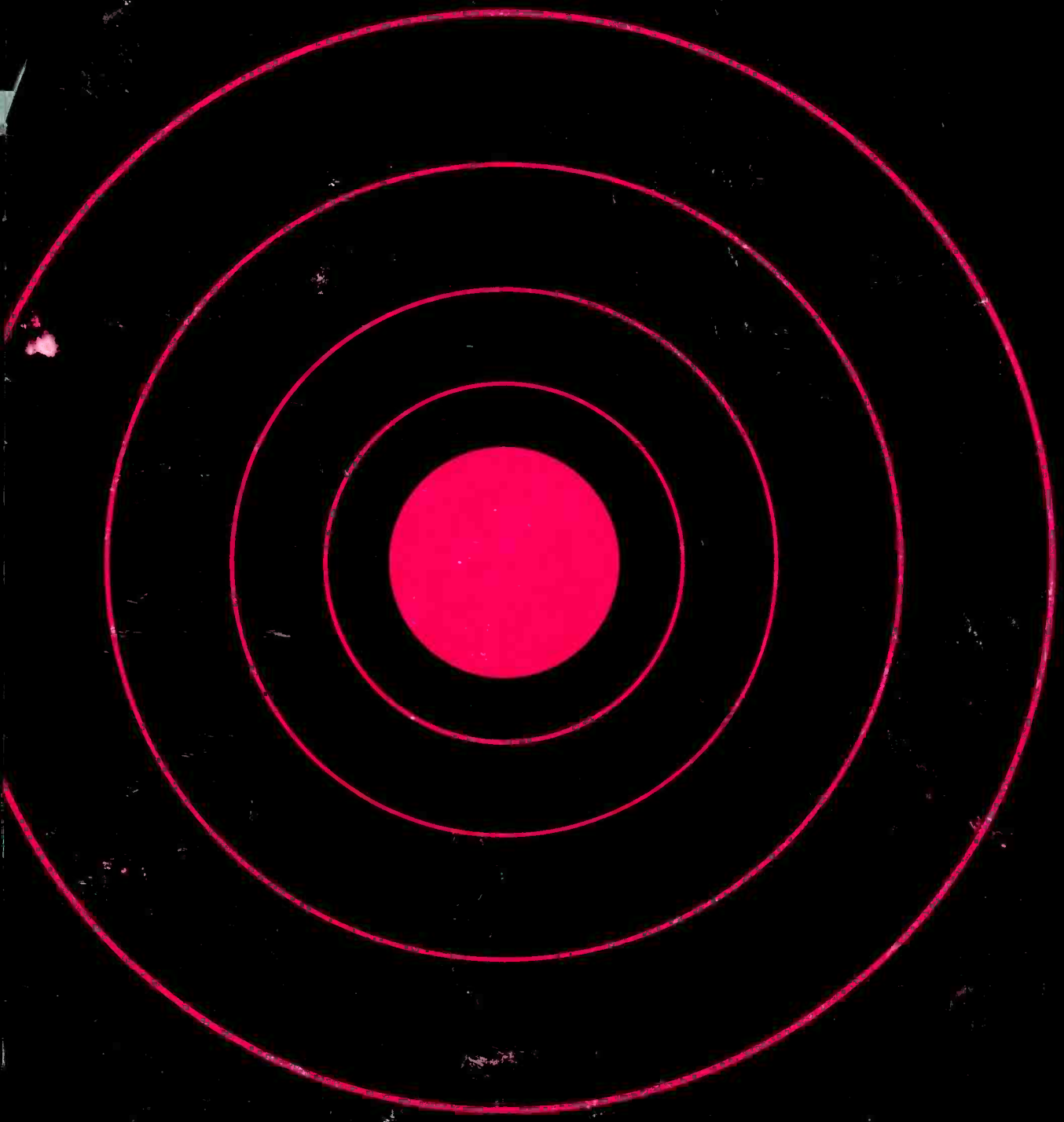
April 1977 45p

studio sound

AND BROADCAST ENGINEERING



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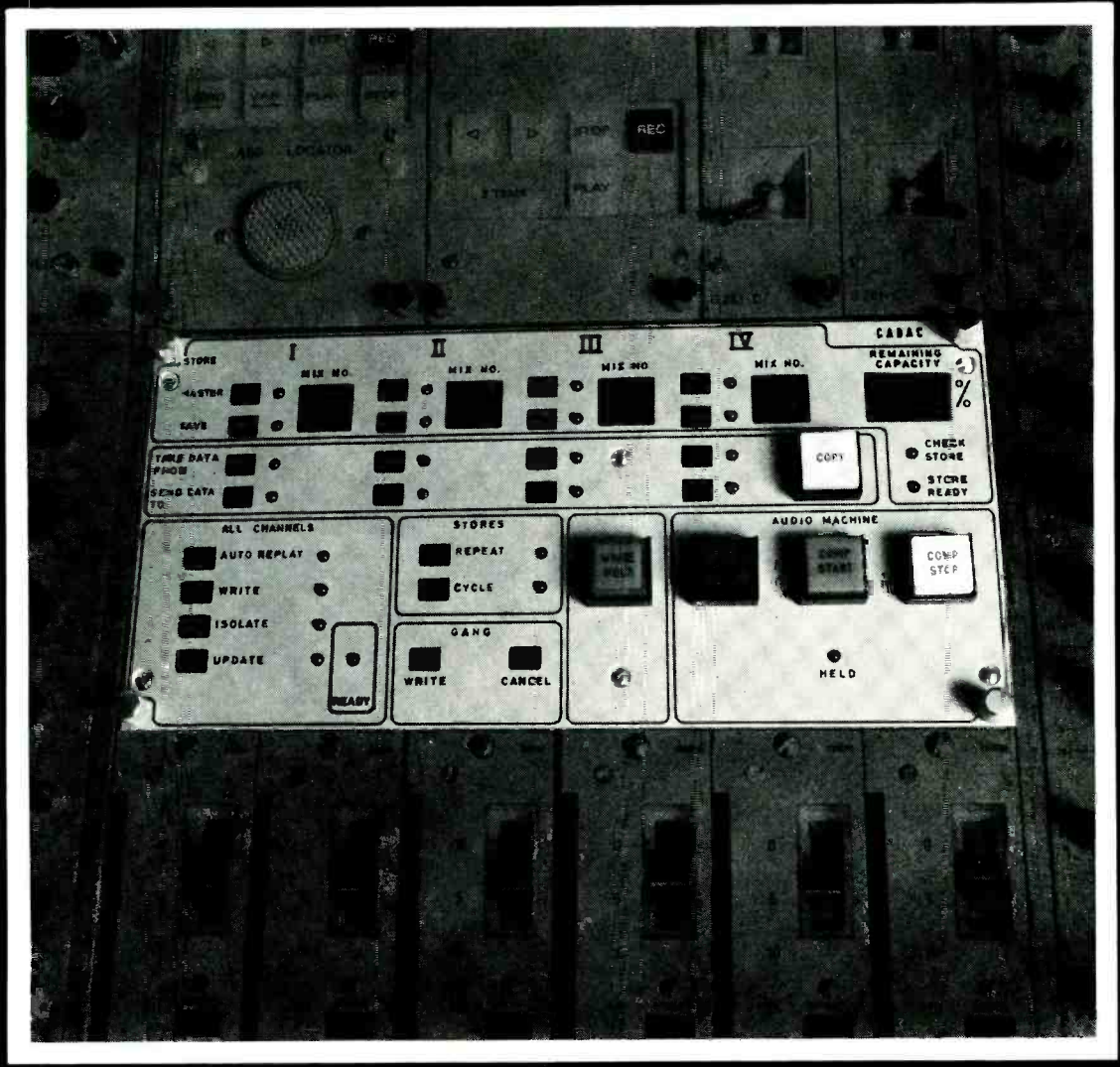

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Telegrams: Aviculture Croydon

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 £7.60 (UK) or £7.20 (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 3899 per issue during 1975. UK: 5689 overseas: 3211. Total average net circulation of 10 030 for January 1976. UK: 6003, overseas: 4027

studio sound
AND BROADCAST ENGINEERING

The cost of technology

This month we review a series of reverberation and delay units, one of which, the EMT, costs £8000. The unit performs superbly and the manufacturer will doubtless sell all that he can produce.

It simulates a foil with ease, bettering the performance of the latter in almost every aspect. For instance, the easy to use controls allow repeatable frequency dependant decay characteristics combined with an accurate definition of the overall decay time. The digitaudio processing enables a range of peripheral effects ranging from a Watkins *Copy Cat* (without the noise) to a digital delay line, albeit without the absolute performance.

But why should anybody spend the kind of money it takes to buy one? It's a dead cert that the people who will already possess an EMT foil, an Eventide delay line and probably a *Copy Cat* as well. It therefore seems doubtful whether the finished masters from these studios will sound £8000 better.

The answers to the question 'Why?' have very little to do with musicality and even less connection with practicality. The principal reason concerns staying ahead of the opposition and/or keeping the clients you've got already; the actual cost in day to day terms is about £170 a month over five years.

It seems crazy that, at a time of falling record sales, studios are prepared to indirectly increase production costs by fuelling an inflationary spiral. It would be easier to understand if such investments offered really tangible working or financial benefits; one can't escape the feeling that the money would be better spent on a new tea machine or even a rack of parametric equalisers.

Technology and studio time the industry has. What it hasn't is a progressive attitude shown by the larger record companies. These big spenders shell out too much money on sure fire success; more often than not they exhibit little control on how the money is spent. If Name band X has what amounts to an open cheque, then it's going to hit the record company for the most expensive, although not necessarily the best, recording facilities around. Why are they the most expensive facilities around? Probably because they've got the highest overheads around, etc.

The record companies should realise that there's a whole lot of recording studios other than the big five, ten or whatever who can deliver a high quality product more cheaply and efficiently while, at the same time, releasing money for new talent.

After all, one of the basic tenets of capitalism states that demand will always rise to meet supply if it's being given away.

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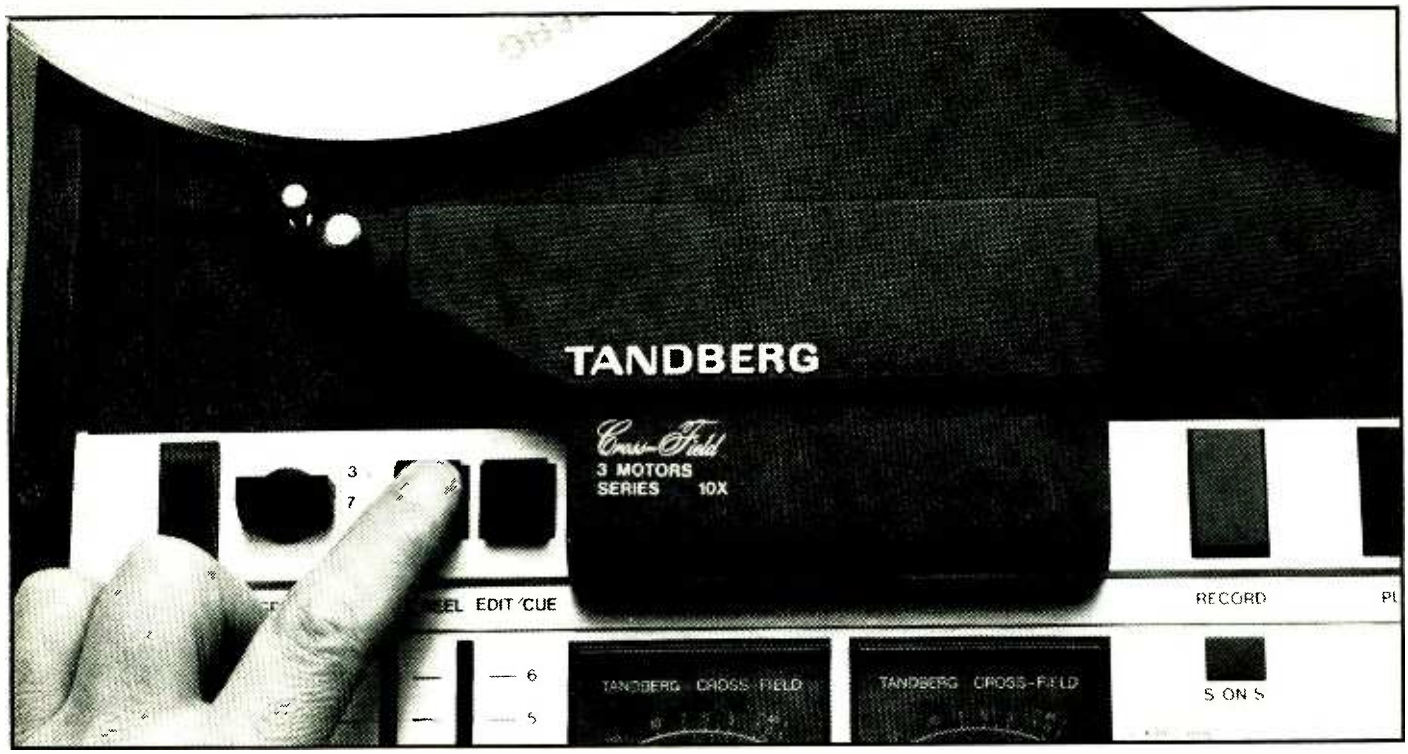


Amateur or pro, once you've recorded with a Tandberg you won't give up till you've got one.

The Tandberg 10X is an amazing piece of machinery. Used in studios and in broadcasting, its professional credentials are outstanding. It's the only one in the world that gives you 10½" reels with a 15 ips facility, and the unique cross-field technique on all three speeds.

And it's exceptionally versatile. It has four input controls – two for microphones and two for line which provide mixing in stereo or mono. The microphone inputs are balanced and the large level meters are peak reading. The meters indicate record and replay levels and all level regulating is by slide potentiometers. A special control (EDIT/CUE) enables you to monitor the tape during fast winding. Another feature is manual spooling for precise location of programme material for accurate cueing and editing. The 10X has three motors, three speeds, four heads and electronic servo speed control – plus many other features, including optional remote control.

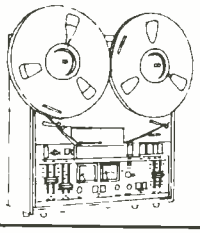
Tandberg 10X for the professional

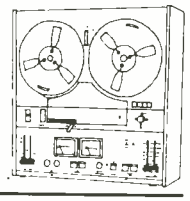
And it's competitively priced.

Although the 10X is the superstar of our reel-to-reel recorders, the medium-priced 3500X offers excellent recording qualities. It's a proven machine – reliable and versatile. It also incorporates the Tandberg Crossfield technique. Other features include three speeds, four heads, A and B monitoring, 30–22,000 Hz + 3dB at 7½ ips and a signal-to-tape noise ratio of 64dB (IEC A-curve).

Of course that's not all. But why don't you call in at a Tandberg dealer and record on these machines for yourself? Or clip the coupon below for more details. Once you do – honestly – you won't give up till you've got one.

Tandberg 3500X for the damn-near professional





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All specifications better than requirements of DIN 45 511

POWER REQUIREMENTS 50 or 60 Hz		240/230/115 V	240/230/115 V
POWER CONSUMPTION		100 W	45 W
TAPE SPEEDS i.p.s		15-7½-3¾	7½-3¾-1⅞
SPEED TOLERANCE max		± 0.3%	± 1%
WOW and FLUTTER, max			
Peak DIN 45 511	15 i.p.s	0.07%	
	7½ i.p.s	0.09%	0.1%
	3¾ i.p.s	0.15%	0.18%
	1⅞ i.p.s		0.35%
Weighted R.M.S.	15 i.p.s	0.04%	
	7½ i.p.s	0.06%	0.07%
	3¾ i.p.s	0.11%	0.12%
	1⅞ i.p.s		0.25%
FREQUENCY RESPONSE:			
DIN 45 500	15 i.p.s	30-30 000 Hz	
	7½ i.p.s.	30-26 000 Hz	30-26 000 Hz
	3¾ i.p.s.	30-20 000 Hz	30-20 000 Hz
	1⅞ i.p.s.		30-11 000 Hz
± 3dB	15 i.p.s	30-25 000 Hz	
	7½ i.p.s.	30-22 000 Hz	30-22 000 Hz
	3¾ i.p.s	40-18 000 Hz	40-18 000 Hz
	1⅞ i.p.s		40- 9 000 Hz
SIGNAL TAPE NOISE RATIO at highest tape speed with Tandberg Tape or equivalent tape.		2-track 4-track	
IEC A-curve (DIN 45 500, weighted)		67dB 65dB	64dB
IEC, unweighted R.M.S. (DIN 45 500 unweighted)		58dB 58dB	57dB
HARMONIC DISTORTION, max.			
From amplifier at 0dB		0.2%	0.3%
From tape at 0dB record level		2%	3%
CROSSTALK ATTENUATION at 1000 Hz, minimum		Mono 60dB Stereo 50dB	Mono 60dB Stereo 50dB
INPUTS Input impedance/sensitivity, max voltage at 400 Hz (MIC inputs are suitable for dynamic microphones. The sensitivity is automatically adjusted for the mic impedance		MIC (balanced): 0.23 mV-35 mV RADIO: 50 k ohms/ 8m V-1.2V LINE: 200 k ohms/ 30m V-5V	MIC: 130 µ V-25mV RADIO: 50 k ohms /8m V-1.2V LINE: 500 k ohms /100 mV-10V
OUTPUTS Min. load impedance/voltage with unloaded output or power output for each channel		RADIO: 5 k ohms/ 0.775 V LINE: 150 ohms/1.5 V HEADPHONES: 8 ohms/5 mW	RADIO/LINE: 5 k ohms/1 V HEADPHONES: 100 ohms/1 V

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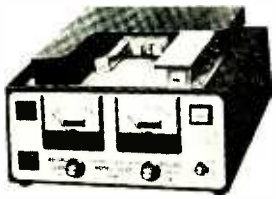

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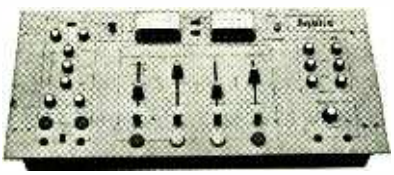

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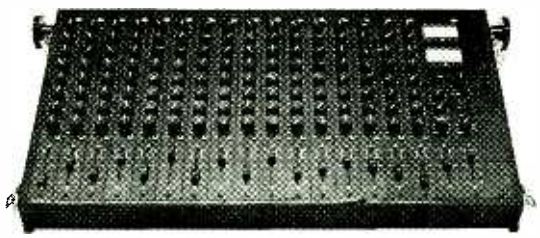

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The Amcron Story

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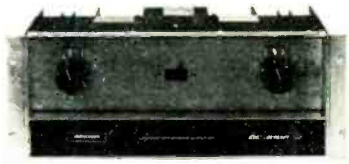
1977



In 1967 Amcron (Crown International) introduced the world's first 'Super-Amp'. This was the DC300! It rapidly became a must for all the major recording studios and top bands such as Zeppelin, Jethro Tull and the Moody Blues.

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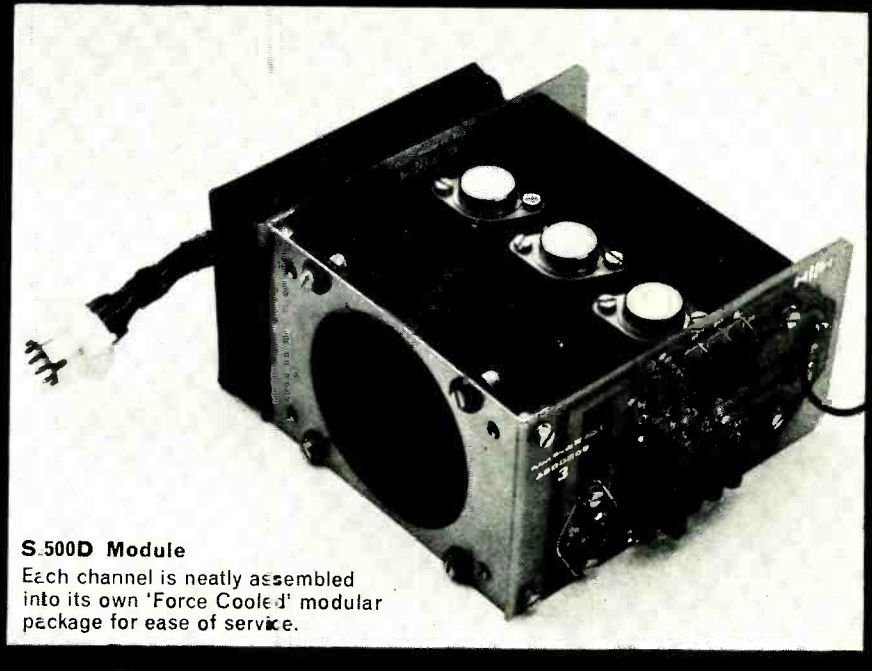

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Maximum undistorted continuous sound pressure level (DIN 45582) at given harmonic distortion	116 dB SPL per system equal to 42 mW or 5 V at 600 ohms
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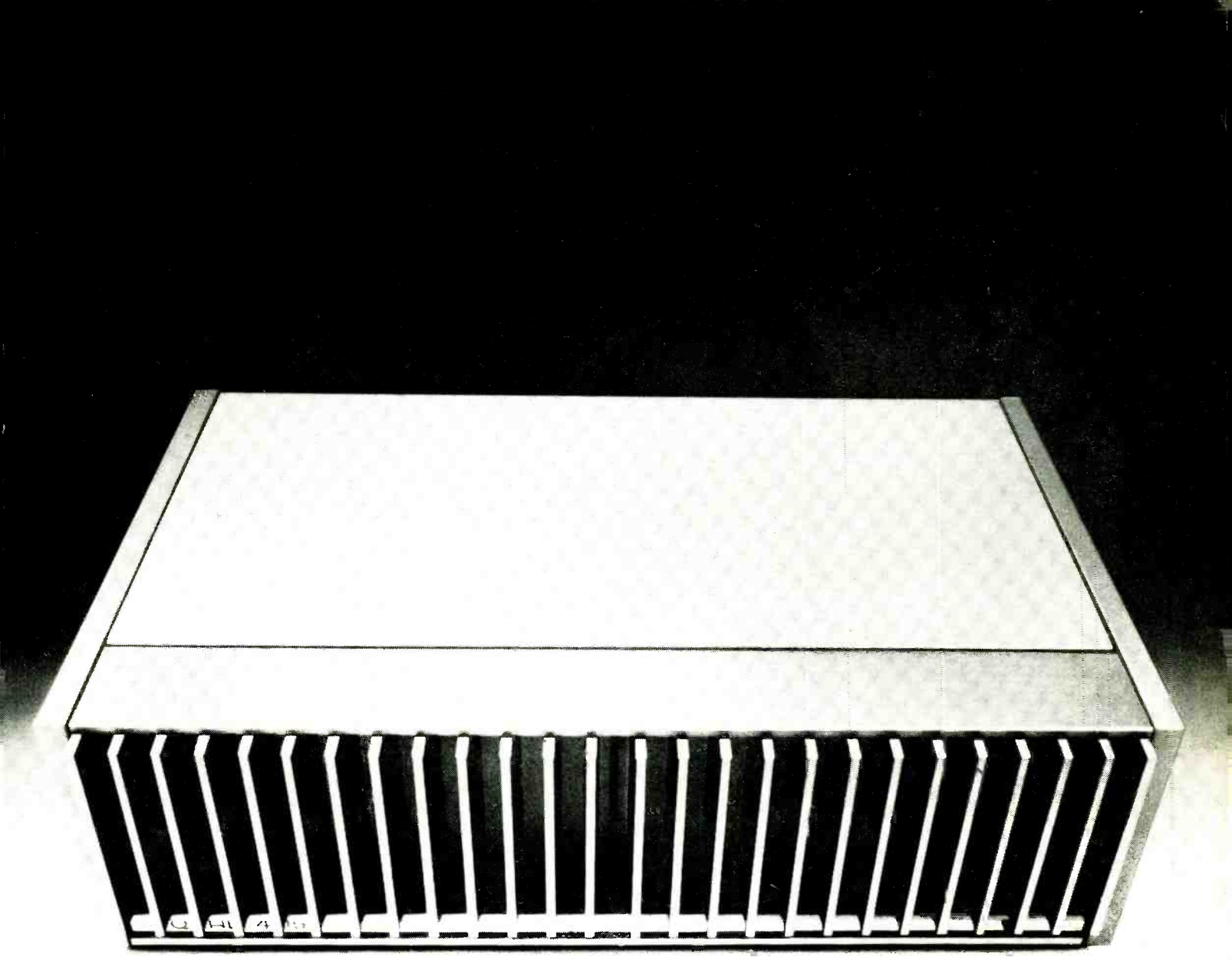

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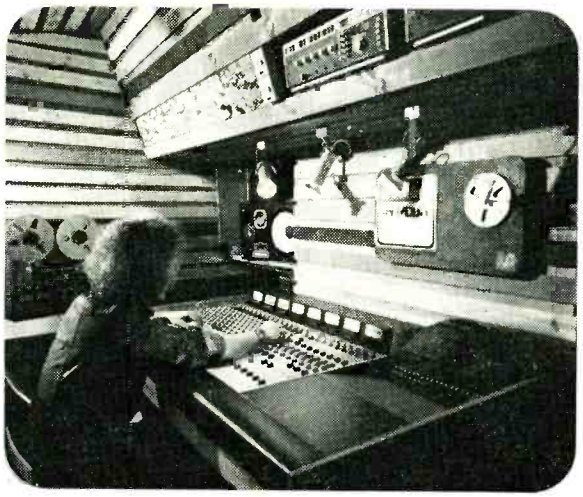

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A short list that explains why the Moduler II should be at the top of yours.

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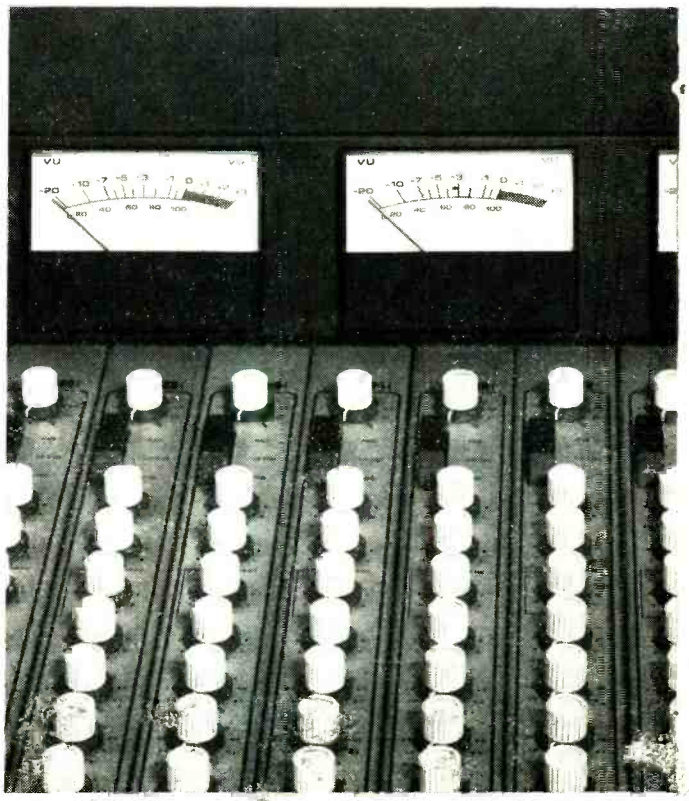

news

Computerisation
Or at least in a small way; the Swedish company Dataton has produced an ingenious modular music manipulation and generation system which can operate manually by patching various processing blocks together, or offer microprocessor control of individual modules.

The company manufactures 13 modules, most of which are fitted with four individual processing channels:

1) Line amps (4-channel)
2) Voltage controlled sound generator bank (4-channel)
3) Noise generator, variable low pass filter
4) Voltage controlled filter bank (4-channel)
5) Envelope shaper (4-channel)
6) Graphic octave equaliser (2-channel)
7) Electronic reverberation unit (2-channel)
8) Ring modulator
9) Signal routing block
10) Fader and pan block (4-channel)
11) Voltage controlled quad pan facility
12) Power supply and power amplifier
13) Micro computer cpu

In addition, the cpu has an 80 address serial data buss for operating external tape machines, slide projectors or whatever. This gives a controlling interface for recording/editing operations, live sound control and electronic music generation. It can also be used to automate the mixdown process in desks of moderate size and control video/audio edits in film work.

