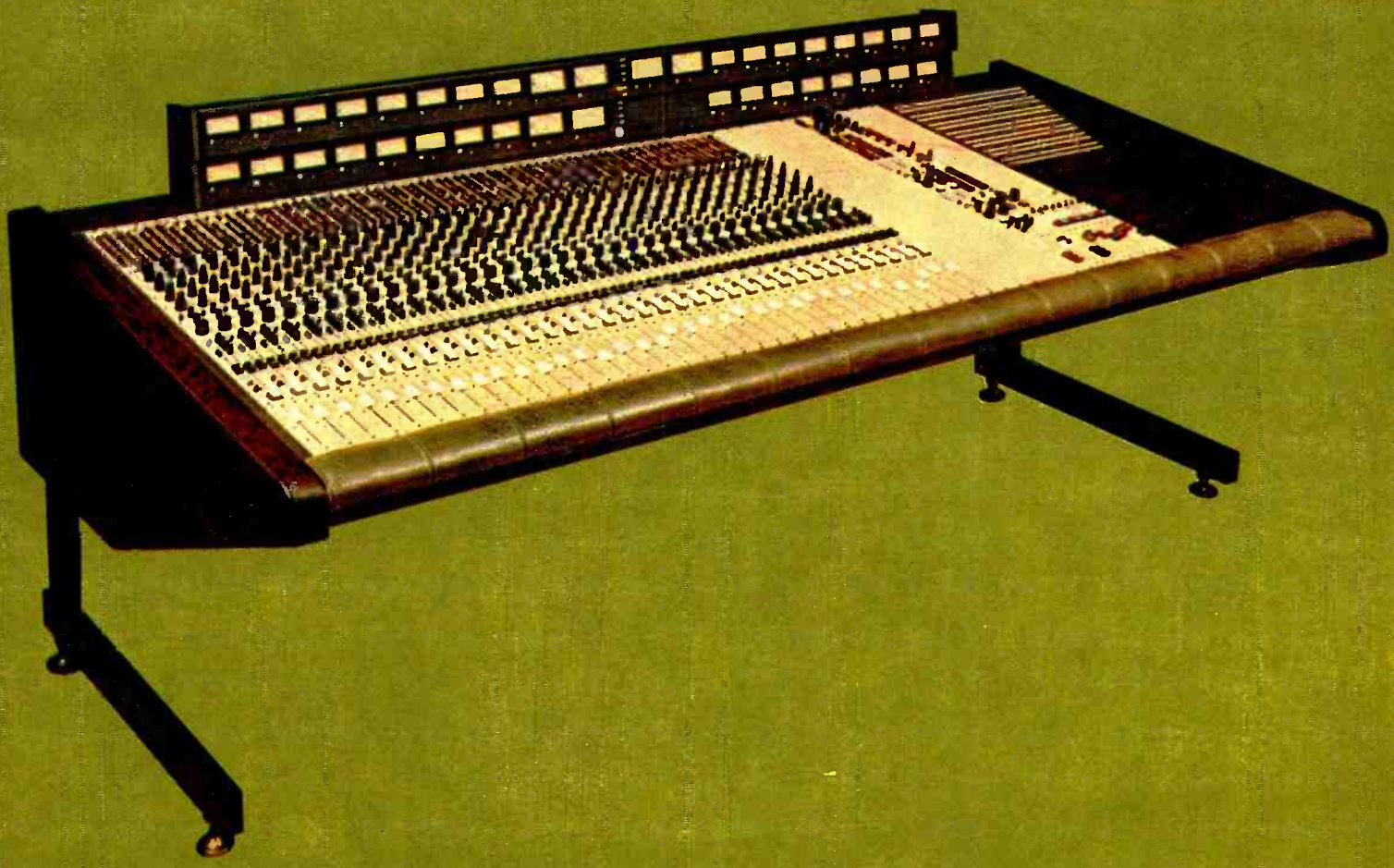
Controls

1. Individual peak accumulate on/off switch for each meter.
2. Master Peak Accumulate on/off switch for all meters.
3. VU/Peak Select (single switch contained on master card).

MCI

MCI (Professional Studio Equipment) Ltd, 21 Claremont Square, London N1 9IX 01-278 8190/99

THE QUIET ONE IS AUTOMATION-READY



MCI

APRS Exhibition 1976: a preview

FRANK OGDEN

The 9th exhibition will be held at the Connaught Rooms, Great Queen Street, London on Thursday, June 17 and Friday, June 18.

Opening hours are from 0900 to 1900 (17th) and 0900 to 1800 (18th).

Agfa-Gevaert. Magnetic recording tape for professional and bulk consumer (such as 3.81 mm pancakes) applications.

AKG will feature a small reverb unit intended for applications in ob vehicles and small studios. Designated *BX15*, it has reverb times from 1.5 to 3.5s in 0.5s steps. Regarding microphone products, emphasis will be placed on the *C414* variable polar response capacitor mic.

Alice will show a synchronised clock system for recording studios, a new monitor loudspeaker using built in Quad current dumping amplifiers (built under licence). Also 'a few mixers such as the *STN6* portable disc jockey mixer'.

Allen and Heath will show the complete range of sound mixing consoles manufactured by the company. In addition, there will be four new products on display: a low cost broadcast mixer, a simple compressor limiter for use with the *Mininix* mixers, a high quality feed forward compressor limiter and, finally, an adt and phaser unit incorporated in one black box.

Amek are to exhibit a 16/8 modular recording console with a 'large range of facilities'. Also a 12/4 *X* series console for sound re-inforcement or recording applications. The company are to show a two channel rack mounting electronic crossover.

Ampex will naturally feature both the ATR-100 and the 50 mm *MM1200* multitrack machine. Improvements on the previous *MM1100* are of a design and maintenance aspect. However the greatest benefit to operational recording engineers will accrue from changes to the Sel-Sync organisation which has now been reduced to the same level of simplicity as other multitrack machines.

Audio and Design Recordings will show the low cost *Scamp* modular sound processing system along with the company's standard range of limiters, compressors, dynamic noise limiters, expanders, parametric and octave equalisers and filters.

Audio Developments will exhibit an addition to the mixer product line—the *Pico* mixer—which has a 6/2 format, twin vu or ppm meters and pfl. It features phantom powering to the usual standards and can be supplied with various connectors. The rest of the mixer range will be shown.

Audix *MXT-1000* mixer makes a first time appearance at the show. It offers custom-built modular construction—the basic system will accept up to 14 modules—while providing two general options. The first is intended for general applications such as outside broadcasting and small recording studios and the other could find applications in on air broadcasts. The company will also exhibit a simple mono version, the *MXT-100*, for the first time.

BASF will exhibit its range of studio tapes as well as the *Unisette*.

FWO Bauch major in Studer, Neumann, EMT, UREI plus two handfuls of other imports. Of special interest on show this year: from Studer, *169* portable mixing unit, an *A68* power amplifier and the long awaited Unisette tape deck for broadcast systems first shown at AES Zurich. From EMT, an electronic crystal time display, a small wow and flutter meter and a micro-impedance meter, whatever that is. From UREI, a response plotting system, a compressor limiter *LA-4* and leveller *LA-5*, a new graphic equaliser *532* and mono or stereo bandpass filters *555* and *556*. Bauch has acquired two more agencies: Transco who manufacture disc blanks and Sontec, likewise, for parametric equalisers.

Beyer Dynamic. The company will show the full range of microphones, headphones and accessories. Among the new products will be included the infra-red cordless headphone system comprising the *IS76* transmitter and a *DT444* headphone/receiver unit. Receiver *IE76* is intended for use with other types of 'phones. A new microphone, *M640*, is intended for pa applications; it features a dynamic cardioid capsule and is of small dimensions. Also on display, the *DT440* headphones using open construction accent wearing comfort.

Bose UK will feature the *800* professional speaker system and the *1800* drive amplifier.

Brenell. The company will show stereo and four channel versions of the *Mark 7* machines using 6.25 mm tape. Also, there will be complete eight and 16 track machines in addition to the 50 mm transport incorporated in them.

Bruel & Kjaer has recently introduced many new instruments, most of which are designed to facilitate automated calibration and testing. The following are late additions to the range and are mostly on show at the APRS for the first time: Distortion Measurement Control Unit *1902*, together with the Heterodyne Analyser perform harmonic, difference frequency and intermodulation distortion measurements. The *1023* Sine Generator includes a frequency modulator, compressor and voltmeter. It gives both analogued and digital indication of frequency and has facilities for synchronisation with other B & K gear. The *2429* Psophometer offers noise measurements through built in filters including telephone line filters, Lin filters (25 to 22k Hz) and CCIR, CCITT and DIN. The set is equipped with matching rectifiers. Also on show will be the new *2131* Digital Frequency Analyser measuring in octave and $\frac{1}{3}$ octave steps from 1.6 to 20k Hz. Two memories are provided for comparison of real time and recorded curves for simultaneous display on a 28 cm screen.

Cadac is to concentrate on the smaller items of studio equipment at this exhibition: vehicle mounted consoles, foldback speakers, electronic crossovers, monitor speaker systems, compressor limiters, Cadac built Dolby *A* systems, equalisers, effect devices and light dimming modules.

Calrec. Main exhibit on the stand will be a 44 input, eight output desk with eight subgroups constructed for BBC, Glasgow. It uses *L* series modules developed specifically for broadcast applications.

Dolby Labs products hardly need further description. New products include *330* stereo *B* type encoder for tape duplication applications and the *CP100* Cinema Processor for use with all current 'and foreseeable' film soundtrack formats.

Philip Drake Electronics are to show a digital delay line offering delay times of up to 100 ms; it can also provide phase 44 ▶

Professionals have been listening through Tannoy Loudspeakers for nearly half a century.

Isn't it time you joined them?

By the late 1920s Tannoy had designed their first loudspeaker system. It was ahead of its time like all the others that followed it. So much so that in a few years Tannoy had become a virtual synonym for natural sound reproduction.

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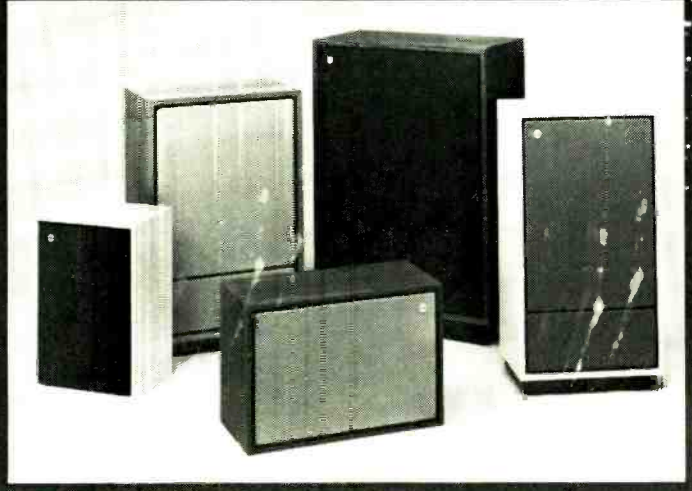


TANNOY® The name says it all

Phonogram Studio London

APRS PREVIEW

advance or retard over 3 ms, frequency shift of ±40% and octave shifting up or down. The unit can be interfaced with high or low level lines. They will also exhibit an eight way talkback system with applications in studio complexes or broadcasting.

Feldon Audio will exhibit the Eventide *Harmonizer*, *Omnipressor* and *Instant flanger* sound bending products and a range of high power amplifiers from FM Acoustics of Switzerland. Power ratings to FTC range from 150 to 300W into 8 ohms.
There will be some disc cutting equipment from Ortofon. Finally, the Pandora *time line* will be on display.

Ferrograph Professional Recorder Co are to exhibit the *Studio 8* series machines as well as an interesting addition to the test gear range—a spectrum analyser for use in conjunction with the company's audio test sets.

Fraser-Peacock Associates are to show the Wollensak range including the *2770* high speed cassette duplicator, the *2551* visual sync cassette recorder and the *2520AV* and *2620AV* cassette recorders. There will also be an Infonics system *200* cassette duplicator and Scotch *AVC* heavy duty cassettes.

Future Film Developments are agents for Rendar, Switchcraft, Cannon, Amphenol, Preh, Hirschmann, Ruwido, plus other manufacturers of aids to hard wiring.

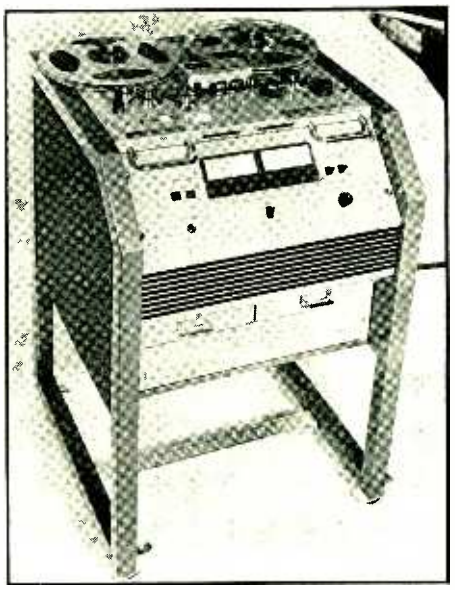
Hayden Laboratories will be showing products from Isophon-Werke, manufacturers of loudspeaker drive units; Kudelski SA who manufacture the Nagra range of portable tape recorders; Sennheiser with its range of microphones and AEG Telefunken will be showing a new version of the *M15* tape recorder for the first time in this country. From the same company comes an *IPS F2000* parametric sweep filter intended for incorporation in multitrack mixing desks.

Helios Electronics. Principal exhibit is a 28/16 +24 monitor desk designed and built for Release Records, Dublin. It features parametric eq on all channels, four echo sends, eight returns. Helios claim ergonomic design as a highlight of the desk.
On peripherals, they will exhibit a new rack mounting parametric equaliser with two separate channels each with a four section sweep, bypass and overload indicator.

Jackson Recording Company. Malcolm Jackson will probably be very silly again.

Jaques Levy will be offering a range of recording lacquers and cutting styli. Also, Pultec equalisers will be shown.

Klark Teknik will show recent, if not entirely new, products. The *SM2* 6.25 mm recorder is available in two versions; the first is for broadcasting while the other is for studio recording. Both feature phase locked dc vari-speed from 15 to 80 cm/s and a digital tape tensioner claimed to keep constant tension in all modes and speeds. They also incorporate NAB/DIN eq switching and variable speed spooling. There will be four graphic equalisers on display comprising the full range: *DN27*, *DN22*, *DN11* and *DN15*. The last is an entirely new unit comprising dual 11 centre equalisers and stereo pre-amp and hi and lo pass filter facilities.



Leevers-Rich Proline 1000 6.25mm machine

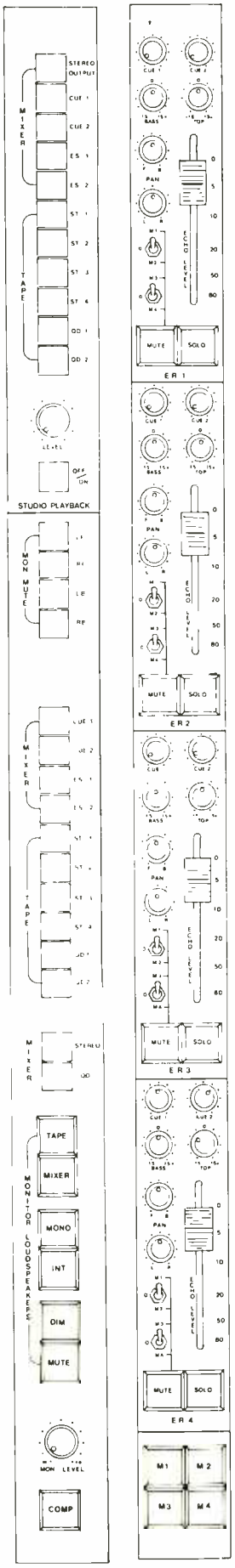
Leevers-Rich/Bias are to introduce a new model at this year's show—*Proline 1000*. Limited information available at time of writing. The latest *E200* machine will be shown which is now equipped with electronic servo controlled tension, modified bias circuitry and an improved erase head. There will also be an Ampro broadcast cartridge machine to be shown at a European show for the first time.

Lennard Developments will feature an addition to the Woelke range of wow and flutter meters. On diplay along with existing models will be the *ME 102CE*. This retains the previous characteristics of the *102* with the addition of a NAB/JIS weighting facility to measure to these standards. The company will also show a range of Woelke recording heads.

Lockwood will show all their existing loudspeaker products as well as a new range of professional disc reproducing equipment.

3M. There will be demonstrations of the *XT-14* autolocator manufactured by Sonaplan, which offers many functions helpful to the editing process. The stand will feature 24 and 4 track machines, API *Maglink* and *Minimag* synchronisers with demonstrations of the latter and the *6110* recorder test set. Naturally, the full range of recording tapes will be represented.

46 ▶



quantum

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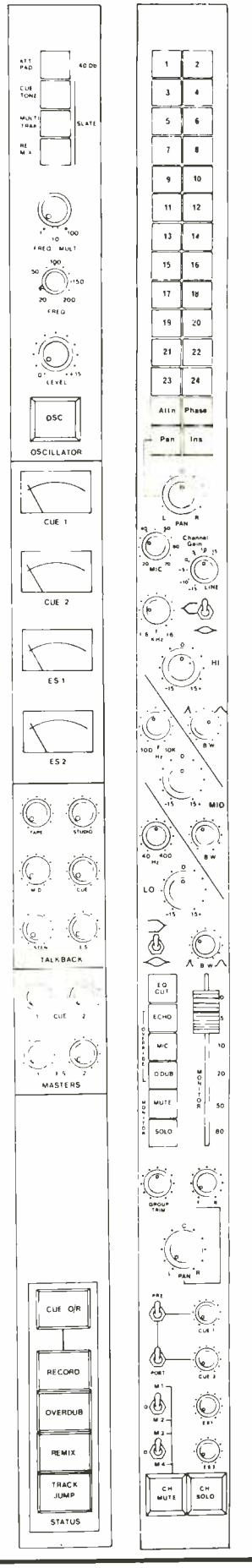

APRS PREVIEW

Macinnes Laboratories will show the full range of Amcron power amplifiers as well as a *CX844* four track tape machine from the same company. Possibly the greatest interest will be in small pa mixers, available in either 16/2 or 16/4, featuring two foldback sends, two echo sends, mic/line switching and phase reversal. An aluminium flight case forms the cabinet.

MCI UK hopes to show an MCI *500* series console intended for CBS. The desk uses vca faders for one buss subgrouping facilities as well as the ability to subgroup the mute function on each channel through a single wired control signal. Naturally, the organisation of these consoles lends itself to automation although MCI has yet to decide which system to head for. The recently modified 24 track tape machines will be exhibited.

Millbank Electronics Group will focus attention on the new PAC System—a range of three power amplifiers with a 30, 50 and 100W rating featuring up to six pa inputs. They can be inter-wired to provide powers to 1000W. The established product lines will be represented.

NEAL have just released details of the new *140* four channel cassette recorder. It uses the full width of a cassette compact to record four channels simultaneously. Four channel Dolby *B* is fitted. The rest of the company range will be represented.

Neve. The company plans to show an example from the new *Compact Range* of recording consoles. There are three new models, and all claim to feature 'innovative concepts of styling and design, greater operational convenience . . . and competitive pricing'. The largest, the *8068*, is a 28 mic channel + four effects return channels featuring full eq and routing facilities, four subgroup, 16 output and 30 channel monitoring console with full quad positioning. The next size down, *8058*, incorporates a 24 in, 16 out + 24 track monitoring thus providing adequate facilities for 24 track recording. The smallest, *8056*, is an 18/8 + 16 format mixer with two effect return channels with full eight way routing.

Penny & Giles are using this year's exhibition to promote a new *Quad Pan* potentiometer. The device accepts a single channel input signal and divides it into four outputs each representing the sound level needed in each channel of a quadraphonic situation. Moving the joystick enables location of a sound source anywhere within the listening rectangle. P & G say that the conductive plastic tracks make for great smoothness of operation. Also on show will be a range of column ppms and the usual faders.

Pyral manufactures recording lacquers in all the popular surface grades and sizes. In addition, they will show their full range of studio recording tape available in the usual packages and sizes for that application.

Quad will show the full range of products including the current dumping amplifier.

Racal-Zonal will show a representative selection from its range of recording tapes.

Radford will be showing the full range of products from the Bristol factory including the *ZD100* and *ZD200* power amplifiers designed for operation into loads from 2.5 ohms upwards with 'virtually zero distortion'. The low distortion oscillator, also on show, is claimed to produce less than 0.003% harmonic distortion from 30 to 20k Hz; the balanced output has a common mode rejection ratio quoted in excess of 80 dB at 1 kHz. There will be the new range of audio volt and noise meters, some of which have weighting networks for measurements to DIN/IEC 'A' and CCIR standards.

Raindirk will show the *Mini-Mixer* range as well as a smaller series. An example from the *Quantum* range of consoles will be represented; the company also manufactures peripherals such as ppm drive cards and other ancillary equipment.

J Richardson Electronics will show the *TC700* tape recorder electronics, used in updating existing machines, introduced at last year's show. New this year is the *MC6000* range of audio mixing channels featuring up to −70 dB sensitivity set against a quoted equivalent input noise level of −127 dB. Facilities include three band eq, pfl, two foldbacks, two echo sends etc.

Rockwool will exhibit its range of acoustic materials which can be used to provide acoustic absorption and fireproof properties.

Rugby Automation Consultants offer a custom built mixer service for a variety of applications ranging from hospital radio to recording studio. The company also manufactures a range of modules for incorporation within an existing desk format. Other products include 50 and 100W amplifiers.

Scenic Sounds will display representative products from the various agencies held: dbx, Schoeps, Amber test equipment, MicMix reverb towers (headphone demo), Orban/Parasound equalisers and frequency selective limiters, and calibration equipment from the White Instrument Corporation. The latter company's products include a 27 centre audio spectrum display analyser with built-in pink noise source and a 27 centre equaliser for monitor correction. Tom Hidley will be on the stand to represent Eastlake Audio.

Shure. Focal point of the stand will be the recently introduced *SR* range of sound re-inforcement equipment comprising *SR101* mixing console, *SR106* electronic crossover, *SR105* power amplifiers and *SR108* horn loaded two way loudspeaker units. The company will also show a widened range of microphone signal handling gear in addition to its microphones.

50 ▶

NEW SOUND MIXER
from MACINNES

16/2
OR
16/4

This new mixer unit has been designed for use in high quality P.A. systems, and is particularly suitable for use in conjunction with AMCRON power amplifiers. Offered as a 16/2 or 16/4 the mixer is built into a strong aluminium flight case.

It is on show at the APRS '76 Exhibition at the Connaught Rooms, from June 17th — 18th.

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Re-recording is the final mixing of dialogue, music and effects to create the soundtrack master for a film. The simplicity of this statement, however, belies many of the practical aspects.

* EMI ELSTREE STUDIOS

IT ALWAYS pays to get involved in the film as early as possible and not wait until the day of dubbing. The work at Elstree can either be for a studio based film or an independent production made elsewhere, such as an all-location film. Either way the film will almost certainly have 'how do we do that' problems somewhere along the line and discussions with the dubbing editor are essential as he will have had various 'dialogues' with the director and made notes of his particular points.

The dialogue tracks are usually the problem today. The films shot on location are very 'catch as catch can' for the production sound mixers which ensures that they have to strive to overcome many new problems. For his part the dubbing mixer owes it to the sound mixer to use their sound and not just say 'post-sync it'.

Usually a film has a very tight schedule—you don't look at the calendar to check the release date, you look at your watch! So you run the film with the dubbing editor and talk about it. It helps if the dialogue can be handled without too much 'off-laying' for level or quality changes, and rock and roll technique does make it easier to catch. This means the editor can devote more time to the problems of finding the sound effects from libraries and shooting the specific sounds and tracks that libraries don't carry.

However, the form of dubbing varies with circumstances. The first few reels are usually laid up complete which makes it possible to run all tracks of a reel checking both the synchronisation and the positioning of the selected effects and music (and that everyone likes the tracks anyway). But to indicate the other extreme a recent film came in for which the music hadn't all been recorded and the post-sync had yet to arrive from America. It was very messy for most of the dubbing, but sorted itself out in the final mix.

A film dubbing theatre's job is to convince an audience that such a facility does not exist, as badly applied sound to the visual can completely shatter the reality that is being put into a film. The audience should not be aware of anything that stops it being real (unless, of course, the subject itself is fantasy). A love scene with camera noise all over it, badly fitting and sounding post-synchronised dialogue and effects, the wrong wind or bird atmosphere—all spoil the realism.

The dubbing theatre is the end of the line for a film. It has been edited, scored, and now it is time to put it all together. The dubbing editor can make life very difficult or easy for the dubbing mixer. No matter how good the sound crew, if the tracks are not right, it shows. A small thing like a door close; if someone shuts the door of a hut a precise door click isn't right. But an untidy close with a rattle or bounce on the end belongs. A guy is on the run—and all villains run or climb up something so they can fall dramatically when they get their come uppance. Who can believe in it when you have the sound of an inhale on a visual exhale?

When a dub works out a lot of people have contributed to it before and during the actual dubbing. Rarely is one completely satisfied—there is always something that doesn't quite gell. But you remember the ones that did come off! In *That'll be the Day* and *Stardust*, most of the music used was by famous artists from original good quality recordings. These had to be treated for the situations in which they were used—fairgrounds, holiday camps, PA systems, dance halls, skating rinks, radios etc. Creating the 'acoustic' conditions was very satisfying.