The system *3000* is manufactured by:
Dataton AB, Box 257, S-581 02 Linkoping, Sweden. Phone: 013-10 07 11.

Bespoke tailors
Professional Tape Marketing Associates announce their dealership for the Control Technology Corporation agency. The principal product is a cassette duplication cue tone generator which provides low frequency tones for tailoring programmes.

The generator takes its cue from either an optical or magnetic trigger attached to the master dupe tape. Following this event, the cue generator waits for a period variable between 1 to 40 ms to make sure that the trigger was genuine and then initiates a sine wave starting from a zero crossing. The sine wave tailoring signal which is recorded on the dupe tapes can comprise 1 to 99 cycles at any normal speed playback frequency from 1 to 12 Hz. An external control sets the speed multiplication factor.

The advantage of the instrument derives from the lack of audible switching click normally associated with free running gated oscillators.
Control Technology Corporation, 80 Turnpike Road, Westboro, Mass 01581, USA. Phone: (617) 366 9668.
Professional Tape Marketing Associates Ltd, Cassette House, 57 Manor Park Crescent, Edgware, Middlesex HA8 7LY. Phone: 01-951 0488.

Roland Synthesiser
The Roland *700* synthesiser, incorporating keyboard controller, main console, vco block, vcf/vca block, interface mixer block, shifter delay block and sequencer, can be purchased in the UK from Freedmans Music Centre, 629 High Road, Leytonstone, London E11. Phone: 01-539 0288.

All blocks of the synthesiser can be routed around using conventional patch cords; each module contains its own input mixer, which means that signal level in the various signal routes can be maintained to optimise signal to noise ratio vs input overload. The manufacturer states that the system was engineered for adaptability of interface with external units. As such, it contains a series of line up oscillators for rapid calibration. Most modules incorporate green leds to indicate the presence of normal signal levels; corresponding red leds show up overload conditions.
UK importers: Brodr Jorgensen (UK) Ltd, Unit 6, Great West Trading Estate, Great West Road, Brentford, Middlesex. Phone: 01-568 4578.

Analysers
The German company Audio Int'l manufactures a range of real time spectrum analysers capable of performing most tasks associated with recording and record production.

The *EA75* offers octave analysis using an led matrix; it features a built-in noise generator delivering both pink and white varieties. There are switchable inputs for conducting comparison analyses.

For more detailed work, the *ARA 412/414* units offer 27 ⅓-octave bands for real time analyses displayed on a crt. The ISO centre bands lie between 40 and 16k Hz. A detailed input circuit provides a series of both high and low impedance ports routed to a common buss. The signal is then passed through successive buffer stages to the 27 filters which, in turn, provide dc outputs relative to the signal levels in each band. The dc levels are scanned every 30 ms and displayed on the crt indicating a range of 27 dB per column.

It features, like the *EA75*, pink noise generators to provide the basic transmission signal for signal path calibration. Further, the crt display can be used remote from the filter array thus providing a high quality large screen oscilloscope.
Audio Int'l GmbH, Postfach 560 229, 6 Frankfurt-am-Main, Gonzenheimerstrasse 2B, West Germany. Phone: 504733.

Noise standardisation
Those who make noise measurements as a matter of course will doubtless agree with Dolby Labs when the latter says that present noise measurement standards are a veritable jungle. With this in mind, Dolby has recently announced its intention to lobby for the CCIR weighting network coupled to an average reading millivoltmeter.

The company states that this method gives very repeatable results which correlate closely with actual listening conditions. Further, average measuring technique (ordinary voltmeters etc) is cheap to implement. With this in mind, Dolby has produced a CCIR weighting filter *Cat no 98* selling for £95, $250.

CCIR measurement also shows the Dolby B system performance to best advantage.

Sell out
All the sites for the June 77 APRS exhibition have been sold out following a meeting of exhibitors at the Connaught Rooms on January 11. During two hours of balloting, 82 potential companies competed for the 99 available sites.

During APRS 76, one in four of the registered visitors represented overseas interests.

Function Generator
Dana Electronics has introduced a portable function generator offering a dynamic frequency range from 0.02 Hz to 2.2 MHz, with sine, square, triangle and variable symmetry of all waveforms for ramp and pulse operation. A vcf input allows the generator to be varied up and down over a range of 1000:1.
Dana Electronics Limited, Collingdon Street, Luton, Bedfordshire. Phone: 0582 24236.

Cassette Tape Splicer
Audico has announced the model *745* automatic cassette tape splicer for use with their model *751* cassette loader.

Advantages claimed include the non-production of air bubbles, ease of operation and performance with most brands of splicing tape and foil. The unit can also be adapted to handle 6.25 mm tape.
Audico Limited, 219 Crossen, Elk Grove Village, Illinois, Ill 60007, USA. Phone: (312) 640 1030.

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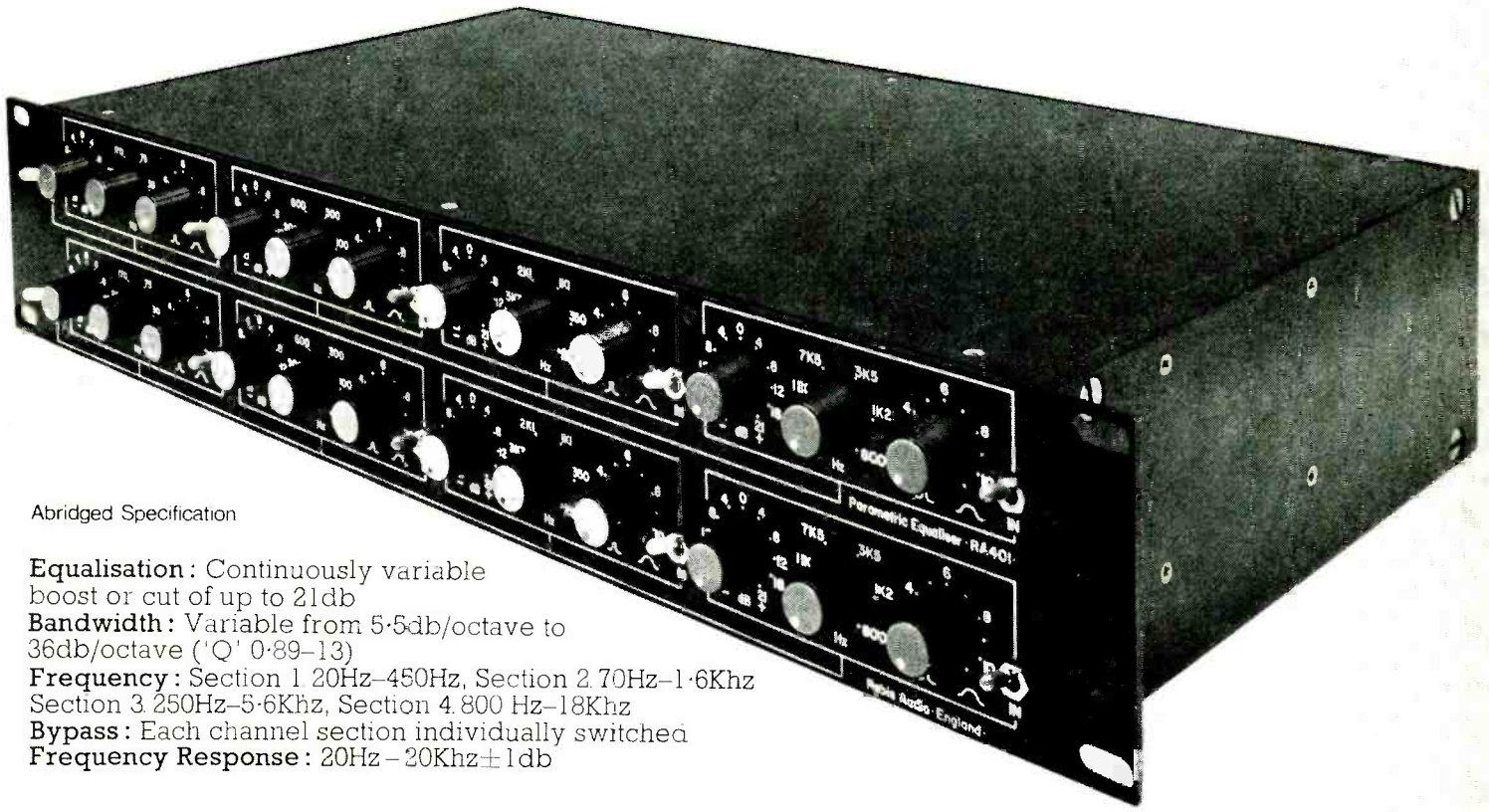
Digital cue synthesiser from Control Technology

Perfectly Parametric Equalisation

Rebis RA401 Parametric Equaliser

Two independent four section equalisers in a compact 3½" mains operated rack mounting unit. Allowing extremely comprehensive parametric equalisation for musical shaping or restoration of degraded programme, the RA401 is a versatile, effective and reasonably priced British manufactured tool for the Broadcast and Recording Industries.



Abridged Specification

Equalisation: Continuously variable boost or cut of up to 21db
Bandwidth: Variable from 5·5db/octave to 36db/octave ('Q' 0·89–13)
Frequency: Section 1. 20Hz–450Hz, Section 2. 70Hz–1·6Khz Section 3. 250Hz–5·6Khz, Section 4. 800 Hz–18Khz
Bypass: Each channel section individually switched
Frequency Response: 20Hz – 20Khz ± 1db

Sole Distributors for Rebis Equalisers
Scenic Sounds Equipment

27/31 Bryanston Street London W1H 7AB
Tel. 01-935 0141

NEWS

Broadcast limiter

The stereo limiter type *FM601* from Broadcast Electronics offers two channels of gain riding combined with peak limiting facilities. It claims to provide automatic level control and optimisation of modulation index without over modulation. It also incorporates selectable pre-emphasis in addition to the compression and peak limiting operation.

The unit costs $1795 from Broadcast Electronics Inc, 8810 Brookville Road, Silver Spring, Maryland 20910, USA.
UK: Broadcast Audio Ltd, PO Box 31, Douglas, Isle of Man. Phone: 0624-4701.

Unfair competition

Some of you out there haven't been playing entirely fair with poor old EMI. In fact, someone has been behaving like a right cad. Fancy ripping off 300 million tape copies without asking permission . . . No wonder record and tape companies don't show more than a slight profit . . . I promise that I'll never tape my friends' records again and instantly destroy all five copies of *Mrs Mills and Friends* (*TC-ASD 4791*).

EMI reckons that it's got tape pirates by the short and curlies through the introduction of a magnetic water marking system much publicised and mostly misreported in the popular press. Basically, it works by magnetically stamping the duplicating tape during the coating process. Normally, magnetic domains are aligned by wiping the tape coating when wet with a magnetic field running along the tape longitudinally. By periodically breaking this magnetic field, patches of random domains are indelibly stamped in the tape which will momentarily increase the tape noise during their passage over a replay tape head while at the same time reducing the playback level of recorded signal.

This will have two principal effects: it will increase the incidence of dropout-type tape defects — asperity noise performance of EMI tape has never been particularly wonderful—and it will be much easier to establish the authenticity of the genuine EMI pre-recorded product. The main drawback of the 'watermark' system is that you have to erase the programme material to hear the regular coded variations in the background tape noise. Naturally the code can't be transferred along with the programme material since it forms an integral and physical part of the original tape. However, although it might save EMI a few, it won't do anything at all towards bettering the reproduction standards of pre-recorded cassettes . . .

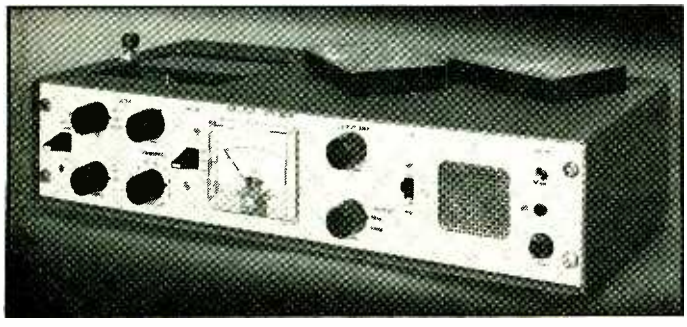
Considering the object of the system rationally (to prevent the manufacture of illegal tapes) water marking authentic cassettes will only have a marginal effect on the coffers of the rightful record company. The best that they can hope to do is to bust a few shops selling the pirate product, both in the UK —although the problem still isn't serious—and farther afield, particularly Italy and non-cong Asia. Look at the situation with bootleg records. These require a great deal more space and technology to produce them although prosecutions have made only the smallest of bites in a £MM clandestine industry. Cassette tape production can be a true cottage, or even bedroom of a cottage, business. No amount of prosecutions are going to dent the vast numbers of illegal producers. In any case, the water marking process will only be of slight use against those who actually bootleg tapes professionally. More often than not, people who want tape issues go to their friends who have the disc version rather than their friendly, neighbourhood tape shop. Where do EMI think that the vast quantity of blank cassettes go . . . amateur dramatic societies?

EMI and others would do far better to put their collective efforts into improving the quality of pre-recorded cassettes. It is quite possible that a technically better product would do far more to squash the bootleggers than a secretive code instilled upon an indifferent cassette.

Since EMI seems to have done quite a bit of time wasting, we would now like YOU to do some. STUDIO SOUND announces a competition to find the best solution to the problem of beating the EMI anti-pirate water mark. The eventual prize winner will receive a free lunch with the magazine staff and one of my illegal *Mrs Mills* copies. Closing date May 17.

Frank Ogden

EMI tape decoder



Very good

MCI (UK) LTD has negotiated an order with Elektrotekna, the Yugoslav import/export agency, for equipment valued at a total of $823 965. Naturally, this comprises of much MCI gear; seven *500* series consoles, four 24-track machines and five 2-channel machines. However, $150 000 of the contract is for UK products; notably those of Dolby and Audio Design Recording. MCI (Professional Equipment) Ltd, MCI House, 54/56 Stanhope Street, London NW1 3EX.
Phone: 01-388 7867/8.

MIDEM 77

Year after year MIDEM grows bigger and better, and more successful. This year there was even talk that the dear old Palais des Festivals, scene of so many deals and stage for many scenes, will soon be replaced by a grander Palais hotter, stuffier, and even more exhausting than the old one . . . but it could never be the same.

At MIDEM 77, the eleventh of the continuing series, in addition to the traditional wheeling and dealing in the smoke-filled rooms and other strenuous activities of a more social nature, Bernard Chevry the man who started it all, was presented with the IFPI Gold Medal for services to the record business. At the opening gala, Denis Comper, IFPI's international coordinator, introduced Dr Stephen Stewart, Director General, who made the presentation speech in latin. A unique gesture on a unique occasion.

Of potential interest to some studios, was a meeting held at a discreet venue between officials of IFPI and representatives of the record business in Poland, Czechoslovakia, Hungary, Bulgaria and Yugoslavia. Ties between East and West Europe have been steadily strengthening over recent years, but this meeting is seen as a major development. Talks of an unspecified nature are to be continued in Paris during April, where there will be a celebration of the centenary of the invention of recorded sound.

With the inclusion of studio hardware and the increasing participation by the representatives of recording studios, there is no doubt that MIDEM has become the only European market place catering for the whole spectrum of the record business. It was good to see the APRS represented.

Neve man

Neve has appointed Dr Martin Jones as a director of the company, with particular responsibility for all engineering services in the group.

Prior to joining Neve in mid 1976, Dr Jones was a lecturer at

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If you were unable to attend the Paris AES exhibition, the name.....

AUDIO KINETICS (UK) LTD

will probably be a new one — but not just another console and multitrack manufacturer — ask anyone who went to Paris.

If you are shopping the market for 32 track capable equipment, talk to the new British Innovators — AK

099 389 324 or 444

the University of Manchester Institute of Science and Technology, England, for ten years, specialising in electronics and electroacoustics.

Almost 100 years of recorded sound

For more than two generations Bernard Leach has been celebrated as the single most influential artist potter living today with a truly worldwide reputation—as strong in Japan, America and the Antipodes as it has been in Europe.

The child prodigy was born in Hong Kong on January 5, 1887 and spent the first ten years of his life sketching pictures of his nanny or *tiku*. He studied drawing at the Slade School of Art during the year of 1903 before furthering his studies under Brangwyn, generally acknowledged to be one of the greatest masters of etching ever to have appeared at a charity function.

His first one man show of pots, etchings, sketches and funny little wet things took place in 1914 during the Tokyo Festival or *Akai* which firmly established the man as a grandmaster in the art of producing pots, etchings, sketches, etc.

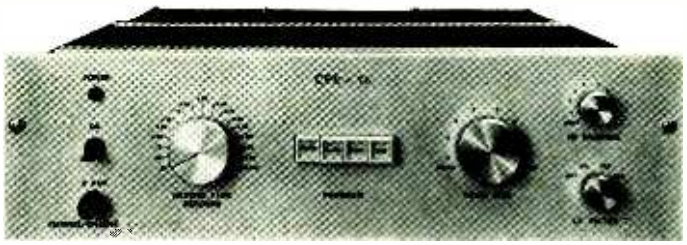
Leach originally went to Japan quite certain that he was destined to be an artist and had trained, as we have seen, in the western tradition of fine art. This training produced clear fruit resulting later on, insofar as Leach is almost unique among potters and artists in having the gift of a distinguished draughtsman and the ability to stand for hours on one leg.

Programmed Reverberation

The new *CPR-16* computer programmed reverberation unit from Quad/Eight measures 13 x 35 x 48 cm wide and features simulation of acoustic chambers, mechanical plates, spring systems and tape loops. A programmable microprocessor allows future expansion for special signal-processing effects.

Operating by totally electronic methods, dynamic range is claimed to be better than 80 dB, noise less than −80 dBm and distortion less than 0.1% thd. Controllable parameters include: reverberation time from 250 ms to 20s; decay time setting (room size); high-frequency damping, and low-frequency filtering.

Quad/Eight Electronics, 11929 Vose Street, North Hollywood, California 91605. Phone: (212) 764 1516.



CPR-16 from Quad Eight

UK: Cinesound International Ltd, Lansdown Imperial Studios, Maxwell Road, Borehamwood, Herts. Phone: 01-953 5545.

VIP

Lovable Len Lewis of Audio & Design Recording, formerly UK sales director, has been promoted to world wide marketing director co-ordinating the efforts of some 20 agents around the world. He will also be responsible for exhibitions and general company pr.,

Chris Walden, formerly of Alice takes over Len's old job and can be expected to sell quite a few more to the broadcast industry.

Audio & Design and Recording, St Michael's, Shinfield Road, Reading RG2 9BE, Berks. Phone 0734-84487.

KONK—correction

Our apologies to Peter Sarony and Associates, the studio architects mentioned in an article describing Konk studios (Feb 77 p 44), whose name we mis-spelt as Savory.

They have also alerted our attention to other features of the control room and overdub booth not mentioned in the article: background noise levels well within NR 15; reverberation times, even before any balancing, 'were very flat and right on target; better than 60 dB sound isolation between the new control room and existing studio, and the control room and overdub booth—both of which are separately floated structures, not only from each other but also from the rest of the building'.

The company is currently engaged on a complete package deal for a Nigerian studio.

Modular mixer

Alice has introduced a new mixing system based on 38 mm wide interchangeable modules for use in a rack frame with no wiring within the frame apart from a single mother printed circuit board. The input module accepts balanced microphone or line inputs, and has treble, mid and bass equalisation with a highpass filter. Echo send and foldback are controlled from the module, routing on the initial version being to four groups direct or via pan. Pfl is fitted together with a channel-mute switch and linear fader. Outputs are at zero level monitored on vu meters, with full pre/post tape monitoring and foldback.

The system is available in any number of channels from two to 32, and is completely expandable by the addition of extra modules.

Alice (Stancoil) Ltd, 38 Alexandra Road, Windsor, Berkshire. Phone: Windsor 51056.

Quick-start turntable

A new unit from Midnight Audio, designed to meet current IBA requirements, features a direct-drive motor, start-up time of less than 0.5s, less than −55 dB rumble, and wow and flutter under 0.05% rms. A direct replacement for Sparta models, the turntable is available with a choice of arms, although normally Sparta or SME would be supplied. The basic unit costs £285.

A later version will be offered with built-in pre-amplifiers and monitor facilities.

Midnight Audio Ltd, PO Box 12, Fleet, Hampshire GU13 8EF. Phone: 02514 20143.

Stolen Property

The following list of equipment contained in a light-brown, very scuffed suitcase was stolen from a motor car parked in South London on 19 February:

Two AKG *C412* capacitor mics (serial numbers 246 and 261)

Two AKG *D202* mics (serial numbers 55377 and 55389)

Two AKG *D12* mics complete with 2m cable and XLR plug

Eleven assorted mic cables and 10m mains cable

(Box file with four screw-in legs microphone stand)

SB1 stereo bar, *SC1* slide clamp and *DB1* drum boom

Several wooden stereo bars

Two lengths of 6.25 mm rope, approx 30m long, and two blocks of polystyrene foam.

If you know the whereabouts of any of this gear either contact your local police, or this office.

More stolen property

Amongst an impressive list of gear stolen from Southern Sounds Recording Studio in Lewisham, South London, during the early hours of 21 February:

Teac *A3340* 4-track (serial number 127457)

Revox *A77* 2-track high-speed

Pair Simms Watts column speakers (serial numbers 3530 and 3564)

Yamaha *YES 700* 6-channel mixer, complete with matching speakers (serial number 2927)

Sharp 8-track cartridge (seria number 40756947)

SAM tone generator (serial number 88421)

MOOG synthesiser (model unspecified)

Premier drum kit in metallic blue sparkle

Columbus copy of a *Les Paul* (resprayed metalflake blue over the normal black)

Rare copy of a Fender *Precision Bass* in sunburst

Vox-string thing keyboard unit

Wurlitzer *200E* electric piano

Mutron-3 effects pedal (fairly rare in the UK)

Suzuki 6-string acoustic guitar

Hofner steel guitar

Sonab *S75* turntable

Trio *KX620* front-loading cassette

Three Shure *585A* mics

Plus assorted mic leads and numerous master tapes, cassettes etc.

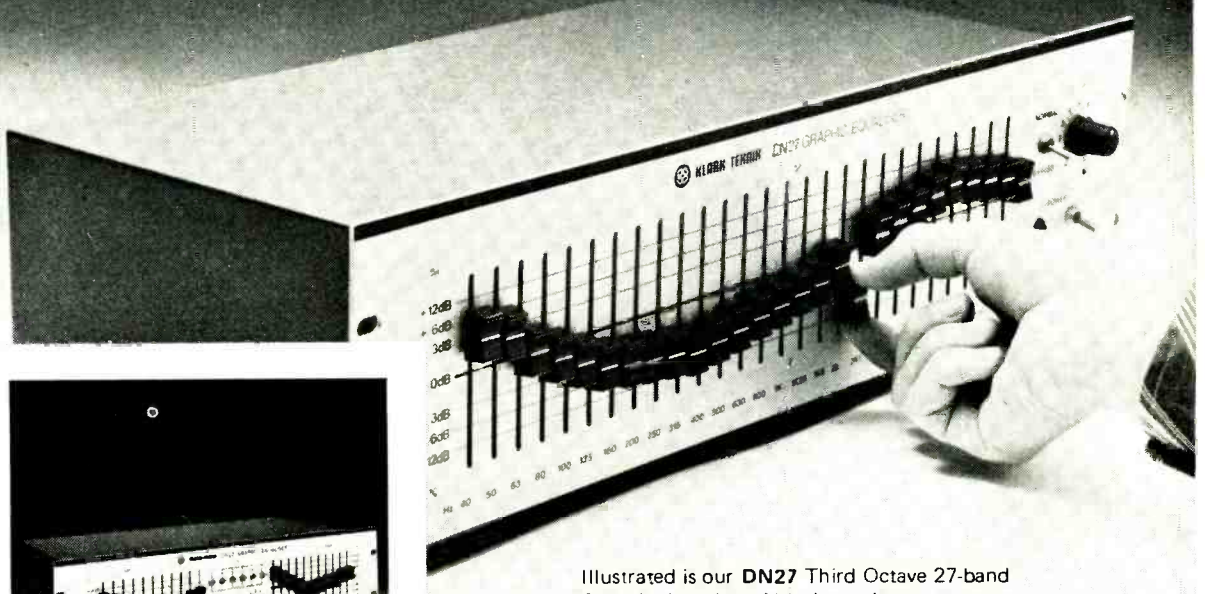
---

agony

Speculation was rife at a certain Independent Local Radio Station regarding the fate of cartridges that were disappearing in alarming numbers. It was not until several week had elapsed that an observant engineer noticed that after the newly-appointed cleaners had been round during the night a previously full bin of used carts left for the next day shift to bulk erase and return to circulation, was now empty. It transpired that the cleaners had received precise instruction to empty *all* waste-paper bins and such like, and who but a trained engineer could tell the difference between waste paper and a pile of cartridges. The result: over £750 of cartridges were destined for a fiery grave.

At the BBC, Thames Television, Capital Radio, Granada, Air Studio, Rockfield, Decca, EMI & Strawberry... they have...

PERFECTION AT THEIR FINGERTIPS



Illustrated is our **DN27** Third Octave 27-band **Graphic Equaliser.** Also shown is our DN22, dual-channel, 11-band unit. Both have many technical plusses which our literature describes.

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Klarion Enterprises, South Melbourne, **AUSTRALIA**
ARC. Sprl., Brussels, **BELGIUM**
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Audio-Quipment, Aachen, **WEST GERMANY**
Pieter Bollen, Eindhoven, **HOLLAND**
Siv, Ing. Benum & Co., Oslo, **NORWAY**
Colosseum Acoustics, Johannesburg, **SOUTH AFRICA**
SATT Elektronik AB, Stockholm, **SWEDEN**
Ultralinear International, Singapore, **SINGAPORE**
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A.E.S. Exhibition PARIS MARCH 1st-4th STAND No 27

Pieces of eight

DICK MILLS*

The development of electronic music has gone hand in hand with multitrack technique. The Radiophonic Workshop uses both to augment its facilities

*BBC RADIOPHONIC WORKSHOP

'1, 2, 4, 8, 16, 24, 32 . . . ' sounds a little like a space-shot countdown in reverse; in fact, it is the relentless count-*up* over the past few years of recordable tracks on our ubiquitous tape machines.

With the increase in the number of tracks came the associated sophistication in sound mixing techniques, particularly in the music world. Perfection had appeared to have come a few steps nearer—provided there was enough time at one's disposal to exploit all the facilities. Every nuance of loudness, balance, position and tone could now be permutated to the satisfaction(?) of the recording engineer. As a well known tv personality would say, 'that's all there is to it'. Certainly it may be the case in some recording studios, with much of the 'expertise' coming into play after the recording session has taken place, but in some instances the multitrack machine can be used in other constructive ways.

In this article, the use of such machines will be examined in the context of the construction of electronic music and special sound sequences as practised at the BBC's Radiophonic Workshop. Here, a small number of creative staff are responsible for the production of specialised soundtrack material for any of the BBC's many programme outlets—domestic radio and television networks plus the External Services and local radio stations—literally an all-embracing area.

The Radiophonic Workshop first encountered multitrack machines as far back as 1960 and the 8-track recorder then in use at the Workshop was considered a somewhat revolutionary, awe-inspiring beast with its 26.7 cm NAB reels loaded with 25 mm wide tape; a frightening sight on full-speed rewind! Compared with today's automated giants with their compacted technology, this early example had to be accompanied by a low trolley which carried the necessary power amplifiers and servo amplifier for the variable speed facility (yes, that luxury had been invented then). It goes without saying that the whole thing was equipped with thermionic valves which tended to help keep the room warm in winter and unbearable in summer. There was a combined record/replay head but, although all eight tracks could be recorded, only one track could be erased. This meant that a clean bulk-erased tape had to be used each time, and a definite campaign of action had to be planned well in advance before any sound was committed to tape. A saving grace was the facility of variable speed and more than once a humble 6.25 mm tape was smuggled on to the machine for an illicit treatment!

As **fig. 1** shows, any reference signal was first recorded on to track 1. This signal could be a metronomic indication (the familiar 'click-track'), a spoken commentary or a whole dramatic scene under which it was planned to add music or sounds. Remember, this was way back in the bad old days of 'mono' when stereo was the exception in radio broadcasting, but in this respect our eight tracks were equivalent to today's 16 tracks (there being no stereo pairs to worry about).

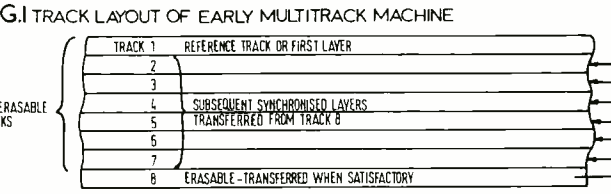
Beginning the review of the next 'thrilling instalment'. Sound cues will be 'tailcred' to fit the time code seen at the bottom of the VTR screen.

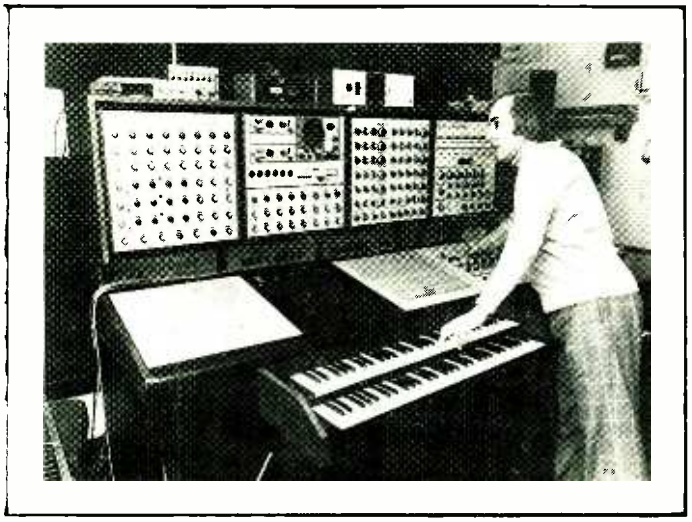
Paddy Kingsland uses ARP Odyssey synthesiser to treat pre-recorded speech in conjunction with EMS Vocoder.

The next layer was recorded on to the erasable track (8); provided all was well position-wise in relation to track 1, this layer would next be transferred up to track 2. Usually all recordings were made at 'peak' level in the interests of maintaining the best signal-to-noise ratio, with the 'dynamics' being controlled during the final mixdown. It will be quickly appreciated that apart from the first and last track to be recorded, all the others will have been recorded twice in order to obtain the correct positionings—and then there was the final mixdown to come. Hence the preoccupation with the preservation of a good signal-to-noise ratio.

Tracks 3-7 were then similarly positioned and transferred, leaving only the addition of track 8 to complete the recorded store ready for the final mix. Any filtering, reverberation, additions, etc were

FIG.1 TRACK LAYOUT OF EARLY MULTITRACK MACHINE





The author checks the 'layer' tuning prior to encoding the Synthi 100's (The Delaware) sequencer memory. (8-track recorder, Studer A80, at extreme right.)

normally left until the final mix, as any error in judgement could not be rectified once the track had been transferred to an un-erasable section of the 25 mm tape.

Unfortunately, all these processes took time and proved to be inflexible to some extent. These conflicted badly with the creative urge when programme deadlines had to be met, and because operational expertise had been acquired using standard 6.25 mm tape machines, multi*machine* working was preferred.

Leaping ahead to the present day, the Radiophonic Workshop is now equipped with three 8-track machines, all with fully comprehensive monitoring systems, remote controls, variable speed and selectable record (with erase) on all tracks. These machines may be used in diverse ways, depending upon the commission undertaken. The composition of electronic music and sound scores at the Workshop is very much a solo occupation, and in this sense the facility of multitracking has proved to be of great value—a lot of the legwork between machines has been reduced for a start!

In its simplest form, music may be built up layer by layer, using headphones to listen to a reference track which may be a simple click-track, or one of the planned musical layers itself; again dynamics and treatment are left to the final mix as before. With the advent of synthesisers (the Workshop has several, some with optional keyboard facilities), many tone colours and treatments can be easily obtained and with the multitrack tape machine the whole process of composition has become less protracted. It is still possible, using multi*speed* machines, to provide 'notes' from processed recorded natural sounds which can then be orchestrated (with razor blade and editing tape) into musical lines and multitracked to form a large sound composition.

The facility to monitor from the recording head not only maintains sychronisation but also provides an extra feed of recorded sound which can be fed through tape delay systems, filters and other treatment devices; with variable speed machines this can effectively vary the length of delay to suit the musical phrasing, and 'phasing' phenomena are often spectacularly and unexpectedly achieved.

Moving from the basic use of multitrack to its application in the radio drama field, certain advance planning has to be considered; with everything synchronised together—speech, sounds, music—the composer cannot suddenly decide to hold up the 'action' while the music is featured. As far as possible, everything must be foreseen and the 'point of no return' is right at the beginning! Much of the work is done as in the film world, with post-dubbing being more the rule than the exception. If the studio recording has been finally edited to the correct programme length and dramatic 'shape', then the composer knows exactly what spaces he has to fill, and in this case the whole programme may be transferred to the 8-track tape as the reference track. On the other hand it may be preferred to only transfer those scenes requiring additions, re-editing the completed sections into the original tape to form the transmission master.

This may give rise to speculation in respect of noise becoming apparent on the 'insert'. However, provided enough attention is paid to adequate recording levels, then this extra generation should not detract unduly from the original quality. The use of compressors, limiters and noise reduction equipment can lessen the probability of reduced signal-to-noise ratio even further. It is possible to 'dub-edit' with no audible sign of dropping-in or -out; a particular machine at the Workshop behaves splendidly in this situation *provided* that at the beginning of the day *all* tracks are set to 'record' and run simultaneously for a few seconds. It appears that this initial burst of energy first thing in the morning gets the gremlins out of the system for the rest of the day!

Where the composer has time to collaborate with the playwright and the director/producer before the studio recording takes place then the composer has a much freer hand, often composing with both speech and music in mind. The whole programme may still be post-dubbed but a better balance may be achieved—at least from the composer's point of view. As mentioned earlier, an 8-track machine may, in reality, only function as a 4-track when stereo productions are involved, although it can be expanded almost to its full capacity if 'pannable—mono' tracks are used; then it depends on how many hands you have free at the mixdown.

Turning from sound radio to television, the composer's task becomes more exacting as very often there are 'sync-points' in the picture that have to be highlighted. One effective way of ensuring that these are accurately met is to transfer these landmarks directly to a reference track. This may be done by an audible count or by using their associated sound cue. In animated film or graphic sequences it is often the case to 'lay' the previously composed sounds at the appropriate point on one track, and the relevant click-track (fitting the calculated rhythm encompassing all the sync-points) on another. As an alternative to the click a percussion track could be substituted; this usually runs throughout the music cue and provides not only an excellent reference but also saves a valuable track on the tape.

Synchronisation is the keyword in all multitrack work and most problems that arise involve synchronisation to some extent. If these can be overcome with the minimum of effort, valuable time is not lost and the result should be all the better for it. One instance occurs where a partially recorded tape is to be added to; further complicate the issue by the need for accurate synchronisation and more tracks than there is room for on the tape, and you've got problems! However, with a little ingenuity it can be done.

FIG. 2 TRACK LAYOUT FOR CONTROLLING SYNTHESISER, AND SYNCHRONOUS RECORDING OPERATIONS

TRACK 1	METRONOME 'CLICK TRACK'
2	
3	
4	TRACKS AVAILABLE FOR
5	INSTRUMENTALISTS
6	
7	
8	PULSE TO DRIVE SYNTHESISER MEMORY STORE

Avid viewers of *Dr Who* (wrongly assumed to be the Workshop's main output demand—in fact, education programmes have this honour) will know that the incidental music is a successful blend of conventional instruments and electronic synthesiser. Both have to be combined artistically for the musical ear, and dramatically to support the pictorial action. The instrumentalists are recorded at a conventional session on to a multitrack tape; the electronic 'lines' from the synthesiser are added later at the Radiophonic Workshop, and here the multitrack machine is closely associated with the large EMS *Synthi 100* synthesiser. Reference to **figs. 2** and **3** will clarify subsequent points in the text.

At the original music recording, a click-track (heard on headphones by the musical director and some of the players) is simultaneously recorded on to a separate track. Later, this same click-track will be used when putting electronic music lines into the

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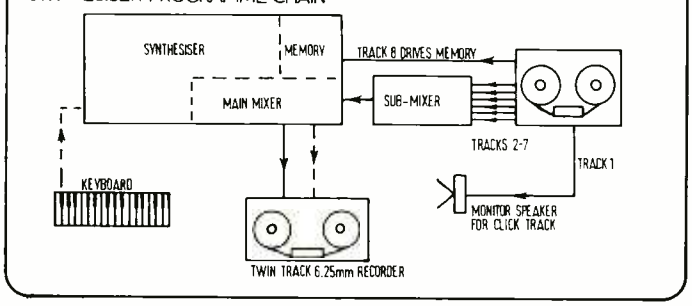
Synthi's memory system. Thus both musical components are recorded in similar tempo. To achieve synchronisation, the pulse normally used to drive the memory when 'recording' and 'recalling' is laid on track 8 *before* any lines are produced from the synthesiser keyboard. By arranging the pulse to run concurrently with the musician's track (and beyond if necessary) the synthesiser's memory will only function when the tape is played. When all the three layers of the memory have been utilised the tape is re-run and the musicians combined with the electronic lines on to a final 6.25 mm master tape. So that full control can be exercised at the dubbing session with the video information, the musicians occupy one half-track of the 6.25 master and the electronic lines the other. In this way, final balancing can be achieved between all audible information—speech, sounds and music.

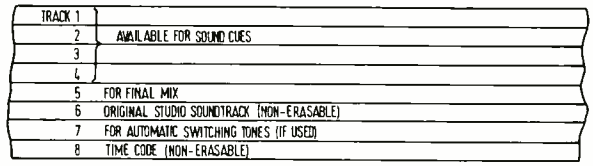
One advantage of using some of the tracks as control tracks is demonstrated where particularly fast-moving lines of electronic music are called for, and manual dexterity cannot cope. If the pre-recorded tape is run at reduced speed, the keyboard operation can be more leisurely since the tempo of the click-track is also

FIG.3 BLOCK SCHEMATIC OF TAPE CONTROLLED SYNTHESISER PROGRAMME CHAIN



reduced (mind you, the musicians sound rather peculiar!). In turn, the memory is driven at a slower rate by the recorded pulse *but*, when the tape speed is restored to normal, after storing the musical lines in the memory, everything becomes high-speed virtuosity. Unlike speeded-up recordings which alter pitch correspondingly, the memory only 'recalls' faster and so the remembered information is played quicker with the pitch remaining unaffected. By *not* using the tape simply as a magnetic store for the electronic lines, options are kept open until the very last mixdown, as adjustments to tone colour, envelope shaping, reverberation, etc can be made at any time as the lines emerge from the synthesiser; the memory can be said to remember the 'tune', not necessarily the

FIG.4 TRACK LAYOUT FOR 'SYPHER' DUBBING SYSTEM



instrumentation.

Although physically away from the Radiophonic Workshop, an 8-track machine at the BBC Television Centre's Sypher dubbing suite is used in a similar fashion. Again, synchronisation is the aim but this time between pre-recorded sound and vision (see **fig. 4**).

Recorded time-code is used to lock together a video recorder and the multitrack sound recorder; synchronism is ensured in all transport modes—play, record or spool. With both machines running simultaneously the dubbing mixer has a choice as to which information he uses as his guide track. It may be the action in the picture, a spoken word in the dialogue or the displayed time code which is superimposed upon the screen. This latter facility enables sound laying accuracy to within 1/25 second (one tv picture frame) the sound cues being cued remotely from 6.25 mm tape machines by selecting the required frame time on the mixing desk. The sound and music cues are laid on to the vacant tracks of the sound recorder, and a further track can accommodate the automatic track-switching signals. When all the additions have been laid, a final mix is made on to another track and transferred later to the master transmission tape.

The result of these sophisticated refinements is a more polished final presentation with no infuriating 'near misses'. With the complex sound and music scores demanded by such programmes as *Dr Who* —requiring split-second cueing for dramatic effect—the fact that this can be achieved means that Mr Spock and the Starship *Enterprise* no longer have the monopoly on finesse! Certain safeguards are built into the system and it is not possible to erase the original studio soundtrack or the synchronising time-code. In fact, with the re-emergence of non-erasable tracks we seem to have come full circle.

Looking ahead, it is not too difficult to envisage multitrack machines being ganged together with a common synchronising system for even greater number of tracks to play with, without resorting to huge tower-block type recording heads trying to imprint wide tapes; it may be that multitrack machines will function equally well as control devices as opposed to musical construction aids. Then we'll all be able to sit back, push the 'start' button and watch it all happen. At least, if we don't like the result we can always blame the machine! ■

The author would like to thank his colleagues at the BBC for their assistance in the preparation of this article.

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Ripped skins
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Pipless maraccas
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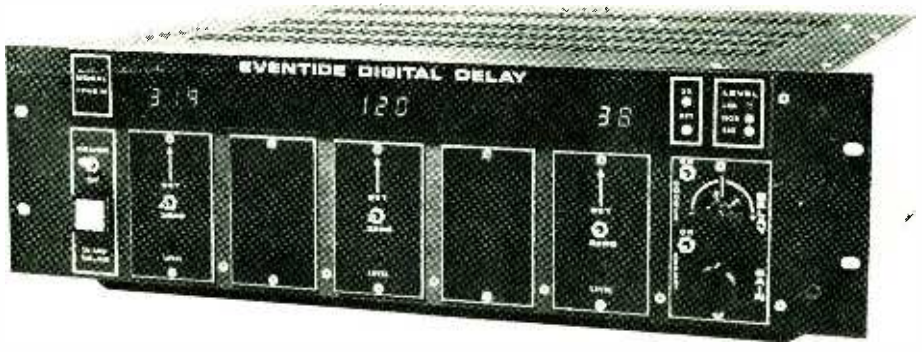
Survey: reverberation and delay units

Forthcoming surveys include synthesisers and special effects units (July) and disc cutting and tape duplicating (August). Information for inclusion in the survey should reach this office (address p3) no later than six weeks before the issue publication date.



Eventide digital delay 1745M

AKG

AKG Akustische Und Kino Gerate GmbH, 1150 Wien, Brunhildengasse 1, Austria.
AKG Equipment Ltd, 182/4 Campden Hill Road, Kensington, London W8 7AS.
Phone: 01-229 3695.
US Agent: Philips Audio-Video Systems, Audio Division, 91 McKee Drive, Mahwah, NJ 07430, USA.
Phone: (201) 529 3800.

BX 20E
Delay principle: spring.
Reverb period: 2s to 4.5s adjustable.
Frequency response: 20 Hz to 8 kHz ±5 dB at $\frac{1}{3}$ octaves.
Input: +6 dB at 2k ohms.
Output: +6 dBm at 200 ohms.
Controls: reverberation time by remote control.
Other features: stereo separation better than 60 dB.
Noise: 69 dB below +6 dB output.
Resistance to external noise: 100 dB spl for feedback.
Power requirements: 110/220V ac, 24V dc at 0.5A.
Auxiliary amplifier: integral.
Size: 43 x 50 x 110 cm.
Weight: 50 kg.
Price: £2200.

BX15
Number of channels: two.
Reverberation principle: spring.
Acoustic isolation: 100 dB.
Decay time: can be set between 1.5 and 3.5s in 0.5s steps independently for each channel.
Unweighted noise output at max reverberation: —66 dB.
Crosstalk between channels: better than 35 dB.
Signal interface: 0 dBm nominal balanced line.
Controls: treble and bass eq.
Power requirements: 220/110V ac.
Dimensions: 43 x 30 x 49 cm.
Weight: 21 kg.
Price: £1520.

TPU 7202
Delay principle: electronic.
Delay period: 0 to 375 ms adjustable in 6.25 ms steps.
Frequency response: 30 Hz to 12 kHz ±3 dB.
Input } standard 0 dBm 600Ω line.
Output }
Controls: output level, delay period.
Companding: internal.
Other features: 200 µs pre-emphasis.
Metering: moving coil.
Noise: 72 dB below rated output.
Power requirements: 110/220V ac.
Size: fits into standard 48 cm racks.
Weight: 10 kg.

AUDIO PULSE

Audio Pulse Inc, Bedford Research Park, Crosby Drive, Bedford, Mass 01730, USA.
Phone: (617) 275 1595.

MODEL ONE
Reverberation principle: electronic.
Decay time: 0.2 to 1.2s adjustable.
Discrete delays: 8, 12, 22, 36, 58 and 94 ms.
Signal interface: unity gain 0.14 to 2V rms at high impedance.
Noise: direct signal path better than 75 dB; delayed path better than 65 dB.
Resistance to external noise: absolute.
Frequency content of delayed path: to 8 kHz.
Total harmonic distortion: less than 0.05% direct path.
Dimensions: 36.8 x 25.4 at 11.4 cm.
Weight: 4.54 kg.
Power requirements: 110V ac.

DENON

See review page 58.

EMT

EMT-Franz GmbH, Postfach 1520, D-7630 Lahr, West Germany.
Phone: 078 25-512.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ.
Phone: 01-953 0091. Telex: 27502.

EMT 250
Reverberation principle: digital electronic.
Decay time: 0.4 to 4.5s controllable in 16 steps.
Decay time at bass frequencies: time factor of between 0.5 and 2 times nominal decay period.
Decay time at treble frequencies: time factor of between 0.25 and 1 times nominal decay period.
Initial delay: from 0 to 315 ms in five steps; there is an additional delay of up to 60 ms in 20 ms steps.
Outputs: four each programmable with individual delay characteristics.
Special effects: phasing, chorus (tonal duplications) super long delay (up to 10s) and echo (single shot from 5 to 315 ms).
Signal interface: normal balanced line level.
Sampling time: 24 kHz.
Noise: better than 70 dB.
Frequency response: 30 to 10.8k Hz.
Total harmonic distortion: less than 0.5%.
Remote control: yes, optional.
Dimensions: 53.5 x 83 x 28 cm.
Weight: 45 kg.

EMT 140TS
Delay principle: plate.
Reverb period: 1s to 4s adjustable.
Input: +1 dB at 5k ohms.
Output: +12 dBm at 200 ohms
Controls: reverberation time (remote control optional).
Other features: stereo output.
Noise: 50 dB below max output level, reverb time = 2s.
Power requirements: 110/220V ac.
Auxiliary amplifier: *EMT 162TS.*
Size: 2.5 x 0.3 x 1.4m.
Weight: 190 kg.

EMT 140Q
Delay principle: plate.
Reverb period: 1s to 4s adjustable.
Input: +1 dB at 5k ohms.
Output: +12 dBm at 200 ohms.
Controls: reverberation time (remote control optional).
Other features: quadraphonic, 4 inputs, 4 outputs.
Noise: 50 dB below full output, reverb time = 2s.
Power requirements: 110/220V ac.
Auxiliary amplifier: *EMT 162Q.*
Size: 2.4 x 0.34 x 1.32m.
Weight: 180 kg.

EMT 240
Delay principle: plate.
Reverb period: 1s to 4s adjustable.
Input: 0 dB at 5k ohms.
Output: 0 dBm at 200 ohms.
Controls: reverberation time.
Other features: stereo.
Noise: 60 dB below full output, unweighted.
Resistance to external noise: 80 phon max ambient level.
Size: 63 x 67 x 30 cm.
Weight: 60 kg.
Other: small in size, suitable for mobile use.

EVENTIDE

Eventide Clock Works Inc, 265 West 54th Street, New York, NY 10019, USA.
Phone: (212) 581 9290.
UK: Feldon Audio Ltd, 126 Great Portland Street, London W1N 5PH.
Phone: 01-580 4314.

1745M
Delay principle: electronic.
Delay period: 0 to 199 ms adjustable in 1 ms steps.
Frequency response: 30 Hz to 16 kHz ±1 dB.
Input: } 0 dBm standard 600 ohm line.
Output: }
Controls: front panel 'delay set' using digital read-out to indicate delay period. 'Double' switch to double delay and halve bandwidth.
Other features: options for pre-wiring delay periods.
Metering: led overload indicator.
Noise: 78 dB below output reference level.
Power requirements: 115/240V ac.
Size: 14 x 48 x 40 cm.

C200
Delay principle: electronic.
Delay period: 7.5 ms to 1080 ms preset adjustable in 7.5 ms steps.
Frequency response: 40 Hz to 12 kHz ±1 dB.
Input: } 0 dBm nominal, balanced or unbalanced.
Output: }
Controls: input level.
Other features: 10 bit resolution.
Metering: overload indicator.
Noise: 60 dB dynamic range.
Power requirements: 115/230V ac.
Size: 48 x 13 x 20 cm.
Weight: 5 kg.

The company also manufacture two sound bending products: the *Instant Flanger* and the *Harmonizer*. Both models use audio delay to achieve their different functions. With both models, the internal delay systems can be used independently of the main function to provide limited delay times to a throughput signal.

HAECO

Holtzer Audio Engineering Corporation, 14110 Aetna Street, Van Nuys, Ca 91401, USA.
Phone: (213) 787 7733.

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Haeco disc mastering delay system

SURVEY: REVERBERATION AND DELAY UNITS

The *ADL 300* digital delay line incorporates a fixed delay of 300 ms for use with the Haeco *VP 1000* automatic variable pitch and depth processor replacing the more usual advance head on the master machine

This digital delay line is said to be a true 16 bit digital delay offering 93 dB of dynamic range without resorting to the use of companding techniques. The sampling rate is 133 kHz offering a bandwidth from dc to 32 kHz ±0.25 dB. Suggested price is $16 995.

Lexicon stereo Delta-T 102

IRPI

Knowles Electronics Inc, 3100 North Mannheim Road, Franklin Park, Ill 60131, USA.
Phone: (312) 455 3600.
UK: Knowles Electronics Ltd, Victoria Road Burgess Hill, Sussex.
Phone: 044-46 5432.

The company manufactures a range of delay units mainly intended to introduce electronic delay into public address systems. Several models are available featuring the same electronic performance (see typical reference specification below) but differ in the output porting arrangements. These may be either fixed or switchable depending on the need for a readily variable delay or a permanent setting. The construction of the units is modular allowing tailored construction to particular needs; up to five different delay taps may be incorporated in a single unit.

TYPICAL SPECIFICATION
Delay principle: electronic.
Delay period: 0 to 120 ms adjustable in 10 ms steps.
Frequency response: 40 Hz to 12 kHz ±3 dB.
Input: } 0 dBm standard 600 ohm line.
Output: }
Controls: two or five output delay controls.
Companding: integral to increase dynamic range.
Other features: dynamic range 80 dB at 800 Hz.
Metering: moving coil.
Noise: —62 dBm at output over 20 Hz to 20 kHz.
Power requirements: 115/230V ac.
Size: 48 x 13 x 31 cm.
Weight: 13 kg.

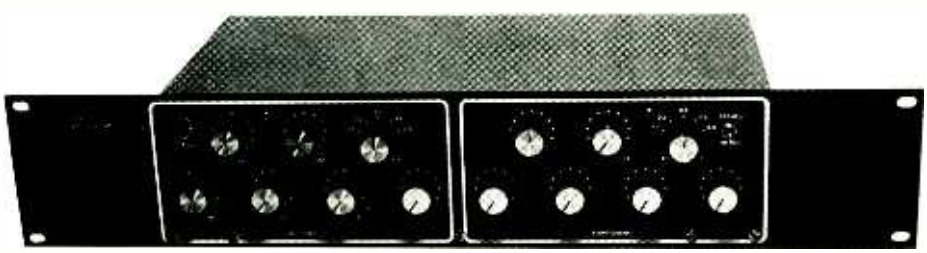
LEXICON

Lexicon, 60 Turner Street, Waltham, Mass 02154, USA. Phone: (617) 891 6790.
Gotham Export Corporation, 741 Washington Street, New York, NY 10014, USA. Phone: (212) 741 7411.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ.
Phone: 01-953 0091. Telex: 27502.

102-B
Delay principle: electronic.
Delay period: 40 ms to 320 ms adjustable in 5 ms steps.
Frequency response: 20 Hz to 15 kHz ±2 dB at —14 dB below limit.
Input: +4 dB at 20k ohms.
Output: +10 dBm at 50 ohms.
Controls: 5 adjustable delay period take-offs.
Distortion: less than 0.3% thd 34dB below limit.
Other features: up to 90 dB of dynamic range.
Metering: led.
Power requirements: 115/230V ±10%.
Size: 48.5 x 17.7 x 40 cm.
Weight: 21 kg.
Other: model *102-A* intended for pa applications, features upper frequency limit of 12 kHz. Model *102-C* offers main-frame delay from 16 to 128 ms.

MODEL 92
Delay principle: electronic.
Frequency response: 20 to 12k Hz ±2 dB measured 14 dB below limit level.
Delay capacity: 120 ms switchable in 7.5 ms steps.
Number of inputs: one.
Number of outputs: two.
Dynamic range: 90 dB typical; 86 dB unweighted.
Distortion: less than 0.1% thd at limit reference level.

Mic Mix Super C



MICMIX

MicMix Audio Products Inc, 9990 Monroe Drive, Suite 222, Dallas, Texas 75220, USA.
Phone: (214) 352 3811.
UK: Scenic Sounds Equipment, 27/31 Bryanston Street, London W1H 7AB.
Phone: 01-935 0141.
France: 3M France, 135 Blvd Serrurier, Paris 19E.
Phone: 202 8090.
W Germany: Audiolive, 5000 Koln 1, Kyffhauser Strasse, 10/46-48.
Phone: 0221-2309.
Agents in Holland, Italy, Portugal, Scandinavia and Spain.

MASTER ROOM II/III/IV
Reverb principle: spring.
Decay times: 3, 5 and 7s.
Signal interface: nominally +4 dBm.
Resistance to external noise: 110 dB spl.
Controls: brilliance.
Dimensions: 14 x 25 x 100/120/145 cm.

STUDIO B SERIES
Regarding signal interface and acoustic isolation, the *Studio B* series are similar to the above. They also have the following operational features:
Decay time: *B2* nominal 2s adjustable 1 to 3s. *B3* nominal 3s adjustable 2 to 4s.
Echo delay: *B2* 20 ms, *B3* 50 ms.
Both models have a remote electronics box fitted with metering and decay, level and extensive middle frequency eq.

C SERIES
Signal interface: +4 dBm nominal.
Distortion: less than 0.1% on direct signal path/less than 5% reverb path.
Noise: better than —66 dB unweighted.
Acoustic isolation: 110 dB.
Delay on echo: 15 and 30 ms (*2* and *3* models respectively).