The desk crew in the theatre must have a rapport and understanding of each other's idiosyncrasies and fortunately our team at Elstree, together with the projection department, transfer department and maintenance, has just that. Without it, all the front in the world means nothing.

Elstree has a 36 input Neve desk with a six way output. It is driven by a desk crew of three on major productions. I handle the dialogue and music while the other two take the sound effects—that's the fun bit, especially on action films. On sound effects premixing which may be busy or complicated all three of us will take tracks.

There are 34 35 mm Interlock replay machines available to us, seven of which are triple track. Twelve of these machines convert to 16 mm if required. Two three track recording machines can be locked in, each track capable of receiving separate information—the reason for this facility I will explain later.

Some films have only a few tracks per reel, but others can be top heavy and require some premixing. Extensive premixing is a disadvantage as it is always possible to commit sounds to each other and then find when you run everything together something

Above, right to left: *Bill Rowe, Ray Merrin (first assistant), Dave Tappenden (second assistant).*

doesn't work. So we premix down on to a three track mix which keeps it loose and even if the reel is very top-heavy with a lot of tracks we keep premixing this way until we run out of three track replay machines or tracks, whichever comes first! When premixing effects, the dialogue and music are run as competition otherwise what seems to be a well balanced premix could become a complete disaster when the *Seventh Cavalry to the rescue* type music is played.

During stereo dubbing (which seems to be coming back into fashion) both triple track recorders are tied in, and if the requirements include a stereo foreign version, the full English dub is recorded on one machine and the non-dialogue mix on the other. Hence six outputs. This serves two purposes—it saves time and also guarantees that the foreign version balance is slave to the main dub.

The other requirements will certainly include a mono optical version and a mono foreign version, and we find that with care the stereo versions will convert directly. As always, a number of things were learnt the hard way; for example, if you don't keep an eye on azimuth and phasing during the stereo dub, you could be in trouble making the mono dub. Nothing chills the blood quicker than the sound of 'waves on the seashore', when stereo into mono won't go. And in stereo dub, mono sound may need to be split to outer speakers to create width for a panoramic scene, or swung around to follow movement . . . in fact we often have to take liberties which can result in great problems if we're not careful! A film dub is then complicated still further by being made up of sounds from several sources, such as the various libraries and music stables.

Dolby Labs, with whom we now have a close relationship, brought science to we 'arty lot'. Each time the music studio supplies the music for a film we also ask for Dolby tone, 10 kHz tone and a reference level at 1 kHz. This information is used to calibrate some of the replay heads to the characteristics of the record heads used, and subsequently the music is only played from those heads. Furthermore each roll recorded in the dubbing theatre has 1 kHz reference, Dolby tone and 10 kHz on the front so that on replay it proves the lot, including the hf response of the head. If a roll replays incorrectly it is checked out with a short test loop. Life gets complicated if music for a film comes from more than one music studio, and if there are variations between the studios, certain heads must be reserved for each recording. For example if it is decided to extend a piece of music and a lift is done for the extension by us, it has to be off-laid and run on a head with our characteristic.

We use rock and roll to dub—no, we abuse it. While dubbing we listen on replay, to detect drop outs (we still get them) and bad punch-ins.

We also use what we call 'fore and aft' meters. Each meter has two needles, the red needle indicates what is going on and the white what is coming off.

This is so advantageous because it indicates level and hf loss on the recording. which, if subtle, are not noticeable to the ear at first, especially during the heat of looking at the screen for cues or at the chart for what happens next, for your cigarette lighter or cup of coffee; one eye on the director, the tut-tutting of the dubbing editor who can't hear his grass growing track, and trying to remember what it was your wife wanted you to bring home!

It is also useful for updating. Get the needles equal, have a quick listen on the A/B monitor switch and punch in.

When the dub is complete the magnetic recordings go to the transfer suite.

They take the reference level, check the hf response from 1 kHz and 10 kHz on the front of each roll and just transfer it. On the end of each roll there is another reference tone which is the guide given to the transfer operator as a check that there has not 50 ▶

Above: *EMI Elstree's re-recording console in their theatre No 1.*

Left: *Boat and water effects being recorded for 'Swallows and Amazons' in EMI Elstree's sound effects theatre.*

been a major malfunction during the transfer of the roll. An optical rush print is checked by us in the theatre by comparison with our magnetic master.

What is really needed is a standard of reproduction in cinemas. At the moment the Academy roll-off is as variable as a temperature chart during a bout of 'flu. While dubbing you think of the good theatres and the bad, and then the American theatres with their speakers and their roll-off.

Dolby Labs spent a great deal of time and money, measuring cinemas, both in Europe and America, but when they showed me the curves I clutched my worry beads and realised you can't win.

With dialogue of borderline intelligibility, you remember the reverb time in such a theatre and the 'bass bounce' in that theatre with the well upho!stered usherette (is she the acoustic problem I wonder?). Do you harden up the dialogue, and hope it won't come out like a whiplash in the text book theatres? Standard sound in theatres will arrive I am sure. So I hope will an improved optical response in recordings.

Good theatre sound is the object of current research and we spent a lot of time with Dolby, developing the extended range their equipment allows. Thankfully other studios and influential engineers are showing interest, especially in America.

The most important thing in a dubbing theatre is the monitor, both level and characteristic. If it is a normal optical dub you switch on the roll-off but if a magnetic release you stay flat. The monitor level is critical. Too low a level and you overshoot and restrict the dynamic range. Too high and you have too wide a volume range—this being fine in the dubbing theatre but useless when competing against the ambient level of a cinema audience. When starting from scratch you arrive at a monitor level in rather a crude way, by running a cross section of other films from reliable stables and take an average setting. From there you shoot something yourself and run it in a good friendly cinema. This is not perfect, but you arrive at the true setting by error detection, ie the complaints are fewer!

A dubbing mixer will turn out a competent job that he knows will be acceptable in most cinemas, so long as he trusts his dubbing room, and keeps proving the room with test pieces he knows. Take him to another dubbing room and he will be most unhappy until he is confident in that room subjectively.

One particular problem that dubbing mixers have is with music as these days most music for film is recorded at music studios with extremely good balance engineers. However the problem starts at the music session since it is monitored on very efficient hi fi speakers at a high level. Everyone loves the sound, so back to the dubbing session. We run and they say 'it doesn't sound as good here'. Of course it doesn't. We are fighting the cinema speaker and usually the Academy roll-off and furthermore the music has to be played at a lower level than when recorded. We have to compensate for these problems and the end result is usually fine, but the initial trauma explaining the differences is difficult. If possible I will attend the music session in order to hear what they hear. This gives me something to work from; a reference.

My relationship with one music centre has proven beneficial both ways because not only do I visit their sessions but they come, when possible, to some of the dubbing.

I actually got into this job by accident, and things just snowballed. Sometimes when the 'Bad News' phone rings (people don't phone good news—just bad) I wonder 'If I could read and write proper would I still do this job?'.

I think so. It's exciting and a challenge. You run a reel for the first time, and the only thing you think is, it'll never work. Then slowly it starts to clear, and like a chef you try a drop of this and a pinch of that, stir well and all of a sudden you have a reel.

There is, however, one part of dubbing that I'm not so keen on—when the rushes are back from the laboratory, and you run the film just sitting back, as it unfolds you see little things that irritate and make you wonder why on earth did I do that, or why didn't I do this instead.

Sometimes a mistake worries you so much that you have to mention it and if everyone agrees then you change it—you know you're really only concerned in case another dubbing mixer spots it! ■

APRS PREVIEW

Soundcraft Electronics. The revised console specification for 1976 embodies all the features of the original plus extra facilities and a new modular form of construction. Input channels are available in multiples of four with standard frame sizes accommodating 12, 16 or 24 input channels. On input channels, facilities have been extended to include two eq options, four cue sends, direct line out pre and post fade, and 45V phantom powering on all mic inputs. Exhibit will be a 28 into 24 console with parametric multiband eq, vu/ppm led meters on every channel and an extensive patch bay.

Studio Republic specialise in cassette duplication in runs of 50 to 5000.

Surrey Electronics. Trevor Brook will be displaying the output from a *Stereo Coder* on a spectrum analyser to substantiate claims for 'the remarkably low beat tone distortion'. The *Stabiliser* offers variable limited frequency shift for use in howl round reduction; transformerless electronics provide balanced input and output lines. There will also be a stereo disc pre-amplifier, other wide range spectrum shifters, distribution amps and ppms.

Tannoy will display their integrated speaker drivers, available separately or within a recently introduced range of enclosures.

Theatre Projects are the UK agents for Altec Professional and will exhibit a full range of this equipment including a 60W monitor cabinet, *9849*, and the well known *604-8 G*. Regarding Altec electronic hardware, there will be a *9440A* two channel power amplifier and the *9860* 26 centre, ⅓ octave graphic equaliser which uses a rejection notch principle.

Trad Sales and Service. Second hand brokers. They will have a couple of 'choice pieces on show but will not know what they are until it happens'.

Trident. At this exhibition, the company stand will feature the new *Fleximix* sound re-inforcement and small studio mixing system; it offers a wide range of facilities in a diminutive size.

Turner will show a range of amplifiers, designed for studio monitoring applications, with ratings between 100 and 500W. Other exhibits from the same company include transportable mixing consoles and mobile sound equipment.

Tweed Audio. The company will show a 12/2 mixer from the range of portable consoles It is the first time that this type of mixer has been exhibited at the APRS.

Edward J Veale & Associates. The firm of acoustic consultants will offer engineers free hearing tests, using an automatic recording audiometer on loan from Amplivox. They aim to show the effects of temporary threshold shift by doing pre and post session tests. The object is to focus attention on the necessity for regular hearing checks.

Vitavox will concentrate on the *Thunderbolt* loudspeaker system first shown at last year's exhibition. There have been slight design changes to the dispersive elements to improve upon the basic response. The *S3* pressure unit has a modified thread to ease fitment to the horn.

Webland Electronics are the UK agents for, among other things, BGW amplifiers and KLH loudspeakers. At the APRS exhibition for the first time, the company will show the complete BGW range comprising three power amplifiers FTC rated between 90W/channel into 8 ohms and 200W/channel into 8 ohms. These power figures are quoted over a 20 to 20k Hz bandwidth with a claimed thd below 0.1% at any frequency.

Zoot Horn will exhibit both the *PMR* and *SMR* series of broadcast, pa and recording consoles. The *SMR* model is available for interface with recording machines from 4 to 24 track depending on desk specification. ■

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SS7

Los Angeles~AES 54th Convention

GORDON SKENE
AND
RAY CARTER

The 54th Convention of the Audio Engineering Society was held between May 4 and May 7, 1976, at the Los Angeles Hilton.

I SUPPOSE one gets used to conventions after a while. Like the majority of eager onlookers who come to observe, touch, listen and grapple for their cheque books, they all come to see the nuances, steer away from last year's lemon disguised in this year's clever packaging, all hoping that this will be the year of incredible innovations.

And this year's AES convention probably was to some extent. For one, Ampex have introduced a new mastering machine, the *ATR-100*, apparently designed to take some of the steam out of the overt popularity increase in the equivalent Studer product within the States. The manufacturer's specification looks very encouraging, performance claims include an unweighted 30 to 18k Hz noise figure referenced to 1040 nWb/m at 76 cm/s of 77 dB for the full track machine in comparison to 72 dB for the two and four track version. Equally, mid range distortion looks very competitive with a claimed harmonic distortion of less than 3% using *456* referenced to a fluxivity of 1040 nWb/m over 'mid range' frequencies at any speed between 19 and 76 cm/s. And they would have appeared to have designed the transport to match even if it was difficult to criticise earlier models. Certainly, even the most well tuned tape op isn't going to notice a quoted 0.02% speed variation between the start and finish of a 700m reel; and when he spools, he won't have to catch a threatening loop if the dynamic braking arrangement lives up to the promise.

Ampex ATR-100

One guesses that the way to market a new noise reduction system is to sell something for nothing in which the real application does not result in a trade off situation. And, according to Telefunken, they have it. Marketed here in the US by Gotham Audio, this sytem apparently takes the previous principles of the established noise reduction systems and, to all intents and purposes, expands on the combined theme with the claimed result of eliminating the disadvantages of the component systems. At first sight, it appears to exhibit a heavy degree of plagiarism, if only because the number of variations possible with signal and magnetic tape is strictly limited. But if what Telefunken say is true, it works. First, it eliminates the need for alignment. The use of four independent processing systems each associated with a particular band results in the suppression of noise pumping effects as well as the tape's own modulation noise. The system is designed to produce a dynamic range of 110 dB, depending of course on the performance of the recording medium. The intended operational signal to noise ratio is 94 dB leaving 16 dB of headroom. Aligned at a basic +4 dB level, the gain of both the compressor and expander remains united at all frequencies. At a tape working level from about −57 to +8 dB, the system shifts this to −85.5 dB to +12 dB respectively, thus increasing the dynamic range from 65 to 97.5 dB.

The attributes of the Telefunken system may have to maintain a low profile status for the time being following the ingenious repackaging of some dbx products. Just introduced, and apparently received at the show with a considerable degree of excitement was the *K9-22* noise reduction replacement card to fit straight into a slot (literally) vacated by a Dolby *Cat No 22* module. This dbx is a pin for pin replacement for Dolby. This seems to be a bit of a slap in the face, but of course, competition is competition, and no one ever said it was clean. This cuckoo offers instant interchange of units within a Dolby mainframe, be it a *361*, *M16* or *M24*, giving the potential for full dbx system characteristics. With the observed emphasis shifting over here from Dolby to dbx, the concept has caused a minor sensation; nowhere more, one imagines, than at Sansome Street, San Francisco.

In addition to the replacement card, the company has also come up with a noise reduction unit, model *194*, specifically for use in conjunction with Nagra tape recording systems. Coupled as both a noise reduction system and a portable mixer for use with models *4.2*, *4L* and *3*, it could provide a useful tool for location motion picture sound recording. The added attractions include a healthy reduction of print through (a plague in motion picture production), an easing of the level matching requirements, low weight (1.35 kg) and the fact that the unit can be bolted directly to the Nagra casing. Anyone who has ever juggled with a Nagra plus extraneous boxes knows the advantage of the latter point.

During the time spent at the convention, the number of subjectively poor sounding speaker demonstrations became increasingly apparent—and disturbing. The immediate thought was that the various makers had decided to bend their talents in the 54 ▶

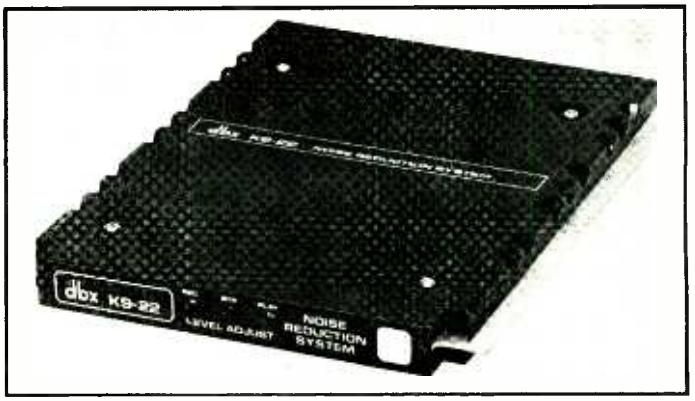
direction of disco style speakers, but this would be to contradict all the claims for 'precision monitoring'. Far more likely is that someone responsible for the music headed for LA with a friend's bag of party discs and a six inch nail. Biggest surprise came when visiting the JBL room who, last year, proved to be one of the big hits of the convention (monitor wise). This year, the unveiling of a rather bland and subjectively muddy line of studio monitors was the created impression, and it came as a distinct disappointment; the response from the scant turnout of previewers in the room seemed to substantiate these feelings.

Judging from the excitement generally surrounding the show demonstrations, there seems to be a bedrock acceptance for the automated facility. After much hesitation by studios on the West coast, the present situation shows there is now a real commitment to the concept. At least one major manufacturer, MCI, claims no less than 32 outstanding orders for versions of the *500* series console, although a processing system from the same company won't be ready much before the end of the year. The MCI automated concept looks promising; the real application should not complicate the ergonomics of mixdown if not actually simplify. The *500* series consoles use vcas as standard fittings which offer subgrouping capability even if no automation facility is fitted. However, when implemented, it should offer several system advantages. In operational mixdown, the engineer simply touches the fader knob to send that channel into the update mode. From then on, a small electronic channel subsystem monitors relative fader movement by a differential process eliminating the need for prior level matching —of course, the system does this, but it's an unconscious process on the part of the engineer. The MCI orders constitute headway although Allison, API and Quad Eight have made much more albeit over a far longer period.

Naturally, the Neve Necam system produced standing room only crowds at almost every one of the two-hourly demonstrations (system description, see STUDIO SOUND, May 76, p14) but no definite orders. Neve isn't worried; after all, not even the richest comes across with $100 000 on the strength of 35 minutes spent squashed against a rear wall. In any event, with three system orders plus many more possibles in the UK, success seems assured.

The people in Tin Pan Alley haven't spent too much time contemplating their own cheerful existence in the hills behind Nashville for they've introduced a new concept to mixdown. Allison refers to it as second generation automated mixdown which amounts to a system of much increased capacity, faster reaction times with a fundamental concept for central control, as far as possible to clear the console of extraneous knobs. From the lightweight technical view, every function of the desk can be accessed by a 12 bit digital word, and control status information is only recorded on tape (or played back from) when the status of a specific control is altered (or to be altered). It is rare to update more than two or three functions simultaneously. Since each update requires 3.2 ms per control, that represents total access times not much more than 10 ms.

Operationally, the system offers a maximum desk organisation of up to 48 inputs, 16 master groups/outputs with each channel



dbx K9-22 noise reduction system

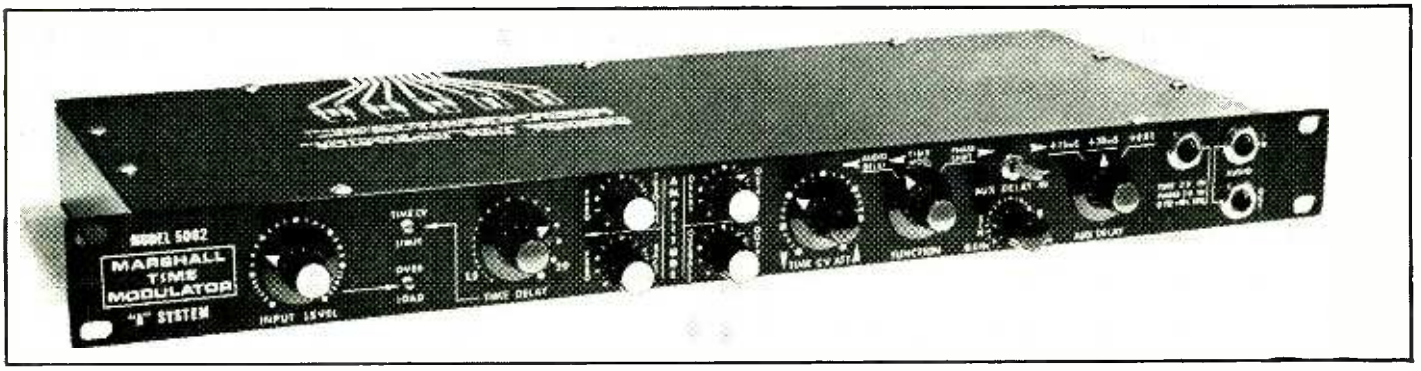
comprising up to 64 automated functions. Clearly, such a desk would be an ergonomic disaster even given automation. Allison has reached the solution to this problem by centralising certain functions such as equalisation and routing. The basic premise is to nominate a channel and then punch in the appropriate setting or output buss from a central, single control panel. Result—the wholesale elimination of eq and routing buttons on the basic channel. However, operational facilities include the possibility of ganged/subgrouped operation. An additional system feature is the implement of a high resolution (within 0.25 dB where it matters) optical/digital fader using a see-through touch sliding belt with an led column to indicate position.

With the conglomerate possibilities offered by the various systems, a point came to mind which may be valid to ponder. Automated systems can make the entire job a lot easier to handle. They save time, they are nominally error proof, and they are this year's crowning grace to electronic achievement. But one can take the introduction of the automated system two ways: first it provides an avenue for the engineer to free his mind from the demands of the mixdown and assume a more creative role in another part of the session; or secondly, by creating a foolproof area of operation make the area open for a sizeable chunk of idiots turned engineer so to speak. With the, self confessed, expensive Necam system, one imagines it couldn't happen. But laws of supply and demand control the industry with the implication that if ever Tascam were to introduce a system . . .

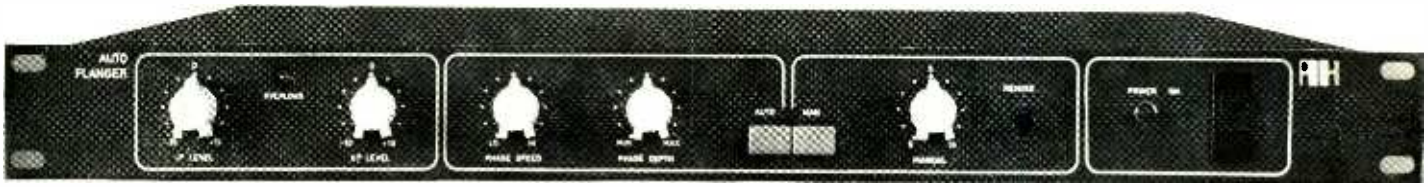
For most people, back to earth . . . and one of the most promising examples to come with the current wave of flanging units. Marshall Electronic, of Joppa Maryland should find there is a ready niche in studios for their Time Modulator. Essentially, it is a voltage controlled, time sweepable analogue delay line with some unusual design and operational features. This accounts for the absence of quantifying noise which, derivatively, allows the dialling of a desired phasing effect/cancellation without the error of a stepped system. A voltage controlled time function makes it possible to programme delay or phasing swings from any remote source allowing easy interface with peripherals such as synthesisers, joysticks and footpedals. Full

58 ▶

Marshall time modulator 5002

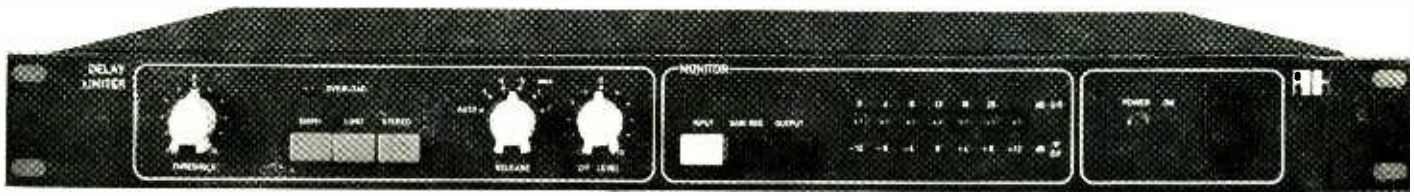


If you think the business needs something new. Here's a first public appearance you shouldn't miss.



At last, for the perfectionist, a satisfactory way to simulate tape phasing electronically.

Thanks to the unit's two free-running delay paths, you'll be able to achieve exact duplication of tape phasing effects.



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And because it does its job so well, it leaves the engineer to carry on with his.

In the studio and effects units, the limiter takes care of those transient signals from pianos harpsichords etc.

Another application is to drive reverberation systems prone to 'pinging' due to transients. This means that low cost spring reverberation systems can be used where before they were unacceptable.

This A.D.T. is designed primarily for use as an automatic double track unit, but its versatility will extend to effects and to synthesising quad from stereo—(ambiance quad).

It utilises a bucket brigade delay line and provides two independent delay paths. Each capable of 25 milli-second delay, switchable in 6 milli-second steps.

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books

STAGE SOUND

David Collison

126pp, £7·50.

Published by Studio Vista

35 Red Lion Square, London WC1.

The number of people qualified to write a book on stage sound can be counted on the fingers of one hand. David Collison is one of that small number and has a reputation which is known both in the UK and abroad. No major work has been written on this subject since 1959, when Burris-Meyer and Mallory published their book in the States, and I had high hopes that this new book would close a large gap on the theatre bookshelf.

According to the dust jacket, the book is a work of reference and practical handbook for sound enthusiasts in both professional and amateur theatre. No assumptions are made that they will have an advanced degree of technical knowledge nor that they will be working with expensive professional equipment.

The text has 126 pages of which half are devoted to black and white photographs and line drawings. Part One contains ten short chapters: *What is sound; Basic Equipment; Loudspeakers; Power Amplifiers; Mixers; Echo and Reverberation; Disc Replay; Microphones; The Tape Recorder* and *The Control Position.* Part Two has three chapters: *Sound Effects; Sound Reinforcement* and *Permanent Installations.* Part Three contains recommendations by the Association of British Theatre Technicians (ABTT) for loudspeaker and microphone connections; a bibliography; a useful list of theatrical terms in four languages; a list of addresses—mainly American—and a glossary of terms.

While reading this book I found it difficult to reconcile the expressed aims of the book with the actual contents. Whatever opinions are expressed in a book the purchaser of a work of reference has a right to expect all factual statements to be correct and a beginner needs a factually correct text. Unfortunately, somewhere along the line things have gone wray with the book's production.

The first chapter has the usual diagram of a piano keyboard related to notes on treble and bass clefs along with frequency comparisons of various instruments. The author has based his frequencies on the arithmetically convenient middle C=256 Hz instead of A=440 Hz and the octave sign is missing from the last 11 notes —as it was in Burris-Meyer and Mallory's book. The human voice is stated to range from 40-1200 Hz!