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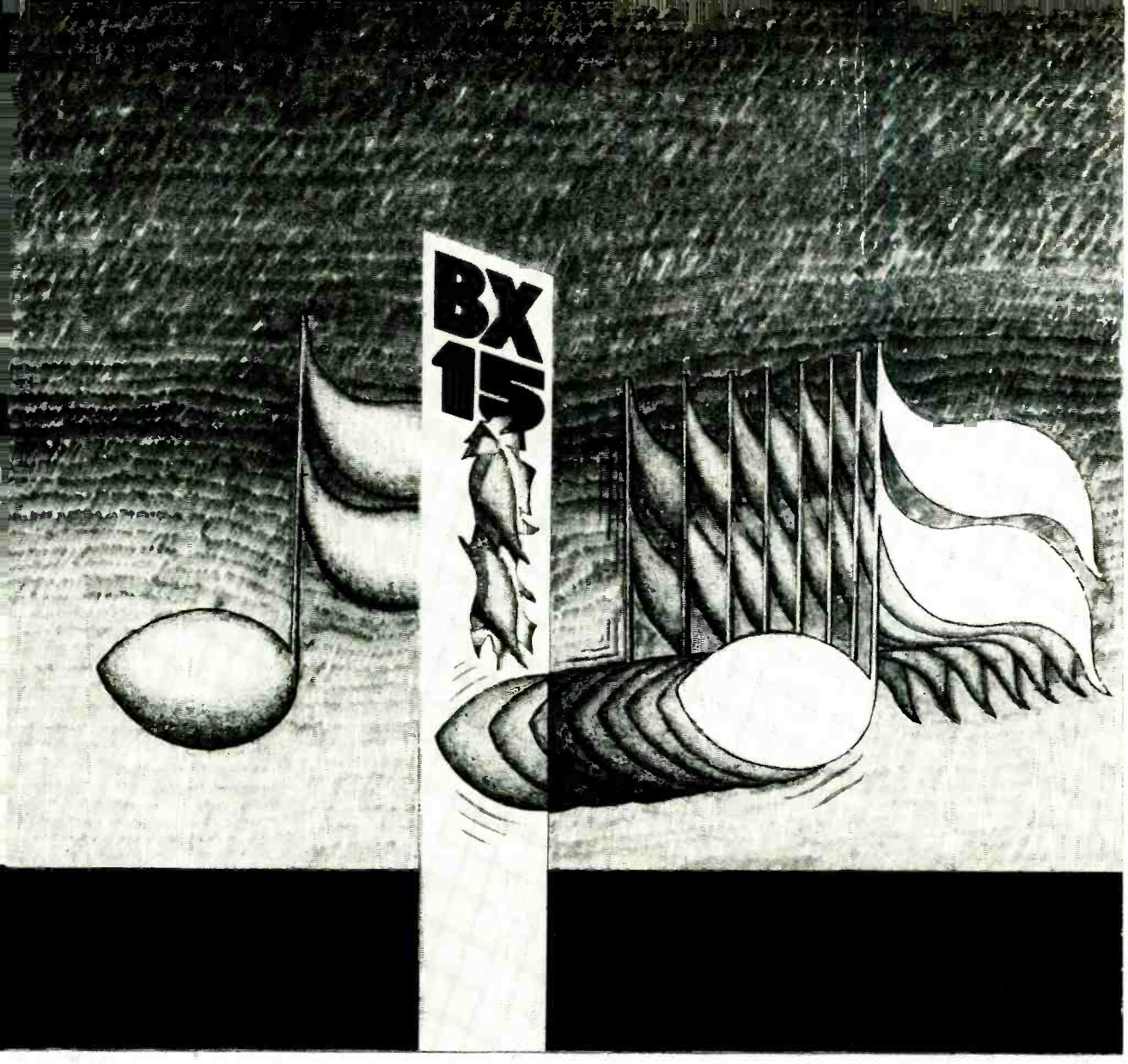

Jump into genuine reverberation

ADV 198/E

New AKG reverberation unit BX 15

From the practical experience gained with the highly successful BX 20 a smaller unit has now been evolved — the handy and robust BX 15. Designed to fill the gap between the less sophisticated and the more costly and some times elaborate studio products. The BX 15 is ideal for small studios, O. B. work and professional musicians.

Brief specification:
Two independent channels with variable high and low frequency equalization. Switchable input level with additional overdriving safety factor by means of a built-in limiter. Inputs and outputs are balanced and the decay time is switchable from 1.5 to 2.0, 2,5, 3.0 and 3.5 seconds. Continuous mixing of 'reverb' and 'dry' signals with separate potentiometers. Dimensions: 17 x 19 x 12 inches (43 x 48 x 30 cm). Weight: approx. 45 lbs (20 kg).

AKG EQUIPMENT LTD. 182/4 Campden Hill Road Kensington London W 8 7AS Telephone 01.229.3695

AUSTRIA
AKG Akustische und Kino-Geräte Ges.m.b.H.
Wien
Brunhildengasse 1
A-1150 Wien
(0222) 92 16 47

BELGIUM
Radelco P.V.B.A.
Italielei 179
Antwerpen
TF: 03-337880

CANADA
Philips Audio-Video Systems
200 Consumers Road
Suite 105
Willowdale
Ontario M2J 4R4
Canada
TF: 494 1453

DENMARK
S. C. Sound
Brondbyostervej 84
DK-2650 Hvidovre
TF: 01-471222

FINLAND
Nores & Co. OY
Fabianinkatu 32
Helsinki 10
TF: 13360

FRANCE
Réditec
27ter, Rue du Progrès
F-93107 Montreuil
TF: 3282580

GERMANY
Akustische und Kinogeräte
Gesellschaft m.b.H.
Bodenseestrasse 226-230
D-8 München 60
TF: 089/870011

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M. Casale Bauer
Via IV Novembre N 6-8
40057 Cadriano di Granarolo
PO Box CP 753—
40100 Bologna
TF: 051/76648

NETHERLANDS
Rema Electronics
Isarweg 6
Amsterdam
PO Box 8501
1015 Sloterdijk
TF: 114959

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Oslo 6
TF: (02) 686360

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TF: 248 96 02

SWEDEN
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S-11721 Stockholm
TF: 08-680745

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CH-8123 Ebmatingen
TF: 97 14 70

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91 McKee Drive
Mahwah
New Jersey
07430
TF: 201-529-5900

Available in 104 countries all over the-world

SURVEY: REVERBERATION AND DELAY UNITS

Decay time: as *Studio B* series with same adjustable control.
The electronics for this series is available in either mono or stereo, rack mounting or free standing.

SUPER C SERIES
Mainly as above but with very comprehensive eq—hi and lo shelves as well as full mid range facilities.

TIME WARP
This is a versatile time domain modifier capable of producing many 'weird and unusual effects' as well as providing up to 100 ms of pure delay. Controls include delay time, adjustable both in fixed steps and by pot control, recycling, direct/delayed mix for phasing etc, vco control of unit clock, mode change and pitch change.
Signal interface: nominal line level.
Dynamic range: 80 dB.
Frequency response: 20 Hz to 10k Hz.
Signal-to-noise: better than 70 dB unweighted.

PARASOUND
Orban/Parasound, Wharfside, 680 Beach Street, San Francisco, Ca 94109, USA.
Phone: (415) 673 4544.
UK: Industrial Tape Applications, 1/7 Harewood Avenue, Marylebone Road, London NW1.
Phone: 01-724 3768.

111B DUAL SPRING UNIT
Number of reverb channels: two.
Principle of operation: four spring lines/channel.
Decay time: about 2s to —40 dB.
Delay time: 30 ms between direct path and onset of reverberation.
Effects: acoustic chambers, mechanical plates, spring systems and tape loops.
Reverb period: 250 ms to 20s adjustable.
Controls: decay time ('room size'), high frequency damping, low-frequency filtering, program power.
Noise: less than —80 dBm.
Dynamic range: greater than 80 dB.
Distortion: less than 0.1% thd.
Size: 13 x 35 x 48 cm.
Price: $5995.

SOUND WORKSHOP
Sound Workshop Professional Audio Products, 1038 Northern Blvd, Roslyn, New York 11576.
Phone: (516) 621 6710.

220 DOUBLER/LIMITER
This unit combines a feed forward limiter with an electronic delay line to provide adt type effects.
Delay time: continuously variable from 5 to 40 ms. Simple modification allows external voltage control of delay time between 2 and 40 ms.
Noise level (delay): 63 dB below rated output.
Delay bandwidth: 50 Hz to 8k Hz.
Distortion: less than 0.7% at rated output.
Limiter attack time: 1 ms for 10 dB reduction in gain.

242A STEREO REVERB
Number of channels: two.
Reverberation principle: spring.
Decay time: nominally about 2.5s.
Equalisation: ±15 dB at 4.3 kHz.
Noise: 70 dB below rated output.
Signal interface: both mic and line inputs, line outputs 0 dBm nominal.

Sound Workshop 242A

Signal interface: line level, unbalanced.
Limiter: can operate in fixed or floating threshold mode to eliminate twangs and bongs due to step changes in programme levels.
Equalisation: bass shelf at 500 Hz; parametric eq on middle giving control of frequency, boost and bandwidth.
Noise: better than 76 dB.
Dimensions: 48.3 x 8.9 x 30.5 cm.
Weight: 4.54 kg.

QUAD EIGHT
Quad Eight Electronics, 11929 Vose Street, North Hollywood, Ca 91605, USA.
UK Agent: Cinesound International Enterprises Ltd, Landsdowne Imperial Studios, Maxwell Road, Boreham Wood, Herts.
Phone: 01-953 5545.

RV10
See review page 62.

CPR 16
Delay principle: programmable electronic.

UREI
United Recording Electronic Industries, 11922 Valerio Street, North Hollywood, Ca 91605, USA.
Phone: (213) 764 1500.
Gotham Export Corporation, 741 Washington Street, New York, NY 10014, USA.
Phone: (212) 741 7411. Telex: 129269.
UK: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts WD6 4RZ.
Phone: 01-953 0091. Telex: 27502.

COOPER TIME CUBE
Delay principle: acoustic.
Delay period: 14 ms and 16 ms, separate channels.
Frequency response: 40 Hz to 10 kHz ±2 dB.
Input: 0 dBm at 600 ohms.
Output: 0 dBm at 600 ohms.
Controls: input gain (2), meter switch.
Other features: channel separation 40 dB. Can be cascaded for total delay of 30 ms.
Metering: moving coil.
Noise: 70 dB below full output. 15.7 kHz bandwidth.
Power requirements: 110/240V ac.
Size: 48.5 x 9 x 19 cm electronics only.
Weight: electronics 5 kg, delay line 15 kg.

EVENTIDE CLOCK WORKS PROUDLY ANNOUNCE THEIR NEW DIGITAL DELAY LINE TYPE 1745M

Features

The 1745M employs random access memories instead of shift registers for maximum versatility and reliability. The standard 1745M offers two independant outputs each providing up to 320 ms of continuously variable delay. Up to 3 additional outputs are available.

Delay is read out in milliseconds on solid-state digital readouts, one for each output. There is no noise when changing delay settings-switching can even be made during recording. For convenience, the 1745M front panel includes switches for instant zeroing of all delays, plus switches for audio recirculation and delay doubling (up to 640 ms at one-half frequency response).

An input level control and optimum level indicator is included.

The Modular design of the 1745M

allows many special features including :

Pitch Changing

Employing novel circuitry for wide range pitch variation and musical harmonising without effecting any change in speed.

Flanging

Including manual and automatic flanging with digital versatility.

Remote Control

Manual and automation – compatible.

These as well as most other options may be added in the field simply by plugging in the printed circuit card supplied.

Feldon Audio Ltd Dept SI
126 Great Portland Street
London W1 Tel : 01-580 4314

Interconnection

DAVE DEARDEN *

The role of the studio maintenance engineer has changed dramatically in the last decade. No longer is he just the 'back room boffin' who emerges, when everyone else has left, to repair the faults . . .

*MCI (UK) LTD

WITH the tremendous increase in equipment complexity, his knowledge and 'feeling' for his work can be almost as important as having the best balance engineers. His experience of differing types of equipment, its location and its general well-being is instrumental in the development of a good reputation for the studio.

Equipment Location

The location of the large number of ancillary pieces of equipment with which every studio is blessed (or cursed) requires considerable thought. This equipment can be divided into two categories: (a) adjustable and (b) preset.

(a) Adjustable equipment means limiters, compressors, equalisers, etc and these need to be located within easy reach of the operator position, so that adjustments can be heard in the correct acoustic perspective as they are made. Remote controls for tape machines should also be easily accessible. On some of today's monster mixing consoles it is quicker to walk straight to the machine rather than walk to the remotes situated at the other end of the console.

(b) Preset equipment includes power supplies, monitor amplifiers, monitor equalisers and crossovers, etc. Power supplies should normally be mounted remote from the console to obviate hum induction into the console transformers and sensitive low-level sections. But, beware of mounting the supplies too far away as problems may then be encountered due to voltage drop in the supply cables. If remote voltage sensing is employed, cable inductance may cause instability in the supply, unless properly compensated. In general, use the largest diameter cable that is practical, and limit the length to about a maximum of ten metres. Take care that the supplies are not mounted close to any other hum sensitive equipment such as tape machines.

Monitor amplifiers should be mounted as close as possible to ; their respective speakers, and large-diameter cable used to connect the amplifier to the speaker. Any appreciable resistance in the speaker cables will reduce the amplifier damping factor, causing 'woolly' bass, due to the amplifier not keeping the speaker cone under tight control at all times. Ideally the speaker cables should be screened to prevent crosstalk into other cables sharing the same trunking, although large-diameter screened cable is not always easily available. It is preferable not to run a speaker cable anywhere near other signal cables, especially its own amplifier input. Most power amplifiers are critical in terms of phase and therefore any coupling between output and input may induce effectively positive feedback, giving rise to instability on signal peaks.

Electronic crossover units are best situated close to the monitor amplifiers, remembering of course, that the monitor amplifiers do produce a fair quantity of heat, so it is preferable to place the crossover below the amplifiers. Ideally, monitor equalisers should be accessible from near the operator position; not because the operator can 'fiddle', but for ease of setting up. (See *Monitor Equalisation*, STUDIO SOUND Feb 77).

By sitting at the operator position and making adjustments in response to an analyser display, any audible effects, be they improvements or degradations, can be heard and modified for smoothest audible response without discrete frequency colourations. However, space close to the console is precious and monitor eq's usually end up nearby the monitor amplifiers.
One solution to this problem is to move the eq's to the console by means of extension cables on the occasions when equalisation is performed.

While on the subject of monitor eq's, it is often found that they are not the quietest pieces of equipment and since they are connected into the system after the console the noise contribution is constant. It is worthwhile considering modifying the console to allow connections of the eq's into the system before the console monitor level pot. The eq noise contribution will then be proportional to monitor level. One point to consider before attempting this modification: is the solo/pfl injection point before or after the monitor level pot? If it is after the pot, the solo/pfl will be heard unequalised, which is undesirable. Console manufacturers please take note.

Cable Routing and Trunking

Having decided the location of all pieces of equipment, the next point to consider is how to get the cables there. Floor ducts and trunkings are the normal method, but the common problem with floor ducts is that the floor is usually carpetted, thereby inhibiting easy access. One solution is to use carpet tiles, which are easily removed. Another way is to construct the floor ducts with removable covers which are carpet covered. With a little care the duct-covers can be made completely unobtrusive, yet easily removable. Wall trunkings if designed to finish flush with the wall treatments can be similarly disguised, although close liaison with the acoustician/interior designer is essential. If it is impossible to keep all trunkings accessible, ensure that sufficient spare cable capacity is available for all future expansion. The small extra expense is well worthwhile when the amount of down-time is considered if half of the control room has to be destroyed just to add a few more cables.

All cable trunk casings should be earth-bound at every joint and finally returned at one place only to the main studio ground point. This could be either the electricity supply company's incoming earth or the studio technical earth if one has been installed. Never rely on the trunking to provide the audio common to the equipment. Separate trunkings should be provided for high- and low-level cables; high-level in this case means ac mains wiring, and possibly loudspeaker wiring. Some organisations run all high-level trunkings at ceiling height and low-level at floor height. Avoid running low-level cables, especially microphone cables near high-current equipment such as air conditioning plants.

Ac mains wiring should be divided into two distinct circuits, wired separately back to the mains distribution board. One circuit, designated 'clean' should supply all audio equipment, while the other designated 'dirty' should supply everything else, eg fridges, typewriters, lighting, etc. This will help to ensure freedom from annoying clicks and pops. In persistent cases, or when the studio operates on existing wiring, troublesome equipment can often be

modified to utilise zero-crossing switches. This will ensure that when switched on, the actual switch-on is delayed until the next zero crossing of the mains waveform, instead of being switched at some random point of the waveform. As the switch-on is at a zero crossing, ie the voltage is zero, the current drawn is therefore zero, and a click is not produced, whereas if switched at some random point in the waveform the high, instantaneous energy drawn will cause the short duration spike superimposed on the mains to appear on all susceptible equipment connected to the same circuit. Any contact arcing which occurs will also be transmitted to other equipment.

A similar problem occurs when using thyristor and triac type light dimmers. These dimmers work by switching on at various parts of the mains waveform to provide varying amounts of energy to the lamp.

In the worst case condition, when switch-on occurs midway through the cycle, the extremely fast risetime of the voltage generates high-energy signals up into the Megahertz region, creating interference to audio and radio equipment.

Generally, in a control room, the audio equipment is well screened and at a reasonably low impedance so problems will not be caused. However, in the studio it is a different matter. Guitar amplifiers, etc are usually high-impedance devices, open to all forms of interference, and problems will usually be encountered. Dimming of studio lighting should be provided by Variacs, which are variable rotary transformers. These vary the amplitude of the mains voltage, without distorting the shape of the waveform. Motor-driven types are available for remote control but unfortunately, Variacs are much more expensive than thyristor dimmers of an equivalent current rating. However, they will avoid any problems.

Equipment Ventilation

All equipment produces heat, some more than others, and some more than it should. A large percentage of all studio faults are caused by equipment overheating, especially faults of the intermittent variety. Careful placement of equipment and ventilation grills plus a small fan or two will minimise these problems. When installing equipment into a rack always try to place the main heat producers near the top. Placed near the bottom the heat will have to travel upwards over every other piece of equipment. Always leave a ventilation space or panel at the top to allow the heat to exit, and at the bottom a ventilation panel to allow cool air to enter. In extreme cases a fan mounted on the bottom panel blowing air into the rack will considerably improve through-flow ventilation. Low-noise fans are available, or two normal fans may be wired in series to give a lower rotational speed while preserving the volume of air being forced into the rack.

If it is not practical to place heat-producing equipment near the top, intermediate ventilation panels should be provided. Where the manufacturer has punched ventilation holes in the top and bottom panels of his equipment it is reasonable to assume that he didn't intend them to be blocked by another piece of equipment sitting above or below it. If fans are provided it is beneficial to fit air filters to them to reduce the ingress of dust, but it is then essential that it becomes part of the regular maintenance programme to clean the filters.

Heat may not always be self-generated. A spotlight shining on a piece of equipment may look quite pretty, but after a few hours, the amount of heating caused by the lamp may make the equipment front panel too hot to touch, especially if it is black (a colour preferred by a large number of manufacturers). In the worst case these temperature variations can cause failure of the device or annoying drift of its characteristics.

Earthing

This is usually the subject which causes the largest number of problems in a studio. Unless the earthing system is efficient and correctly wired there can be little chance of a system which is free from hum, clicks and other miscellaneous rf noise. A few simple ground rules (pun intended) will hopefully provide some insight into the requirements.

(a) Provide a main System Earth. This should be either the electricity supply company's incoming mains earth, a cold water pipe known to go reasonably deep into the ground, or preferably a completely separate technical earth. If the mains supply has heavy machinery, an air conditioning plant, or other rapidly changing loads connected to it, it is likely that the mains earth will not be suitable, so try the incoming cold water pipe. However, be wary of these as many modern installations use plastic piping in parts. Ideally, install a technical earth. This is usually formed by three or four earthing rods spaced at least ten feet apart hammered down to a depth of ten to twenty feet. The number and depth is dependent upon the soil type and dampness. All rods are connected in parallel to further reduce the earth impedance, using at least 3 mm^2 cable, and taken to a suitable connection block. From this point, a cable is run to a connection block into each area in the building and used as the audio equipment mains earth for that area.

(b) To this point connect the console earth, all rack metalwork and the chassis of all equipment using a separate wire for each.

(c) With the exception of the microphone cables, connect the shields of all cables at one end only, never at both ends.

(d) At the other end of the cable, connect the cable to the equipment chassis earth (usually pin 1 of a Cannon connector) through a 0.01 μF capacitor or larger. This effectively connects the cable screen to earth at both ends for most effective rf screening, without causing low frequency earth loops. The capacitor may be at either end of the cable.

(e) The microphone cable screens should be connected at both ends, but should never be cross connected outside the console.

(f) After wiring, check that no earth loops exist. To do this, firstly remove the mains plug, which will normally be supplying the earth connection to the equipment or, in the case of a two wire device, the chassis connection to the technical earth. With an ohm-meter, check that a high resistance exists between the chassis of all pieces of equipment. If not locate the 'loop' and remove. Replace all mains plugs or chassis earth wires and the earthing system is complete.

(g) When connecting equipment with 'unbalanced' inputs, such as power amplifiers, initially connect as for balanced inputs. Test the system. If it operates satisfactorily, offer up a prayer of thanks and leave it that way. If it doesn't, ie it hums or oscillates, connect the 'low' side of the input cable to earth at one end only. Try either end for best results.

Observing the above points should result in a system free of extraneous hum and rf noise.

Equipment Interfacing

Although the problems of interfacing equipment have been drastically reduced in recent years, difficulties still exist in certain areas. Dual standards in the methods of wiring connectors, odd input and output impedances, strange levels and headroom inadequacies all combine to add difficulty to a supposedly simple task.

(a) *Microphone Impedance.* Most of the microphones commonly found in Europe have a nominal rated impedance of 200 ohms. However, this does not mean that the input impedance of the console microphone input should also be 200 ohms. This is a nominal mid-frequency impedance, and at high frequencies, could be much higher. An attempt to match impedances between microphone and console will usually result in increased high-frequency distortion due to the microphone being unable to supply sufficient current into a low-input impedance. These microphones are designed to operate correctly into an impedance of at least five times their rated impedance, ie into an input impedance of at least 1000 ohms. This is voltage matching, where the input impedance does not appreciably load the microphone, which is then effectively working into an open-circuit and therefore generating its highest possible output voltage.

On the other hand, American microphones are usually designed to be able to operate into an input impedance equivalent to their rated impedance without causing an increase in distortion. They are designed for power matching, ie for maximum transfer of power from microphone output to amplifier input.

(b) *Impedance and Cable Length.* Most ancillary studio equipment, such as limiters equalisers, etc has also been designed for voltage matching. The input impedance is usually greater than 5000 ohms, thus causing an insignificant load on the previous stage. Output impedance is usually less than 200 ohms, allowing the unit to drive

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into loads of 600 ohms or greater with negligible effect on the output level. 600 ohm input and output impedances are relatively uncommon these days in general European studio practice. However, in America for some obscure reason, 600 ohms still seems to have some magical significance.

Consider though what happens when an amplifier drives a length of cable. The cable has capacitance and in conjunction with the circuit impedance will form a lowpass filter. At what frequency will the high frequency loss start to occur? For instance, an amplifier has an output impedance of 600 ohms which is connected by a cable 50m in length, to another amplifier with an input impedance of 10000 ohms. If the cable capacitance is 500 pf/metre the total capacitance will be $50 \times 500 = 25\,000$ pf or 0.025 μf. The formula to calculate the −3 dB frequency is:

$$F = \frac{1}{2\ RC}$$

where R = circuit impedance in Mohms.
and C = circuit capacitance in microfarads.

The circuit impedance, see **fig. 1**, is the parallel impedance of Z_3 and Z_2 which is calculated as follows:

$$R = \frac{1}{\frac{1}{Z^1} + \frac{1}{Z^2}}$$

$$= 566 \text{ ohms}$$

$$\text{Now the } -3 \text{ dB frequency, } F = \frac{1}{2\pi RC}$$

$$= \frac{1}{2 \times 3.1416 \times 0.000566 \times 0.025}$$

$$= 11\,247 \text{ Hz}$$

The response will now fall at a rate approaching 6 dB per octave above this frequency which is obviously an unsatisfactory situation, but what can be done about it? A lower-capacitance cable could be used, or the circuit impedances changed. For instance Z^2 could be reduced to say 600 ohms, meaning that the −3 dB frequency would be 21 220 Hz, which would be much better. But, this now means that the potential divider formed by Z_1 and Z_2 will constitute a 6 dB attenuator (see **fig. 2**).

$$\text{The attenuation will be } \frac{Z_2}{Z_1 + Z_2}$$

$$= \frac{600}{1200}$$

$$= 0.5 \text{ or } -6 \text{ dB}$$

Therefore we have replaced one problem with another but have still not achieved a satisfactory solution. If we reduced the amplifier output impedance Z_1 to say 200 ohms, this would now give a −3 dB frequency of 32 840 Hz with a negligible attenuation of 0.17 dB.

FIG. 1

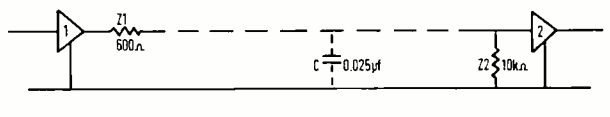
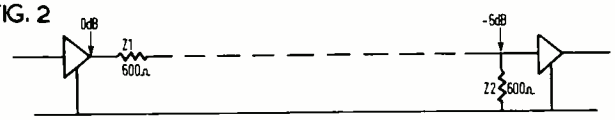


FIG. 2



This illustrates the importance of a low output impedance when driving cables of any appreciable length, a point which must be borne in mind when installing equipment and choosing cable types. A common example of this type of problem is the cable used to connect an electric guitar to its amplifier or direct injection box. Here, circuit impedances are normally very high, and six or seven feet of cable can cause problems. Another common source of problem is cable length between disc pickup cartridge and amplifier—the frequency response aberrations can become very complex when there is also an inductive component present. This, combined with the cable capacitance, will resonate at a certain frequency, which may be within the audio spectrum . . . the simple piece of wire to connect one piece of equipment to another is not really so simple after all.

To summarise: amplifiers, etc should generally have as low an output impedance as practical, and should connect into a reasonably high-input impedance of at least 5000 ohms, a bridging load. The classic 600 ohm to 600 ohm matching situation has no real application in normal recording studios but only when dealing with extremely long lines, such as telephone lines, where the line itself has a characteristic impedance determined by its capacitance and inductances per unit.

(c) *Cable Connectors.* The studio business is fraught with dual standards and confusions, even down to a simple job of wiring a Cannon connector. Current American practice is to use pin 1 as earth, pin 2 as signal low, and pin 3 as signal high. European practice reverses pins 2 and 3. When all equipment contains input and output transformers, this does not cause any problems, provided that all cables are connected the same way. However, when the equipment is unbalanced, there will be a problem because in a system wired to the European standard, pin 3 will be signal low, ie earth with an unbalanced system. If this is now connected to an American standard unbalanced piece of equipment with pin 3 being signal high, a short circuit will be present, across input and/or output. This is a very common cause of new equipment being returned to the dealer, with the message 'it doesn't work', although the dealer is subsequently unable to locate any fault. Each studio should decide upon which standard to conform with, and wire all cables that way. If unbalanced equipment is purchased and wired to the other standard, the equipment internal wiring should be altered to suit.

There is yet another dual standard regarding the Cannon connector. This is the choice of sex for inputs and outputs. Most commonly the male connector (the one with pins) is the output while the female connector (the one with sockets) is the input. However, certain broadcasting organisations have reversed matters and manufacturers of equipment destined for broadcast applications supply equipment, wired this way. When this equipment finds its way into studios, again it is best to change the equipment internal wiring.

Cable Checking and Phasing

A lot of wasted time and uncertainty is caused in any studio by suspected cables and patch cords, which may exhibit any or all of three faults.

Incorrect connection at one connector causing phase reversal in balanced circuits, and shorted input/output in unbalanced circuits. A very simple cable check box is shown in **fig. 3.** This is well worth the small amount of effort needed to construct and will indicate any of the above fault conditions. Light emitting diodes are used as indicators as these will respond rapidly enough to enable the user to see intermittent faults, which only occur when the cable is moved or stressed.

The checker box, although shown with only one pair of connectors, may be made with as many parallel connectors of different types as

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For use with A-size cartridges only, our compact Beaucart Type 10 measures a trim 3½" high by 5¾" wide by 15¾" deep. Both mono and stereo are available in record or playback versions. Reproducers are furnished with a primary (1 kHz) cue with secondary (150 Hz) cue, and tertiary (8 kHz) cue and fast forward capabilities available as an option.