The book contains many comparative and relative statements without providing a basis for comparison. These statements provoke questions, the answers to which the beginner needs to know but which the author doesn't supply. By the second page I was also asking these questions. For example: 'Sound levels are subjective and the ear quickly adjusts to growing intensities'. Is the converse true? This is a very important point in musical theatre; audiences have difficulty with dialogue immediately following a loud musical number. How does one cope with the problem? 'The human ear can determine the source of sounds within approximately 15° horizontally . . . but finds it more difficult to determine the source of sounds vertically.' How much more difficult? In 1968 Roffler and Butler found that a change of 5° in the vertical plane could be clearly heard.

Chapter Two is about the basic equipment one is likely to find in a theatre and the methods of interconnection. Particularly useful is the section on the 100V line system for connection of loudspeakers, although the terms 'in parallel' and 'in series' are not defined nor is there any warning about possible overall loudspeaker system failure with speakers wired in series.

The author's statement that ideally each loudspeaker should have its own amplifier is surprising. This statement is often made by audio engineers outside the theatre but the method can lead to a great deal of complexity and inflexibility in an 'effects' situation.

'They [power amplifiers] come in many shapes and sizes with varying inputs and power ratings' and 'A deep bass sound requires a large area of air moving slowly' are two remarks taken from the next two chapters on loudspeakers and amplifiers. This style of writing occurs frequently and is probably due to the fact that the author is not a technical writer. Unfortunately it means that certain sections of the text come across as mere padding with little information content. Mixers are dealt with in one and a half pages and again one wishes the author would commit himself to positive statements rather than generalities: 'A mid frequency boost accentuates the voice frequencies . . . A sophisticated mixer will have presence in different bands to cater for a range of voices and instruments.' But which frequencies? Is mf cut useful?

The chapter on echo and reverberation greatly over-simplifies the problem and I doubt whether anyone new to it could disentangle instructions for tape delay echo. The illustrations are also over-simplified to the extent that, if following them, it would be impossible to produce echo. The one page chapter on disc replay contains the kind of information that can be gleaned from almost any issue of *Hi-Fi News.*

By the four-page chapter on microphones, I had realised what an impossible task it is to write a book on theatre sound. Almost all of Robertson's book on microphones is relevant to the theatre; how much should one try to incorporate in a book on stage sound? Obviously more than can be contained in four pages. The same applies to almost all the chapters in the first section. The chapters on the tape recorder is a beginners guide to the topic and consists, almost, of a handbook to a domestic recorder, hints on editing tape for the theatre (are scissors still used for editing tape?) and trouble shooting. Infelicities are still to be found: '5 cm/sec=3¾ ips'; on page 42 'a magnetic head has an extremely narrow gap' but on page 45 'a full track head has one large single gap'. No distinction is made between half track stereo and twin track nor between domestic machines with power amplifiers and tone controls and the machines more likely to be found in the theatre.

The final chapter in Section One on the control room contains more contradictions. After arguing for the sound operator to be able to hear what the audience hears and that ideally there should be a permanent room at the rear of the stalls or circle, he illustrates his points with a diagram in which the control room is offset from a central position and another diagram in which the sight lines are such that from a position in the circle at least half the stage would be invisible. It is in fact impossible to hear what the audience hears from inside a control room, no matter how large its window, and the only totally satisfactory position is amongst the audience.

Part Two is really one man's approach to sound effects and sound reinforcement. Even in this account of his own work, the author contradicts himself. At one point he claims column speakers to have a wide, smooth frequency range with minimum coloration but two pages later they have a restricted power and frequency range. He carefully describes how he angles and aims speakers in the theatre but has a photograph of his own rig for *Superstar* which contradicts his remarks without any qualification.

In view of the current fad for radio microphones, the section on this subject omits a great deal of necessary information. No mention is made of the fact that licences must be held for each microphone; the procedure for obtaining them; allotted frequency range as 174.1-175 MHz; and that it is considered good practice to have the frequencies spaced

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BOOK REVIEWS

at least 0.9 MHz apart. How is it possible, therefore, to use five or six radio microphones together? They could possibly be narrow band/low quality, but these compromises are not discussed.

A method for miking the stage from the floats position is discussed by the author, but I feel that some more justification of such techniques is necessary in view of the considerable criticism levelled at them. The author omits a great deal of the background theory for this method as originally outlined C.1970 and as a result the method may be (and currently is being) used in totally unsuitable circumstances. The author's statement that the microphone should be angled between 30° and 45° (without stating whether this is to the horizontal or vertical) contradicts the theory of operation.

The gremlins have also been at work on the photographs. The rear of a power amplifier is shown to illustrate the line input socket, but all the connectors are Cannons. An EMT reverberation plate is referred to as an 'echo plate' and the Grampian *666* unit as an 'echo spring' (why wasn't the *636* used?). This loose terminology may confuse a beginner, even if it is in common use. The AKG *C414* microphone is labelled *C12A* and the Neumann *U87* a *UH1T*. The old favourite ribbon microphone finds its way into the index as ISTC *4039*. Many of the photographs could have supplied details missing from the text but are usually taken in long-shot to show complete equipment. It is a pity that so much space is wasted with what are rather irrelevant photographs—recording traffic in Whitehall in 1923; recording footsteps at dead of night; firing a cannon on HMS Victory with recording equipment and engineers masked by smoke(!); a 24 track Studer and a full page photograph of the counterweight system of an SME arm.

Apart from one reference to Madame Tussauds, all examples are taken from the proscenium theatres, and I find it very regrettable that despite the proliferation of end stages, thrust stages, theatres in the round etc, no mention is made of the special problems associated with these types of stages since many of the methods outlined in the book are most applicable in these cases.

It would have been very useful for the beginner if the author had suggested types and makes of suitable equipment in various price ranges for use in the theatre. The book is lavishly produced with only one printing error but for reasons given, a very disappointing book which is difficult to recommend at the price of £7.50.

Ian Gibson.

AES 54th CONVENTION—LOS ANGELES

internal strapback and feed-through mixing functions allow maximum control of echo and automatic double tracking (ADT is the company trademark) functions. Naturally frequency modulation of the control voltage input enable all the usual effects associated with this type of hardware. In demonstration, the total number and variety of effects were subjectively satisfying.

In a similar electronic line, Eventide introduced their *Model H910 Harmonizer* (which we hope to review shortly). This is a 'versatile special effects instrument' based on digital circuitry (including rams) but the name indicates *the* special effect of the unit which is referred to as 'pitch changing'. Unlike 'frequency shifting' which creates dissonances, the *Harmonizer* is claimed to vary pitch by up to ± 1 octave but still maintain the harmonic relationships and thus the 'musical' value of a signal. Several applications could exist; for example in the broadcast field a taped voice could be speeded up (or slowed down) to fit a particular time slot and the pitch returned to its original level without alteration of the tonal qualities.

Perhaps occasionally forgotten is the maintenance and calibration aspects of studio work. Amber, the Canadian instrumentation firm caused quite a buzz with its powerful, all purpose test set, *4400*, for use in conjunction with an auxiliary oscilloscope. It comprises a function generator, sweep generator, noise generator, comb generator, burst generator, autoranging digital level meter, autoranging digital frequency counter, wave analyser, rejection filter, spectrum analyser and digital plot recorder (for fuller description, see 'Comprehensive test set' p34.

By and large, this AES convention did not hold the large number of startling nuances of previous years. Perhaps hype has always been recognised, and equipment with true merit has formed a far larger proportion of this year's AES. Whatever the true situation, people were generally very interested (over 300 sets of papers were sold at $20 dollars a time) and the intentions were there for people to lodge large sums of money with each other or whatever. Most people agreed that visitors in the category of cowboys and tyre kickers was definitely down on last year, while the real number of visitors with money to invest showed a very definite increase (exact figures aren't yet to hand).

One always walks away feeling that this year's convention had the epitomy of audio design and technology, it just seems inconceivable that audio equipment could go through any more transmutations. But even with all this convincing, the next show comes on and convictions are blown to the wind. Perhaps that's why one can never be blasé about the LA AES. ■

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Hollywood film music

LEONARD BROWN

Film music in Hollywood is supported by an established recording industry where 'fashion' is of little consequence.

Photographs courtesy of Ted Keep

Twentieth Century-Fox

THE MOTION picture industry is slow to change its production methods, and when it does, the movement is ponderous and wary.

This reluctance is made up of several parts.

Innovation entails a risk of capital for long range results and that kind of money is often hard to find. The economics of the picture business are bound to the product itself, to the short term gamble on script and stars, sets and costumes and on the other elements which will show up on the screen.

For another thing, Hollywood believes devoutly in that which has proven itself in practice. The strongest affirmation is in the phrase 'it works'. And workability is the ultimate measure of all that goes into picture making, as well as the source of imitation and cycle.

But most basically perhaps, the movies are made by craftsmen and technicians who have perfected what they do. They are specialists, unique in their skills and intimately concerned with quality. They tend to be individualistic and proprietary. And, having witnessed past flurries of experimentation and ephemeral gimmickry, they are inclined to weigh new techniques and equipment with seasoned scepticism. Against this tightly professional background, change has been making itself felt. Just how revolutionary or how permanent it will be remains to be seen.

For a first hand look at the current state of motion picture recording, I made a visit recently to the scoring stage at Twentieth Century-Fox, where *Sherlock Holmes in New York* was in post production.

The picture is an original tale about the Great Detective, written by Alvin Sapinsley, directed by Boris Segal and produced by John Cutts. The score was composed by Richard Rodney Bennett. Cutts and Bennett are Englishmen, and they were delighted when I told them that I intended to write about the scoring of their film for a magazine produced in England.

I had been hearing talk about the influence of the record business on music for films. The booth was unmistakable evidence of this, an opulent room-within-a-room, acoustically snug and comfortably furnished. The lighting from flush fixtures in the ceiling was ideal. There was neither glare nor reflection from the window.

The console was on the upper of its two stepped levels, which gave the mixer, Ted Keep, a truncated view of the screen at the back wall of the studio proper, a flaw in planning which suggests that the designer had momentarily forgotten the relationship between the picture and the music. The console is a 16 track Auditronics with 35 inputs. In addition to its familiar recording functions, it incorporates buttons and lights for communication among the mixer and his projectionist and recordist. Another, smaller desk at the side of the main console enables the mixer to play back the music track in a rough mix of sound and dialogue tracks, all synchronised to the film.

I looked around at first to see where the tape was running. There were two Ampex decks in the room. One 12.5 mm console was covered and unplugged. The other, a 6.25 mm machine, ran constantly without any apparent reference to the session. Ted Keep explained. He was programming through the heads of the 6.25 mm deck to add a touch of echo, thereby enhancing the gas-light romanticism of score and story. The actual monaural recording on three-track mag stripe film was taking place a block-and-a-half away in the re-recording building.

In addition to Keep and the invisible recordist, the crew included a prop man, who had set up chairs and music stands, a stage or boom man, who had placed the mics to suit Keep's requirements, a projectionist, who ran the film from his booth above the mixing room, and an editor or cutter. The cutter's duties are awesome. He shares with the composer the responsibility of seeing that the cues are in sync with the action. He starts and stops the clock, punches cues, builds 'click tracks', cuts acetates of instrumental tracks for vocal dubbing and marks streamers and flashes on film. More about all of this later.

The luxurious appointments of the mixing booth are in startling contrast to the recording stage, itself a great, gaunt barn of a building lined with exposed acoustical batting. Someone remarked, 'Isn't it a toilet?' As a guest, I hesitated to agree. Instead I asked Keep about its qualities as a studio. He said that it had a bit too much 'life', but that the problem was going to be worked on. The 36 musicians who were performing the score seemed untroubled by their environment.

Their conductor was Leonard Rosenman, himself a noted composer whose score for Stanley Kubrick's *Barry Lyndon* won an Oscar. (Bennett told me later that he never conducts his own scores. 'I never learned to conduct', he said. 'That would have been four more years in school . . . '). Rosenman's concert-master was Paul Shure, of the California Quartet.

Motion picture scores are usually performed in brief takes, which are called 'cues'. Each cue is only as long as the scene or sequence it accompanies.

While the film was being set up in the projector, Rosenman led his orchestra through the matching cue. Keep listened attentively, mixing and balancing his 23 Sony *C-37* phantom powered mics. Bennett followed his score, calling out a correction on the talk-back when someone played a wrong note.

A light flashed on the console, indicating that the film was ready to roll. Keep pushed the warning light button, Rosenman was ready. Keep signalled for the film to roll.

There was a flickering on the big screen. Then the streamer, a crude line across the film, appeared. Rosenman's baton came down, and the cue was recorded. Bennett found a flaw, so the film was rewound, and the process was repeated. And the cue was finished.

They broke for lunch, and I joined Rosenman, Bennett and Keep for a sandwich in the commissary. I was astonished at how smoothly the work had gone. I asked Rosenman how much rehearsal time he'd had with the orchestra. 'Only what you saw', he told me. Studio musicians are adept at sight reading, even with difficult scores such as Bennett's obviously was.

Both composers are young men, yet both have had busy and distinguished careers. Bennett scored *Murder on the Orient Express*, *Far from the Madding Crowd*, *Nicholas and Alexandra* and *Lady Caroline Lamb*, among others. Rosenman's credits include *East of Eden*, *Rebel without a Cause*, *Edge of the City* and *Fantastic Voyage*.

Rosenman likes to experiment, and he feels that avant garde scoring improves the vocabulary of film music. He told me that he had written the first 12-tone score for a major motion picture, *Cobweb*, in 1955.

Both write and perform concert music.

Why, then, I asked Rosenman, do you do this? I think I expected him to say that it was for the money. Top film composers command as much as $25 000 a feature picture.

But his answer was, 'Because I love film'.

We talked about what he described as the 'invasion' of the record business people. He said that the technology had benefited, but the musicians were musical illiterates for the most part. 'They're not interested in film music, only in eight-bar tunes which will make hit songs. They're a pernicious influence.'

Bennett agreed.

Keep expressed other reservations. Having been a recording engineer for Liberty Records prior to his present career in pictures, he has perspective on both fields.

Record companies, Keep said, tape in 'dead' studios, and the rule is to set up mics in absurdly excessive numbers, leaving it to the engineer to keep in balance. His ideal is to achieve what he calls 'acoustical' balance in the studio. He looks upon the microphone as a primary tool, to be used sparingly and accurately.

He doesn't trust Dolbys. He records at high levels. This, he explained, helps to preserve the whole effect intact when the music fades under dialogue, rather than just the melody with the other parts lost in the fade.

He described some of the extraordinary situations he has encountered. There was the Jerry Fielding score for Dalton Trumbo's *Johnny Got His Gun*, a World War I story told through the flashback memories of a soldier whose wounds have turned him into a vegetable. Keep researched the recording techniques of the period, then built his microphone from a two metre megaphone with diaphragm and coil at the small end. To record the score by Ralph Burns for *Lucky Lady*, a picture about bootlegging in the 1920s, Keep duplicated early carbon mics by suspending telephone ear pieces from booms. In both cases, he positioned the orchestra according to the energy of each instrument, relative to the mics, and in the latter instance boxed the musicians with baffles to subdue the liveliness of the stage ambience.

After lunch, we returned to the scoring stage.

Motion pictures are rarely filmed or scored in straight sequence from beginning to end. The first cue after lunch was for the final scenes. Bennett had composed an exquisitely tender theme to enhance a bittersweet farewell between Holmes (Roger Moore) and Irene Adler (Charlotte Rampling), and the wistful epilogue as

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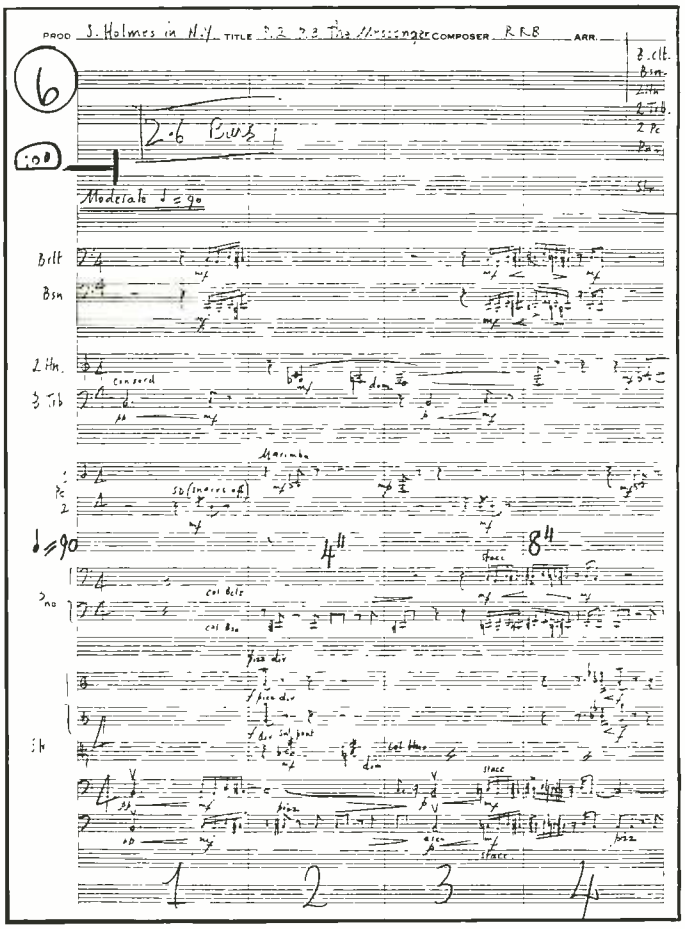

Left: *L to R: Professor Moriarty (John Huston), Irene Adler (Charlotte Rampling), Doctor Watson (Patrick Macnee), and Sherlock Holmes (Roger Moore), in 'Sherlock Holmes in New Yerk'. A film which will be shown on tv in the United States, and on theatrical release abroad.* **Above:** *Page from Richard Rodney Bennett's score for Sherlock Holmes, New York.* **Below:** *View of 16 track Auditronics recording console at Twentieth Century-Fox Pictures. Seated at the desk in the background, composer Richard Rodney Bennett.*

Holmes and Watson (Patrick Macnee) depart in their hansom.

Again, Rosenman and the orchestra sight read through the material, to my ear flawlessly. But there was a brief and urgent conference between composer and conductor. Minor corrections were made in one of the parts.

Keep was checking his levels. The monitor system consists of eight *Altec 604s* above the window, plus another two to the rear for quadraphonic playback. Each of the eight speakers has two separate controls, one for each track. Keep detected a gap in the coverage. The boom man hurried into view, tightened a mic connector, grinned and shrugged with embarrassment, then vanished into his corner. It was a tiny crisis, resolved in a matter of moments, calmly and smoothly, and I only mention it here as an illustration of the unruffled professionalism which characterises motion picture music craft. The record business could profit from the example.

When Keep was satisfied, he gave me his attention until the musicians were ready. The board signalled that the unseen participants—the projectionist and the recordist—were poised to go.

I wanted to ask him about an enormous, gaudy beach umbrella on the right side of the stage. It served as a ceiling baffle for jazz or rock drums, he explained, adding that he had discovered the best mic position to be high above the drums and directly under the umbrella. He usually records drums with a single mic, to the occasional dismay of pop drummers who are accustomed to four or five—until they hear the results in playback. On the *Sherlock Holmes* sessions, he was using five mics for the percussion section. 'They're moving around a lot', he said almost apologetically.

Now, in less than 15 minutes of preparation, the musicians were ready to record the long and delicate cue. Keep hunched attentively over his board. Other than to punch the record, projection and warning buttons, there was little more to be done. The mix was secure.

The sync frame counter, a pre-set automatic device, chattered as it counted off the 40 frames leading into the cue, then started the mag track.

The film rolled; again the streamer appeared on the screen; and Rosenman led the music along at exactly the perfect tempo for the action. There were a couple of flashes on the film to indicate emphasis, and the orchestra responded with the required accents.

After the playback, there was a rush to congratulate Bennett, who seemed very happy with the outcome.

It was a good note to leave on, so next I went around to the music editing department. I had an introduction to Leonard Engel, supervising music editor, who would be able to explain some of the technical aspects of cueing.

Engel proved to be a very friendly man, and a fund of information. I told him what I had seen thus far, and he said that the *Sherlock Holmes* sessions, with only streamers and flashes, were 'primitive' when compared to some of the more intricate cues. For films involving complicated action and scores to match, click tracks are cut—loops of film which are hole-punched at regular intervals to produce clicking sounds when played to the conductor's headset. This enables him to control the pace of the music relative to the events on the screen, working in the relationship between audio and visual as a kind of metronome. A click track might be a simple one click per second, ie once every 24 frames, which is the normal speed of film. Or it might be immensely difficult, as in the case of a variable click track.

Engel gave me an example. A long sequence in a recent Western, *Breakheart Pass*, showed a railroad car filled with soldiers rolling out of control downhill, picking up speed as it went, until it crashed off a trestle into a deep ravine. Composer Jerry Goldsmith's score was to accelerate at the same rate until the wreck at the climax, thus building the excitement of the horrifying turn in the plot. 'It was a problem in calculus', said Engel, to cut a click track which would help Goldsmith to quicken the music in smooth sync to the action. It was simple enough at the beginning when the rail car was moving slowly. The frequency of clicks could be increased by dropping a frame, from one in 24 to one in 23. But as the action raced towards disaster, the frequency had to be computed in sprockets to avoid jerkiness.

Formerly, click tracks were prepared mechanically. Now there is a digital click track. And to further aid the composer in matching his music to film action, there is *Project Tempo* by Carroll Knudson, 'a computer-accurate book of charts showing the relationship between tempo, timing and beats based on the speed of 35 mm film as standardised at 27.45m per minute'.

How important is all of this? Virtually from the beginning, motion picture music has been deemed essential to intensify and sustain dramatic form and feeling, to involve the audience in character and conflict and to reinforce the viewer's attention span. The earliest known film score was written by Camille Saint-Saens in 1908 to be performed by a pit orchestra during the running of a silent movie. And in the case of at least two highly successful pictures of recent years, *Jaws* and *The Exorcist*, the consensus of critics has been that music contributed an indispensable power to their total impact. A note by note, frame by frame wedding of arts into a dramatic synthesis made that happen.

Engel told me of an interesting incident which measures the significance of motion picture music from a somewhat different angle. One of the first jazz scores for film was by Alex North for Tennessee Williams's *A Streetcar Named Desire*. Part of that score was censored by the studio as being 'too suggestive'.

Earlier, Ted Keep had praised the 16 track tape capability for its economy and versatility. One reel of 1.5 mil tape is nearly equivalent to three rolls of 35 mm film. Keep liked that, as well as the control he could exercise in adding or subtracting tracks. He

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Orchestra under conductor Leonard Rosenman performing Richard Rodney Bennett's score for 'Sherlock Holmes in New York'. Recording booth in background.

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had used 16 track tape to record *The Towering Inferno*, among other assignments, and he pointed to the obvious advantage of being able to proceed readily to mixdown for sound track lp mastering.

I asked Leonard Engel how he, as a music editor, felt about 16 track.

He was unimpressed. 'It's the greatest tinkertoy ever made', he remarked. To his way of thinking, mag film is more flexible because virtually any reasonable number of tracks may be assembled in sync by means of film sprockets. I was told that this could amount to as many as 50 tracks for a large scale production.

Schedule also imposes limitations. Scoring is one of the final steps in post production. With only one 16 track system, mixing must wait until recording is completed. Under the pressure of time, Engel said, mag tracks are often edited and re-recorded while the scoring sessions are still going on.

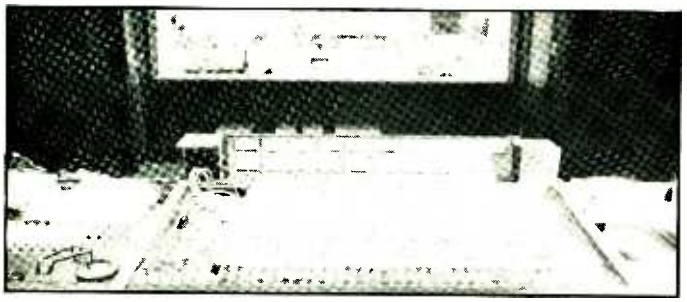
I asked Engel what qualities music editors bring to their work, aside from their technical skills, and he said that all of the editors in his department are able to read music and that most of them play instruments.

How, I asked him, did a composer approach his work? Through repeated screenings of the film? With a moviola at his side? Usually, he said, the composer screens the picture once to get the over-all sense of it. The editing department provides a set of synoptic 'music notes' followed by a 'musical breakdown' nearly as thick as the script itself, giving the timing and content of every scene and indicating every cut. The composer works from these.

After my conversation with Engel and Keep, I could see the sense in both points of view, each representing well reasoned opinions derived from long and varied experience.

Before the advent of mag stripe film in the 1950s, sound was recorded optically on film through light valves. This is still the generally accepted sound projection system for theatres. Each take had to be perfect, and because of the lag in processing exposed tracks, acetates were usually cut simultaneously for playback, to make sure that there were no mic failures, no extraneous sound and so on. Optical sound was exacting in technique and severe in its limitations, with no margin for error or allowance for edit-and-splice. Yet that is the way it was done during what is now called the 'Golden Age' of Hollywood film music, a period of epic scores played by full symphony orchestras, often with choruses, and staged musical numbers with dozens of singers and dancers. Small wonder, then, that Hollywood approaches change with reluctance.