TYPE 20
For use with all NAB standard A-, B-, and C-size cartridges, a wider, 3½" high by 10⅛" wide by 13¼" deep Type 20 Beaucart machine is offered. These reproducers and recorders are available in mono or stereo. All Beaucart machines incorporate unique features such as our patented pancake motor and adjustable air damped solenoid for quieter overall operation than any other machine on the market.

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letters

Dear Sir, While your review of my book Modern Recording Techniques *makes several valid criticisms which I will attempt to correct in the next edition, your other comments indicate that your reading of the book was superficial to the point that you misinterpreted several of my statements.*

As you should note from the introduction as well as the back cover, the readers I am addressing are musicians and producers as well as aspiring recording engineers, and my purpose is to familiarise them with the techniques and equipment they will find in a typical studio. Specific equipment model numbers, photos and specifications follow the generalised descriptions so that the reader might have some landmarks in what otherwise could seem an ocean of knobs. This also aids them in differentiating between devices of the same general category that produce vastly different sounds.

With regard to those sections which you flatly state are 'wrong', I suggest you reread them. My comment on p95 about saving time by storing tape tail out refers only to the playback alignment tape used to calibrate the tape machine. This tape should be stored in a played condition to insure an evenly tensioned and flat pack to prevent stresses which could damage the tape during storage, as well as to guard the tape edges from damage. To achieve this while leaving the tape stored head out would require you to play the tape through upside down after completing the alignment. This is where the time would be wasted.

The text does not say that storing tape tail out reduces the amount of print through. Rather, on p101-102, it states as you do in your review that print through is independent of the wind, but that rewinding from tail out just before playback reduces it. Tail out storage also causes the loudest part of the print through to follow rather than precede the signal.

As concerns your comment about the 'elastic band', either you have had little experience splicing or you have been fortunate enough to work only with tape machines which maintain constant tape tension. My comment refers to those machines that do not have constant tension.

In any non-sprocketed tape drive system with unequal take up and holdback tensions, there is always some tape slippage at the capstan. The degree of slippage depends on the difference in the force applied by the two reels. If the torque of the motors is kept constant, the force on either side of the capstan will vary inversely to the diameter of the tape packs on the respective reels. At the head of the reel take up tension will exceed holdback tension causing less tape slippage, while at the tail of the reel holdback tension will exceed take up tension causing more tape slippage and resulting in a slower tape speed. To prove this, I suggest you try an experiment: record the same frequency tone near the head and again near the tail of a 26.7 cm reel of tape on an unmodified Ampex AG440. *Splice the recorded section from the head of the reel into the middle of the recorded section at the tail of the reel. When playing this section you will hear a distinct change of pitch at the transitions from tail section to head section and back again. No amount of shouting at or adjustments by your maintenance man will correct this. Only the installation of an accessory device which maintains constant tension will do so. Since the majority of open loop tape transports in use do not maintain constant tension, it is important that people using them be aware of the problems their speed variations can cause.*

Yours faithfully, Bob Runstein, 44 Dinsmore Avenue, 610 Framingham, Mass. 01701, USA.

Mike Thorne replies:
Taking Bob Runstein's three points specifically:

1. Specific model numbers are ideal, since otherwise vague, unhelpful and unjustifiable generalisations appear. That's what the review said, also.

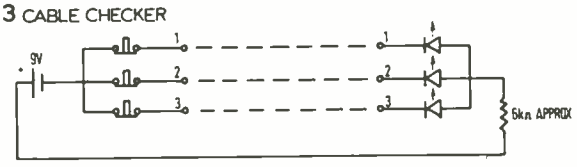
2. My mistake; my notes coincide with the author's on pp 101/2. Unfortunately their disorganisation mirrors that of the book, and the overall comments stand.

3. These comments are fair enough; whether you tolerate such characteristics in a studio tape transport is your choice.

INTERCONNECTION

required to encompass the studio's needs. When a cable is plugged in, all leds will light, assuming the cable has electrical continuity. By depressing each push button in turn, the corresponding led should go out verifying the phasing, unless the connectors have been cross-wired, when it will indicate which connections are reversed. If a button is depressed which does not extinguish any led, a short circuit exists between connections.

FIG. 3 CABLE CHECKER



Cleaning

Recording studios must represent one of the most unsuitable environments for delicate electronics. Computer rooms and other sophisticated electronic equipment habitats are usually clean air rooms, dust free, and carefully controlled in terms of temperature and humidity. Not so the studio. Wide temperature variations, extreme humidity (cups of coffee, Coke, beer poured into equipment) and an atmosphere loaded with nicotine and other strange chemicals all wreak their toll on equipment and components.

One common victim of atmospheric contamination is the capacitor microphone. The capsule becomes covered with a layer of dust and dirt, which becomes a muddy mess when subjected to humidity, eg when used close-mike for vocals. The mud becomes electrically conductive and shorts out the capsule polarising voltage. The microphone then ceases to work, but when checked later, is found to have resumed working, since it has now had time to dry out. The remedy is usually simple. Using a fine camel hair paint brush, and distilled water, the capsule is washed to remove the muddy film, excess moisture is then absorbed using a thin strip of blotting paper, and the microphone is then left in a warm dry place for a few hours to thoroughly dry out. Care must be taken not to damage the very delicate capsule diaphragm.

Drinks commonly get spilled into equipment, solidifying switches and causing other problems. All of the substances are water based and that is usually the only thing that will shift them. Carefully dissolve the residue using a paint brush and water, preferably distilled water. Again absorb as much as possible with blotting paper. Try to keep the water to a minimum and away from unaffected areas. To dry out inaccessible areas such as switches, after washing with water, continue washing with alcohol which will absorb the water, and evaporate quickly. It is advisable to subsequently treat the contacts with a contact lubricant which will prevent further deterioration.

Printed circuit edge connectors are usually a source of intermittent problems. The best way of cleaning these is not burnishing with Duraglit or other cleaner, but to use a simple typewriter eraser, which will clean non destructively, and will not leave any contaminating layer on the board. Relay contacts can be cleaned using contact burnishing cards, which must be used with caution, as it is very easy to clean away all the precious metal plating. A non-destructive method is to use an ultrasonic cleaner, which can also be used to clean a multitude of small objects such as jack plugs and fader tracks. ■

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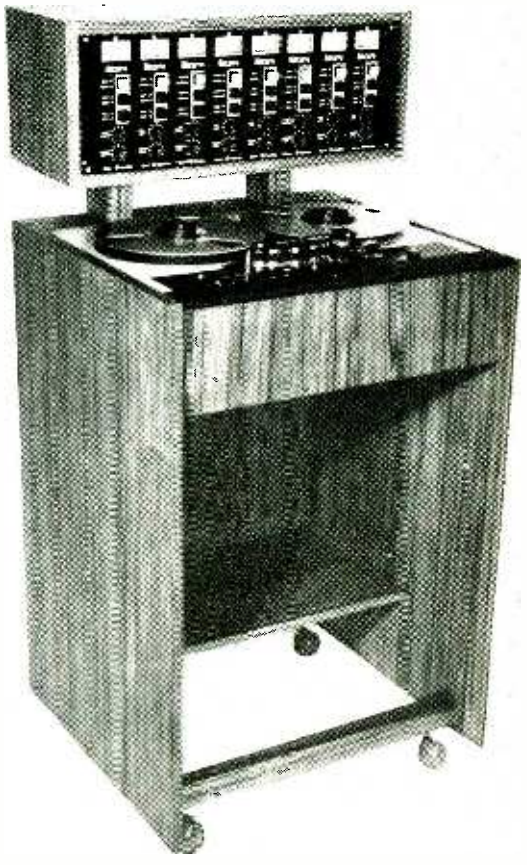

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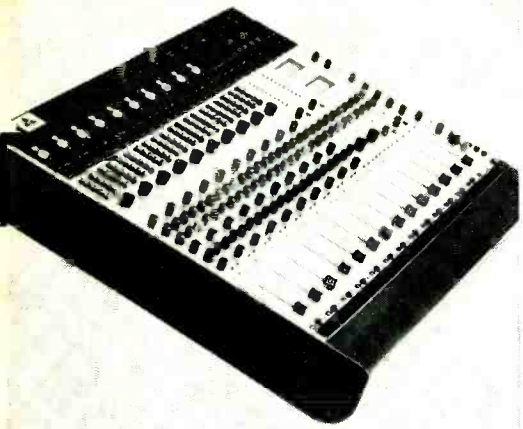

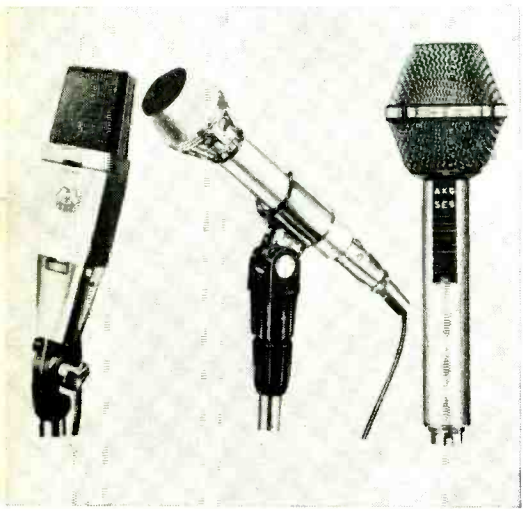

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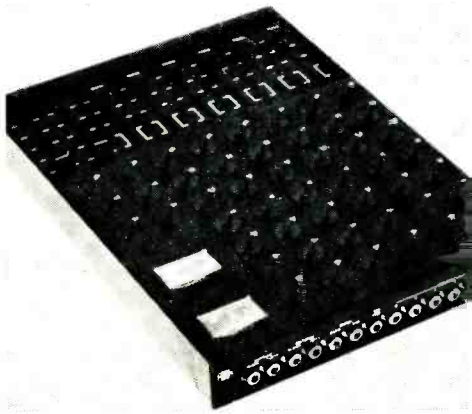

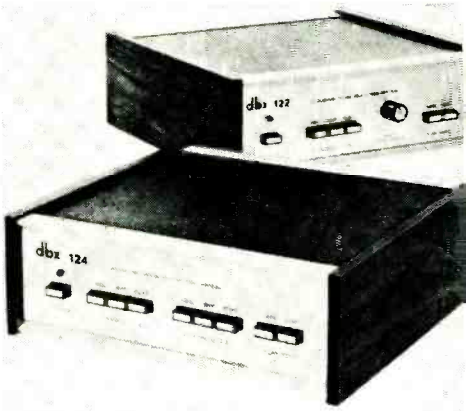

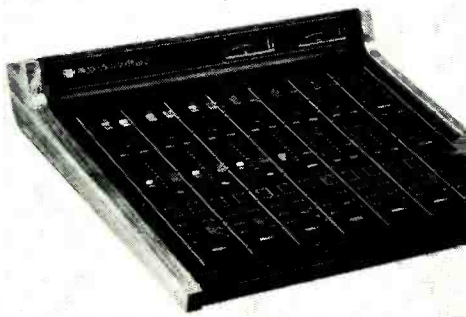

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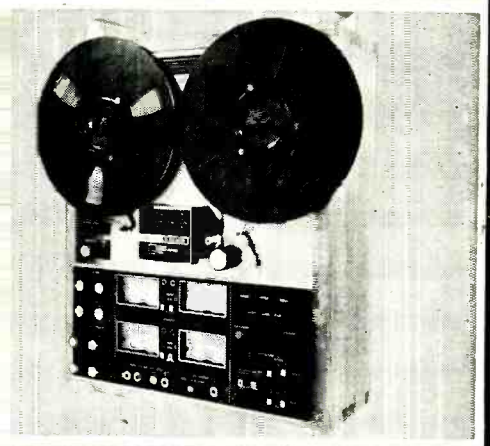

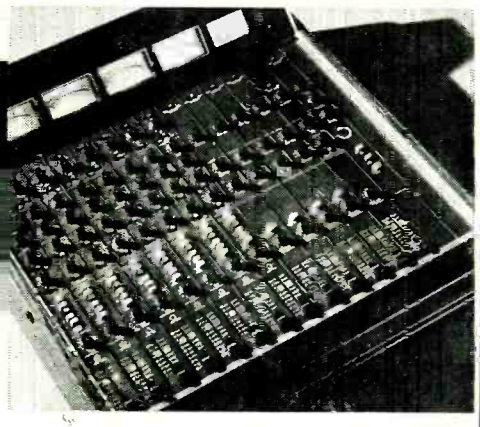

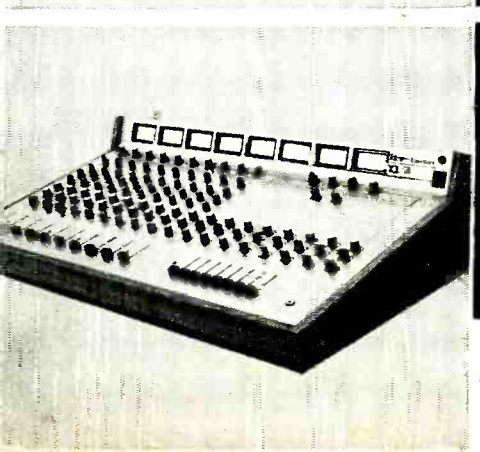

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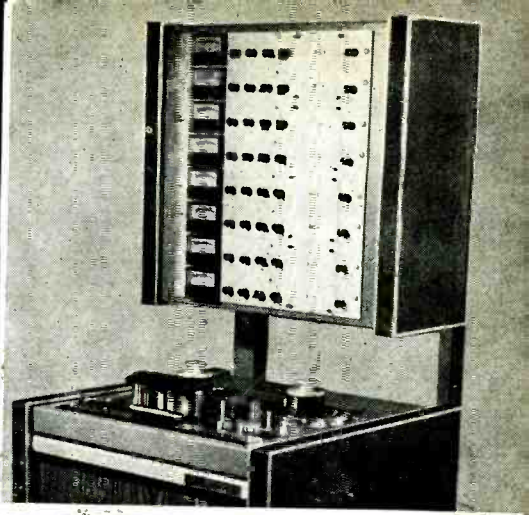

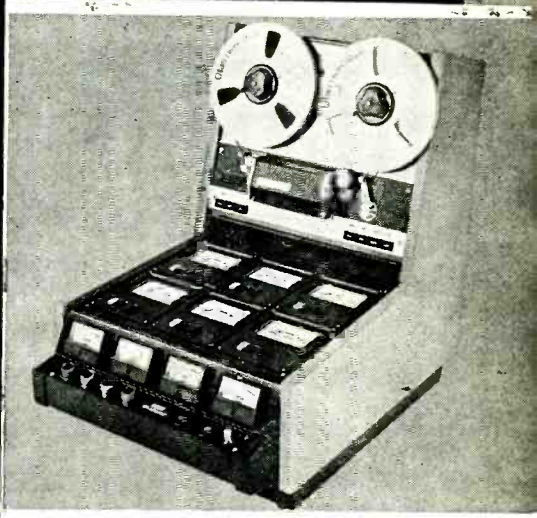

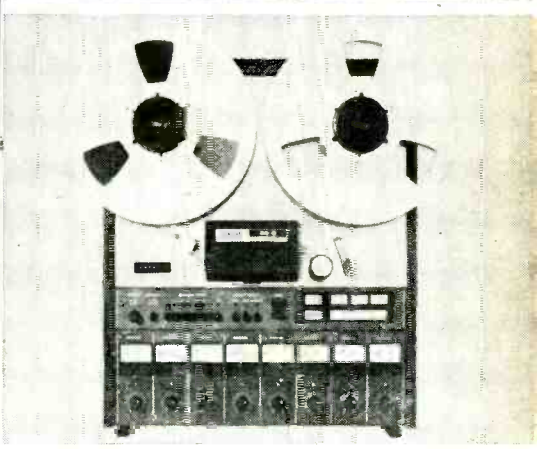

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Ken Scott

I imagine one tends to build up prejudices in the music industry after a while; preconceived notions as to how things are supposed to be run, how a session is supposed to go, what an album should sound like and so on. The American attitude towards the growth of an album project has always been met, at least by myself, with a certain degree of suspicion. I have always been suspicious of how much of a group's project is sweetened to mask the lack of ability—and, for that matter, how much ability is entrusted to the producer to bring out a band's forte and how much the producer will experiment to achieve those goals.

I have found, and this is not necessarily true of all US producers, that there is a certain safety with a proven formula. A certain hit-proven potential that has been implemented over and over again is comfortable monetarily, but hardly creative. And unfortunately the group that is saddled with a producer who doesn't understand what their sound should be, is faced with a frustrating experience.

During the past few years a society has sprung up, consisting for the most part of engineer/producers who have taken upon themselves the responsibility to grow with and expand upon a group's sound. In essence, the age of the creative producer.

Probably one of the most successful, both here in the States and abroad, is Ken Scott.

One of the startling aspects about Scott is the fact that he encompasses two major areas of a project, something which has been generally unheard of here. It has been felt for some time that if you were an engineer you had almost no right to be a producer, and on the other hand if you were a producer you had no right to be an engineer, and so the battle raged.

In breaching this battle Scott has had to face a few problems; for one thing maintenance engineers hate him with a passion due to his unwillingness to tinker with electronic parts himself. So every time anything goes wrong during the session the maintenance department is called upon, even during the most horrifying hours of the morning.

But those are moot points (although maintenance people themselves will hardly agree with that), the overriding factor being that the role of the engineer as producer and vice-versa are being met with success, and a certain deal of curiosity, here on the West Coast.

'What I look for in a studio to record is atmosphere. The musicians have to feel at home . . . it can't feel too clinical. For mixing, a smooth monitoring system. I dislike working with JBLs. My favourite monitors for mixing are Cadac's, which are known in England but not over here . . . they're great. Since I've been working at A&M a lot, I've been mixing through their system which is made up of Altec *604Es* with Vega woofer's and Monitoring Lab crossovers. I like working at A&M because of the choice of rooms to work in, and I usually alternate between Studio D and Studio A. Studio D is fairly compact, not too dead but verging on dead as opposed to live, and if I need something for overdubs and I want a live sound then I'll go over to Studio A which is a lot bigger and a lot more live.

'I find very little difference between studios over here and studios in England. I feel most at home with Cadac speakers and desks which are English and I don't know of a studio over here that has either. But apart from that I notice very little difference.

'I still engineer my own sessions; far from being a distraction I find the complete opposite. I know how to get my sound very quickly and very easily and I don't have to worry about it again, whereas if I were sitting next to someone and I have to tell them what to do all the time: first off, it wastes time trying to convey to them exactly what I want. I did try one album where I used an engineer, and I found that even though we had gotten the sound right, or what I was after, I found I was listening more technically than musically the whole way through because I wasn't in complete control of it. I had that slight nervous feeling that it wasn't quite there the whole time. I suppose I could take it to the point of "ok, add another 2 dB at 10k" and take all the guesswork out of it but it's quite often, when I'm doing it, I'll take it to plus 4, see what that's like and then back it off a bit; but by the time I've told another engineer to do that it would be so much time spent, and it's simply not worth it.'

When discussing what a producer can and does do to a group's sound, a recent case in point came out concerning the past two albums by the Tubes. The first album was produced by Al Kooper, the second by Ken Scott.

'I feel that Al (Kooper) had gone to the point where he didn't think enough of them as musicians. It was more a feeling of "they're adequate, we'll just put them down as quickly as possible, and then we'll spend the rest of the time making it sound good by adding orchestra on virtually every track," whereas on the majority of the album I tried to make it more theirs, which it is, and they are extremely competent musicians so they have it within themselves to do it. So why try and add everything else if you can get away with it? There are some tracks with orchestra on them, but I tried to keep that down to a minimum, except for *Don't Touch Me There*, which was our try at the Spector Sound; to copy it as much as we could, that was our plan from the very beginning. I liked that sort of thing. I like doing as many varied projects as possible, like doing a jazz-rock kind of thing to the Tubes, a lot of it depends on what you do well. Some people work better doing lots of different things while others work better by keeping their talents to one type of thing. Both can be rather detrimental but I think a lot of it has to do with faith in one's self . . . that kind of thing. Some people strike a hit formula and they become scared to veer away from it . . . to become safe in one's success, which is rather strange.

'I'm lucky in that I can get rid of most things; like a jazz-rock album which you do very quickly . . . everything happens at once in the studio. That takes care of one thing in my system, and then I'll do Supertramp which takes six months and it's really starting from rock bottom and gradually building up, and that's *another* thing out of my system.'

One of the things that has always struck a note of curiosity with me is how many and varied techniques are used for mic placement. I feel that until a few years ago, many engineers as well as producers didn't really care how critical the mic placement itself was, just as long as something was committed to tape; the rest could be eq'd into shape later. I don't know how rampant this situation was in the UK and Europe but on the West Coast, from the early sixties till the early seventies, mic placement of any consequence went straight to hell in a hand basket, as many acid-rock lps of that period will attest.

'With regard to mic placement I will always, or nearly always, place the mic the same way all the time, but it's very much a question of getting everything sounding right in the studio. I've never gone out of my way to experiment . . . *that* much, apart from the normal thing where the drummer will hit the mic and move it away a bit and suddenly the sound totally disappears. I will spend god knows *how* long before we start anything, just getting it right in the studio. I went through a situation on the new Stanley Clarke album with one of the drummers we used who I'd never worked with before. He wasn't used to my way of working,

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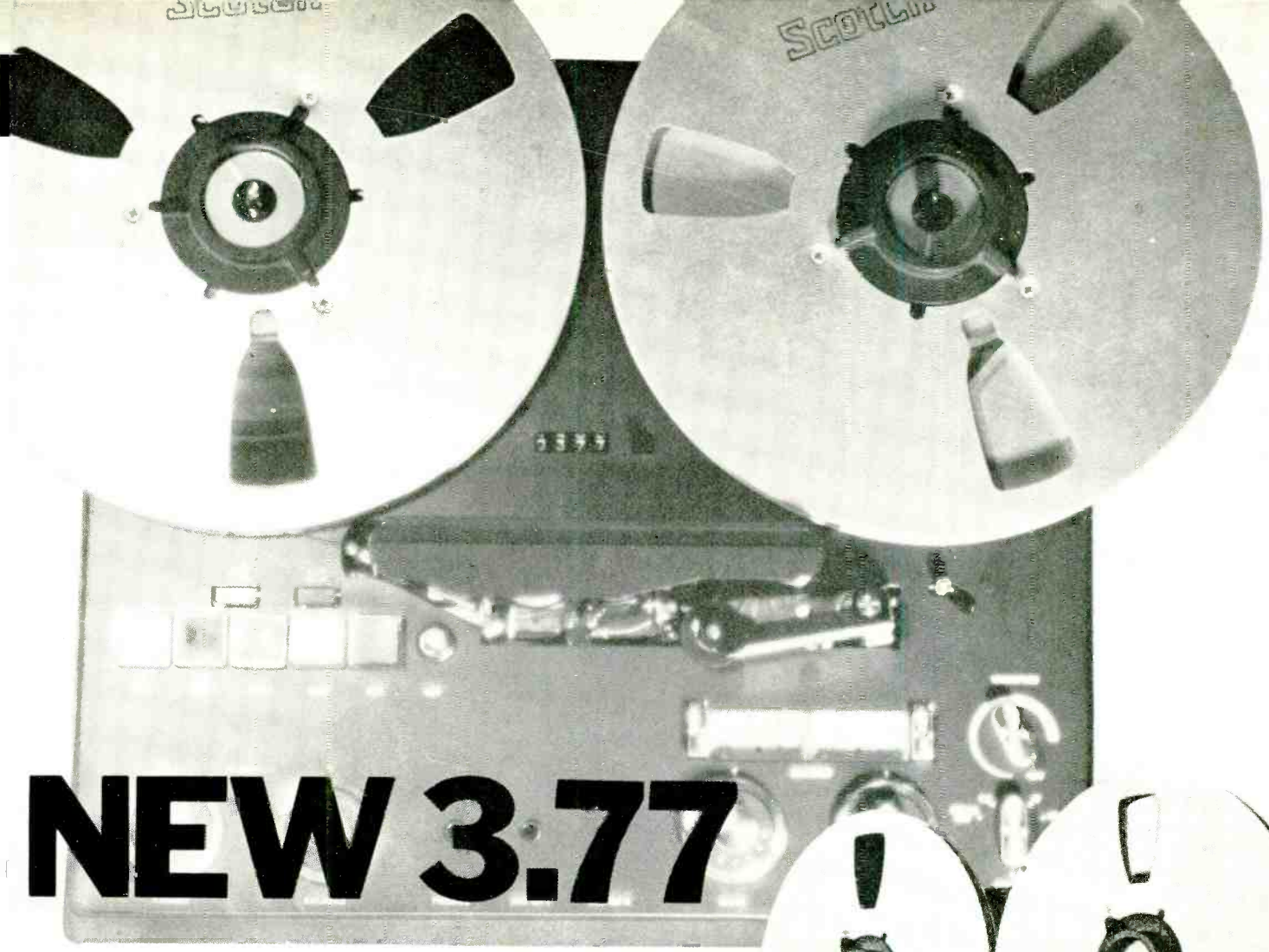
Ken Scott and Supertramp. The walls of his office are lined with those little gold jobs.



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so having got him to strip his drums down *completely* once because there were rattles and loads of things, he put them back together and they still sounded bad. I know *how* many cymbals, it was just incredible.'

As of this writing it is unclear what Ken Scott is up to now though he is certainly up to something. One thing that came out of our discussions which may prove to be

Ken Scott with The Tubes at A & M Studio—and resulting insanity

started getting comments about becoming too technical, getting away from the music and all that kind of thing, and it's weird because I hadn't come across that kind of thing for a long long while. But the strange thing is if you let a bad drum sound go by, such as a slight squeak in a bass pedal . . . if you don't notice it right from the beginning on the session and you get the track that you like, then a couple of days later you'll be overdubbing something and you suddenly hear this squeaky bass drum pedal. From then on you hear it every time; it seems to leap up in volume until in the end it's louder than *anything* else on the track. As far as drums go, however, I'm one of those people who uses lots of mics. I usually use an *84* on snare (Neumann); *87*s, one on each of the toms; either an AKG *D25* or one of the EV *RE* series mics on the bass drum; and then a ribbon or ribbons of some sort for cymbals. In England there always used to be Beyer *M100*s, I find them a lot smoother than using a condenser or something. I used to hate cymbals a lot, I loathed them and would mix them way down, then the first time I worked with (Billy) Cobham, which was the biggest drum kit I *ever* worked with . . . with all those mics on toms there was no way that I could get rid of cymbals—there was so much pick-up. As a drummer he is just superb and his use of cymbals and everything was so much better than I'd been used to up until that point . . . I suddenly got to like cymbals. On the Stanley Clarke album he was playing 13 toms, two bass drums, snare, don't

an interesting and long overdue occurrence is the proposal for a formation of a producers co-op consisting of Ken Scott, Roy Thomas Baker and Robin Cable. The purpose of the organisation, as far as it was disclosed, was to form a group of producers who would act as a placement service, so to speak, with new acts. A placement service in the sense that a band in need of a producer could come to the organisation and between the three could find one who could best cultivate their sound for disc.

As far as any further discussions in that area were concerned it was left up for the events of the future to decide whether or not it would become a reality. I feel the formation of a group such as that would be the answer to a lot of problems with misconceived productions and 'shots in the dark' for many otherwise worthy bands. It could prove to be the tonic that the sagging music industry in the States needs —but only time and demands will tell.

Special thanks to Barbara Birdfeather and Barry Krost Management.

Gordon Skene

KQED

San Francisco is well served indeed with radio and television stations—numerically at least. The programme output of these stations is not, with a very few exceptions, what might be termed 'enlightening' or 'good' broadcasting. In reaction to this, the station KQED was set up some 23 years ago with no advertising and a strong educational bias, which it retains to this day.

KQED is one of those rare American birds, the public broadcasting station, independent of advertising for its revenue. It is both a television and radio station, and when I visited it, the tv side was moving from its old premises up the road to new ones under the same roof as the fm radio operation at 1011 Bryant Street, in Downtown San Francisco. The cost of the move and the two new tv studios was setting the station back some $2M. The move itself was taking place during the annual fund-raising auction, which constituted an ob exercise for the station.

The KQED auction was instigated soon after the station took to the air during one of the regular financial crises when donations and sponsorships had fallen off. The auction, televised live, has become an institution and all sorts of things get donated: a Cadillac *Seville*, the world's largest box of chocolates, or a non-speaking part in *Streets of San Francisco*. Even 15th century Ming bowls have found their way to the auction table.

Controversy and discussion in depth have always been a hallmark of KQED programming; consciously so, because this is what makes the station different from all the others. The news doesn't have to be 'happy'; it is at the same time national, international and local. The station is answerable to no commercial influences other than its viewers and listeners. It reaches around three-quarters of a million households in the San Francisco Bay area, among a potential audience of around one and three-quarter million households, and in addition reaches audiences in Northern California via relay stations. The tv service produces about 30 hours of its own programmes a week, including a regular evening programme *Newsroom*, which has become an institution it could hardly abandon, and there is a regular schedule of children's and educational broadcasts. A substantial proportion of the programmes originate in the UK, including such well-known attractions as *Monty Python*, *Upstairs, Downstairs*, and Wagner's *Flying Dutchman*. On occasion, the tv and radio combine to put out a play or film with an alternative minority language soundtrack in addition to English. Instructional programmes (about 28 hours a week on TV) account for a substantial part of the daily output.

Unlike many other radio stations in the area which provide mainly background music or are predominantly news stations heavily larded with commercials, KQED aims firmly at foreground listening between 0600h and midnight. There is a regular programme pattern that nevertheless contains considerable variety, including phone-ins, civic affairs reports and local music. The day gets off to a good start with the relay of BBC Radio Newsreel at 0630h (local time); regular news and headlines throughout the day are interspersed with such items as record reviews, a midday concert, talks and interviews, jazz and folk programmes, international music competition finals, and programmes for ethnic minorities in Chinese, Korean, Spanish and other languages. The major omission is pop, which is mostly left to the commercial specialists. Details of programmes are published regularly in the supporters' magazine *Focus*, which doubles as a kind of 'Radio Times' as well as being an excellent general interest magazine in its own right. The station maintains good relations with the other media and indeed, received considerable help from commercial stations when it was getting off the ground.

A substantial proportion of KQED's revenue comes from its supporting members, around 120 000 people who pay regularly to keep the stations on the air. In the 1974-75 financial year their contributions totalled nearly $2.5M. Volunteers from all over the Bay Area raise money for the station in one way or another. Most board meetings of the station are open to the public and there is a great feeling of involvement among the regular audience. The auction brings in around $700 000, about three-quarters of the value of the goods donated by local industry, commerce and individuals. Last year some 50 foundations and family funds contributed over $75 000 in general support, with special grants for local programmes and community services. Total operating income for 1975 was just over $5M as against an expenditure of just under $5M; for 1976 the station was working on a budget of some $400 000 more.

In television, particularly, the fact that a growing proportion of the station's income is from the public direct means that it is constantly having to look for wider audiences at the expense of the minorities. There's also less money available for experiment. To get the audiences it has to entertain as well as educate and inform — hence *Monty Python*. There is a familiar ring to the

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Why do people who choose to listen to and watch the station also choose to pay to do so? They don't have to. Many don't. But as John Rice, the station's recently retired manager and programme director has said, the reason for the support is a combination of gratitude and fear. People see and hear what they like and want to be sure they can have more of it. They also realise they can't count on their neighbours to pay for it.

John Fisher

Hi fi for engineers and multi track for the masses

As any journalist covering both the professional studio and the domestic audio fields soon finds out, they are separated by a yawning chasm of disinterest. Most hi-fi enthusiasts know little or nothing of what goes on in a recording studio and frequently display hilarious ignorance, for instance by sneering at just those loudspeakers (eg JBL and Tannoy), that are used to monitor the recordings which they buy and play on their hi-fi. Likewise, some studio engineers seem blissfully ignorant of some quite important facts of domestic hi-fi life. Like, for instance, what actually happens when their four-track quadraphonic masters are encoded and decoded using some of the quad systems adopted by the record companies. It would also help if studio engineers bore in mind the kind of volume level at which the average domestic user listens, how this differs from the monitor mix level, and what the difference does to bass and high frequency balance.

The baying hordes of hi-fi enthusiasts who attend domestic exhibitions are inevitably unwelcome at the APRS, AES, etc. although there is no equivalent bar to a studio engineer attending a hi-fi exhibition, few are frequent visitors. This can, in certain circumstances, be a pity. For instance at the recent Sound 77 audio and hi-fi exhibition held at the Excelsior Hotel near Manchester Airport, there were several domestic items of potentially valuable interest to the studio engineer.

Take the matter of direct-cut discs. Hi-fi freaks are now positively clamouring to pay as much as £10 a time for Sheffield and similar direct-cut recordings imported from the USA. But still no British record company or enterprising independent studio has cottoned on to the market and produced a competitive home-grown version. Surely this is ridiculous, because there is no shortage of studios with in-house cutting facilities and British producers and musicians are more than equal to the challenge. Particularly interesting at Manchester was the launch, by the enterprising Cambridge hi-fi firm, Monitor Audio Ltd, of a completely new form of direct-cut. Whereas all the discs so far released in this country have been 33⅓ rpm albums, Monitor Audio is now importing *Crystal-Clear* discs which are 30 cm albums (for some unaccountable reason pressed in opaque *white* vinyl), recorded at 45 rpm. The faster disc playing speed is claimed (apparently with justification) to improve frequency response, eliminate pinch distortion and drastically reduce inner groove cutting distortion. The first *Crystal-Clear* issue was disco-style music; the second is West Coast rock group music; and a classical release is next on the list—all at a retail price of around £7.50.

Another interesting discovery was the shake-up which has taken place in the British distribution operation for products from the German firm Uher. The BBC and various Government departments are, of course, heavily committed to using Uher reel-to-reel equipment, and this has preserved the company's interest in marketing in the UK, despite the problems of falling sterling. Over recent years the British Uher agency has passed through several hands, and even more addresses. The price has also continually fluctuated, and the Germans have finally realised that they were losing out on public confidence in a big way It was getting to the point where only the most dedicated (or heavily committed) Uher user found the game worth the candle. Now the German company has set up a wholly-owned subsidiary company, Uher Ltd., at 24 Market Place, Falloden Way, London NW11, and both stabilised and drastically reduced the price of its cassette and reel-to-reel equipment. For instance, the new *SG630* logic controlled open reel machine, with video-style omega loop tape transport (to provide a dreamy rock-'n'-roll edit facility and minimal tape wear) is now available at less than £500 excluding VAT. This is quite literally several hundred pounds less than the tag that every observer familiar with past Uher pricing policy was putting on it. As the machine and the company policy re-think becomes better known, the *SG630* must surely be considered—and hopefully reviewed—as a possible alternative to the Revox *700* as now found in so many small studios.

The other surprise at Manchester was the Teac-Tascam recording mobile parked outside the exhibition hotel and open to visitors. It emerged that the Teac truck was on its first trip out, having been completed only the week before. The thinking behind the truck is as interesting as its equipment.

It was put together in a week by Andy Bereza and Paul Nice. They are now embarking on a campaign to take the truck, and with it the whole concept of low-cost multitrack recording at home, out to just those people whom Bereza feels should be interested in it. Between 1969 and late 1975, Bereza was a designer for Allen and Heath equipment. He quit, at obvious financial loss to himself, in favour of what is clearly total commitment to the concept of low-cost 'multitracking. Bereza points to the way in which large modern studios now cost so much to equip and run that only the major groups, with a bottomless pit of record company resources behind them, can escape the 'You've only got half-an-hour more to be creative' pressures that can so easily arise when the studio cash registers are ticking over at an alarming rate.

Since leaving Allen and Heath, Bereza has been variously connected with Teac, in the States, Japan and now the UK. Construction of the mobile was the logical extension of his ideal—to get musicians, songwriters, producers and their ilk hooked on the idea of multitracking at home. The truck, an Austin-Morris Luton Transit, was bought secondhand, re-sprayed and fitted out inside as a small mobile control room for around £1500. The gear installed notched another four or five thousand. We have already reported (STUDIO SOUND AES Convention Report, p38, January 1977) on the 8- and 4-track recorders that Teac are now marketing, and the mixers for use with them. The truck has a Tascam *80-8* 12.5 mm 8-track and an *A3300S* 4-track 6.25 mm machine, all tracks having automatic dbx facility. Initially a single Teac 8-into-4 mixer was installed, but the rack mounting has been designed larger to take another, similar, unit side by side to provide a 16-into-8 facility. Doubtless, and not entirely unconnected by the tie-up in the UK between Acoustic Research and Teac, the monitors were *AR 16s*, but these are due to be changed for larger AR models.

During the Manchester exhibition, Bereza made appointments with local musicians living locally or gigging in the area, to call in, see the truck, play with equipment and hear what it could do. For example, while I was there Paul Nice demonstrated stereo reduction with an 8-track original previously recorded for Teac in the States. Future plans including taking the truck to more hi-fi exhibitions as well as visiting anyone seriously interested at their homes or on gigs. Because the mobile had been finished only a

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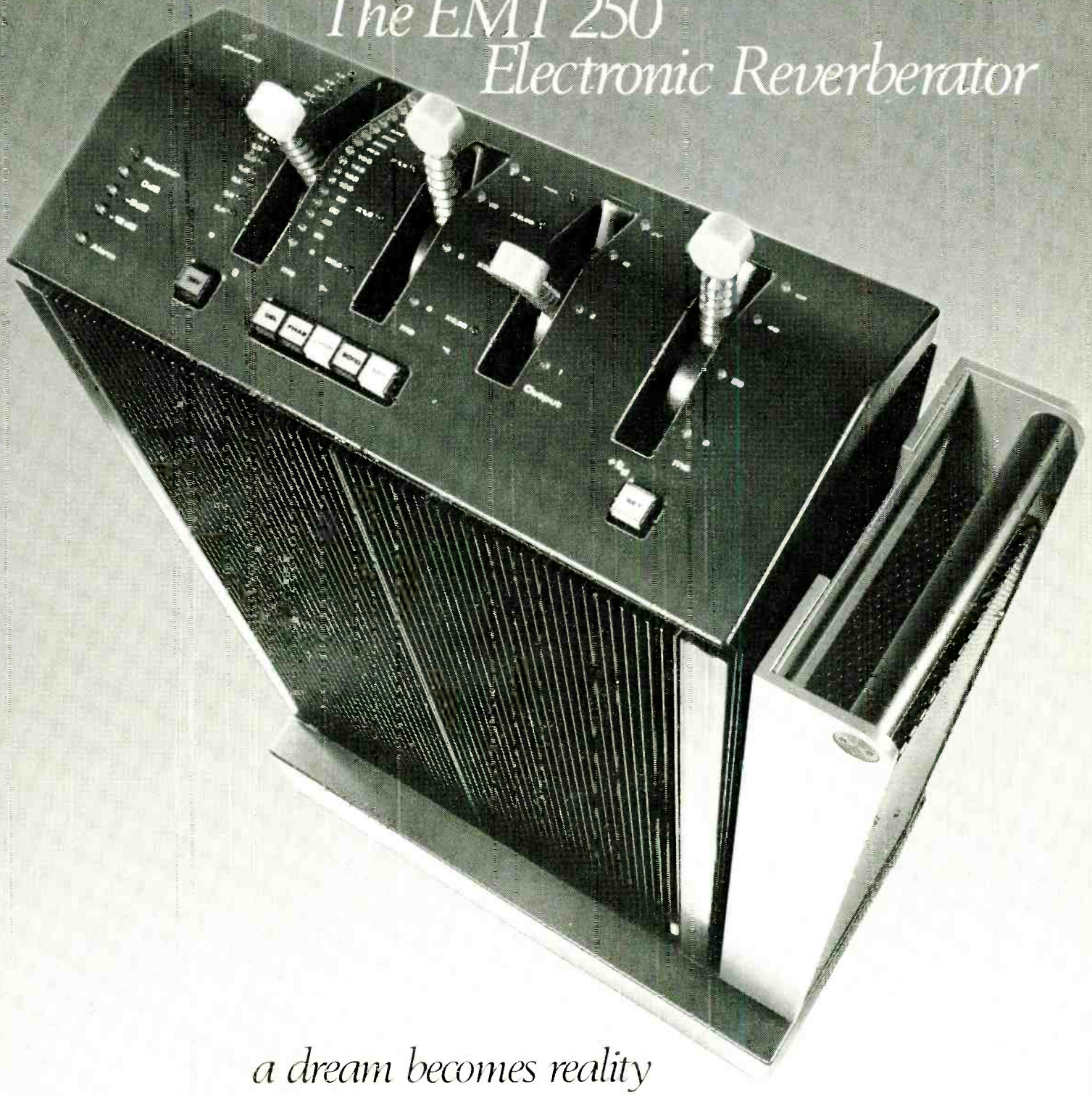
The Teac mobile with Tascam equipment will be parked outside the spring Hi-Fi exhibition at Heathrow, between April 19-24 and is open to interested visitors.

The EMT 250 Electronic Reverberator



a dream becomes reality

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WORK

few days before the Manchester exhibition opened, there was virtually no advance publicity; in future its whereabouts will be advertised well in advance.

No one involved in the project has any illusions about the two main problems in selling the idea of multitrack power to the people. Firstly, there's the feeling that multitrack equipment must be expensive and difficult to operate. Well, 12.5 mm tape is relatively cheap and although it will take a little time to educate a novice musician in the art of mixing, there is no doubt that the Tascam 8-track recorder system is beautifully simple to use.

Inside the Teac-Tascam truck and team

The dbx units are automatically servo - controlled by the machine. Eight 'track-ready' buttons, with flashing leds, are used so that the track or tracks on which a recording is to be made can be advance selected ready for use and then automatically switched from playback to record by pressing a single button when the tape is running. This is possible because the Tascam machine uses a single head for both record and playback, the third head being provided only for monitoring facility. In other words, there's automatic full simul-sync at all times, each gap of the main head stack is independently switchable between playback and record.

Even so, Bereza well acknowledges the extent to which education of those fresh to multitracking will be necessary. 'It's a wonderful system,' said one new user. 'But every time I try and reduce my 8-track tape to 2-track stereo I keep erasing two tracks.' Bereza had to remind him that even with Tascam simplification to reduce from 8-track to stereo master you still need an extra stereo machine! Another clever dick pointed out they'd never get the 12.5 mm tape into an 8-track cartridge. The other hurdle which Teac, the mobile, Bereza and Nice will have to overcome is the feeling that no budget narrow-track facility can possibly produce the kind of master quality suitable for disc cutting and commercial release. But here the Teac team have an ace up their sleeves. Several discs have already been issued from masters recorded using Tascam equipment in domestic circumstances, for instance a small living room. Perhaps the most successful to-date is the album *Success anp Failure* by the West Coast musicians Dalton & DuBarry. Teac have taken these two under their wing for the express purpose of showing how low-cost multitrack can benefit talented musicians looking for recognition and not yet eligible for a blank cheque from a major record company to cover studio time. In fact, the Dalton and DuBarry lp is available in dbx-encoded disc version.

Professional studio engineers by now feeling cynical about the ability of such low-cost equipment to come up with the goods, should be careful how loudly they voice any such reservations—unless they are in turn prepared to come up with the goods and partake of a blindfold test between the end product of low and high cost multitrack recording. Although STUDIO SOUND is and will remain concerned mainly with the high cost end of the market, no one who takes recording seriously should ignore the benefit—or perhaps even the threat—to their livelihood of the low-cost alternatives now becoming available.

After all, *Sergeant Pepper* was made on 12.5 mm 4-track machines and was moderately successful.

Adrian Hope

Quadrafile: four way split

For some two years now, audio enthusiasts have been boring and bewildering their uninitiated friends with a curious in-joke.

'Have you got your copy of *Quadrafile*?' queries audio enthusiast number one.

'No, not yet,' replies audio enthusiast number two, 'but I gather they're nearly ready.'

At this both parties fall about laughing, to the intense embarrassment of the outsider, who hasn't heard of *Quadrafile*.

For the benefit of uninitiated readers anxious to be clued up on the in-joke, *Quadrafile* is an individually - numbered, two - record album set available from Hi-Fi News and Record Review*, intended to compare the four quadraphonic surround sound systems so far adopted on a commercial basis.

Critics will doubtless bemoan the fact that *Quadrafile* doesn't include examples of Ambisonics or BBC Matrix H, but does include a side devoted entirely to the Nippon-Columbia UD-4 system, which, at least so far as Europe is concerned, has passed into limbo. But the background to how *Quadrafile* was produced, how long it all took, and what it involved, readily explains such apparently illogical inclusions and omissions. And, by the way, it may well be that UD-4 is not as dead as anyone would be excused concluding—watch this space for future news.

The idea behind *Quadrafile* was conceived as far back as May 1974 by Michael Thorne, when he was with HFN/RR. Thorne is now with EMI as an A&R man (not entirely unconnected with the Sex Pistols signing) but between HFN/RR and EMI, was Editor of STUDIO SOUND. If our report on the production of *Quadrafile* sounds uncharacteristically puffy for these pages, it has nothing to do with Thorne's past connection with the magazine. For one thing, he deserves (but doubtless won't get) the OBE for perservesance against all odds and finally bringing the project to fruition, some two-and-a-half years after the original idea was dreamed up. Also because *Quadrafile* is the first project of its type (and probably the last, unless there are any audio masochists around), there is no yardstick for critical comparison. Incidentally, and doubtless with an eye to current EMI policy over quadraphonics whereby the company puts out single-inventory SQ issues of all classical material but with only ambience information in the rear channels, Thorne wishes something to be known: the whole *Quadrafile* project was signed, sealed, delivered and irrevocably wrapped up before he left STUDIO SOUND for Manchester Square.

At HFN/RR Thorne was putting together what subsequently proved to be the definitive series of articles on the state of quadraphonics art at that time. Feeling he had gone as far as he could with words, the next step seemed logical: produce a series of records with the same programme material recorded in each of the four quadraphonic formats, and let the reproduced sounds speak for themselves.

To secure agreement in principle from the four companies involved —CBS for SQ Matrix, Sansui for QS Matrix, JVC for CD-4 discrete, and Nippon-Columbia for UD-4 Matrix-cum-discrete—was relatively easy and took only six weeks. Thorne's original idea was to have around 12 minutes of test material ('all the usual garbage that hi-fi freaks expect') and then move away and into what really matters—musical programme material. In the event, the test signals now take up only five minutes of each 25 minute side, the rest being music.

Thorne regards the test signals as being 'over-simplified musical signals and situations which are a necessary precursor to the real music. As a result, the tests are rather more interesting signals than the usual 'Hullo, I'm on the right, well hullo to you, I'm on the left' tedium. The track entitled *electronic footsy*, for instance, sends electronic signals moving around the listener in circles; or more accurately *should* do, and does to an extent, depending on the capability of the system and reproduction set-up. But no comparative judgements here. Buy the record, and listen to it for yourself.

The object of the few test signals that were finally included is to enable the listener to adjust his ears and then listen to the music. The tests are thus a starting-point for the music and Thorne hopes that most people will not bother to play them after the first few times round. They are there because our ears do need adjustment to any new medium. For instance, how many people,

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are really hearing stereo as intended? All over the world, people are lying flat on their backs, sideways on sofas, or in armchairs backing onto a pair of loudspeakers, wondering what all the fuss over stereo is about. Not until you've sat somewhere at least near the 'ideal' stereo seat between and in front of a pair of correctly-phased, correctly balanced, respectable transducers, do you realise what Blumlein had in mind nearly half a century ago. But, having once heard the remarkable firm phantom images that a stereo system can produce, your ears are ripe for all future listening.

It was doubtless this kind of policy philosophy and the detailed sleeve notes, which were prepared in advance of production rather than as an afterthought, that enabled the project to kick off fairly smoothly. There were no real problems over securing verbal agreements in principle from the four companies backing the different quadraphonic systems represented on the discs. After all, at least in 1974, they were all still raring to go on quadraphony. The snags, which gave birth to the 'why are we waiting' in-jokes, came with virtually all the subsequent and practical stages of progress.

On a political level, there were problems in the no-man's land between verbal and written agreements. It would have been all too easy to find plenty of mediocre musical material, for instance from bands that the record companies were anxious to plug, that could be included as musical material. But Thorne didn't want mediocre material. 'I wanted to show the surround sound medium off with material which exploits it creatively.' For Thorne, the surround sound medium is *not* the message. And he wanted creative exploitation by the likes of Pink Floyd, Bartok, Yehudi Menuhin, Stephane Grappelli, Mike Oldfield and Mahler. He finally got them, but the sheer number of people who need to say yes and physically sign on a dotted line before you can even start to put that kind of material together is frightening. Put another way the more well-known or famous the artist or material, the more people there are in a position to say no. And there have been enough unsatisfactory attempts at producing test or compilation discs with high-calibre material for a great deal of fingers to have been burnt over the years. So for Thorne, every new executive, agent, artist, or manager encountered meant starting the explanations from scratch, all over again. As he says: 'They've been bitten too many times by too many people who know nothing about record production and even less about music.' Not so surprising then that, to clear the Bartok extract alone required the agreement of no fewer than eight different people in London and New York.

The legal problems were, of course, only half the battle; there were plenty of difficulties on a technical level. The object was to produce a record set that would be of value to studios and engineers as a production tool, as well as being of interest to the general public, curious about quadraphonies and surround sound. It goes without saying that it was necessary to have exactly the same programme material on all four sides. However, to ensure the best cut for each quadraphonic system, with no possibility of the protagonists afterwards pleading unfair competition due to unsympathetic cutting, it was necessary to provide four separate mastertapes, one for each company to use for their cut. In fact five production masters were made, one as a safety. Although it was adjudged acceptable, in fact unavoidable, to have the musical material mastered through an extra generation (because no record company in its right mind releases original master tapes for external use), feelings were that each test material section on each master had to be an uncopied, first-generation recording. For this reason the tests on the beginning of each side are individual to each disc, the signals having been laboriously produced five times over, for recording direct onto each master tape. Hence there may be a slight discernible timing difference between tapes. But in technical terms the signals are on tape within ±0.25 dB (overall) tolerance, and thus for listening purposes as near identical as makes no practical difference. All in all, therefore, it is hardly surprising that recording the test signals took two solid days of concentrated devotion, surrounded by a Cape Canaveral of electronics.

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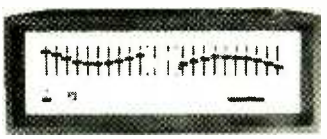

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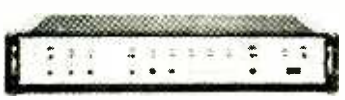

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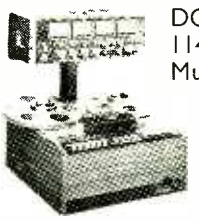

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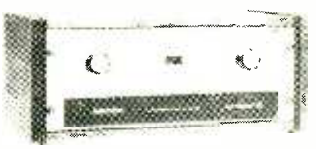

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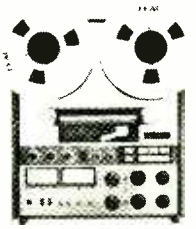

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sound versions of Mike Oldfield's *Tubular Bells* are now available, the only quadraphonic master tape available during the gestation period of *Quadrafile* was a compromise mix with only ambience information at the rear. Permission was obtained to go back to the original 16-track master and re-mix the two passages incorporated on *Quadrafile* in true surround sound. This was done with Tom Newman and Alan Parsons. Re-mix from the multitrack master was also necessary on the Yehudi Menuhin-Stephane Grappelli track, because it was found that EMI's production master was already encoded in SQ. Not surprisingly, Thorne is anxious to acknowledge that 'the production wouldn't have been possible without advice and help over and above the call of duty from a large number of sympathetic friends in and around the industry.'

At all times during re-mix, there was a need to avoid unfairly favouring one system or placing another at a disadvantage. Take just two examples. It is a mathematical fact that phantom images at rear centre will emerge anomalously phased and thus diffuse and disturbing from SQ matrix encoding and decoding, but in phase and firmer from a phase-symmetrical system such as CD-4. It would also have been easy to blow CD-4 (and to a lesser extent UD-4) apart by expecting it to cope with excessive sound levels towards the end of the 25-minute side where tracking becomes especially critical. One criticism voiced of the *Tubular Bells* mix is that at the end of the sequence the bells themselves appear at centre front less dramatically than would be ideal in the context of the music. But just as Thorne avoided placing any instruments in the *Tubular Bells* mix at rear centre (to give SQ a chance), so he also avoided cranking up the level of the centre front bells at the end of the track (to play fair by CD-4).

'We needed to achieve an intuitive balance between the limitations of all the systems', is his way of summing up what could also be regarded as the decidedly clever trick of leaning backwards in four directions at once, so as not to favour or show up the deficiencies of any one system unfairly.

'You can't possibly have hundred-per-cent impartiality when you have only nine tracks and one record,' he adds, 'but I hope that we've at least got some way towards it.' The sleeve note echoes this: 'The aim of this album is to help you understand the difference, not pick the winner. As explained in the systems' notes, there *is* no winner.'

Alternatively one could say that all four systems have been given exactly the same length of rope with which to hang themselves publicly to fascinatingly-different degrees.

Perhaps most important of all, the project inevitably begs one vital question. Is there really any place for quadraphony in the home? As the four sides show only too well, no system of encoding and decoding can yet produce a realistic illusion of a central sound; that is to say a sound which the listener feels is emanating from where he sits in the middle of the room. Likewise, the psycho-acoustic manner in which conventional two-speaker stereo works, whereby the listener hears a stereo spread from two loudspeakers which he is *facing*, ensures that no listener can ever hear a realistic image-spread from the side. Doubtless the time will come when a true surround of sound can be re-created in a domestic environment, either by sophisticated decoding techniques applicable to the systems demonstrated on the *Quadrafile* record, or by the refinement of systems still in the pipeline. Quite what it will cost the domestic user, and whether the end will justify the expense is another open question. But it's a very relevant question, because, in the final analysis, no record company will spend time and money on producing a surround-sound-capable product if the general public cannot afford to take advantage of the surround-sound capability. As disclosed in the recent *Work* piece on Pink Floyd's current studio activities, even that group, which with *Dark Side of the Moon* has probably achieved more surround-sound fame than any other, initially mixes new material only into stereo.

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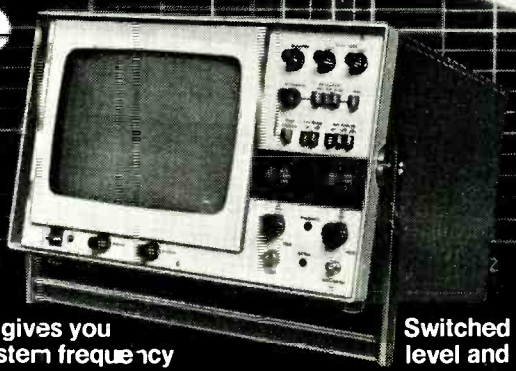

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SS/4/77

reviews

EMT 250 electronic reverberator unit

Hugh Ford

MANUFACTURER'S SPECIFICATION

Operating modes (program)

(a) REVERBERATION PROGRAM

Reverberation time at 1 kHz: 0.4s to 4.5s, controllable in 16 steps.

Reverberation time at 300 Hz: factor of 0.5 to 2.0 referred to the basic reverberation time, controllable in 4 steps.

Reverberation time at 6 kHz: factor of 0.25 to 1 referred to the basic reverberation time, controllable in 4 steps.

Basic delay of first reflection: 0, 20, 40, 60 ms.

Outputs: 4, usable as mono, stereo or quadraphonic outputs.

(b) DELAY PROGRAM

Delay times: 0 to 315 ms, selectable in 5 steps, additionally 0 to 60 ms selectable in 20 ms steps.

Outputs: 4, each programmable with freely selectable delay times.

(c) SPECIAL PROGRAMS

Phasing: changing amplitudes of the harmonics.

Chorus: tonal duplications.

Space: extremely long reverberation time of 10s.

Echo: repetitive slap-back with an attenuation of 10% in the time intervals between 5 ms and 315 ms.