16 track Auditronics console at Twentieth Century-Fox



To round out my impressions of new trends in film music, I spoke with several other composers and with the agent who represents them.

Stan Milander, of Bart & Levy Associates, an agency which specialises in representing composers, believes that the public is beginning to understand and appreciate the contribution musicians have made to film. He sees evidence of this in the release of an increasing number of sound track albums and title songs. I asked him why so many films are scored by the same few composers, and he said that producers are inclined 'to go with track records', with the proven thing. However, he added, there is a current influx of young producer-directors who are open to innovative ways to make a film score work creatively.

Milander referred me to some of his clients.

One of these, Gerry Fried, was nominated for an Oscar this year for his documentary score, *Birds Do It, Bees Do It*, written for electronic instruments. Fried's credits include several Stanley Kubrick films, among them *Paths of Glory*, and scores for Robert Aldrich. He recalls the era of optical recording as 'a composer's nightmare', and speaks of the introduction of three-stripe mag film as a tremendous stride forward. Today, working with 16 and 32 track systems, he finds 'few technical limitations', although it has only been within the last three or so years that the studios have revamped their recording consoles.

The function of his art, as he sees it, is 'to get inside the heads of a mass audience as quickly as possible'. Thus the need to employ musical 'clichés, to get the blood and adrenalin flowing' for people who are musically unsophisticated.

I mentioned the famous Dmitri Tiomkin Oscar acceptance speech, 'I would like to thank Beethoven, Brahms, Wagner, Strauss and Rimski-Korsakov . . . ' Today, Fried said, the influences are, in addition to pop and jazz, Bartok, Stravinsky and Copland. Copland, in particular, 'did it so *right*' when he scored *The Red Pony*, that there are echoes of his music in the scores of many pictures about the open plains.

Fried has used ring modulators, octave dividers, oscillators, phasers and instruments programmed through synthesisers—and at the other end of the scale, he conducted a 93 piece orchestra because 'that was what Robert Aldrich (the director) wanted for *Too Late The Hero*.'

Another Milander client is David Shire, composer of the hauntingly nostalgic score for *Farewell My Lovely*, based on Raymond Chandler's private eye novel, and the 1975 Oscar nominee, *Hindenburg*. For Francis Ford Coppola's *The Conversation*, Shire filtered solo piano cues through an ARP synthesiser. He likes electronic instruments, not for what he calls 'instant strangeness and futurism', but because they can 'widen material almost to infinity'. These resources have emerged at a time when Shire sees a need for new aesthetic tools and techniques. Motion pictures are exploring a wider range of emotion, he told me, and 'musical scores can follow into the nuances of this feeling'. He is acutely aware of the recording process, of the placing and balancing of instruments and microphones and of 'the ways you can get an orchestra to sound. The composer should have a choice in how his notes are going to be recorded.'

I have intended here to convey a necessarily fragmentary overview of Hollywood film music today, of the quality of the people who make that music, and of the changing means by which it is produced.

The most important single influence is the record industry, and its highly developed and singularly successful technology. If the studios and studio people are slow to adapt and accommodate, it should be kept in mind that they have worked for nearly 50 years to achieve their own highly developed and singularly successful technology.

Moreover, their's is a going concern. On any given day the job may be to record a marching band, a troupe of Swiss bell ringers, a yodeler with three second echo delay, a Basin street jam session, a gamelan orchestra, a Trinidad steel band, a Roman phalanx of tubae, a quintet of recorders, a chest of viols, a salon (for lack of a word) of synthesisers, a heavy metal rock group, the New York Philharmonic or the Metropolitan Opera Company—or even a combination of several of these musical entities. All these *have* been added to film at one time or another, and many more to boot. To interrupt, not to say *dis*rupt the process with radical modification is to place great investments in jeopardy, but perhaps worse, it is to deprecate the professional accomplishments of technicians, many of them highly honoured by their peers, who have built the movies from borrowed and improvised arts and sciences to a highly developed industry with an integrity of its own. This is why it will, and probably *should*, take time to revolutionise sound in the motion pictures.

As for the composers, they are intelligent and receptive to that which is new, be it avant garde musical language or electronic breakthrough in the generation or reproduction of sound. They scarcely need to be forgiven if they lack respect for the unlettered, the would-be film composers who are called 'hummers' among post-production men. If the record business is to contribute effectively to the film industry, let it be with the best and not the least they have to offer. ■

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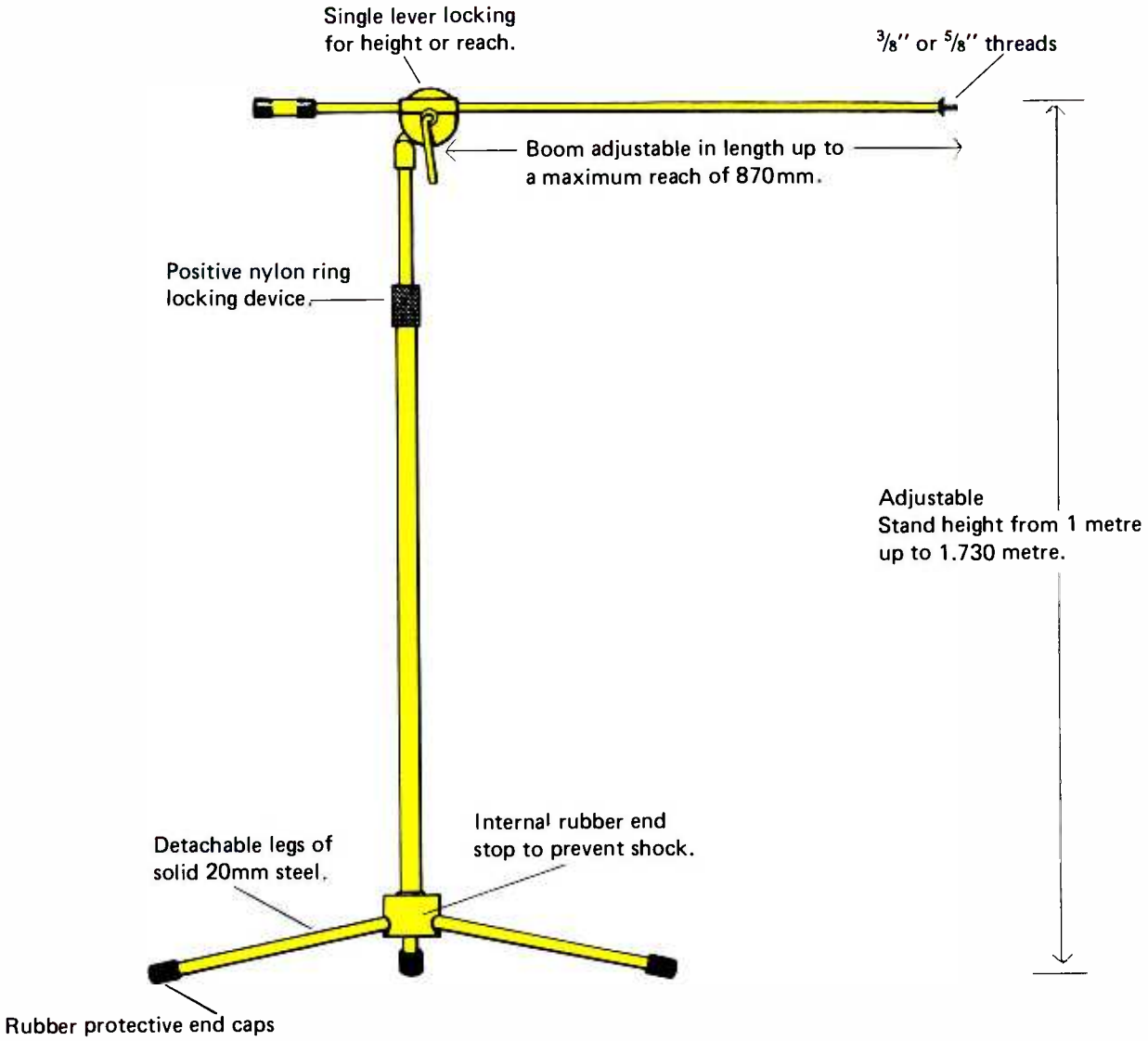

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work

The original control room. Dave Edmunds prepares to do an overdub.

Rockfield

They don't shout about it but they started it. Started what? And who are They? *They* could be the studio or, perhaps, Charles and Kingsley Ward. Perhaps, it all amounts to the same thing. But what, exactly, did they start? A recording facility that wasn't in London, that in itself unusual in 1964, or a durable fashion for rural studios echoed subsequently by many famous names. Take your pick; Rockfield was the first country studio to open in the UK and, over the passing years, has still been able to preserve the mentality that went into the original concept of a place to work in relative peace and quiet without the hassle of meter maids, traffic noises and crushing overtime rates. The other part of the concept is that the good life does not compromise the facilities on offer. Both the 16 and 24 track studios lack for nothing and the latter will be much in advance of many of its peers when the new Allison Automation/Rosser 42/24 desk is installed.

The roots of the Monmouthshire studio go back to the early sixties. Brothers Charles and Kingsley used to play the pubs and clubs of Wales and the southwest doing an early rock act with varying degrees of local fame until the inevitable time arrived for country boys to go to the city and chance their fortune. George Martin said what a pity it was that they didn't bring the tape to him before 'cause he might have been able to do something with it—there you are, that's life. But, in the event, things did happen, albeit fortuitously. The Brothers met Joe Meek who involved them with recording and engineering work in a converted room in his flat. The venture was a success resulting in the acquisition of more extensive hardware. For reasons of space, this created almost as many problems as it solved. Anyway, the stresses of milking the cows on the family farm in the morning, commuting from Monmouth to London to do the sessions, and back again in time to milk the cows in the evening proved too much. Something had to be done.

The answer seemed logical enough: move all the hardware down to the farm where there was plenty of room. But would the clients come? If they were to, then the recording studio would have to be run in such a manner as to offer some special advantages—like all the things which make a feature of the rural environment.

The suggestion that these two country boyos would start a top flight recording studio outside the boundary of the London County Council gave the recording status quo a little snigger. Then a laugh when idea became fact. Then a frown when the waiting list for studio time generally exceeded theirs. The country studio was born. From then on, life for the Ward Brothers became a natural progression culminating in a 24 track studio with automated mix-down and their own record label . . .

Nobody has specific job functions at the studio, although people naturally tend to gravitate towards what they're best at. These days Kingsley, an amiable eccentric whose zany craziness belies the fact that his head is firmly screwed on, handles most of the business side—entailing trips to London about three days a week. He also makes vats of tea. His wife, Anne, looks after the bookings and provides sanity where necessary. Kingsley also supplies much of the guiding light for the Rockfield record label. He used to do most of the session engineering in the early days but has since handed the bulk over to staff engineer Dave Charles, an ex drummer and client who liked it so much at the studio that he stayed.

Charles, self-described as 'the disappointment of my mother's life when I gave up classical piano to play rock and roll', sees his main function as a jack of all trades. A bit of producing here, a bit of engineering there, design a studio somewhere else, make more tea, etc. His manner suggests a three way cross between Tom Hidley, Fred Emett and Farmer 'the last 16 of the cows fetched top price at Monmouth Market' Giles. Like his brother, he is as totally charming as he is a head case. Not that it's loose. He was responsible for most of the acoustic design, which can be shown to operate very efficiently. Where necessary, he takes advice on hardware matters from Otto, the maintenance engineer, and Rosser Electronics, a local studio hardware manufacturing firm with whom Rockfield has dealt since the beginning.

The studio is situated a couple of miles down the road from Monmouth town centre, thus offering quite reasonable travelling connections with the Big Smoke. The complex is formed from a large farmhouse and a converted quadrangle of typically agricultural outbuildings such as barns and stables, etc. The original studio, a 16 track facility unchanged for the last five years, was constructed from an extension built onto the farmhouse. There is nothing of the plush veneer associated with urban establishments; it looks rather as if the carpenters had deserted three-quarters of the way through the conversion job. This results from a split roof with sound proofing at one end and bare rafters at the other. Whatever the aesthetic considerations, it works,

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The original studio.

although the rafters in the control room give it a fairly bright feel. This has never worried people who did control room overdubs; indeed, the only instruments that Dave Edmunds, musician best described as a rock Mike Oldfield and regular Rockfield client, didn't overdub seated in at the control room desk were the grand piano and the drums. Besides, one imagines that people who regularly use a facility with a dominant characteristic tend to adjust for it when doing the resulting mix down.

In contrast, the new studio installed in the yard quadrangle has completely neutral characteristics. It was deliberately designed flat and dead by the Brothers Ward and that was what they achieved. The control room is large, although it has to be to accommodate the massive Cadac monitors. At the time of the writer's visit, the hardware complement was in a state of flux caused by the expected arrival of the automated Rosser desk. With 42 inputs and 24 outputs, it is going to be the biggest around. It was decided to go for the Allison computer mix-down system for reasons of compatibility with other studios in the UK. At present, three other studios use the same system. "Pat Moran came to Rockfield with a group called 'Spring' which Charles and Kingsley auditioned. After hearing them it was decided to manage and handle their recording careers. They then recorded an album here produced by Gus Dugdeon. Later the band dismantled and Pat decided to stay on as an engineer. He has been engineering for four years and in 1975 he was highly commended for the Ace Single 'How Long'."

Control room peripherals are not lacking either. Since it opened, the new studio has collected Eventide digital delay lines and omnipressors in addition to all the usual things such as compressors and plates. Both Charles and Kingsley have great respect for using the natural properties of rooms and open spaces to add ambience to recorded music. With this in mind, they built an entirely separate studio adjacent to the main (new) control room, with acoustic properties more in keeping with a church hall although the reverberation of the large room can be loosely controlled by opening or closing floor-to-ceiling curtains covering all four walls. This room provides three main functions: a bright recording studio, an echo chamber and a table tennis room. For the second function, careful shifting of speakers and microphones can give a very natural feel to the reverb. But they

This is a recording studio.

are going one step further still.

Charles is going to build—wait for it—a chandelier room. It is a highly refined and totally controlled echo chamber wherein all the ceiling suspended sound reflecting plates are adjustable. 'It's going to be an oblong room about 30m long with three lots of tracking running the length of the room. Running in that, there will be tracking beams at right angles to the first ones. Below that, suspended from the lower tracking, will be plates of glass about 1m x 2m which will revolve through 360°. If we have about 14 of these, we can slide them down and along into various shapes; you can form rows and channel sound through passages—you can do what you like.' He says that the reason for the length is to get a respectable echo at the bass end; something which he considers the downfall of all existing designs. The design work will be based on results from empirical tests once the initial concept is realised: 'What we'll do is to put down a basic channel, put some sound through and take it from there . . . We'll see what eventualities will come from there which you can't see at the moment. It's all a question of building and trying the thing. It may be totally unsuccessful but we've every reason to believe it will be a success.'

The courtyard in the quadrangle also gets used for add-on echo although, anywhere else, it would annoy the neighbours: 'There's no problem with them. We could not be curtailed by distressing neighbours.' Don't suppose they could. Charles and Kingsley have bought them all out.

People at Rockfield implied that there were two good reasons for creating their own label. Firstly, it could provide a lucrative return provided that the a & r was handled carefully. And, according to them, there is no shortage of local talent simply waiting to be discovered. One wonders what influence the early life of the Brothers Ward had on this. Give the locals a break.

The other reason was put succinctly like this: 'Agency and production companies like XXX have bought up recording studios and will no longer allow their acts to record at other places . . . this is a prod in the back to studios like us to have our own people to fill up the gaps . . . get a good distributor like RCA and there are no problems.' At only £240/day (£24/hour) there aren't many gaps.

Generally, Kingsley and Charles don't see the studio getting much bigger. They reckon it's big enough; to increase the size would be to imperil the country image. Further, it would mean that Kingsley would spend even more of his day on the telephone. There will be equipment updates as they become necessary. Already, plans are in hand to modernise the original 16 track studio and turn it 24 track. But there again, the terrible twosome seems capable of just about anything.

Frank Ogden

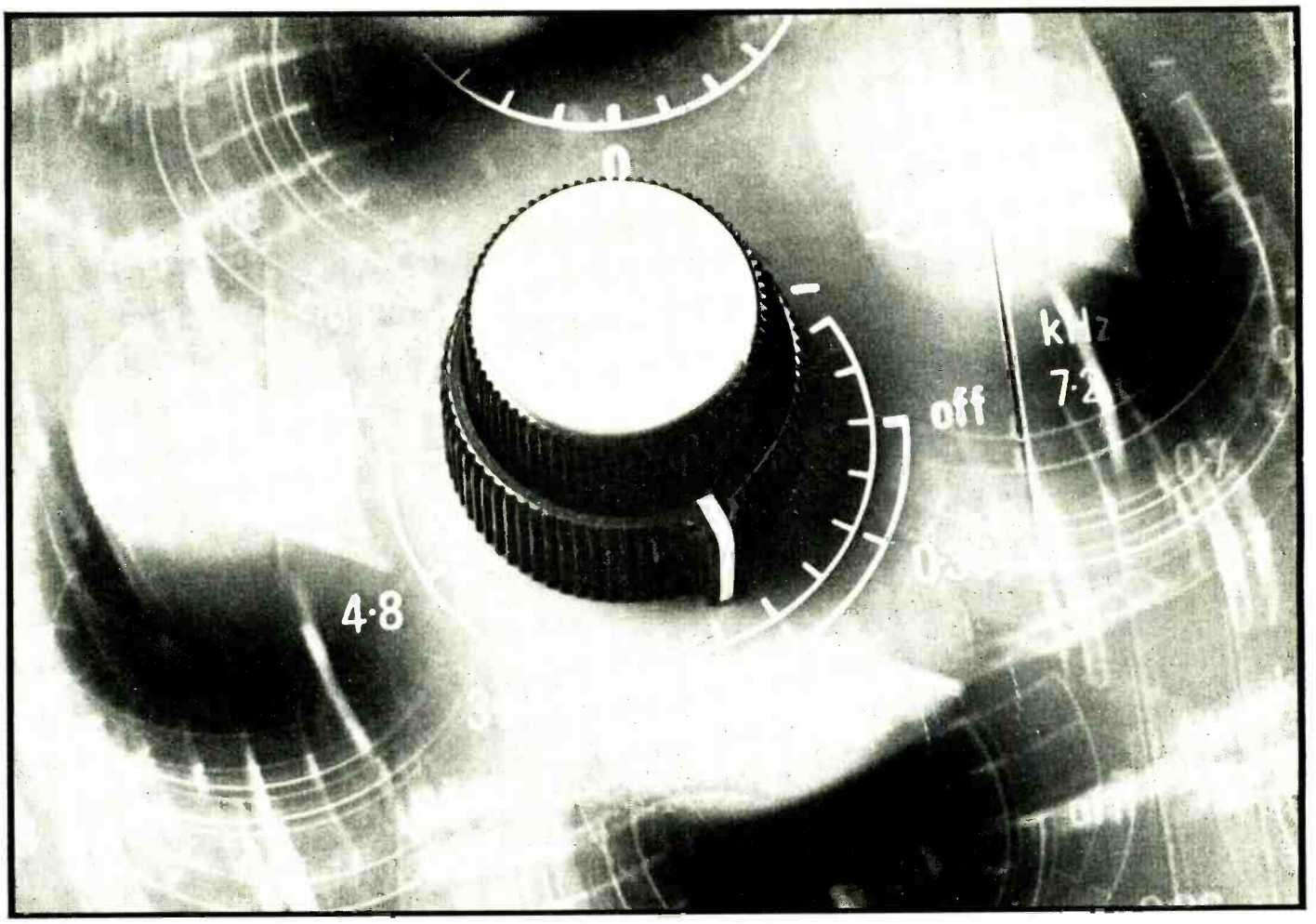
Heep nice studio

When I heard that Ken Hensley, guitarist, keyboard player and songwriter for the rock group Uriah Heep, was building his own recording studio at his house in Henley, I ill disguised my boredom. In fact the thought occurred to me that people might be more interested in hearing about a rock artist who had decided not to build his own studio. Albeit in politer terms, I made the point to Hensley that although I didn't doubt his ability to plan, build and equip a home studio, I would lay even bets that it would unexpectedly cost him so much to finish and run that he would end up hiring it out, at least to recoup maintenance costs. 'No,' he told me, 'it's part of my house, so I certainly don't want strange musicians and bands trooping in and out. In any case, I've set myself a very tight budget of £15 000 for eight track, and I reckon I can stick to it.' That made the story sound more interesting. Fifteen grand is more or less the price of a small cupboard freehold in some parts of London, so I was interested to see and hear how Hensley could put together a fully operational, eight-track studio for the same amount. With only a little cheating he seems to have done it.

Like so many rock artists these days, Hensley has a large house in the Henley rock and roll retirement area, which looks as if it once belonged to a bank manager. How times change; but that's another, sociological story. Three small rooms along one side of the house made an ideal area to gut and rebuild as a small studio and control room. As there was to be no external modification of the house and no plans to use the end product on a commercial basis, local planning permission wasn't needed. Hensley brought in local builder Bob Pullenger to do the construction work and Tony Patrick to do the electronics. Working regularly with Uriah Heep at the Roundhouse Studio, he also had the happy chance to pick up a mass of useful technical information first-hand from the Roundhouse engineers.

The first move was to clad the walls of the gutted area with board, fibreglass and veneer, and the ceiling similarly, but with fireproof tiles. Double glazing on all windows and heavy doors home-built (cheaper than buying ready-made) came next. Choosing the equipment proved rather less easy. Hensley had originally wanted Studer—'I had been conditioned to think Studer'—but couldn't find a secondhand eight-track for less than around £6000 to £8000. So he stopped thinking Studer and thought Scully instead, finding a reasonable machine at half that price with Malcolm Jackson. Next

72 ▶



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came ten secondhand Dolby *361*s at around £200 each, and a new Allen & Heath 16/8 mixer, for around £2000 including special patch bay. Originally Hensley had been 'thinking Neve', but the cheapest secondhand Neve available was around six grand. The Allen & Heath had everything that Hensley needed, but was a bit restricted on eq. So four channels of Audio & Design sweep equalisers were bought at £700 new for patching in wherever necessary—an interesting thought for anyone wanting sophisticated eq but short of enough readies to buy a desk with everything on every channel.

A Master Room echo at £800 proved a reasonable substitute for EMTs and at a fraction of their price. A dbx compressor/limiter, Eventide *instant phaser* (originally used by Hensley on stage) Neumann and AKG mics more or less completes the picture so far.

Yet to come are noise gates and mic stands, which should bring the total equipment bill up to around £11 500. The mild cheating starts with a pair of Tannoy *Lancasters* and an Amcron *D60* for monitoring and left over from a domestic hi-fi, a Revox *A700* now to be used for stereo mastering and a Teac 4-channel originally bought for simple multitrack home recording and now pressed into service for echo. In the garage there's already a pile of keyboard equipment used for the band. A Steinway grand in the music room can be used for recording simply by patching through the adjoining walls.

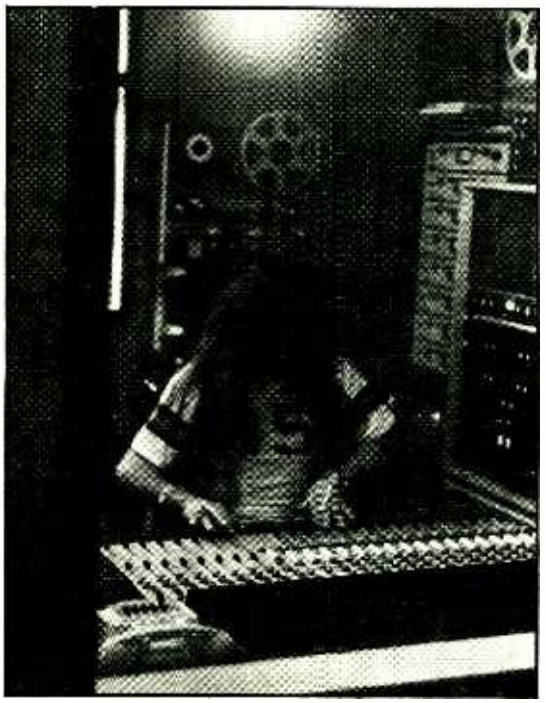
All in all, then, it looks likely that Hensley will get his studio functional, and apart from keeping engineer Patrick on wages, the running costs should be low enough to make the project realistic in the long term. Fine; but what's the justification? Is it just a toy, or can it pay?

Hensley works on the road with Uriah Heep seven or eight months of the year, and for the rest of the time records and rehearses with the band. By his own admission, obsessive about music, and interested in very little else except his home and racing car team, Hensley has relatively little time to spare. He writes most of the songs for Heep, has a couple of solo albums already out and plans more. There are also hopes of film and jingle writing. Whether or not the old school of musician and writer likes it, the new breed of musician-writer, of which Hensley is typical, 'writes' by producing demos. To produce demos in London costs not only the time of getting there and back but also costs more than a little studio time. Hensley is confident that he can produce, not only the demos he needs for passing on his songs to the band (deliberately simple, to avoid temptations for the band simply to re-create the demo sound) but also fuller demos for other artists interested in his songs. He is also confident that the carefully considered concessions made to keep the budget down to 15 grand will not prevent him from producing master tapes if the need arises. And at no cost to himself he can now also find out a few things for himself; like, for instance 'spend three days trying to get that American acoustic guitar sound that I haven't yet managed to get'.

Given all this, it seems likely that the studio will more than pay its way. When I left, Hensley was just off on a USA tour, and Patrick was planning to bring in local musicians for shakedown tests. It's a nice idea. Offer the studio to local musicians, charge them only the cost of tape, and let them record what they like, while using them as studio guinea pigs to iron out all the bugs. Doubtless by now some local Henley aspiring musicians will have had the unusual opportunity of recording an 8 track demo for free.

What Hensley has done really amounts to an interesting set of compromises which so far satisfy him. As someone accustomed to working in professional studios they may or may not cause him frustration in the longer term. I suggested that we talk again in six months time and find out how things had worked in practice.

Adrian Hope



Above: *Ken Hensley*

Right: *Ken Hensley trying out the controls*

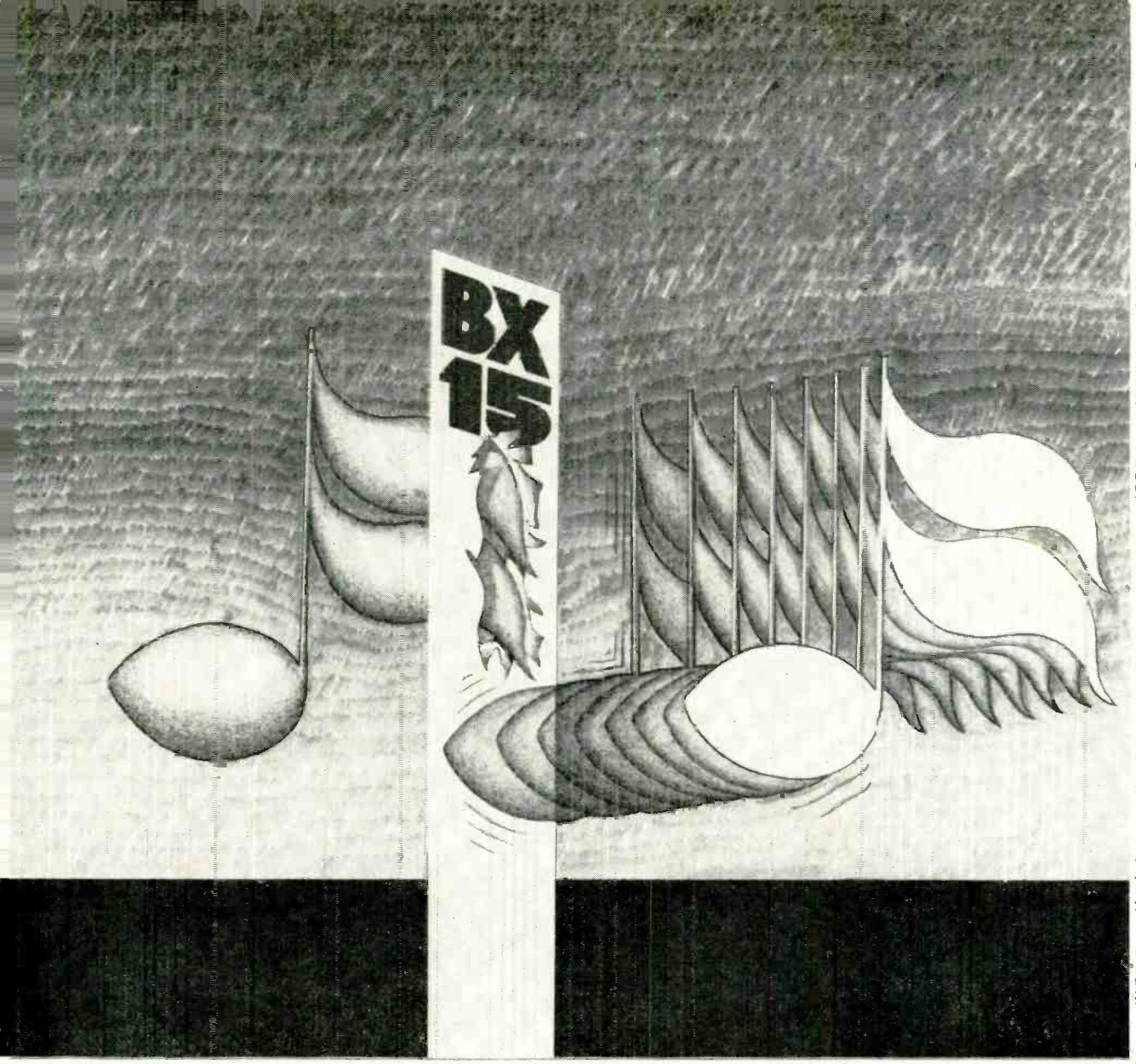
Mountain music

For many musicians, a holiday in Switzerland could be a lakeside resort with sunshine and surrounded by mountains, a restaurant terrace to chat over the standard aperitif before a good meal and then a jam session or get together in a mountain chalet with homely atmosphere. When that tricky riff starts getting too tricky you could try a flutter of 20 or 25 francs at the Casino next door or just have a drink in the bar or on the balcony. Nice, n'est-ce pas? Substitute recording session for jam session and studio for chalet and there you have Mountain Recording Studio SA Montreux, Switzerland. I was taken on a very comprehensive tour recently of the studio by John Timperley, chief engineer and in charge of production, and the first thing that is evident is the homely and warm atmosphere of the small studio, which we visited first.

The acoustics are Westlake designed. As can be seen from the diagram, the layout of the traps for drums, bass and keyboards are such that you have open studio contact, visual and personal, with high separation between instruments. The raised platform is more lively and is used for guitars, brass, woodwinds, strings, etc, the studio floor slate, covered with removable carpets and rugs. Walls are a mixture of wood panelling and stonework, plus hanging drapes on rails so acoustics can be altered at will; ceiling is of the active trap system. The studio is designed for small to medium groups (which, from a musician's point of view, I would put at up to ten with comfort). Contact with the control room (which is on the floor below) is by cctv so the feeling is playing in a cosy room and not a studio—a very relaxing situation and certainly conducive to the process of getting on with making good music and forgetting about the distractions of the control room. Instruments I saw available in the studio were Hammond *B3* with Leslie, Yamaha grand and a couple of Fender Twin Reverbs. Microphone selection is very comprehensive, spanning Neumann, AKG and Electrovoice. John personally likes the Electrovoice *RE 20* for vocal work.

Next stop on the tour was the rack room downstairs, not a medieval torture chamber but a confrontation with row upon row of Cannon sockets and the terminations of some 30 km of mic cable. An expensive project but one well worth it in terms of flexibility, the room houses the mic lines from the concert hall downstairs—54 in all; they can be patched directly into the control room desk and by

74 ▶



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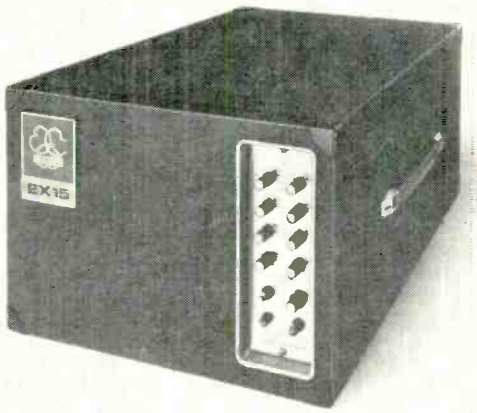

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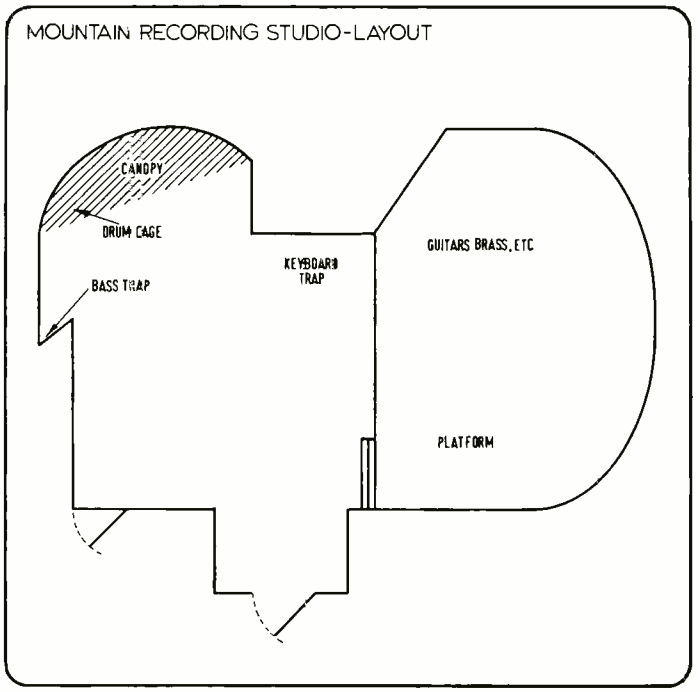
means of split leads and distribution amplifiers simultaneously patched into lines for radio and tv ob vans, not to mention also back down into the hall for injection into a pa desk. This means that a group, orchestra or whatever can be miked up to best advantage and the same microphone used for recording in the studio, the radio tv ob (where the engineers can do their own mix) and for the pa in the hall (where the group's balance engineer can mix the sound *he* wants). In short, everyone is catered for—avoiding 'I don't like your mix' arguments.

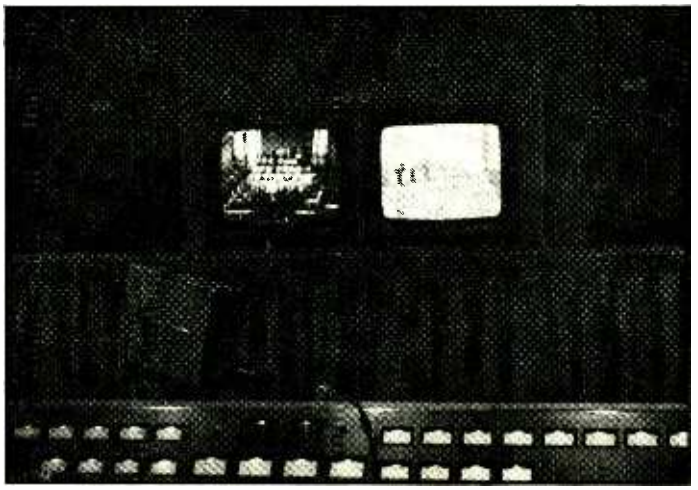
From the rack room we descend to the control room. Before you enter, there are two small cubby holes adjoining the corridor, one housing the array of Amcron power amplifiers and the other the EMT stereo echo plates. At the time of the visit co-manager Anita Kerr was having a lesson in setting up a Moog *Series 12* (presumably also at client's disposition) by David, John's co-balance engineer. Though a bit small (space governed by the Casino and not by finance), the control room is designed on the same lines as the small studio, intimate and cosy. Upon seeing the giant Neve 32/24 desk, you are reminded of the chicken and the egg; desk or room? The control room is designed to be completely symmetrical for quad and the acoustics are certainly first class. We listened to some pop recordings made in the concert hall in stereo—image was rock steady at any point in the room. Monitoring is by four *TM I* speakers which are built into the walls and each powered by a Crown *DC 300A* and two Tannoys —used mainly for classical music—each powered by a *D150*. All speakers are bi-amped and the final adjustments to the room acoustics are done by equalisers housed in the amplifier rack room. It is worth a mention that control room frequency response is measured for flatness about once a month with B & K test equipment and any tweaking done as necessary.

The custom Neve desk is very flexible—simultaneous quad and stereo mastering no problem—with special attention to foldback and monit oring; it is possible to have separate 24 track remix, one for the producer in the control room and another for the musicians in the tudio upstairs. There are also four foldback outputs. For those interested, the equaliser sections on the input channels are even more flexible and comprehensive than on the standard Neve desks and have met with approval already from clients. The studio only opened at the end of 1975.

Westlake Audio control room at the Mountain Recording Studio, Montreux



Cctv monitors to studio and recording hall



A whole array of Studer *A80s*—from two to 24 track and eight in all—are in recesses behind the desk, thus saving floor space and making it easier to circulate in the room. The Eventide phasing units and ddl, Universal Audio limiter/compressors and Kepex units are mounted on a small trolley which can be wheeled into position where and when wanted, as can the tea and coffee machines. The 32 Dolbys are also mounted into the wall.

Contact with both small studio and main concert hall is, as mentioned, by cctv, the three screens mounted in full view in front of the desk. Camera positions are such that visual contact is very good indeed. Lighting in the control room (always important) is controlled by a panel of switches and three dimmers, so any ambience can be created to suit—as was easily demonstrated. All in all, the surroundings are such that working here must be a real pleasure—John mentioned that during the Jazz Festival he was often working 12 to 16 hours at a stretch with no fatigue being noticeable.

From the control room, last stop was the main concert hall downstairs. (The studio complex is on three floors.) For those who are familiar with the Casino, no explanation on the acoustics is necessary—for those who don't, suffice it to say that this is a *designed* concert hall! The hall can be divided by partitions into three sections, so if you have only 70 musicians to record and not 250, you can feel more at home in one of the wings. Again, the live sound is very comfortable with a complete absence of boomy or ringy resonances. As can be heard from recordings made of concerts here, this is a hall ideally suited at the same time for performing and recording. As would be expected, lighting facilities are very extensive.

Though this article may seem rather like an eulogy, this just reflects the pleasure when one finds working conditions that will be most enjoyable for musicians and production teams alike. The aim of the managers of the studio, Anita Kerr and Alex Grob, is to make it a European cultural centre, joining the two functions of concert hall and recording studio together to form a focal point for musicians and artists. To this end, they have also formed a production company. Rates are a reasonable $100 an hour—flat rate—whether it is for 24 track recording or just editing.

Terry Nelson

■

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SS

reviews

Nagra IS-LT portable recorder

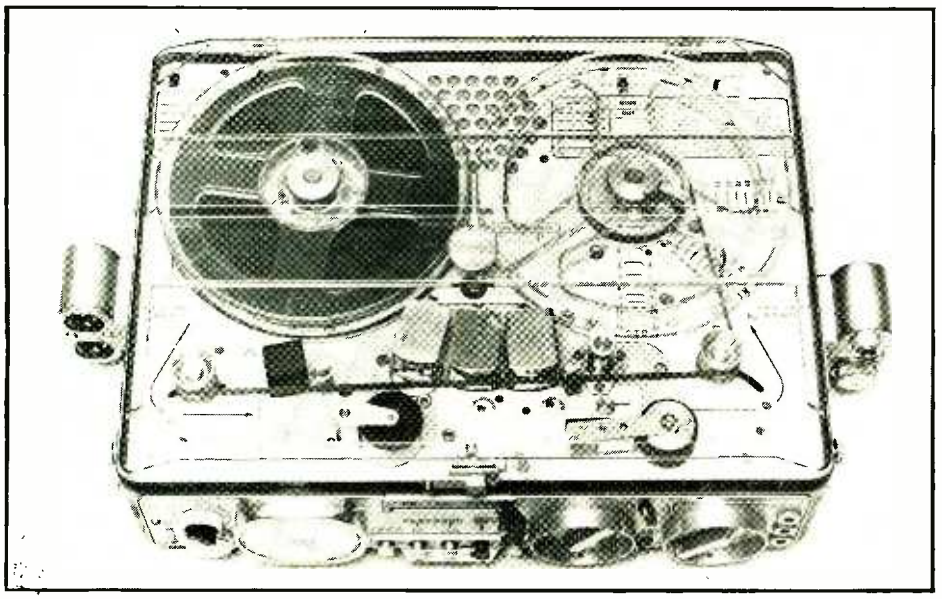
Hugh Ford

MANUFACTURERS SPECIFICATION

(Typical figures referred to reference level 0 dB = 320 nWb/m)
Input: 200 ohm, maximum sensitivity 0.2 mV.
Condenser mic: (T +12V), maximum sensitivity 1 mV.
Unbalanced line: 218 mV, 100k ohm.
Balanced line output: 4.4V ≥ 600 ohm.
Pilot signal input: 1-10V rms.
Pilot signal output: 1V rms.
Crystal generator: 50 or 60 Hz, 1V rms, internal switching.
Clap: acoustic by short recording of 'beep', or pilot generator break, or both simultaneously.
Loudspeaker amplifier: 300 mW.
Record-Playback Performance
Frequency response: at —20 dB, 50 Hz to 15 kHz ±2 dB.
Signal-to-noise: ASA 'A' weighted NAB equalisation and 3M *206* tape better than 66 dB. CCIR equalisation and *LGR30P* tape better than 64 dB.
Distortion: at 400 Hz, third harmonic less than 1%.
Speed regulation: at 19 cm/s, ±0.1%.
Wow and Flutter: per DIN 45 507 ±0.12%.
Internal power supply: 8 x 1.5V D *(R20)* batteries.
Recording time: with standard batteries 8h continuous, 18h in 2h per 24h rating.
Operating temperature range: —30 to +70°C.
Dimensions: excluding handle and connector lugs 275 x 200 x 80 mm.
Weight: including batteries and tape, 4.5 kg.
Price: £1638;
Manufacturer: Kudelski SA, 1033 Cheseaux/ Lausanne, Switzerland.
UK: Hayden Laboratories Ltd, Churchfield Road, Chalfont St. Peter, Bucks.

THE Nagra type *IS* machine is basically a single track recorder with the 'Neopilot' pilottone recording system, and is specifically intended for film and broadcast recording work where only a monophonic recording is required. Two basic models are available, the *IS-L* which is a single speed machine operating at 19 cm/s, and the type *IS-LT* which is a two speed machine operating at 19 cm/s or 9.5 cm/s. Mechanically both machines are identical and are based on a three motor design which, unlike other Nagra recorders, gives the facility of fast winding the tape in either direction—and fast winding does mean fast winding!

The maximum spool diameter which can be accommodated is 127 mm giving a potential recording time of 16 minutes when using standard-play tape at 19 cm/s which will probably be the most common usage. As with the Nagra *IV* the spool hold down is by means of knurled nuts. From either spool, the tape passes over a tension sensing roller effecting a constant tension wind which proved to be of excellent quality in all modes of operation. From the payoff spool the tape then passes to the ferrite erase head and thence over a fixed guide and to a tape driven stroboscopic roller of very light weight. Underneath this stroboscope there is a red led, driven from an internal crystal source which provides a reference for checking the tape speed. Following these items there are the three heads, record, pilot and replay, a further fixed guide and then the capstan assembly.



Both the capstan pinch roller and the stroboscopic roller are moved by the three position slide type control knob on the front of the transport; this level has a stop position for tape loading when the tape path is completely clear of obstructions, a test position when the tape is pushed into contact with the heads with the electronics activated, and an on position when the pinch roller is engaged and the tape running. When in the test position, the spool brakes are left on, but a toggle switch on the top of the transport can be used to disengage the brakes when editing.

The normal inputs to the machine are two microphone inputs which may be switched for dynamic or capacitor type microphones by screwdriver operated switches underneath the machine; microphone powering can be optionally +12V, -12V or +48V by internal adjustment. When the 'line' button is pressed one microphone input is disconnected and replaced by a line input which may be either a voltage input to two unbalanced banana sockets in the side of the machine or a current input to a seven pin Tuchel connector.

Recording level is controlled by two calibrated gain controls, both of which are recessed for safety and are calibrated in decibels. In the playback mode one of these becomes a replay level control affecting the line output, the meter and the headphones socket. Perhaps surprisingly, these levels are fixed in the record mode with no provision for altering the monitoring level at the headphones.

Level monitoring is controlled by a tape/direct switch in the conventional manner, the metering being by a single meter which may be optionally a Nagra 'modulometer' or a new device called a 'super vu meter'. In the review machine a 'modulometer' was fitted and this had an exceptionally clear scale calibrated in decibels, in addition to which there was the battery check scale and a further small scale associated with the inbuilt automatic level control. This device was switchable in and out of circuit with the option of the meter indicating either level or compression according to the setting of the on/off switch co-axially mounted with an automatic level control threshold potentiometer. So far as audio is concerned the only remaining control is a small four-position switch which selects filters in the record mode—the provisions are for a flat response, high pass speech filter, the latter plus extra bass attenuation and finally roll-off.

Pilottone input is via a four pin Tuchel socket which is normally fitted with a dummy plug which links the internal crystal source to the pilot input thus providing a crystal sync recording, which like

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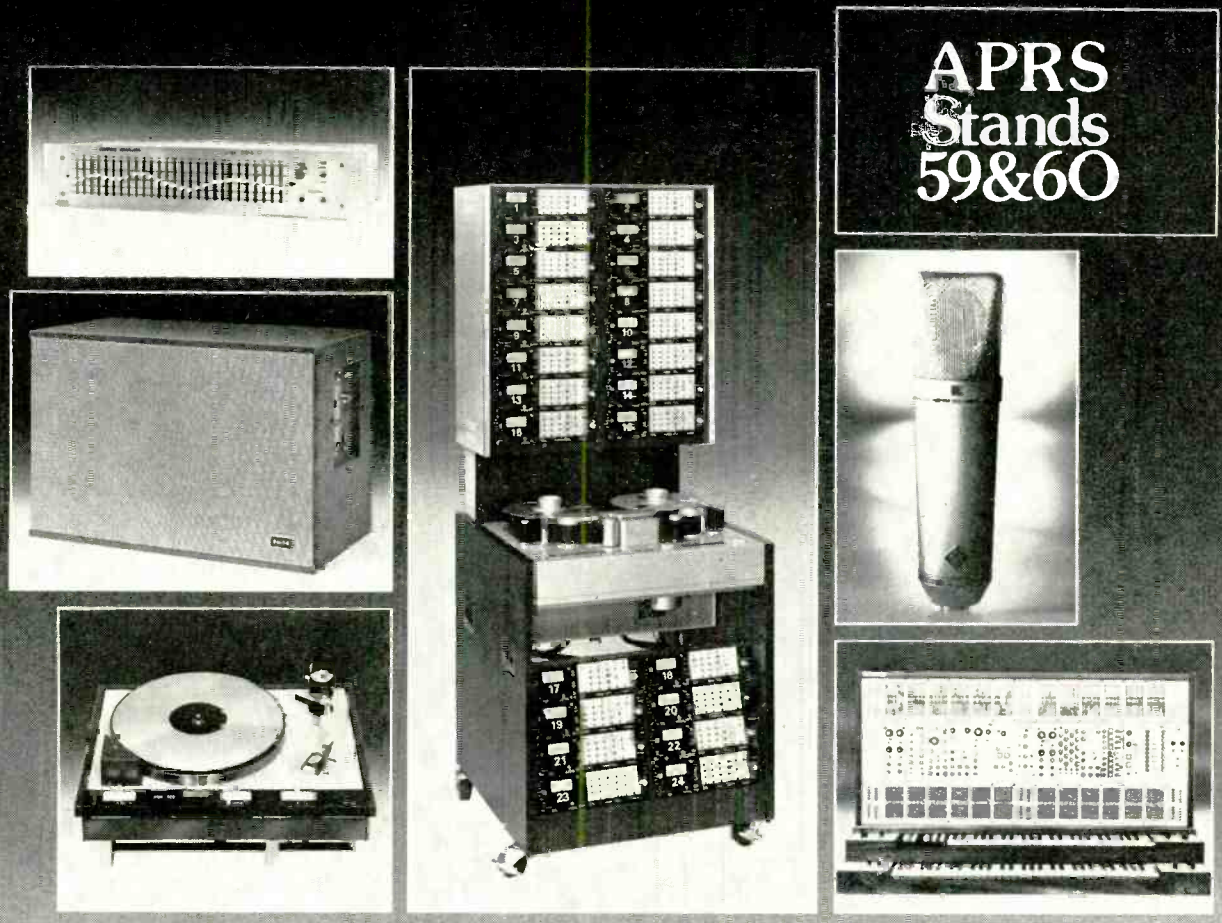

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NAGRA IS-LT

other pilottone sources is indicated by a cross type indicator at the front of the machine which turns white when pilottone is present during recording or playback. The same socket also functions for generating clapper signals which may take the form of either a burst from the internal reference oscillator, or by blocking the pilot generator, clapper initiation being by application of a dc voltage.

Pilottone output is at the previously mentioned seven pin Tuchel socket on the side of the machine which also provides for speed correcton, current line input and dc power to external accessories.

Normal internal powering may be by means of ordinary dry cells or by rechargeable cells with the option of a mains power unit type *ATI* which also serves as a charger for the rechargeable cells. These three devices very simply clip on to the rear underside of the Nagra and automatically make contact with the machine without plugs or sockets. Furthermore, the mains/charger unit also clips externally on to the rechargeable cell package for independent charging.

The mains/charger unit automatically selects its mains operating voltage over the range 110V to 240V nominal supplies at 48 to 52 Hz, surprisingly not covering 60 Hz. As a further surprise it is also specified over the voltage range 100V to 145V at 400 Hz. Mains input is by a standard IEC connector and the power supply/battery charge function is selected by a screwdriver (or coin) operated switch which provides for two charging rates. The only other user functions are a pilottone output at banana sockets and a red light which either indicates that the charger is in action or that the power supply is overloaded in the power supply mode.