Digital coding

A/D and D/A Convertor: 12 bit, quasi 15 bit by triple switching and the quantising ladder (flying comma). Sampling frequency 24 kHz.

Processor: operating speed per instruction 50 ns. Clock frequency 20 MHz.

Memory capacity: random access memory 128 Kbits Read only memory 16 Kbits Mos delay (shift register) 60 ms.

Analogue section

Input: balanced, input impedance ≧5000 ohms. Input level nominal +6 dB adjustable from —10 dB to +15 dB.

Outputs: 4, balanced, output impedance ≦60 ohms, output level nominal +6 dB adjustable from —10 dB to +15 dB.

Overload margin (headroom): max +21 dB.

Signal to noise ratio: in reverberation program: 70 dB rms (unweighted) referred to nominal value. 76 dB rms (unweighted) referred to full drive signal. In delay program: 75 dB rms (unweighted) referred to nominal value. 81 dB rms (unweighted) referred to full drive signal.

Frequency response: 30 Hz to 10.8 kHz +1 dB —3 dB.

Total harmonic distortion: delay program ≦0.5% at nominal level at 1 kHz.

Remote control: possible through 30 conductor dc cable.

Dimensions: 53.5 x 83 x 28 cm (w x h x d).

Weight: approx 45 kg.

Power consumption: 300W.

Price: £8000.

Manufacturer: EMT Franz GmbH. Postfach 1520, D-7630 Lahr, West Germany.

UK agent: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Hertfordshire.

IT must be said that the EMT electronic reverberator unit uses mos digital technology, and that it is unlike any other reverberation unit currently available. Reverberation and other functions are achieved without the use of any moving parts such as plates, foils, springs or air columns.

Ah! you might say—what about digital delay lines? Well I agree that these are purely digital, but the EMT reverberator has this function too, and it is no ordinary delay system albeit restricted to 315 ms delay.

As with all digital audio devices the single audio input is passed through a low pass anti-aliasing filter and from there to an analogue/digital converter—in the case of the EMT device, this is a 12 quasi 15 bit convertor feeding a shift register which can be manually switched to provide up to 60 ms delay in four steps of 15 ms. The output from the initial delay is fed into an extremely fast computer which works at a clock frequency of 20 MHz and provides an instruction time of only 50 ns.

Full details of the purpose-built computer may be found in a paper read at the AES 50th Convention in London which was presented by Barry Blesser, Karlo Baeder and Ralph Zaorski. In essence, given a fast enough computer with enough fast digital storage it becomes possible to simulate almost all subjective audio effects in addition to those associated with filters of the most complex types. Commercial computers with adequate speed are not only extremely bulky, but also very expensive and quite unsuited to practical studio problems. While various microprocessors are now available, these suffer from an inappropriate instruction code for processing audio signals, and furthermore they are not particularly fast in relation to audio signal processing where, given a sampling rate of 24 kHz, the complete computation must be completed in 41 microseconds.

It is as a result of these problems that the special computer in the EMT reverberator was designed. Its 50 ns instruction time together with 125 000 bits of random access memory and 16 000 bits of read only memory provide some very unusual features which occupy about 500 integrated circuits.

Before detailing the available functions it must be mentioned that the single audio input is split by the processor into four separate outputs which, with some functions, provide stereophonic or quadraphonic effects derived from the computations within the processor. Basically there are six different effects selected by illuminated pushbuttons: these are known as 'reverberation', 'delay', 'echo', 'space', 'chorus', and 'stereo phasing'.

In the reverberation mode three separate controls are functional and provide for not only reverberation times from 0.4s up to 4.5s in 16 steps, but also for variations in the low frequency and the high frequency reverberation characteristics. This means that the reverberation time at high and low frequencies can be adjusted relative to mid-frequencies, and the arrangement is such that high frequency reverberation time above 6 kHz can be controlled in four steps. They can be equal to that at mid-frequencies down to a quarter of that figure; likewise the low frequency reverberation time can be set in four steps (at 300 Hz) between half and twice the mid-frequency reverberation time.

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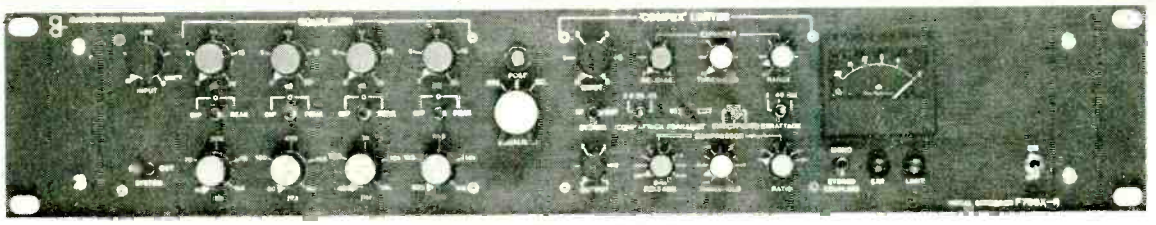

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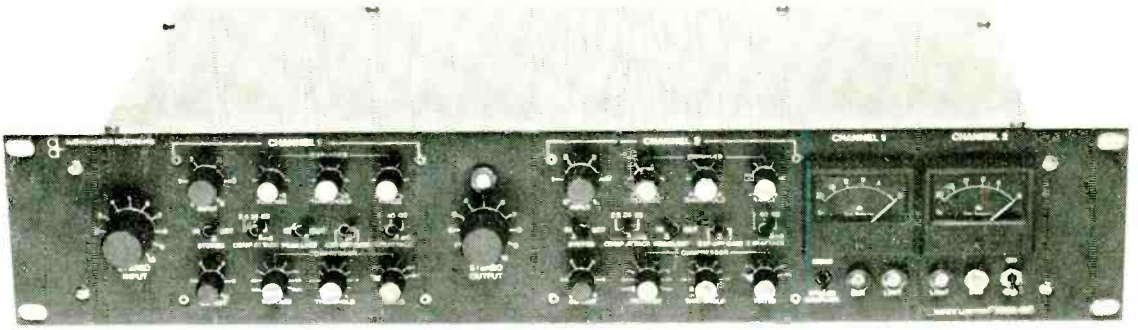

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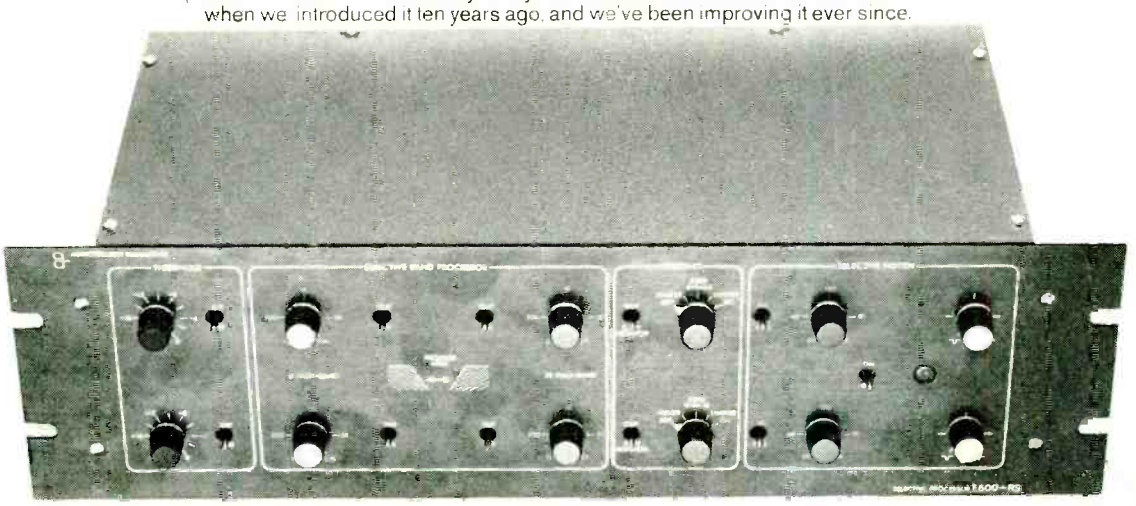

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As in other modes the initial time delay can be adjusted from zero to 60 ms in four steps, and this overall control in the reverberation mode provides unsurpassed flexibility over a very wide range. Furthermore, just to add to the realism of the excellent reverberation characteristic, the computer provides 19 different delay elements and a 'dis-correlator' separates the reverberation outputs of the four output channels.

Turning to the delay mode, as with reverberation, the EMT is not just a simple delay line. In addition to the initial 0 to 60 ms preset delay applied to the input signal the four output channels can have an individually set delay from zero to 315 ms in 5 ms increments. Thus the four output channels can have different delays; the delay in a given channel can be altered at the press of a button or the delay can be gradually altered in a given channel.

In the echo mode the four output channels operate in parallel and are thus identical, with the 0-60 ms delay available as before. The echo time can be varied from 315 ms (a large hall) down to 5ms (science fiction gimmick) in 19 steps which may be continuously varied. This is a pure non-absorbant echo which decreased in amplitude by 1 dB 'per bounce'; this covers a very wide range of echo time requirements which can of course be equalised at the desk in the echo return.

The 'space' function is a sort of super echo and reverberation with an effective reverberation time of about 10s. This gives a quite un-natural sound which can only be associated with science fiction but which may find other applications.

Unlike the 'space' mode, the chorus mode is well back to earth and is intended to make a single performer sound like a case of multiple adt. If one considers the effect of a number of identical instruments playing in unison this leads to different arrival times of the sound at the observer. The EMT device provides this effect from a single input by subjecting the four outputs to different random delays resulting in the apparent distribution of the input sound over a large area.

The final program, that of phasing, is achieved by the conventional method of subjecting the audio signal to a variable time delay which is set to between zero and 3ms by the controls. This is added to the original signal to form a comb filter. However the EMT unit goes beyond this concept in order to provide the four outputs. The right channel outputs are subjected to a further fixed 3 ms delay before the addition of the first delayed signal. Further, as the front outputs are derived by adding the signals, the rear outputs are obtained by subtraction, thus forming a rather complex phasing system.

Mechanically the unit is in an unusual form, being a free standing unit with four lever type controls mounted at its top rather like the throttles of an aircraft. Each control position is associated with led indicators and the interlocked mode selection switches are also illuminated. This makes it very easy to see the control settings. In addition there are five more indicators—four of these indicate audio signal level, and the fifth, labelled 'alarm', indicates that the unit has overheated and is about to shut itself down if the temperature continues to rise.

The level indicators consist of three green leds labelled 0, −6 and −12 dB program level, and a red led labelled 'register'. This indicator is illuminated under overload conditions which, in digital systems, create disastrous distortion. It is possible to remove the complete control panel and use it as a remote control built into the desk. In these circumstances it is connected to the reverberator unit by an 80-way cable handling only dc control signals.

Below the control panel the unit consists of a black finned body, the front and back of which can be hinged out to gain access to the electronics. One side comprises the audio signal section and the other side of which is the digital section, with the power supplies built on to the base and side of the unit. Signal connectors are balanced *XLR*s in the base which also houses the mains IEC input connector, voltage selector and clearly labelled fuses.

Within the unit, the standard of construction is first class with the use of high quality printed boards and components, servicing being aided by the use of sockets for all active components. However, the servicing information in the instruction manual is, to say the least, somewhat sketchy, and no component identifications were found either on the printed boards or in the manual. While fault finding in the audio sections should be straightforward, the digital section is another matter, and probably the only practical method of servicing will be factory replacement boards.

Input and outputs

All audio connections are transformer coupled and floating, and are variable in level by internal pre-set controls. The input impedance was found to be satisfactorily constant at 10 100 ohms which is preferable to the specified greater than 5000 ohms. The sensitivity for 0 dB indication is internally variable from −12 dBm to +15.5 dBm at 1 kHz. However, it was noted that the level indicator appeared to be after some pre-emphasis to the tune of 12 dB at 10 kHz—something not mentioned in the literature.

At the output the available level for 0 dB indicated input level was internally variable from −9 dBm up to +18 dBm with a very low output impedance in the order of 20 ohms and an available output level of up to +24 dBm before clipping.

The level indicator had accurate 6 dB steps, with the red overload indicator coming on at 6 dB above the zero level and was fast acting with an adequate hold time.

Frequency response and noise

As is to be seen from fig. 1 the overall frequency response is very flat up to 11 kHz at which point it is apparent that an extremely sharp anti-aliasing filter is applied. Unlike so many digital audio devices there was no sign whatsoever of beats as this turnover point was approached, and the applicaton of any sine-wave frequency gave a completely clean output.

With the unit set for 0 dBm operating levels at the input and the output, the noise at each of the four outputs was found to be identical,

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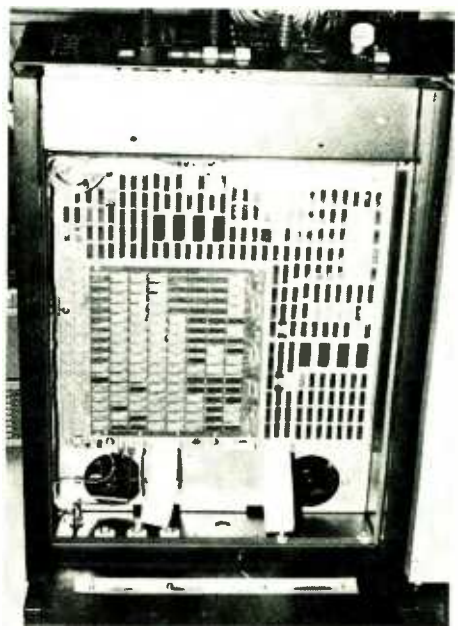

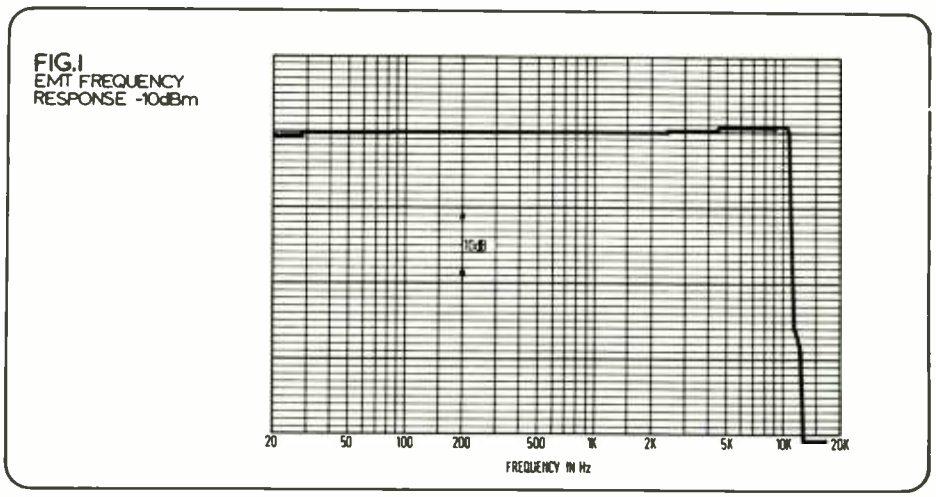

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It is already installed in many broadcasting stations both here and abroad.

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With the experience gained we've never looked back, and the SP 10 Mark II represents a considerable advance in turntable technology.

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Another benefit is that a record can be easily cleaned 'on air' with no audible speed variation.

The three speeds (33, 45, 78) are selected by illuminated microswitches and the start/stop function can also be remotely operated. Extremely useful if you are operating a bank of turntables.

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For more information about these and other benefits just write to Technics, 107/109 Whitby Road, Slough, Berkshire SL1 3DR. Tel: Slough 27516.

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The SP 10 Mark II Quartz-controlled Direct Drive Turntable.

but to depend upon the selected operating mode as follows:

MODE	noise 20 Hz to 20 kHz	'A' weighted
Phase	—84 dBm	—85.5 dBm
Delay	—83.5 dBm	—84.5 dBm
Chorus	—83 dBm	—84 dBm
Reverb	—76.5 dBm	—77 dBm
Space	—75.5 dBm	—76 dBm
Echo	—75.5 dBm	—76.5 dBm

Bearing in mind that there is a 6 dB margin level above the 0 dBm output these noise figures represent an excellent performance for a unit of this type.

As is seen in **fig. 2** which represents a constant bandwidth analysis of the output noise from 200 Hz to 200 kHz, there are discrete high frequency tones in the output, but it is felt that they are at such a low level that they cannot introduce problems in other equipment.

FIG. 2
EMT 1kHz BANDWIDTH NOISE ANALYSIS

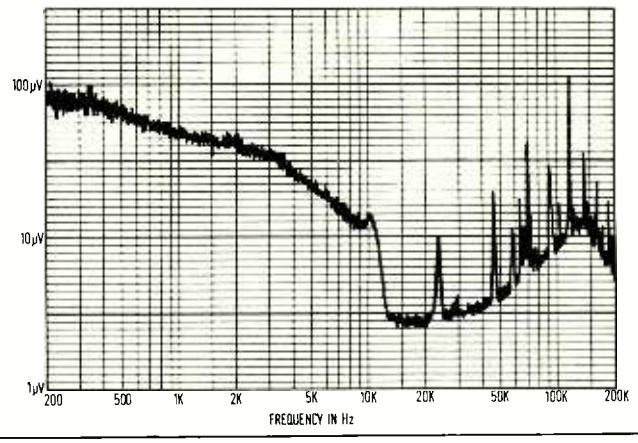
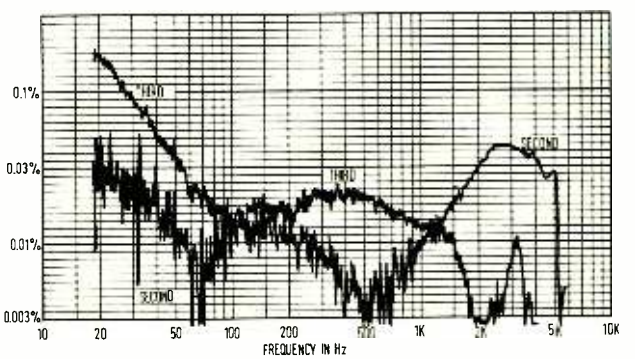


FIG. 3
EMT HARMONIC DISTORTION -10dBm



Distortion

The measurement of individual harmonic products in the delay mode produced **fig. 3** which shows that the second and third harmonics are at a very low level. So far as distortion in other operational modes is concerned there is no reason why it should be any higher than in the delay mode. This is because the only difference between modes is in the digital processing of the audio. Various tests were applied to other modes using tone bursts, and it is pleasing to report that nothing but perfection was noted.

Reverberation and delay

Checking the calibration of the four position initial delay control indicated that, while the steps were exact, the actual delays were on the long side, but this is really immaterial in practice. In the actual delay mode all delay times were about 1% longer than indicated, but the relation between the steps was precise and, as should be the case, there were no waveform degradations.

The reverberation time in this mode was measured in the flat frequency response setting at 1 kHz and found to correspond to the calibration. In the variable bass or cut treble mode the mid-frequency time remained constant while the outer ends of the audio band behaved precisely as expected. **Fig. 4** shows the decay characteristic of a 1 kHz tone with the reverberation time set to 2.8s and indicates good distribution of reverberant signals. Measurement of the reverberation time in the 'space' mode showed that it was 10s but that other parameters were similar to reverberation.

FIG. 4
Reverberation set to 2.8s, 100 ms/0w

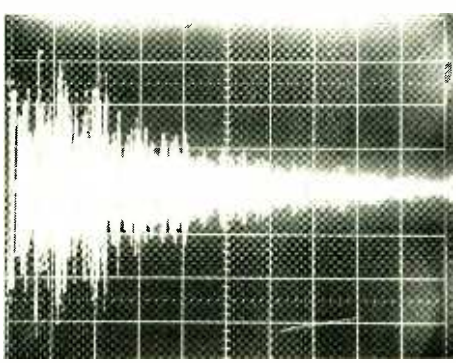
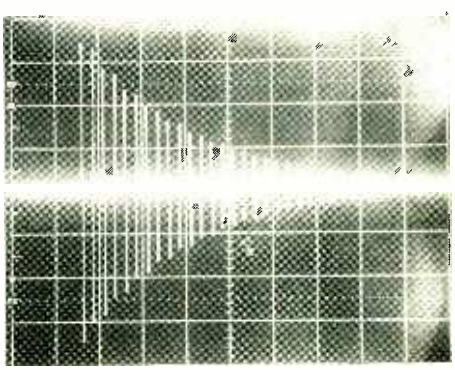


FIG. 5
5 ms echo



Echo

The only other mode in which meaningful measurements can be readily made is the echo mode; this offered an extremely clean repetition of the input signal at all echo settings. **Fig. 5** shows the output from the reverberator in the echo mode with a 1 kHz toneburst applied and the echo set to 5 ms. It is to be seen that the individual echos are separated by a constant time and that there is a steady decay, of exponential form as occurs in nature.

Summary

So far as measurements are concerned, the EMT reverberator gave excellent performance, but the frequency response being limited to 11 kHz may be a limitation in some circumstances.

Subjectively the reverberation mode is in my opinion unsurpassed in quality and offers the unusual facility of being able to change the relation between reverberation time and frequency at will.

All the other modes provide very useful subjective effects which are clean in their action, but I suspect the phasing mode will not provide the more dramatic effects that some people wish to use.

While this unit is very expensive, it is very versatile in its operational modes, and offers most excellent reverberation characteristics. ■

Week after week, Dolby makes the top of the charts

MUSIC WEEK, DECEMBER 4

This Week	Last Week	Wks. on Chart	TITLE	ARTIST		LABEL & NO.	PUBLISHER	PRODUCER
1	2	5	UNDER THE MOON OF LOVE	Showaddywaddy	✓	Bell 1495	Carlin	Mike Hurst
2	1	3	IF YOU LEAVE ME NOW	Chicago	✓	CBS 4603	Island	James William Guerico
3	3	6	NO NOISE REDUCTION USED					
4	4	2	SOMEBODY TO LOVE	Queen	✓	EMI 2565	EMI/Queen	Queen
5	13	4	LIVIN' THING	Electric Light Orchestra	✓	Jet UP 36184	Jet/U.A.	Jeff Lynn
6	10	3	MONEY MONEY MONEY	Abba	✓	Epic EPC 4713	Bocu Music	Polar Music
7	8	5	NO NOISE REDUCTION USED					
8	5	6	IF NOT YOU	Dr. Hook	✓	Capitol CL 15885	Sunbury	Ron Haffkine
9	9	6	LOST IN FRANCE	Bonnie Tyler	✓	RCA 2734	Mighty/Rak	McKay/Scott/Wolfe
10	6	15	MISSISSIPPI	Pussycat	✓	Sonet SON 2077	Noon/Britico	Eddie Hilberts

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Denon EM-2000 professional echo machine

Hugh Ford

MANUFACTURER'S SPECIFICATION

Tape speed: 19 cm/s to 57 cm/s continuously variable.

Delay time:

No. 1 head 37.5 ms to 150 ms
No. 2 head 94 ms to 280 ms
No. 3 head 132 ms to 397 ms
No. 4 head 168 ms to 502 ms

Heads: 1 Erase, 1 Record, 4 Reproducing.

Wow and flutter: within 0.15%.

Frequency response: 50 Hz to 12 kHz within ± 3 dB at 38 cm/s.

Signal-to-noise ratio: better than 56 dB at recording level of 0 vu.

Distortion: less than 2%.
Input: +4 dBm balanced, 10K ohm.
Output: +4 dBm balanced, 600 ohm.
Power requirements: 100, 120, 220V ac, 50 or 60 Hz.
Power consumption: 40W.
Dimensions: 420 x 306 x 135 mm.
Weight: approx 16 kg.
Connectors: Cannon *XLR 3-14* for input (male). Cannon *XLR 3-14* for output (female). Cannon *XLR 3-14* for power.
Price: £1350.
Manufacturer: **Denon Instrument Company, Japan.**
UK agent: Cine Sound International Ltd, Lansdowne Imperial Studios, Maxwell Road, Borehamwood, Hertfordshire.

THE *EM-2000* is a tape loop delay system which uses a fixed 1.3m length of 12.5mm tape in an endless loop, with a claimed tape loop life in excess of 1000 hours. Tape drive is by means of a large diameter capstan driven by an electronically controlled servo motor. This is variable in speed from 19 cm/s to 57 cm/s by means of a front panel control.

A solenoid-operated capstan pinch roller effects the tape drive. With one exception tape guides comprise twin 6.35 mm wide ball bearings; one guide is supported on a sprung arm in order to maintain the loop tension. The fixed guide is situated between the headblock and the capstan—I have the impression that this guide is well over the nominal tape width.

The fixed headblock supports a twin-gap ferrite erase head, a metal record head and four playback heads, all of which are adjustable in position by means of a four-screw mounting. Rather strangely, twin-channel heads are used with a track width approximating that of the 6.25 mm stereo format. These two tracks which are separated by a fair distance are for some reason wired in series, and to my way of thinking this spells disaster from the point of view of the effects of tape skew on short wavelength recordings. Clearly the use of 12.5 mm tape offers mechanical handling advantages, but the use of a standard 6.25 mm head would be far preferable to this odd arrangement.

A further mechanical criticism concerns a long unsupported length of tape in the area of the heads; not only is this length of tape undamped, but its guidance is suspect because of the wide exit guide which precedes the capstan.

Internally there are two printed boards: one domestic-quality board on the tape transport plate which is probably part of the servo system, and one large fibreglass board in the base of the unit which clearly supports the audio section and power supplies. Both boards and tape transport are connected entirely by plugs, such that servicing problems become simplified, and all components are clearly identified by screen printed references.

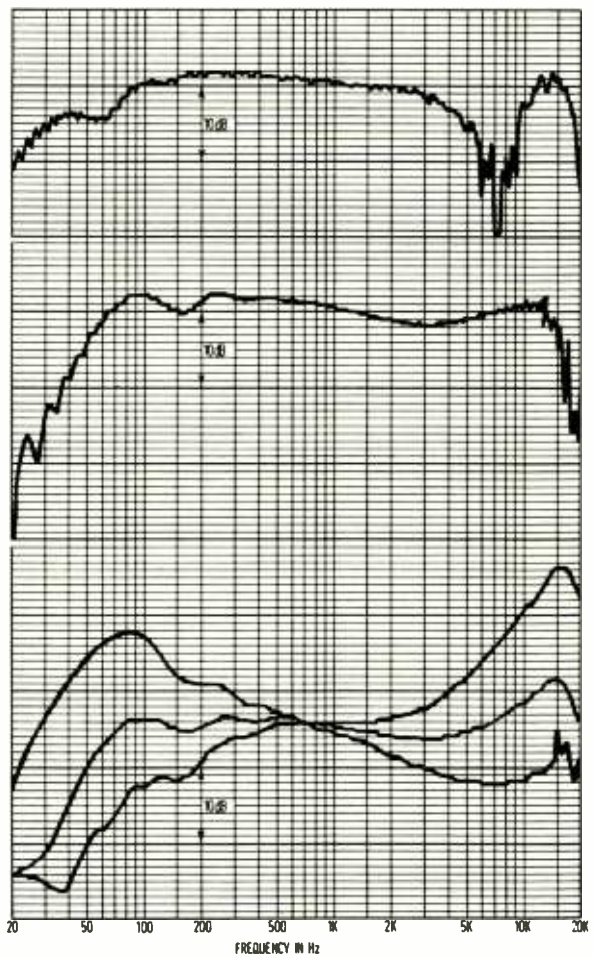
In the operational mode the delay is controlled by the combination of the tape speed which is set by a front panel knob calibrated from 0 to 10, and the selection of the desired replay head or combination of replay heads by means of four front panel potentiometers.