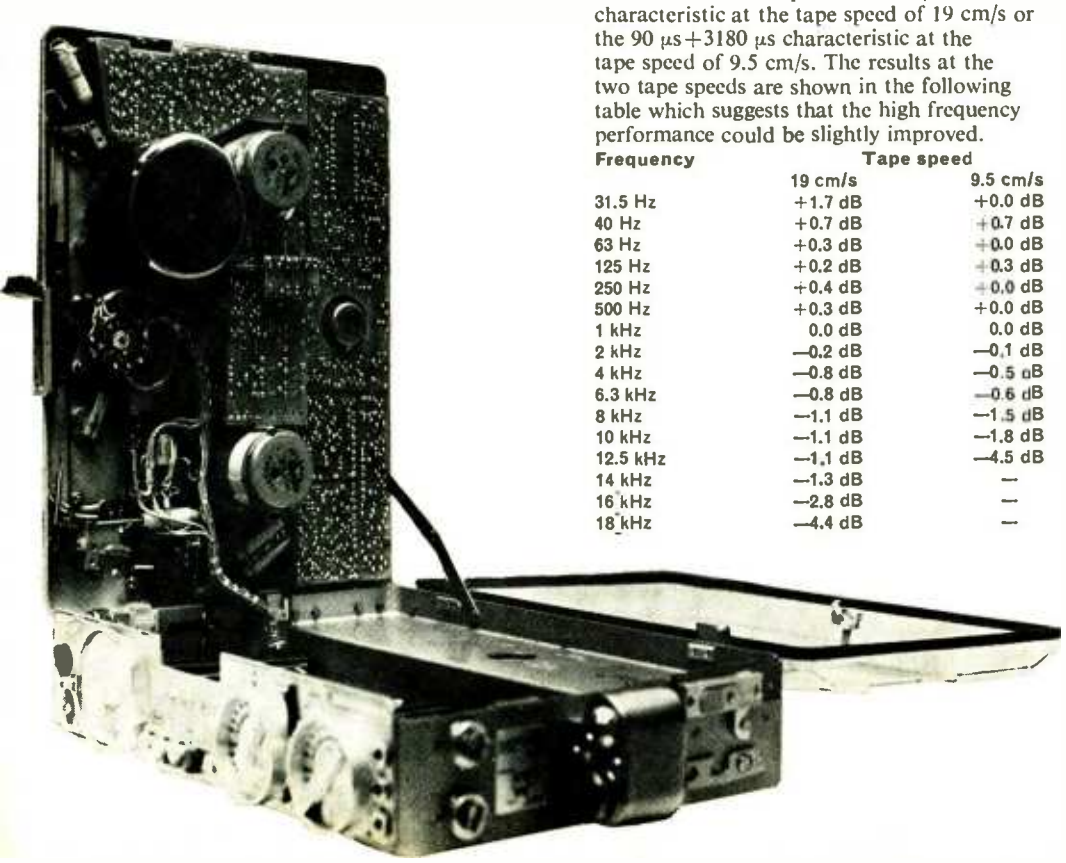


FIG. 1
NAGRA IS
RECORD TO PLAY
FREQUENCY RESPONSE
19cm/s

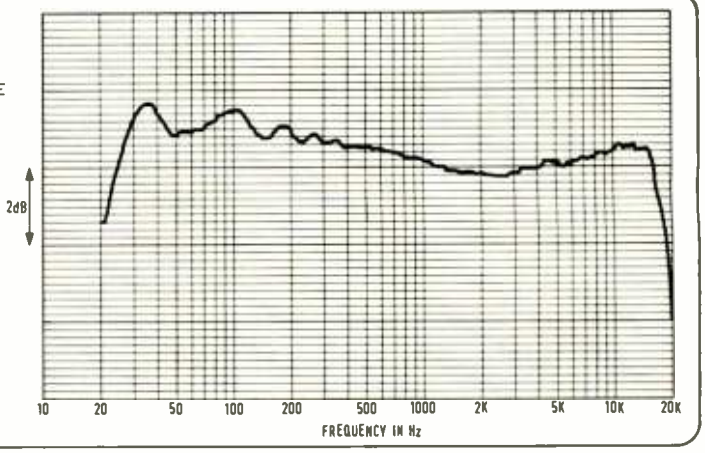
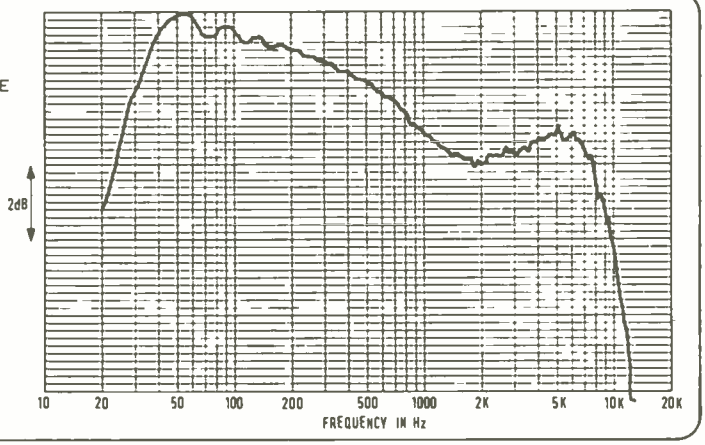


FIG. 2
NAGRA IS
RECORD TO PLAY
FREQUENCY RESPONSE
9·5cm/s



Replay performance

Initial investigations were directed at checking the replay frequency response using BASF calibration tapes to the 70 μs characteristic at the tape speed of 19 cm/s or the 90 μs+3180 μs characteristic at the tape speed of 9.5 cm/s. The results at the two tape speeds are shown in the following table which suggests that the high frequency performance could be slightly improved.

Frequency	Tape speed	
	19 cm/s	9.5 cm/s
31.5 Hz	+1.7 dB	+0.0 dB
40 Hz	+0.7 dB	+0.7 dB
63 Hz	+0.3 dB	+0.0 dB
125 Hz	+0.2 dB	+0.3 dB
250 Hz	+0.4 dB	+0.0 dB
500 Hz	+0.3 dB	+0.0 dB
1 kHz	0.0 dB	0.0 dB
2 kHz	—0.2 dB	—0.1 dB
4 kHz	—0.8 dB	—0.5 dB
6.3 kHz	—0.8 dB	—0.6 dB
8 kHz	—1.1 dB	—1.5 dB
10 kHz	—1.1 dB	—1.8 dB
12.5 kHz	—1.1 dB	—4.5 dB
14 kHz	—1.3 dB	—
16 kHz	—2.8 dB	—
18 kHz	—4.4 dB	—

It is believed that the correction of replay equalisations is a simple screwdriver operation, but as is not unusual with Nagra equipment, no proper instruction manual was available. However, replay head azimuth was checked and found to be correct, and it should be emphasised that this is a very simple and secure adjustment.

On the maximum available output before clipping, it was found that the replay amplifier clipped at a flux level corresponding to +9 dB above the reference level of 320 nWb/m—it is felt that this level is not adequate for future tape materials and is rather marginal with current tapes. So far as could be determined, this clipping occurred in the early amplifier stages and remained relatively constant with frequency.

Turning now to replay noise, the performance was found to be really excellent with a very substantial margin between machine noise and tape noise. The following figures which relate noise to the reference level of 320 nWb/m at 19 cm/s or 250 nWb/m at 9.5 cm/s were unaffected by the use of battery or mains power and also refer partially to the recording performance of the machine. The only matter of concern in the above table is the unweighted noise with the machine set to 19 cm/s. This took the form of a cyclic noise at about 50 Hz and depended upon the motor load at the capstan but not upon whether mains or battery supplies were used. Checking the output noise spectrum did not reveal

any other spurious tones of significant level, but it was noted that irrespective of the mode selected some bias frequency at 116 kHz appeared in the line output. However the level was very low—at least 60 dB below the reference level of 320 nWb/m.

Condition	Reference level to noise 19 cm/s	9.5 cm/s
Unweighted rms noise band limited 20 Hz to 20 kHz, motor running:	56/63 dB cyclic	70.5 dB
'A' weighted rms noise machine only—no tape:	76 dB	70.5 dB
Machine erased *LGR30P*:	64 dB	63.5 dB
CCiR weighted rms noise machine only—no tape:	72.5 dB	68 dB
Machine erased *LGR30P*:	58.5 dB	57.5 dB
CCIR weighted DIN peak meter machine only —no tape:	68.5 dB	63 dB
Machine erased *LGR30P*:	54 dB	53 dB

Record/replay performance

Because the machine had been set-up for BASF type *LGR30P* tape, all record/replay measurements were made using this material, as changing bias or record equalisation is an internal wiring operation. In this context it is interesting to note that the tape speed selector has four positions, two for each speed. While it is understood that the two extra positions are intended for the future use of chromium dioxide tape (this is quite an interesting material at 19 cm/s under the right conditions), maybe they could also be used for alternative tape types? Anyhow, using the machine as supplied the record/replay frequency response is as shown in **Figs 1** and **2** for the two tape speeds. The performance at 19 cm/s is seen to be extremely flat with little evidence of low frequency head contour effects, but at 9.5 cm/s the response is decidedly disappointing in its entirety.

Checking third harmonic distortion showed that 3% third harmonic of 1 kHz at 19 cm/s occurred 6 dB above the reference level of 320 nWb/m and 3% third harmonic of 333 Hz at 9.5 cm/s 7 dB above the reference level of 250 nWb/m—all reasonable figures. Reference to **Fig. 3** shows that second and third harmonic content at a constant record level of 320 nWb/m at 19 cm/s; it is of particular interest that the even harmonics are at a very low level.

The measured noise performance has already been tabulated and shown to be excellent; the introduction of 4 dB(A) bias noise over bulk erase noise is a little on the high side.

Crosstalk between the pilot track and the audio was found to be completely inaudible, as were servo system tones and other possible spurious noises which are common to portable recorders. In addition the erasing performance was extremely good, a 1 kHz tone at reference level being erased by a minimum of 85 dB.

A final aspect of the record chain is the characteristics of the inbuilt filters. The response of the filters is plotted in **Fig 4.** from which it is apparent that their characteristics are similar to those of the Nagra *IV* series machines.

Inputs and outputs

The recorder's line output is in the form of a balanced output from standard banana sockets with a maximum drive capability of +24 dBm from a source impedance of approximately 70 ohms. In the monitoring mode this output delivered 4.4V rms for a tape flux of 320 nWb/m with a minimum load recommendation of 600 ohms. The only other audio output is the headphone output which is at a fixed level when in the record mode. The measured output was 0.58V for no load conditions from a tape flux of 320 nWb/m, with an associated internal source impedance of approximately 20 ohms. Whilst such a fixed level output may be subject to criticism, the internal impedance and the voltage level have clearly been carefully chosen, and the output will happily drive Sennheiser *HD414* phones or more

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FIG. 3
NAGRA IS
DISTORTION AT
320nWb/m 19cm/s

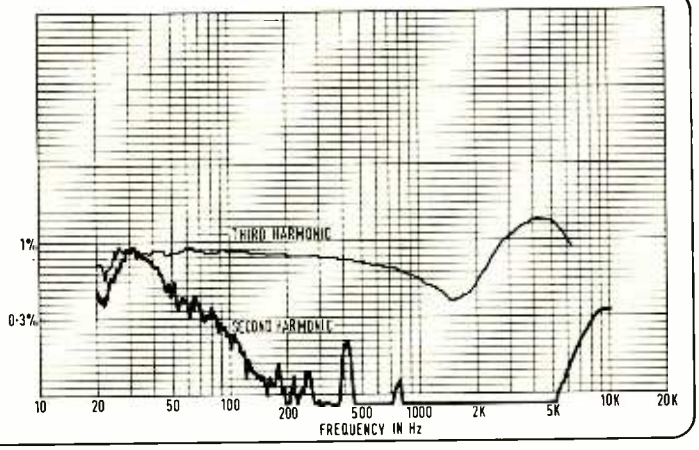


FIG. 4
NAGRA IS
FILTER RESPONSES

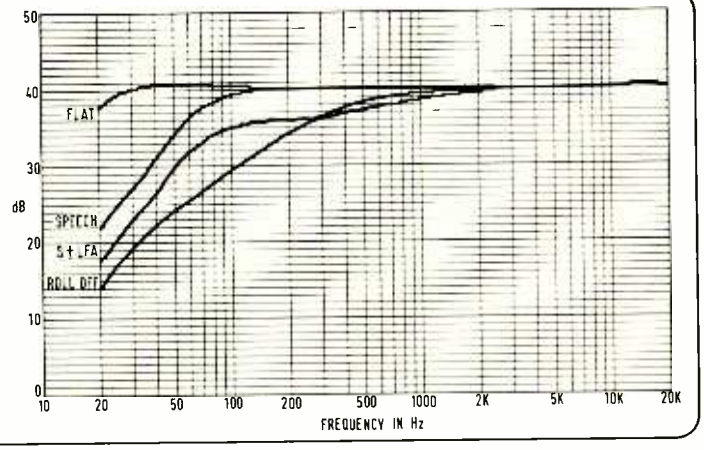
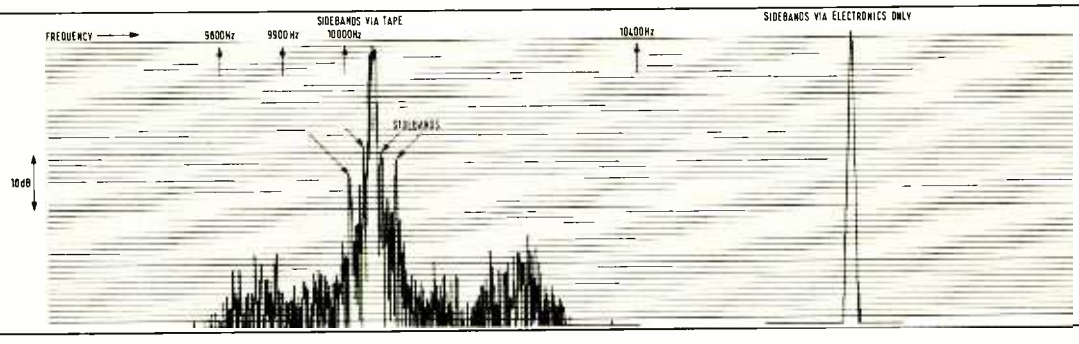


FIG. 5
NAGRA IS
SCRAPE FLUTTER SPECTRUM ANALYSIS



NAGRA IS-LT

conventional moving coil phones.

On the input end the line input was found to have a sensitivity of 210 mV for recording reference level of 320nWb/m with an overload margin in excess of 10V and a sensibly high input impedance of 100 000 ohms which was for all practical purposes constant with record level settings. Noise from the line input was constant irrespective of input gain at −76 dB unweighted below an equivalent tape flux of 320 nWb/m (i.e. −76 dB below 210 mV at maximum gain).

The sensitivity of the dynamic microphone inputs was found to be 185 μV for recording reference level, a well chosen sensitivity for most dynamic microphones with its associated input impedance of 8000 ohms at 1592 Hz which is more than adequately high. Measurement of the equivalent input noise showed that over the band 20 Hz to 20 kHz when loaded with 200 ohms the input noise was −126.5 dBm (0.37 microvolts), with an input clipping point of 55 mV!

The capacitor microphone input showed less desirable characteristics so far as overload capability and input impedance were concerned—an overload point of about 400 mV will be too low for some applications and an input impedance of 188 ohms is far below some microphone manufacturers' recommendations. On the other hand the input sensitivity of 820 μV was high and the equivalent input noise of 1.3 microvolts was low, and the powering of a nominal 12V was very accurate at 11.92V.

The pilottone output was found to deliver 1V rms sinewave over a wide range of pilot level inputs, provided that the input was in excess of around 0.2V at which point the pilot indicator operated. Checking the frequency of the internal crystal source showed that it stabilised at +0.1% on nominal frequency.

Other matters

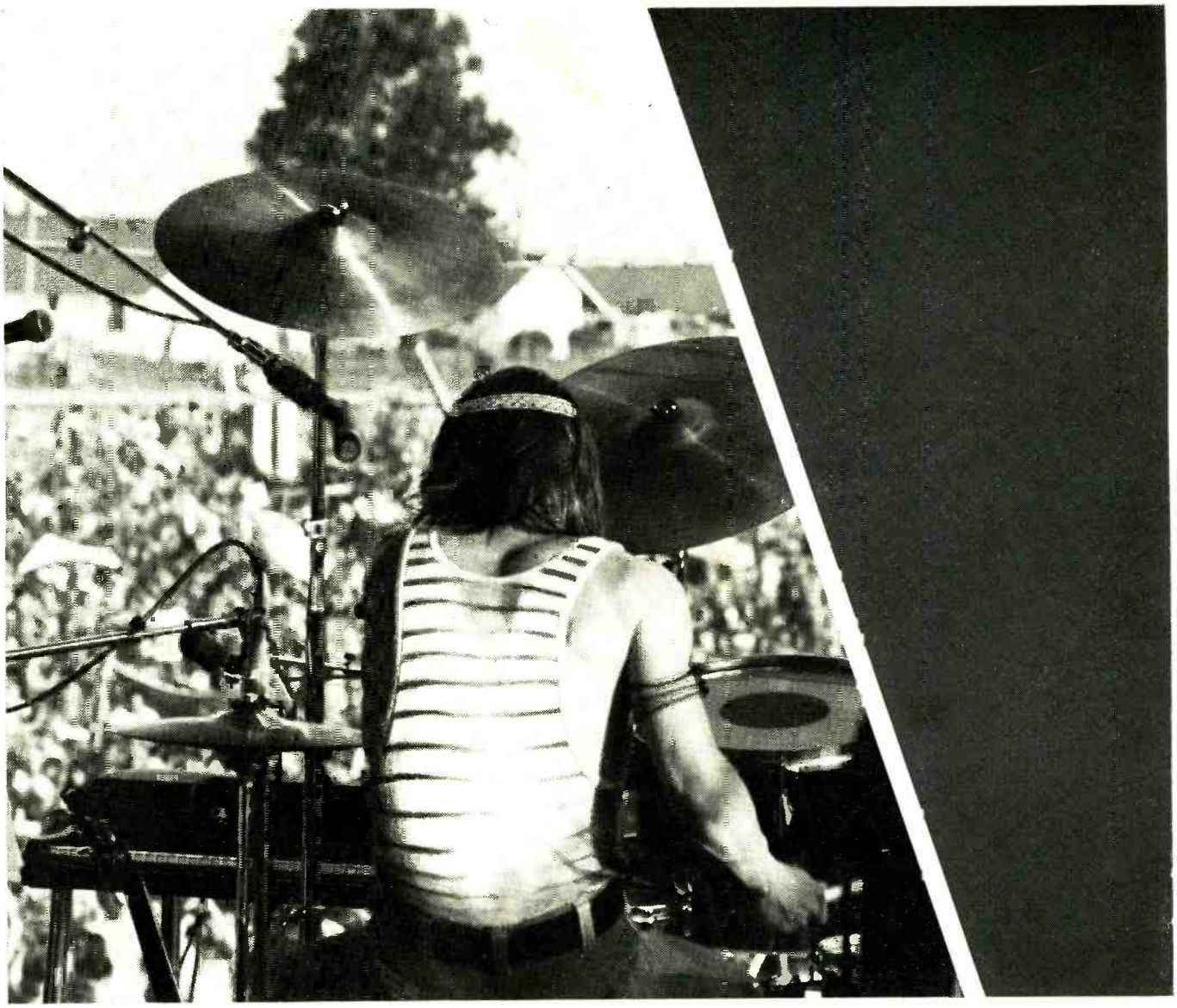
The modulometer takes the form of the well established Nagra device which has a short integration time and a relatively long release time, this is a well established meter which I personally like, and in the case of the Nagra *IS* it has a remarkably clear scale. It is not however an illuminated meter as is the case with the Nagra *IV* series. Subjective testing of the automatic level control system on the single microphone input showed that it had the characteristic of a rapid attack time with a long hold followed by a rapid decay. Such a characteristic can be extremely annoying due to background sounds 'pumping'. However, the variable threshold control can be used to overcome this objection and with careful use this system can give good results.

Wow and flutter, as measured to the DIN weighted method, was to a good standard and virtually constant throughout a reel of BASF *LGR30P* tape—0.035% at 19 cm/s or 0.05% at 9.5 cm/s, the unweighted figures being 0.15% and 0.20% respectively. However, the scrape flutter situation was not so healthy as is shown by **Fig 5** which is a narrow band spectrum analysis of a recorded 10 050 Hz constant tone. Reference to this figure shows that there are two distinct pairs of sidebands not short of 20 dB below the wanted tone, and that there is a considerable amount of sideband noise.

Summary

In practical use, the Nagra *IS* is a delightful little machine which is so much lighter and more comfortable to use than its bigger brothers. Naturally, being so much smaller it has less facilities, but for very many purposes it offers all that is required for broadcast and film work. Such applications would normally use the higher tape speed of 19 cm/s which offers excellent performance; however, it is felt that the facility of working at the lower speed of 9.5 cm/s is somewhat of an afterthought! One operational snag to this machine is possibly that it offers too many facilities, such that a 'driving lesson' is vital before the machine is used for serious work—but it does not take too long to master the basic operation.

All indications are that the machine is solidly made and that its form of construction is such that it should be very reliable and robust as is so essential for location work. Performance-wise, there are, of course, some limitations, but as has been seen, the basic parameters are excellent. ■



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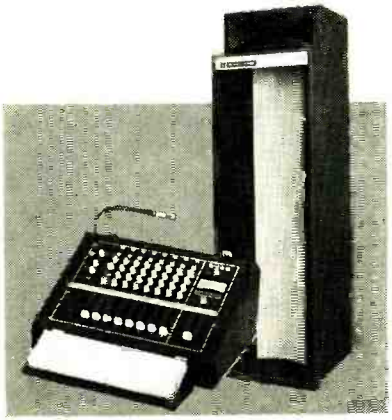

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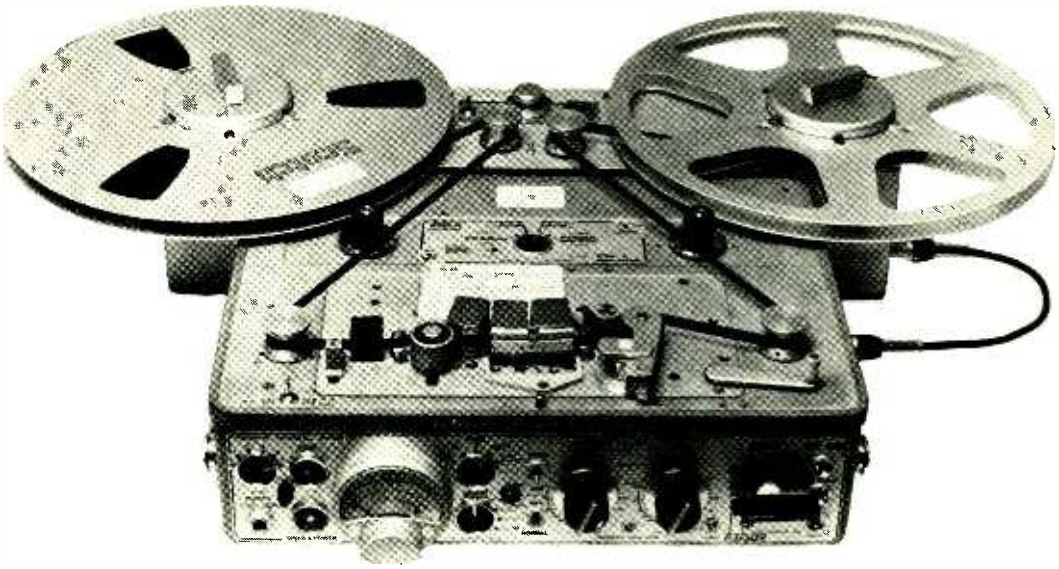
81

Nagra QGB large reel adaptor for Nagra IV recorders



Hugh Ford

THE NAGRA *QGB* is the much awaited adaptor for converting the excellent Nagra *IV* series recorders into large reel machines, thus making the recording performance of the Nagra *IV* virtually equivalent to a studio machine. The *QGB* takes the form of a rectangular box having the same height as the Nagra *IV* when in its horizontal position, and the unit can be clamped on to the basic transport within a few seconds making use of the two metal hoops at the rear of the machine. It is naturally necessary to remove the Nagra's plastic cover to accommodate the larger reels and the modified tape path.

A single cable, equipped with Tuchel connectors, links the power socket of the Nagra to the *QGB* adaptor which includes a further socket so that the normal powering functions of the Nagra remain available. Three powering modes are therefore possible—the complete setup may be powered from the Nagra's internal batteries; it may be mains powered from the normal Nagra power supply, or the internal batteries may be charged when the adaptor is in use. As the power linking cable does nothing except provide powering facilities, the function of the large reel adaptor is controlled solely by tape tensions or tape movement; it could therefore be used with any other recorder, provided that a suitable tape path can be arranged.

Turning to this particular aspect, the *QGB* adaptor contains two separate servo motors (one for each reel) on to which the spools are mounted by means of adaptors. These adaptors are available for either cine type, NAB or European AEG type spool hubs. Each is equipped with two spring loaded prongs which locate in a cutout in the servo motor driving plate, thus providing a very simple method of mounting the adaptors. This sytem completely encloses the servo motor spindles when the adaptor is in transit thus eliminating the possibility of damage to the motor shafts while in transit.

Probably the most interesting adaptor is the NAB. This device provides a positive lock for NAB spools which are located on to a splined drum which engages their slots and are then pressed on to their reference face by three retracting spigots. It follows that no slop whatsoever is possible in any direction. While at first sight the adaptors have a slightly 'tinny' feel about them, in use they are functional and foolproof. From either spool the tape passes over a roller which is mounted on a spring loaded arm at the centre of the adaptor, from where the tape goes to the normal input and output rollers on the Nagra and through the normal tape path avoiding the Nagra's spool hubs. As the latter could possibly do tape damage if the tape were to spill, threaded sleeves are provided to cover the hubs and in particular their spool locating pins.

Also at the centre of the adaptor are the three operational controls and a black and white cross type indicator which shows a cross when the adaptor is in operation and tape tensions etc are correct—a blank indication occurs under fault conditions, including insufficient power supply voltage.

The most useful control is the fast winding knob which is pulled to initiate the fast wind mode and rotated in either sense to effect variable speed spooling in either direction. The other two controls are a 'loading switch'—a three position miniature toggle switch which is in its centre position for normal operation and disenables either the left or the right spooling motor for loading in the other two positions, and a small slide switch labelled 'automatic standby'. The latter is a power saving function which when in operation de-powers the spooling servo motors when the tape has not moved for about 1·5 seconds and applies the spool 84 ▶

MANUFACTURERS SPECIFICATION

Dimensions: 435 x 96 x 110 mm.
Operating temperature: 0 to 70°C.
Weight: 3 kg.
Rewinding time: for 267 mm reels of 730m when powered by mains supply; full reel 2 min, half reel 1 min. When powered by fully charged cells in Nagra, rewinding time multiplied by 2.5.
Power consumption: normal transport 220 mA, fast rewind 300 mA, standby 5 mA, stop without tape 1 mA.
Operating time: with rechargeable cells installed in the Nagra (recording and rewinding); 4 Ah cells 8h, 2.5 Ah cells 5h.
Accessories: *QGBC* Cine type reel adaptor, *QGBA* AEG type reel adaptor, *QGBN* NAB type reel adaptor.
Price: (including QGBC) £420 + VAT
Manufacturer: Kudelski SA, 1033 Cheseaux, Switzerland.
UK: Hayden Laboratories Ltd, Churchfield Road, Chalfont St Peter, Bucks.

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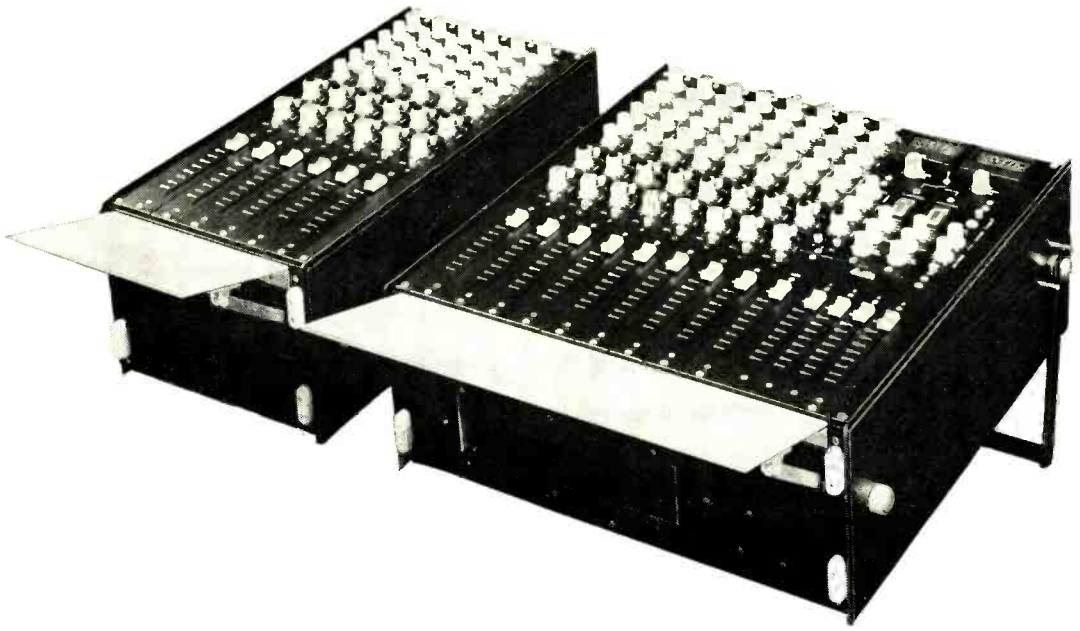

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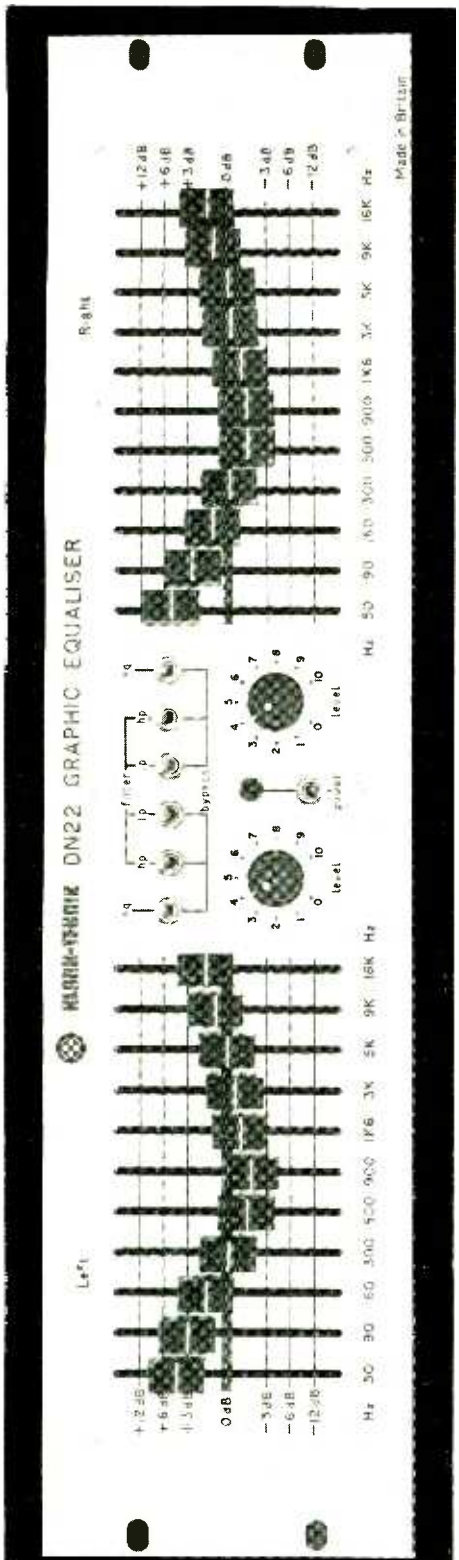


NAGRA QGB

brakes, thus saving power when the tape is not moving. A final operational control is another small slide switch located at the right hand end of the unit between the Tuchel sockets for the power supplies. This slide switch simply switches between either an external power supply or the Nagra's internal batteries.

Construction

The spool hold-down platforms are an integral pulley mounted onto a shaft equipped with an electromagnetic brake. This takes the form of a cork mat which is spring loaded between a fixed and a rotating plate. A quadruple electromagnet assembly is used to release the brake, thus providing a fail safe feature in the event of loss of power. Each spool platform is driven by a dc motor via triple belt drives, and other than the tension sensing arms, these are the only moving parts within the unit. The majority of the servo electronic circuits are mounted on to two glass fibre printed boards which house an amazing number of transistors but are not unduly crowded; however, no component identifications are printed on to the boards which does not exactly help servicing work!

In addition to these two printed boards, the tension sensing arms and their immediate electronics are mounted on to a third printed board and other small boards are associated with each spool turntable.

As is to be expected from anything from the Kudelski stable, sound engineering principles have been adopted throughout and the standard of both electronic and mechanical construction is very high. Furthermore, the accessibility of all components for servicing is excellent, it being a very simple matter to remove the protective covers.

Operation

The attachment of the adaptor to the Nagra recorder was found to be quick and simple and provides a really secure mechanical mounting. So much so that it is possible to use the combination of the Nagra and the adaptor as a portable unit, but in this role it forms a rather bulky contraption!

The reel adaptors were found to be a secure fit both on the reels and on the drive hubs, but the recommended method of loading the tape on the machine was tiresome. In practice it was found far better to ignore the loading switch (which disenables one reel motor at a time) and to thread the tape directly between the two spools initially. It was then easy to take a loop from the tape straight on to the tape path and drop this on to the recorder. In fact the loading switch could be an operational hazard for, it if were accidentally operated during tape motion, there was a good chance of tape damage.

Checking the quality of the tape wind showed that a good pack was obtained when using 3M type *206* tape both in the normal recording mode and in the fast wind mode when powered from the internal power supplies, however the use of the maximum winding speed with external power was found to produce a rather 'leafy' wind. The measured winding tension was 70g which is clearly a compromise between power consumption and good winding quality. But no problems are anticipated even with single sided spools; clearly these must be handled with some extra care. When internally powered the time to rewind a full NAB spool of standard play tape was found to be four minutes and 30 seconds at full speed, falling to two minutes and 15 seconds when externally powered.

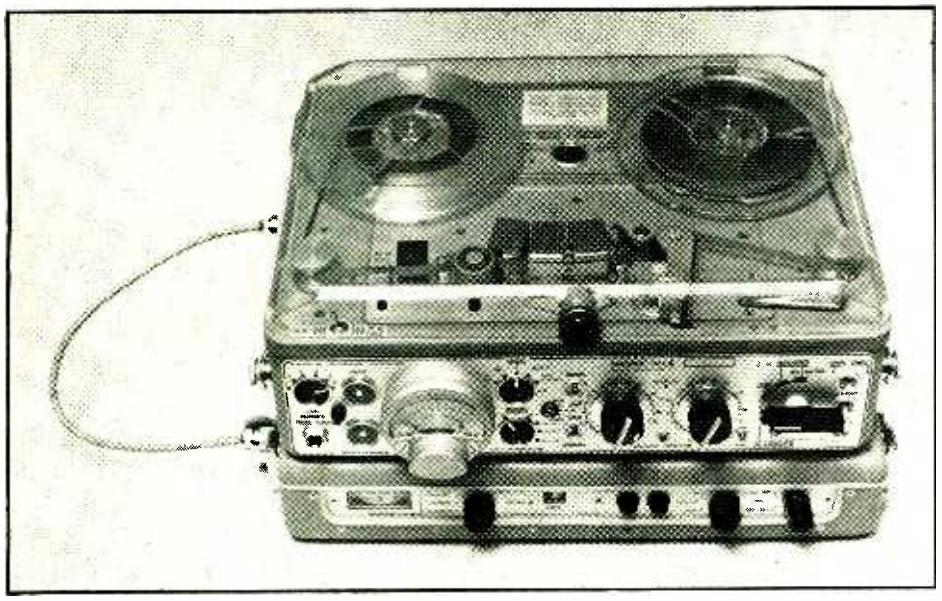
Wow and flutter of the Nagra was found to be unaffected by the use of the large reel adaptor. The performance with the authors well used Nagra was 0.035% DIN weighted at a tape speed of 38 cm/s increasing to 0.05% at 19 cm/s. This wow and flutter performance was achieved after a rapid start time, which depended upon whether the 'automatic standby' function was in use. To re-iterate, this facility is switch selected when required and puts the adaptor servo system into a low power consumption standby mode if the tape has been static for a short time, the full servo power being re-applied as soon as tape motion is detected. Without automatic standby, the start time was measured as 800 ms at a tape speed of 38 cm/s or 500 ms at 19 cm/s. With 'automatic standby' the start time becomes variable depending upon the precise tape tensions in the static mode, but speed stability is achieved quite rapidly. Another potential disadvantage of the automatic standby mode is that the reel brakes are applied during standby and are released on re-start with a slight click which could in some circumstances be undesirable.

The brakes were another source of noise when the tape was run out, in which circumstances the spools took rather long to stop and the brakes made an unpleasant squeaking noise. This lack of brake power was also evident in the case of power failure which, in the fast wind mode, slung a large loop but did not result in disaster. A final aspect of the large reel adaptor is the possibility of editing on the Nagra with large reels. This tended to be a clumsy operation as satisfactory tape tensions for rocking and rolling were difficult to achieve; the change of function of the loading switch to a motors off switch might alleviate both this problem and the ease of loading.

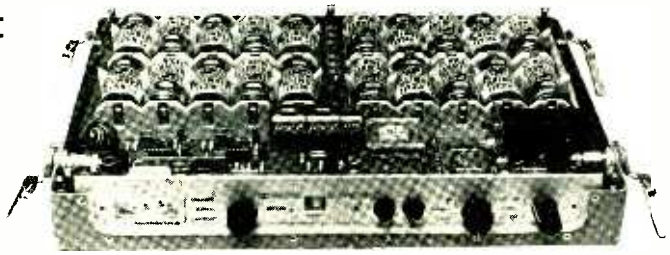
Summary

The large reel adaptor offers the valuable facility of using NAB spools on the Nagra *IV* (and possibly other recorders) and gives excellent tape control in all but the fastest wind mode when using mains power. Power consumption is generally minimal with the result that the battery life of the basic Nagra is little affected. Likewise, the normal wow and flutter performance of the Nagra appears to be unaffected by the use of the large reel adaptor and a good start time is retained.

While this is certainly not a cheap addition to the Nagra, the facility of using NAB spools can be extremely valuable for location work and, in this application, the *QGB* large reel adaptor is to be strongly recommended.



Dolby A unit for Nagra IV by Future Film Developments



DNR-Q4S

Hugh Ford

MANUFACTURERS SPECIFICATION

Noise reduction: Dolby A-type professional characteristic using *Cat No 22* modules. Noise reduced by 10 dB between 30 Hz and 5 kHz rising to about 15 dB at 15 kHz.
Case dimensions: 330 x 216 x 60 mm excluding spring fasteners, controls and connectors.
Weight: 4.5 kg.
Power required: 20 to 28V dc at 300 mA maximum.
Battery life: more than six hours per charge in any mode. Battery will withstand hundreds or even thousands of charge cycles if used correctly. Self-discharge 70% after one month at 20°C. Shelf life is indefinite.
Signal levels: record and play input signals must be identical. Dolby level may be in the range 150 to 500 mV, internal auxiliary amplifiers are switched in as required.
Input impedance: unbalanced 47k ohm without internal auxiliary input amplifiers, switchable with amplifiers 'in' between 47k ohm and 100k ohm.
Output impedance: unbalanced, low with internal auxiliary output amplifiers 'in', otherwise 2.5k ohm. In either case load impedances should be high and not less than 10k ohm.
Headroom: 15 dB minimum, normally 23 dB at inputs, 18 dB at outputs—above Dolby level, before clipping.
Distortion: less than 0.01% thd at 1 kHz in auxiliary amplifiers at Dolby level. Overall: less than 0.1% thd at 1 kHz Dolby level—0.2% thd 40 Hz to 20 kHz at Dolby level.
Noise level: record/play 80 dB (30 Hz to 20 kHz bw) below Dolby level.
Crosstalk: record/play better than —60 dB at 10 kHz with Nagra *IV-S* at Dolby level.
Matching: plus or minus 1 dB between channels and units 30 Hz to 20 kHz.
Settling time: 2s on internal supply, converted to 0.5s by DNR-CIE shorting plug or by using external supply.
Switching signals: standby/on and play/record switching is either by —10V signals or by grounding positive sensing inputs.
Price: £881.88 including batteries and leads. Power supply/charger £102.92.
Manufacturer: Future Film Developments, 90 Wardour Street, London W1.

FOR some time now there has been talk about Dolby A noise reduction for the Nagra *IV* and now at last the Future Film Developments unit has materialised to meet this requirement. So far as the Dolby noise reduction part of the unit is concerned, the standard Dolby *Cat 22* modules are used so there is no compatibility problem in this area. However, connecting the *Cat 22* modules to the Nagra *IV* was a problem area because not only does the external noise reduction socket on the Nagra *IV* offer signal levels which are incompatible with the Dolby unit, but also the available signals are limited in their number and are complicated in their function because of the internal switching within the Nagra *IV*.

In order to overcome the signal level compatability problem the noise reduction unit contains four buffer amplifiers for the audio signals, two input buffers and two output buffers each of which has an associated internal gain control for setting levels. An internal relay deals with the record/play signal routing and Dolby function switching, and this relay is automatically operated when the Nagra is switched into record by sensing via a level detector the Nagra's power supplies to the record section.

A further level detector is used to sense the Nagra's dc supplies and to drive a second relay which automatically applies power to the *Cat 22* modules etc when the Nagra is switched on. Thus, the power consumption of the noise reduction unit is minimal in the standby mode.

The Future Film Developments unit may be used with a standard unmodified Nagra *IV-S* by connecting the unit to the Nagra via a small adaptor box which is fitted with two leads, one of which goes to the 'ext NRS' socket on the Nagra and the other of which goes to the 'outputs' socket which is repeated on the adaptor box. The use of the unit this way provides the automatic switching functions for record/replay and stop/start, it does not however solve the problem of the complicated internal switching within the Nagra which makes alignment of levels tiresome and also inhibits the possibility of monitoring the input signal before Dolby coding.

Modifications to the Nagra have therefore been devised to overcome these problems; the modification kit simply consists of replacing the 'ext NRS' socket on the Nagra with a pre-wired 14-way *Lemo* connector. This modification gives the noise reduction unit direct access to the playback pre-amplifier and the recording amplifier, such that fixed level signals are available from tape and the Nagra's gain controls do not affect levels between the noise reduction system and tape.

So far as the Nagra's original performance is concerned, this is restored by inserting a dummy plug into the new noise reduction socket and other than the noise reduction switch becoming inoperative the performance is completely unaffected. When this modification is incorporated the Dolby unit can be aligned without any complications, and a further great advantage is that the unprocessed signal can be monitored before tape in addition to which the Nagra's level controls and other functions behave as they would without noise reduction.

It follows that this is a well worthwhile modification if the Dolby unit is to be used, and in the following review it is assumed that this modification will have been done. Also, as the Dolby noise reduction system has already been reviewed in STUDIO SOUND in the form of the Dolby type *360* units which use the identical noise reduction module, I do not propose to deal with the performance of the Dolby system per se. Reverting to the Future Film Developments unit, this is about the same depth and width as the Nagra *IV* but about half the Nagra's height. However, it is also quite heavy, largely because of a self contained power supply in the form of twenty 'C' size nickel cadmium cells. An optional carrying case with a shoulder strap

88 ▶

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is available, but as a portable unit the Nagra *IV* attracts enough comment about its weight without the extra weight and bulk of the Dolby unit!

The mechanical construction is based on a shallow alloy box, the lid of which is secured by means of four toggle clamps. The box has a smart crackle finish in light grey/green and is of relatively strong construction, however no attempt is made to protect the front panel controls from mechanical damage. Internally there is a single large glass fibre printed circuit onto which all the electronics except the Dolby modules are mounted, including the front panel controls. The power supplies are also mounted on to this board by means of moulded plastic battery holders and the *22* modules plug-in underneath this mother board. The construction of the complete unit is generally neat and to full professional standards, but components are not identified on the board and the albeit provisional instruction manual does not include a board layout to assist with servicing. In other respects the provisional instruction manual is excellent and it does include full alignment data and operational recommendations.

Turning to the physical layout of the unit, the input/output connector is on the left hand side of the unit and a short cable is provided for linking this connector to the modified connector on the Nagra. On the right hand side of the unit there is a further connector of the *Lemo* type for connecting to the external mains power unit/battery charger. The front panel houses three rotary switches—a two position switch for selecting internal or external powering, a further two position switch which switches the power on/off and effectively also switches Dolby in/out, and finally a three position switch for checking operation. The latter switch has a 'normal' position and a 'check left' and 'check right' position. In the latter positions a front panel meter, calibrated with Dolby level and also DIN 320 nWb/m level, is connected to the left or right channel. Also, when in the record mode, the Dolby tone is recorded and a miniature red led illuminates to indicate this condition. In addition to the Dolby level meter there is a second small meter for battery checking; this is a simple device with the scale divided between red and white, the latter indicating a satisfactory battery voltage. Finally there are two 20 mm fuses for internal and external power supply protection. While a spare fuse is supplied within the unit, neither of these fuses are clearly identified with their correct ratings.

Before turning to details of the noise reduction system, mention must be made of the mains power supply type *DNR-P1A* which is designed not only to power the noise reduction unit or charge its internal batteries but also to power a Nagra *IV* recorder (or a Nagra *III* by changing tapes). The mains input is via a standard IEC connector and is then fed to a slide type on/off switch, a slide type voltage selector for 100/125V or 200/250V at 50/60 Hz, a pilot light and 20 mm mains fuse. Inspection of the unit from a point of view of electrical safety revealed that both slide switches would not meet the requirements of British Standards for clearance between live parts and the chassis of the power unit—these should be modified.

On the output end there are a further two 20 mm fuses, the fuseholders being identified with the required fuse ratings. There is an external power/charge battery switch for the noise reduction unit which in the latter position has an associated red led for indicating the correct charging conditions. The dc output to the recorder is via a seven pin Tuchel socket which matches that on the recorder; power to the noise reduction unit is via a five pin *XLR* socket. In addition to these outputs there is a 1V pilot output at power line frequency from two banana sockets.

The standard of construction of this unit is, to say the least, substantial. The housing is a heavy duty alloy cast box fitted with a good class carrying handle. Internally the layout is clean and accessible with the electronics section mounted on a glass fibre printed circuit which, for some reason, includes a further fuse not identified in function or value.

FIG. 1
NAGRA IV-S PLUS
DOLBY NOISE SPECTRUM

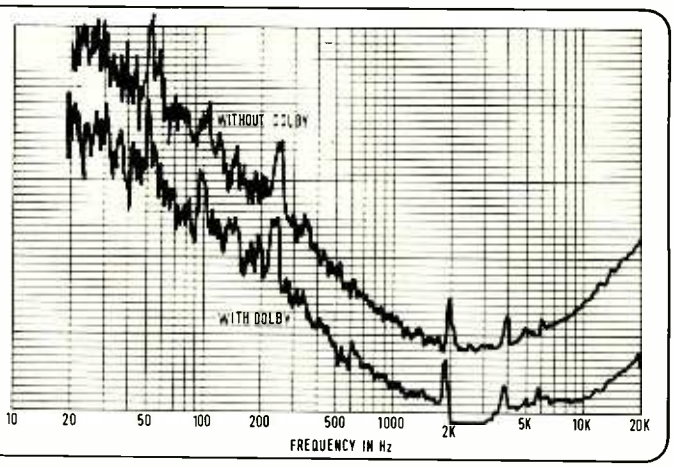
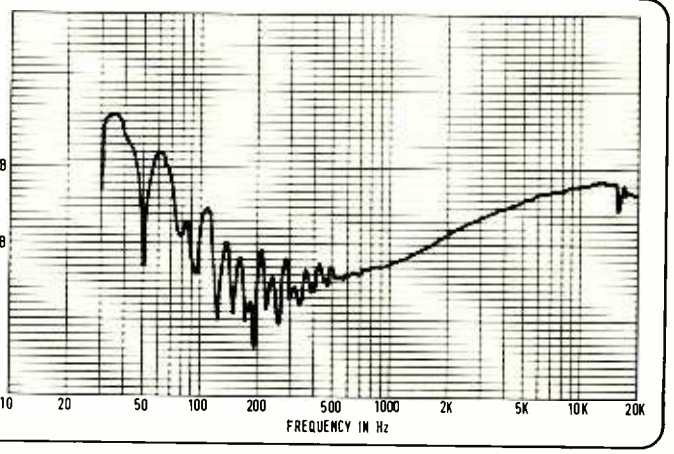


FIG. 2
CROSSTALK AT
DOLBY LEVEL 19cm/s



Performance

As with any Dolby system it is vital to set Dolby levels on record and replay before using the system. In the case of this unit with a modified Nagra *IV* this is a simple procedure aided by the use of three multi-turn preset controls for level setting of each channel. Once the recorder alone has been correctly aligned a reference level tape is replayed and the replay gain pre-set adjusted for the correct indication on the Dolby level meter, the *Cat 22* modules are then set to unity gain by using a second pre-set and cancelling noise reduction by means of an internal press type switch and finally the record gain is adjusted by using the internal Dolby tone oscillator. Unfortunately, as a result of the design of the Nagra, it is necessary to re-align these levels for each tape speed. But generally a particular operation uses a single speed, and re-alignment is really no hardship anyhow.

Measurements of the available noise reduction showed that over the band 20 Hz to 20 kHz the Dolby unit reduced replay noise by 11.5 dB in terms of rms noise with 14.5 dB reduction occurring in the third octave band centered on 16 kHz. The overall picture of noise reduction versus frequency is shown in **Fig 1** which was plotted with both the Dolby unit and the Nagra mains powered. It is therefore noteworthy that mains hum components are at very low levels, but this was only achieved by removing the mains power unit at least one metre away from the recorder. This power unit has a very large stray magnetic field from its mains transformer with the result that not only

FIG. 3a
DISTORTION AT DOLBY LEVEL. DOLBY IN 19 cm/s

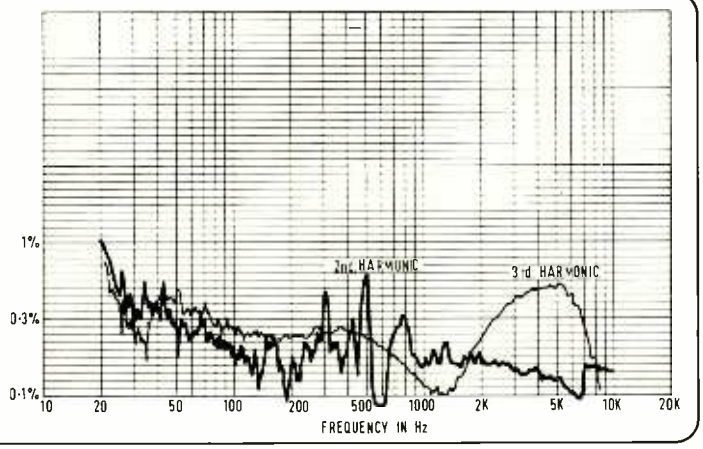
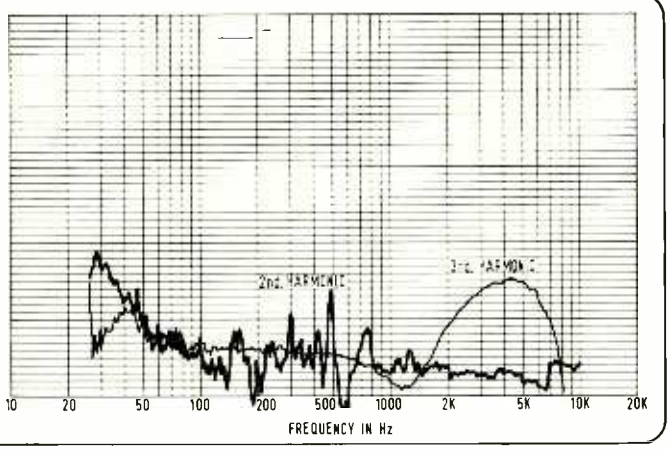


FIG. 3b
DISTORTION AT DOLBY LEVEL. DOLBY OUT 19 cm/s



must it be kept well away from the recorder, but also must be rotated for minimum hum induction. Crosstalk between channels while using the Nagra with noise reduction is shown in **Fig 2** which demonstrates a quite satisfactory situation but does not conform to the specified –60 dB crosstalk at 10 kHz where the measurements give 55 dB. This however is of no practical significance for normal audio recording. Distortion with and without the noise reduction system in operation with a constant amplitude recording at Dolby level at a tape speed of 19 cm/s is shown in **Figs 3a** and **3b** from which it is to be seen that the use of the noise reduction system introduces a very slight increase in second harmonic distortion and up to about 2 dB increase in third harmonic distortion at some frequencies. It is not however felt that these differences could be audible and the distortion performance is generally very good.

Checks on other parameters in conjunction with the Nagra *IV-S* did not reveal any shortcomings that could be associated with the Future Film Developments conversion of the Dolby modules for use with the Nagra, and it is interesting to note that a simultaneous code/decode version of their adaption is possibly on the way. This will overcome one of the major disadvantages of the system whereby it is not possible to monitor the unencoded signal from tape.

While this unit is basically designed for use with the Nagra, it has internal facilities which make it quite suitable with other recorders if suitable inputs and outputs can be arranged with the recorder. In addition to the internal controls already mentioned there are two banks of dual in line type switches, one for each channel. These switches provide variations in available input or output gains and loading variations to suit other interfaces, also the specified methods of record/replay and on/off switching are versatile for interfacing with other control systems.

Summary

Very much thought has obviously been put into the design of this noise reduction system, and, in particular, into the modification which has been devised for the Nagra *IV-S*. Without this simple modification, the system is not quite so simple to use, and personally I would strongly recommend its incorporation which in no way upsets the normal Nagra performance. The noise reduction system, as such, does all that is claimed of the Dolby system, and its use produces fully compatible tapes. Furthermore, alignment is extremely quick and simple. Clearly the disadvantage of this system is its weight and bulk, and also it is very expensive—if you really need Dolby with the Nagra in a relatively portable form this system is the only answer, but neither your back or your bank will like it! ■

dbx 192 noise reduction system for Nagra IV-S recorder

Hugh Ford

MANUFACTURERS' SPECIFICATION

Compression/expansion ratio: fixed at 2:1 compress; 1:2 expand linear in decibels.
Dynamic range: greater than 100 dB unweighted.
Equivalent input noise: 100 dB below Nagra 0 vu (20 Hz to 20 kHz).
Effective noise reduction: greater than 30 dB.
Input impedance: greater than 10k ohms.
Output impedance: 100 ohms.
Maximum input/output level: +13 dB with 0 dB =560 mV, which is equivalent to Nagra 0 vu.
Unity gain level: 560 mV rms adjustable.
Record/play frequency response: ±1 dB: 30 Hz to 22 kHz. +1, —3 dB: 25 Hz to 25 kHz.
Harmonic distortion at 0 vu, record-play cycle, with tape recorder:

	2nd	3rd
100 Hz	<0.2%	<0.5%
1 kHz	<0.1%	<0.05%
10 kHz	<0.2%	<0.1%

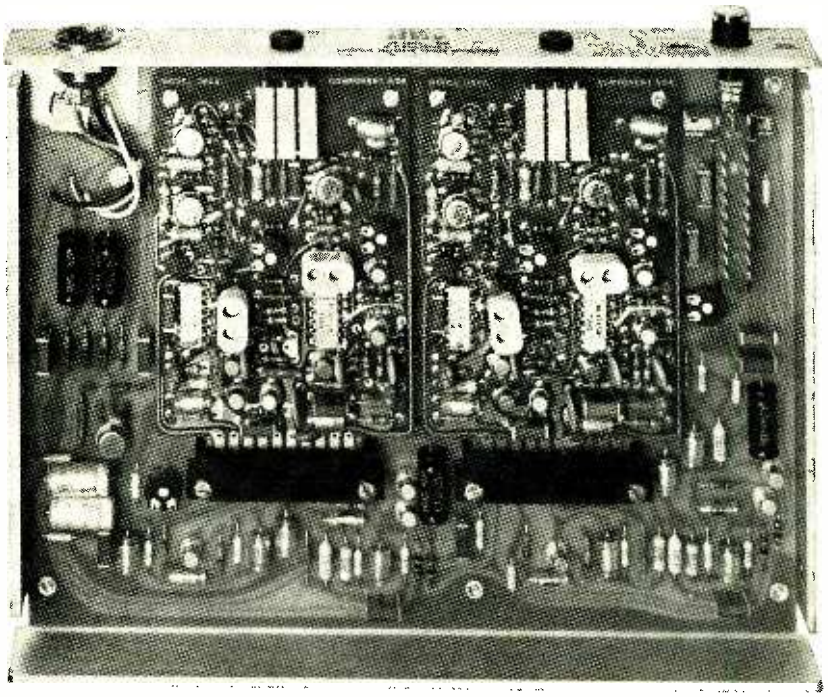
Intermodulation distortion: at 0 vu, record-play cycle, with tape recorder—less than 0.2% at 0 vu SMPTE.
Power supply requirement: —10V dc.
Power consumption: 330 mW.
Operating temperature range: 0°C to +60°C.
Connector with cable: DIN, mates with Nagra *NRS* connector.
Controls: record/play switch, level set controls.
Case: natural anodised 3.2 mm aluminium.
Dimensions: 22.9 x 18.1 x 3.2 cm.
Net weight: 1.1 kg.
Price: £360, $600.
Manufacturer: dbx, Inc, 296 Newton Street, Waltham, Mass 02154, USA.
UK: Scenic Sounds Equipment, 27/31 Bryanston Street, London W1.

EARLIER reviews in STUDIO SOUND have dealt with the dbx noise reduction system, and also with the Nagra *IV-S* portable recorder. Both units showed an excellent performance and the now possible combination of a very high quality portable recorder (stereo at that) with a noise reduction system, which is not only light and compact, but has negligible power consumption, is something which many an engineer has dreamed about!

The dbx unit is designed to mount underneath the Nagra recorder and consists of a very heavy duty alloy tray containing the electronics which is secured directly onto existing screw holes in the Nagra by means of angle strips. Both the signals and the power, which is derived from the Nagra, are connected by a single short lead which plugs into the existing Nagra external noise reduction socket. Thus adding the dbx system involves only four screws and a single cable equipped with DIN type connectors.

Internally, the dbx consists of three printed circuit boards. These comprise a mother board into which are plugged two noise reduction cards—one for each stereo channel. The mother board comprises an input buffer and a rather complex input filter for the noise reduction cards together with a power supply section which splits the Nagra –10V supply into a positive and negative rail for the noise reduction system. In addition there is a manual record/play switch for changing the noise reduction function. The standard of layout and component quality is first class, but individual components are not identified—it is hoped that later production models will have identified components.

The only front panel operator control is the record/play pushbutton switch, which is of the type which shows a green coloured window when the record function is selected. Two ten turn 'level match' 92 ▶



potentiometers can be screwdriver operated through holes in the front panel, and the only remaining front panel feature is the DIN style input socket which has all its connections clearly identified.

Practical application

Initial attempts to secure the dbx to the base of a Nagra *IV-S* showed that while the fixing holes in the dbx brackets were correctly located the screws which secure the existing feet to the Nagra were too short and of the countersunk type which is inappropriate to the holes in the dbx mounting brackets. Furthermore, it was found that while the mounting surface of the dbx is virtually flat, it does not correspond to the base of the Nagra which has several minor protrusions about the battery cover. It follows that, not only must dbx provide long mounting screws, but they should also supply four small spacers (or similar) so that the noise reduction unit does not foul the protrusions on the Nagra baseplate.

Having overcome these problems the dbx plugs into the noise reduction socket on the Nagra by means of a short lead which is equipped with locking plugs at each end. As, at the time of writing, no instruction book was available for the noise reduction unit, some time was spent exploring the functions of the Nagra in conjunction with the noise reduction system.

It came to light that the Nagra's noise reduction system socket was only functional when the 'TAPE/DIRECT' monitoring switch was in the 'DIRECT' position when in the replay mode. In the record mode the noise reduction socket was always in action but the line output and headphone monitor were located after the noise reduction processing—this means that it is impossible to monitor an unprocessed signal when recording. However, the metering system always indicated the signal applied to, or read from, tape; it may be argued that the characteristics of the meter are not ideal for monitoring a 2:1 compressed signal.

In the replay mode the meter can monitor the signal off tape, but normally monitors the signal output at the line outputs. These are controlled by two level pots on the recorder when (as is essential) the TAPE/DIRECT switch is in the 'DIRECT' position. Some caution is required in the adjustment of the replay level controls, for while the noise reduction system had unity gain around the zero of the Nagra meter, the replayed signal from tape is expanded both above and below this level. As a result, the available output from tape is considerably in excess of the normal and the line output amplifiers can be easily driven into clipping if the replay gain is set too high—this condition can be avoided if a weather eye is kept on the level meter indicating the output level.

From the preceding comments it should be apparent that some caution is required when using the dbx noise reduction system with the Nagra; fortunately, the likely finger troubles are to be found in the replay mode where mis-operation will have immediate, obvious and drastic effects upon audio quality. It is however unfortunate that it is impossible to monitor the unprocessed signals in the record mode.

Performance

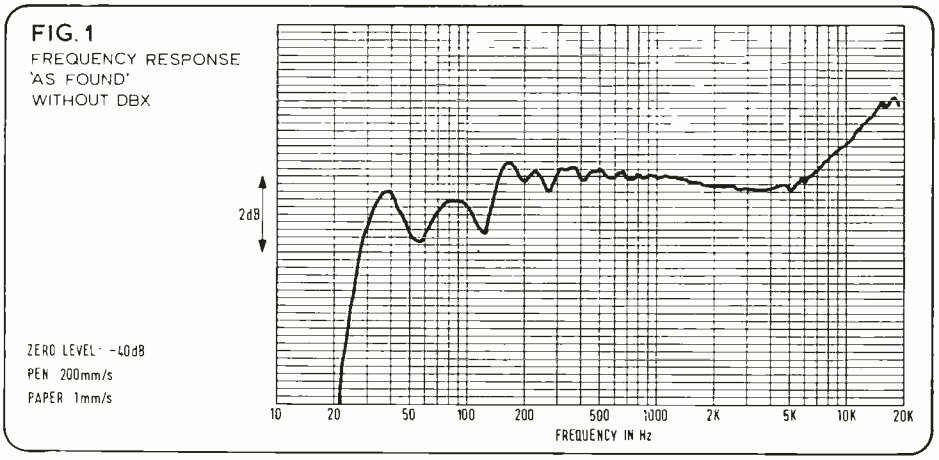
Because the basic dbx noise reduction system has already been subjected to a detailed review and field trial in an earlier edition of STUDIO SOUND, I do not propose to go into the detailed performance of the system as such, but purely to comment on the performance of the type *192* unit in conjunction with the Nagra *IV-S* recorder.

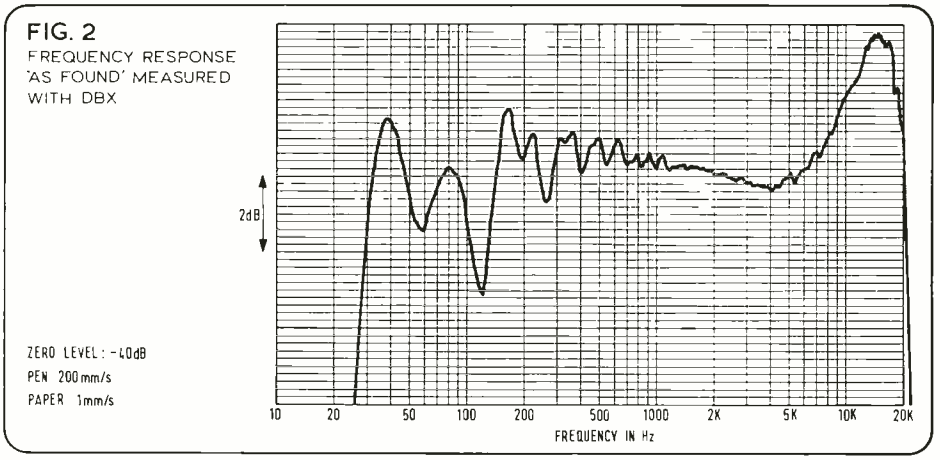
As the basic dbx noise reduction system works on the principle of 2:1 compression on record and 1:2 expansion on replay it is a basic fact that frequency response errors in the record/replay process will be doubled. **Fig. 1** shows the record/replay frequency response at 38 cm/s of the writer's Nagra which had not been aligned for a considerable period of time, but was probably typical of many machines in use in the field. The effects of using the dbx system on this machine are shown in **fig. 2** from which it is to be seen that the +2 dB response error at 15 kHz becomes +4 dB and that the low frequency head profile effects are also doubled with a consequent serious dip in response at 125 Hz. The high frequency errors can of course be corrected by proper alignment of the machine, but there is nothing to be done about the low frequency head profile effects which are fairly serious.

On the distortion front **fig. 3** and **4** show the third harmonic content from the record/replay process at a record level of zero on the Nagra meter (510 nWb/m) at a tape speed of 38 cm/s using CCIR equalisation. From these plots it is quite clear that there is a useful improvement in distortion at almost all frequencies in spite of making the measurements at such a high recording level at high frequencies.

Spot measurements of the second harmonic content at 1 kHz and 100 Hz also showed a useful improvement, particularly at 100 Hz, but this turned out to be an unfortunate choice of frequency because of the low frequency head profile effects upon the frequency response.

It has already been mentioned that considerable care is necessary to avoid clipping the Nagra's line output amplifier and that use should be made of the level meter during replay to avoid this condition, but perhaps this problem should receive some explanation. In the replay mode, with dbx in use, the meter indicates the signal after expansion, or without dbx it indicates the replayed signal from tape. Now, the dbx is normally set for unity gain at zero meter indication and during recording the meter is showing the signal applied to tape which may go as far as +4 dB meter indication. When such a signal is replayed the +4 dB becomes +8 dB as a result of 1:2 expansion. Thus if the Nagra's replay gain is set to handle a normal signal it will





have to cope with an extra 4 dB when dbx is used which may drive the output beyond its +10 dBV output capability.

The following figures demonstrate the maximum attainable dynamic range using 3M *207* tape at 38 cm/s in terms of the three per cent third harmonic distortion point at 1 kHz related to noise:

	without dbx	with dbx
20 Hz to 20 kHz unweighted	74 dB	103 dB
'A' weighted rms	76 dB(A)	103 dB(A)
CCIR weighted rms	74 dB	99.5 dB
CCIR weighted with DIN quasi peak meter	70 dB	95 dB

The above indicates a very substantial improvement and it is thought that the actual noise improvement is better than indicated by these figures which were influenced by breakthrough of the capstan servo tone; unfortunately time did not permit a detailed investigation into this factor.

Summary

The dbx noise reduction system for the Nagra recorder offers a substantial reduction in noise and overall increase in dynamic range, with the result that recordings may be made at lower levels with consequent reduction in distortion. In addition there is no reason to disbelieve the dbx claim that the system is fully compatible with other dbx noise reduction systems.

A further advantage of the use of dbx noise reduction with the Nagra and other potential systems which record pilot tone is that the effective pilot tone crosstalk appears at a much lower level in the output, as do print through and other spurious signals generated within any machine.

However, a price has to be paid for this luxury, and in the case of the dbx concept any frequency response errors in the record/replay chain are doubled, as are tape uniformity errors. In the case of the Nagra *IV-S* the middle and high frequency response can be adjusted to be extremely flat, but low frequency head profile effects become somewhat emphasised when the dbx system is used.

On the mechanical front the dbx unit is very well built, but a little more thought is required about the method of mounting the unit on the Nagra *IV*.

Operationally things are not particularly sweet, but dbx have clearly done all that they can with the limited connections available on the Nagra *IV*. My impression is that the noise reduction connector on the Nagra was, perhaps, given insufficient thought by the manufacturer as it only gives a pair of inputs and outputs and a single power rail which has been put to good use; the dbx unit draws remarkably little power from the Nagra supplies.

Ideally facilities should have been incorporated for simultaneous noise reduction code/decode for proper off tape monitoring, and also automatic record/replay switching—perhaps this is something to come in the future? ■

FIG. 3
NAGRA IV
RECORD/REPLAY
DISTORTION
WITHOUT DBX

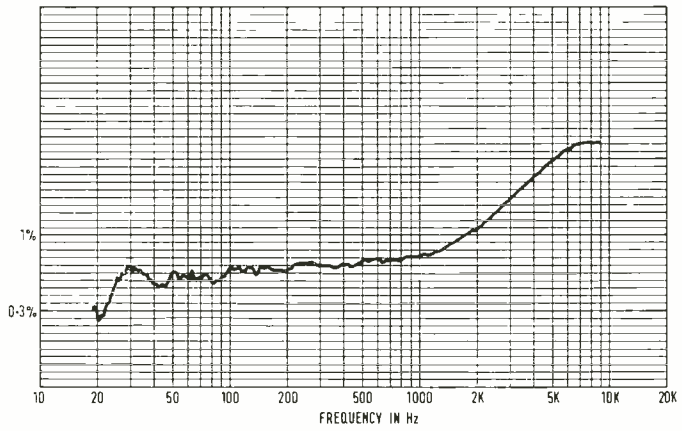
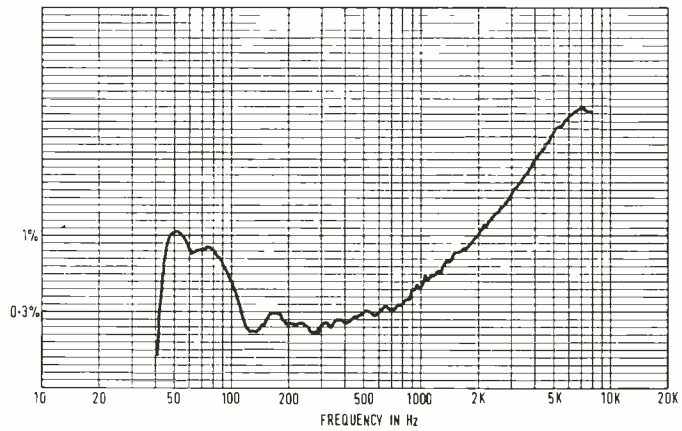


FIG. 4
NAGRA IV
RECORD/REPLAY
DISTORTION
WITH DBX



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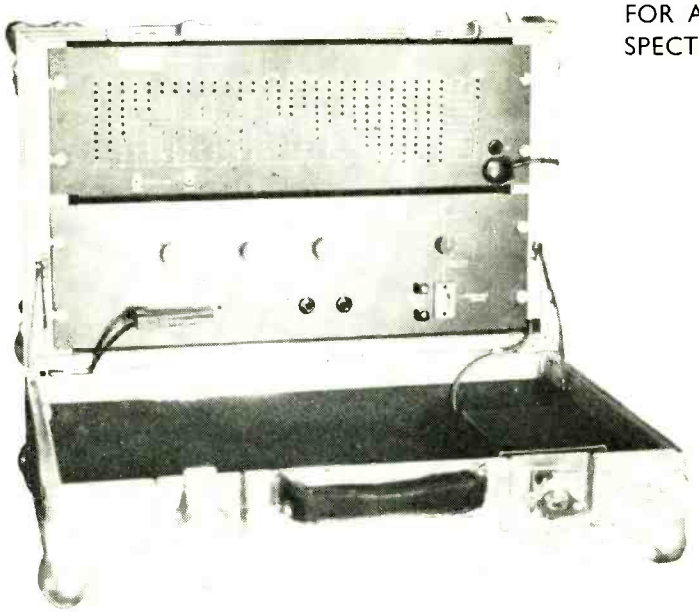

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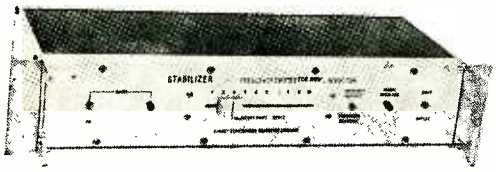

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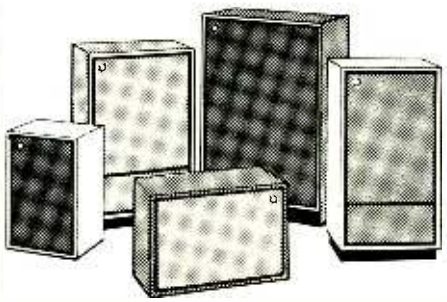

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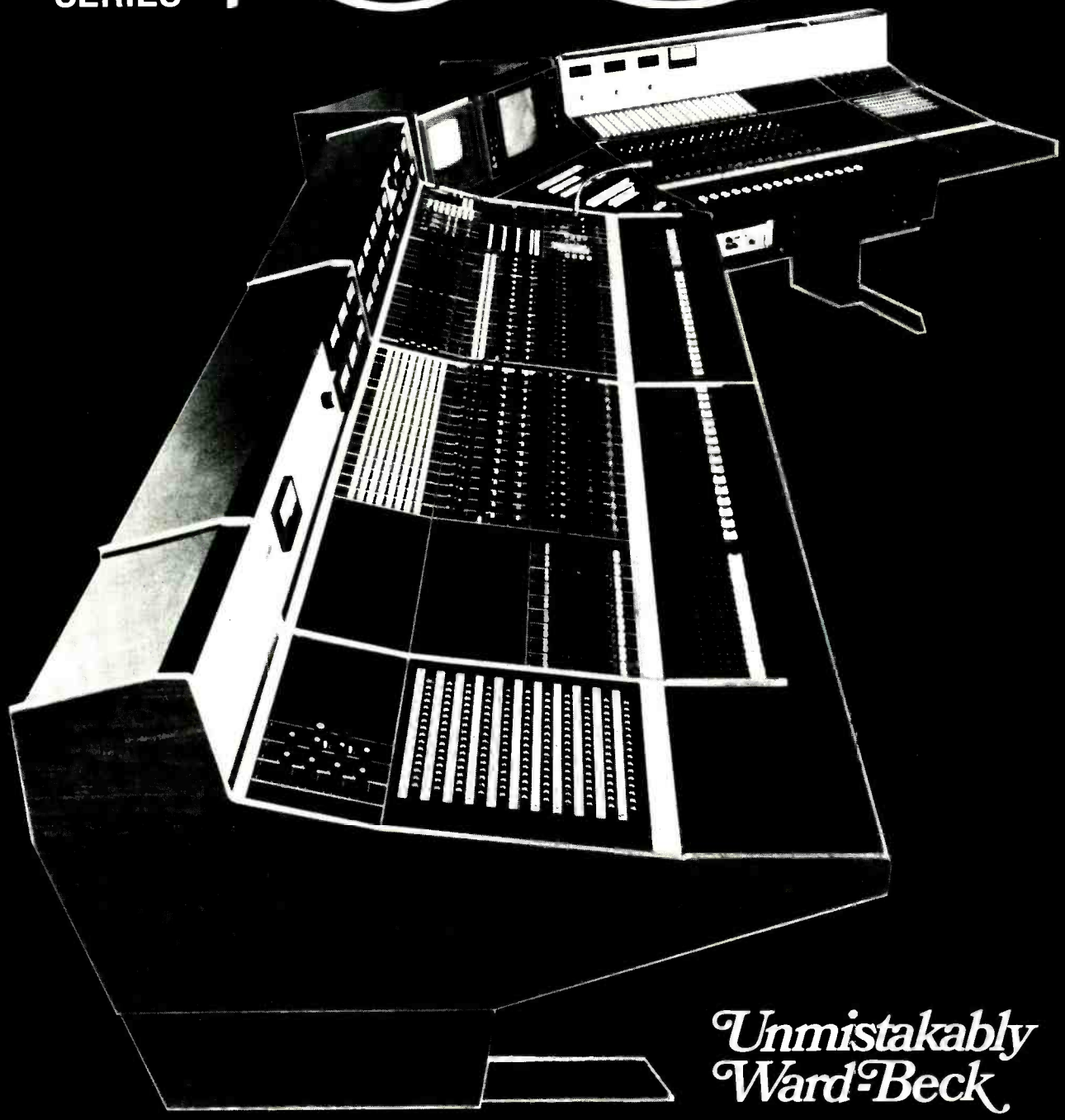

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