The erase head is permanently in operation, and the record signal is derived from two sources: (a) the input signal which is controlled by an input level control and monitored by a vu meter; (b) a 'repeat' signal in which selected replay signals are fed through a 'repeat'

FIG.1
DENON FREQUENCY RESPONSE REPLAY HEAD 4 SLOW SPEED

FIG.2
DENON FREQUENCY RESPONSE REPLAY HEAD 4 FAST SPEED

FIG.3
DENON EFFECT OF TONE CONTROLS HEAD 1 FAST SPEED



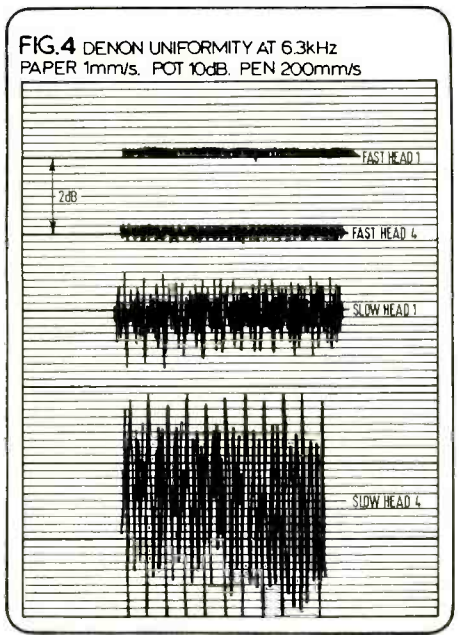


FIG. 4 DENON UNIFORMITY AT 6.3kHz
PAPER 1mm/s. POT 10dB. PEN 200mm/s

level control and also through treble and bass equalisation.

Similarly the output signal is also derived from two sources, the first being the selected replay signal which has a master level control and bass and treble equalisation, and the second being a fixed amount of the input signal which can be added by means of a rear panel switch.

Other rear panel facilities include switch selections of the input and output signal levels between +4 dB and −20 dB, a jack for a remote start switch, and the power connectors with an associated fuse. Audio input and output are by means of *XLR* connectors, but on the review sample the power connector was of the miniature Bulgin variety. Perhaps the manufacturer's specifications really was right about the audio input connector being identical to the mains power connector!

Input and output

The balanced input was found to have a constant input impedance of 10 600 ohms in the +4 dB sensitivity setting with the impedance being unaffected by the record gain control; in the −20 dB input gain setting the input impedance became to a degree sensitive to the record gain setting with the impedance varying from 13 000 ohms at minimum gain to 7400 ohms at maximum gain. The sensitivity at 1 kHz for an indicated record level of 0 vu was +2 dBm in the +4 dB gain setting or −23 dBm in the −20 dB gain setting.

At the output the source impedance remained constant with the two output level settings at about 470 ohms; the output level for 0 vu record level was +4 dBm to −19 dBm according to the output level setting. With the output unloaded these levels increased by 5 dB.

Personally I prefer to see a really low output impedance, but the Americans still seem to go for 600 ohms which should of course be *actually* 600 ohms. However it was nice to find the input impedance around 10 000 ohms.

Frequency response, distortion and noise

The overall frequency response of the delay system was found to depend upon the tape

60 ▶

DENON EM 2000

speed as expected: the results at the highest and the lowest speeds are shown in **figs. 1** and **2** with the tone controls in their mechanical centre positions. It is to be seen that the performance at the lower speed is decidedly poor, probably as a result of azimuth errors on head 4 which was used for replay. However, similar results were obtained with heads 1 and 3.

Fig. 3 shows the effects of the treble and bass tone controls on the overall frequency response; it seemed that the available boost from the treble control is excessive.

Checking the 3% third harmonic distortion point at 1 kHz showed that it was not much affected by the tape speed and remained at 8 dB over a record level indication of 0 vu, which is about the minimum permitted safety margin for a genuine vu meter as was fitted to the unit.

The replay noise level naturally depended upon the tape speed. The following 3% third harmonic distortion level to noise ratios were measured:

	fast	slow
unweighted rms 20 Hz to 20 kHz	—52 dB	—51 dB
A weighted rms	—57 dB	—55 dB
replay electronics only		
A weighted rms	—61 dB	—61 dB

By normal recorder standards these figures are far from inspiring and the margin between tape noise and machine noise should be much larger. However no significant contribution to noise was found to come from hum or mains frequency harmonics.

Delay, wow and flutter

Checking the available delay times in relation to the head positions and the tape speed revealed the following delay times, which are not generally in agreement with the manufacturer's specification:

	maximum speed	minimum speed
head 1	29 ms	81 ms
head 2	70 ms	193 ms
head 3	108 ms	296 ms
head 4	139 ms	383 ms

Wow and flutter as measured to the IEC peak weighted standard varied from good at the maximum tape speed to decidedly poor at the lowest tape speed and was objectionable at most speed settings. The measured performance was as follows:

	wow and flutter
maximum speed	0.05%
half speed	0.15%
minimum speed	0.35%

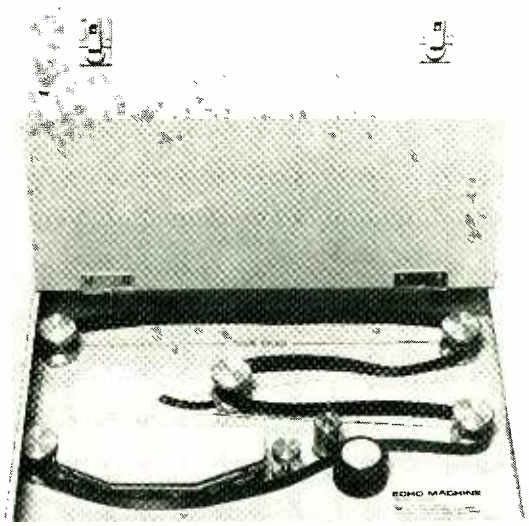
Other matters

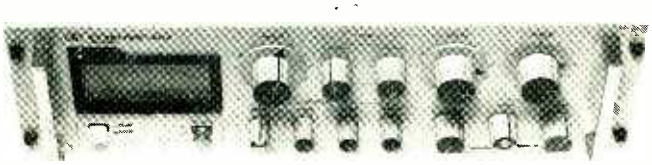
The uniformity of reproduction was checked at 6.3 kHz for heads 1 and 4 at maximum and minimum speeds, the differences being substantial as is shown in **fig. 4.** It is considered that these differences are caused by tape skew and the peculiar head arrangements using twin track heads.

Subjective performance correlated with the points which have already been mentioned in this review, and the available effects are those which can be readily imagined from the use of four different delays heads, variable tape speed and the availability of feedback into the record chain from the output.

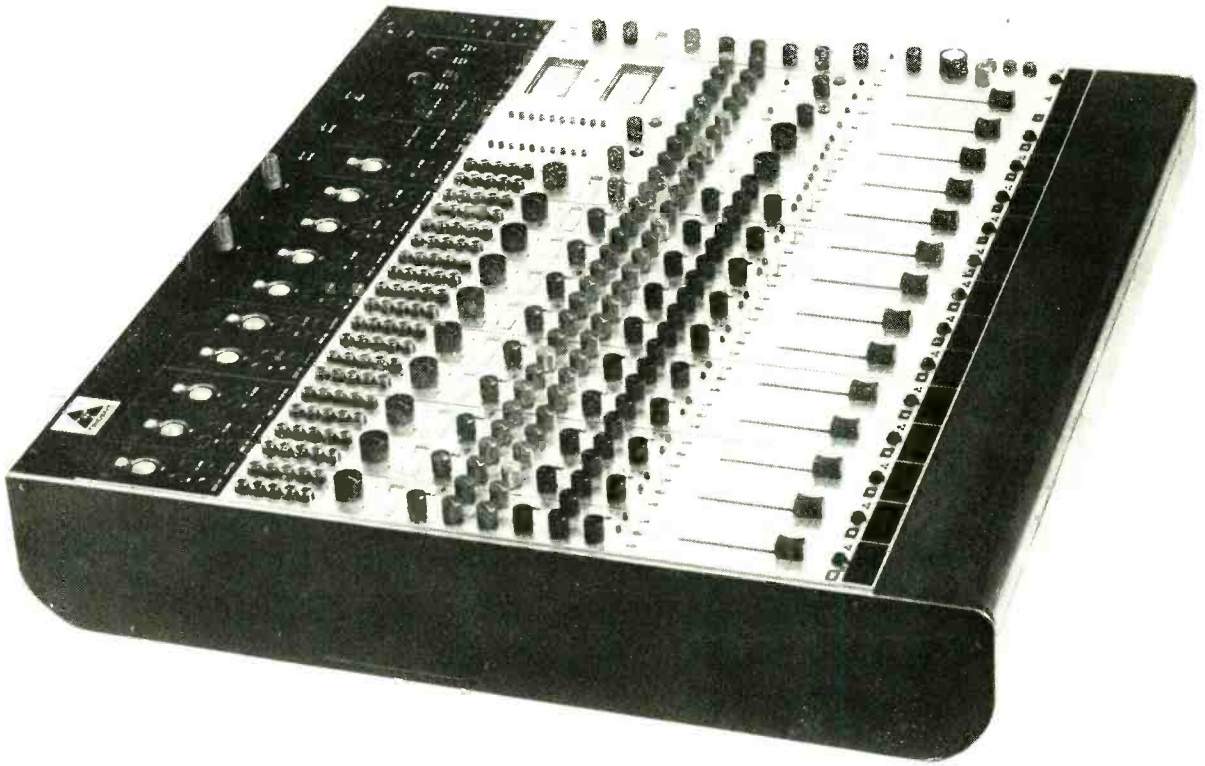
Summary

I find the performance of this echo machine to be decidedly disappointing from the point of view of music recording, but it could find applications in speech. The normal objections to tape loop devices are those of poor reliability, and it is impossible to comment upon this aspect of the machine in the very short time available for this review. However, giving credit where credit is due, the mechanics of this device are solidly made. ■





Go for the best .... go Fleximix



... and build on it

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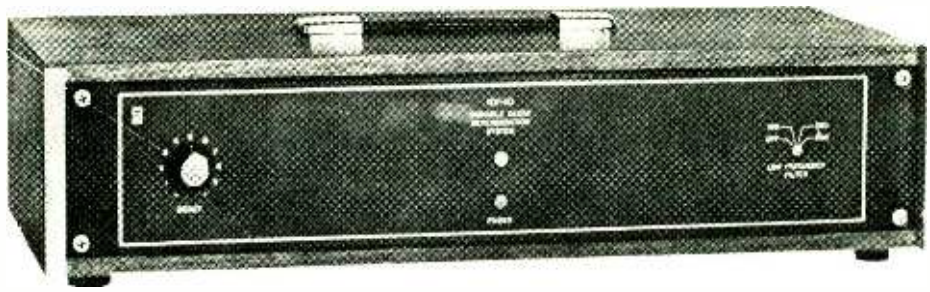
Quad/Eight RV10 reverb unit



Hugh Ford

THIS reverberation unit is basically a spring type device, but with the unusual feature that four parallel springs are used with different mechanical characteristics. A front panel 'decay' control mechanically alters the effective reverberation characteristics of all four springs in parallel, the reverberation spring assembly being flexibly mounted within the cabinet.

The unit, intended for mounting in a standard 483 mm rack, has only two other controls, the power on/off switch with its associated indicator lamp and a four position highpass filter which can be either 'off' or set to 100, 250 or 500 Hz. To the rear of the unit there is the fixed two-core mains lead and an imperial size mains fuse together with a six-way barrier strip for interface with the transformer coupled and floating input and output.

Internally there is a single plug-in printed board for the signal electronics and a well screened power supply which includes a further printed board, both boards being of good quality but with many component identifications being either buried or absent. The standard of layout and wiring gave the impression of a well made prototype rather than a mass production unit of the best quality.

MANUFACTURER'S SPECIFICATION

Decay time: continuously variable 5s to 1s at 100 Hz with the maximum decay time falling with frequency above 300 Hz.
Low frequency roll-off: off or 18 dB/octave at 100 Hz, 250 Hz or 500 Hz.
Initial delay: the full delay pattern is realised after 55 ms and then the reverberation time runs in four continuous trains of multiples of the delay times.
Signal-to-noise ratio: 60 dB.
Immunity to external noise: greater than 55 dB.
Distortion: less than 0.25% up to full output level of +18 dBm.
Input sensitivity: variable with internal adjustment between +4 dBm and —20 dBm.
Input/output impedance: 600 ohms transformer isolated and floating.
Effective band pass: 100 Hz to 7 kHz independent of delay time setting.
Power requirements: 117V ac at 12W.
Dimensions: 483 x 89 x 267 mm.
Shipping weight: 7.7 kg.
Price: £660.
Manufacturer : Quad/Eight Electronics, 11929 Vose Street, North Hollywood, Ca 91605, USA.
UK agent: Cinesound International Enterprises Ltd, Lansdowne Imperial Studios, Maxwell Road, Boreham Wood, Hertfordshire.

Input and output

The floating input was found to have an input impedance of 743 ohms at 1592 Hz as opposed to the nominal input impedance of 600 ohms, with the input sensitivity being set such that the unit had a 3 dB gain as measured with a ⅓-octave band of white noise.

Like the input, the output is also fully floating. Although the measured output impedance of 134 ohms is adequately low for most purposes, it is certainly nothing like the specified 600 ohm. Personally I would have preferred to have seen a slightly lower output impedance together with an input impedance in the order of 10 000 ohms—this combination is so easy to match into other equipment.

So far as the signal handling capability is concerned, the output could deliver well in excess of the specified +18 dBm before clipping with the noise from the unit lying at −61.5 dBm 'A' weighted. The unweighted figure was close to −46 dBm as a result of excessive 50 Hz hum pickup within the unit, but the mains frequency harmonics were at a much lower level and unlikely to give trouble.

Frequency response

The overall frequency response, determined by feeding the unit with white noise and performing an effectively constant bandwidth spectrum analysis of the output, is shown in **fig. 1.** This was carried out at the minimum and maximum decay time settings.

While these results are generally in conformity with the manufacturer's literature, it is felt that the very rapid roll-off above 6 kHz might limit the use of this reverberation system.

Fig. 2 shows the effect of the switchable highpass filter on the frequency response; it may be seen that the 100 Hz setting has little effect upon the low frequency performance.

Reverberation time

The feature of using four parallel springs is important because, not only is there an initial delay from the input to the output (which is an inherent feature of a room) but also it splits the echoes into four differing return times. Clearly this simulates a feature of any live room where the echoes from different parts of the room arrive at different times.

From this point of view the performance of the unit is shown in **fig. 3** which, in the upper trace, shows the effect of a short 1 kHz tone burst. The lower trace depicts the resulting output with the first return arriving about 25 ms after the input has been applied.

Measurement of the effective reverberation time using ⅓-octave bands of white noise gave poor correlation with the manufacturer's plot of 'decay time' in relation to frequency, suggesting an almost constant minimum decay time at minimum decay setting, claimed to be around 1s. At maximum decay time setting the manufacturer suggests a 5s time between 100 and 300 Hz then falling steadily to 1s at 7 kHz.

My measurement of reverberation time (time to −60 dB) are shown in **fig. 4** which illustrates a small control range. However, **fig. 5** shows that there is, in fact, a large vari-

64 ▶

FIG.1
RV10 FREQUENCY RESPONSE AT VARIOUS DECAY SETTINGS WITH WHITE NOISE INPUT

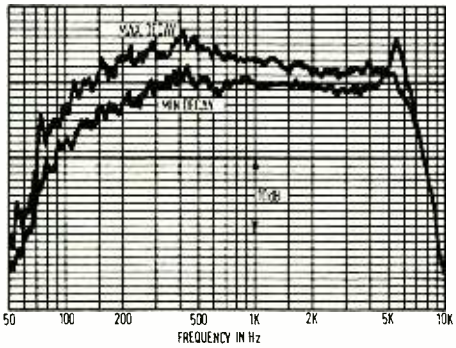
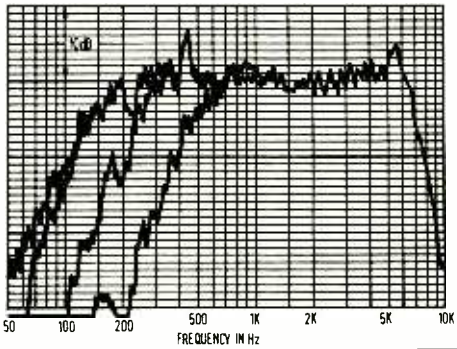


FIG. 2
RV10 HIGHPASS FILTERS



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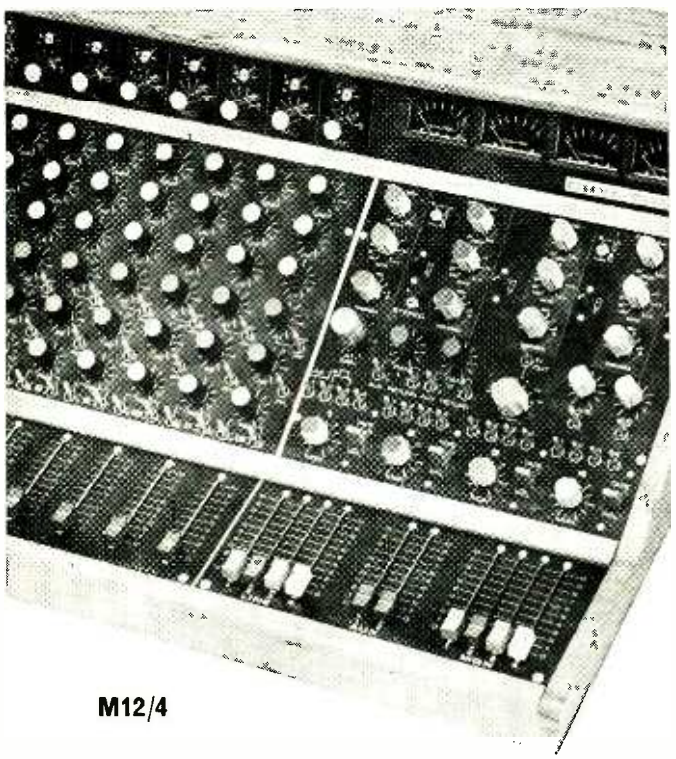

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ation in the early decay and it may be that different measurement techniques have produced the different results.

Other matters

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Subjective listening tests showed that the characteristic 'twang' of more conventional spring reverberation units was virtually absent provided that the unit was not severely overdriven, in which circumstances it could be caught out on transients.

I get the impression that the overall sound is more akin to a tunnel rather than a room, but this should not be treated as a criticism as simulated room type reverberation isn't always what's wanted.

Operation of the decay time control between its extreme positions gave results which I consider to confirm my reverberation time measurements; I don't think that the overall range of decay time is commensurate with the manufacturer's suggested 5:1. ■

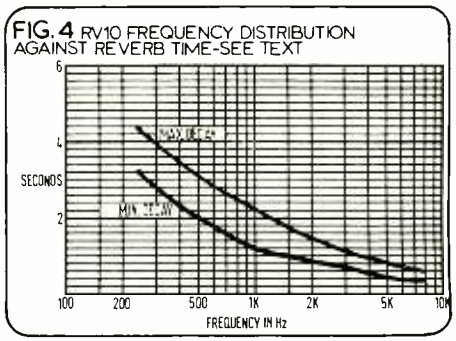
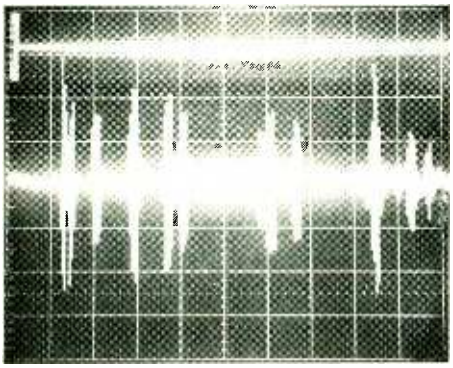
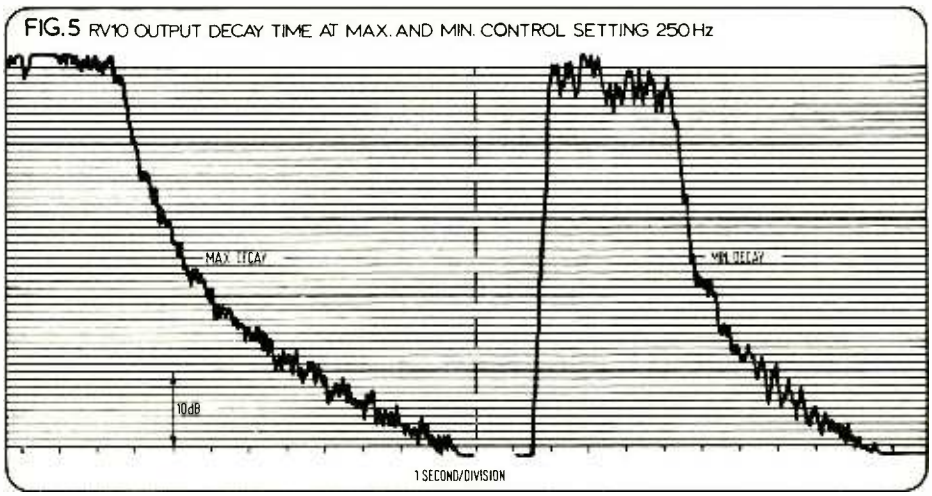
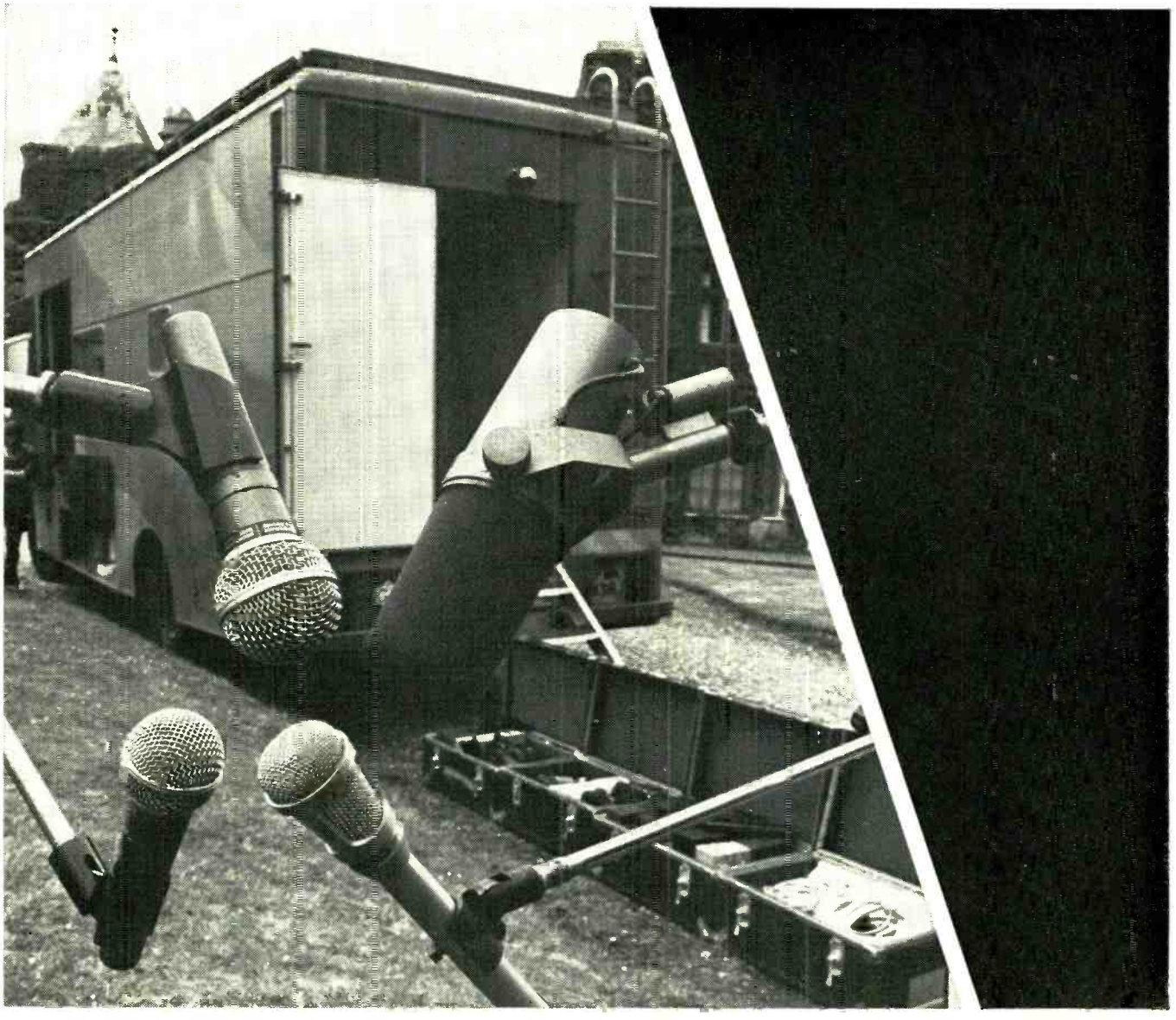


FIG. 3 Quad/Eight, 1kHz burst (top trace) echo returns (lower trace) 20 ms/div







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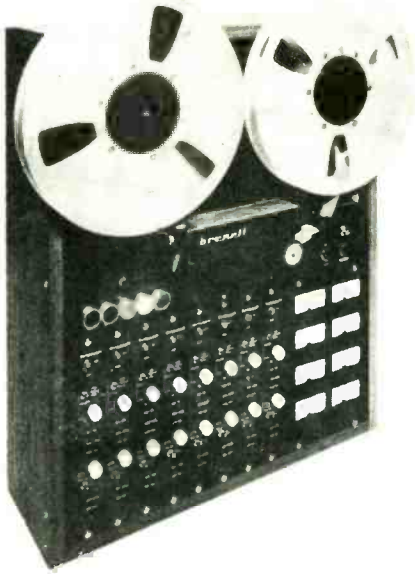

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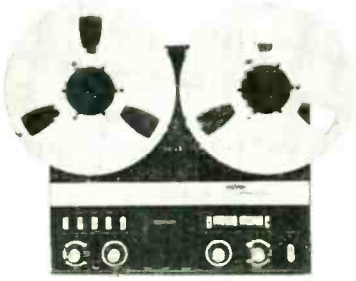

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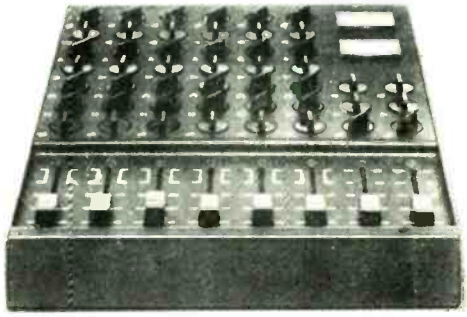

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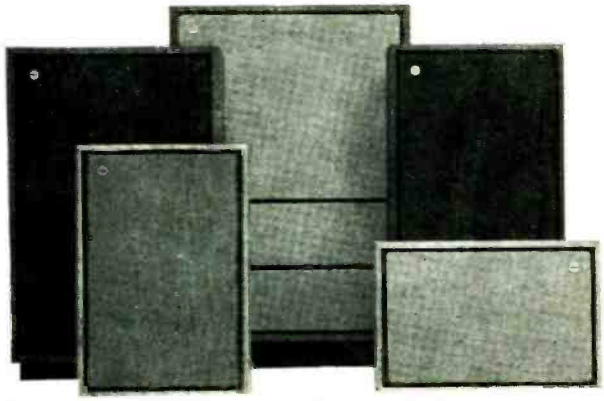

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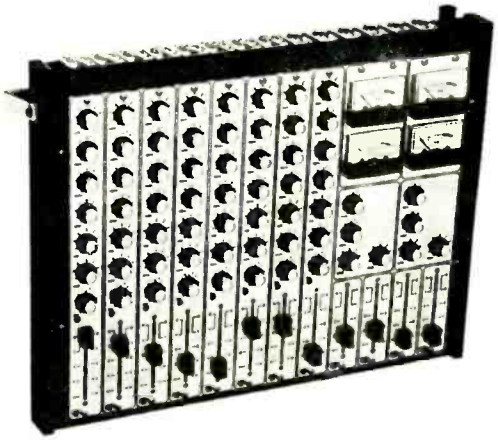

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Published by Link House Publications Limited on behalf of the proprietors, Link House Holdings Limited, 10-12 South Crescent, Store Street, London W.C.1, and Printed by Arthurs Press Limited, Woodchester, Stroud, Glos. GL5 5PB.

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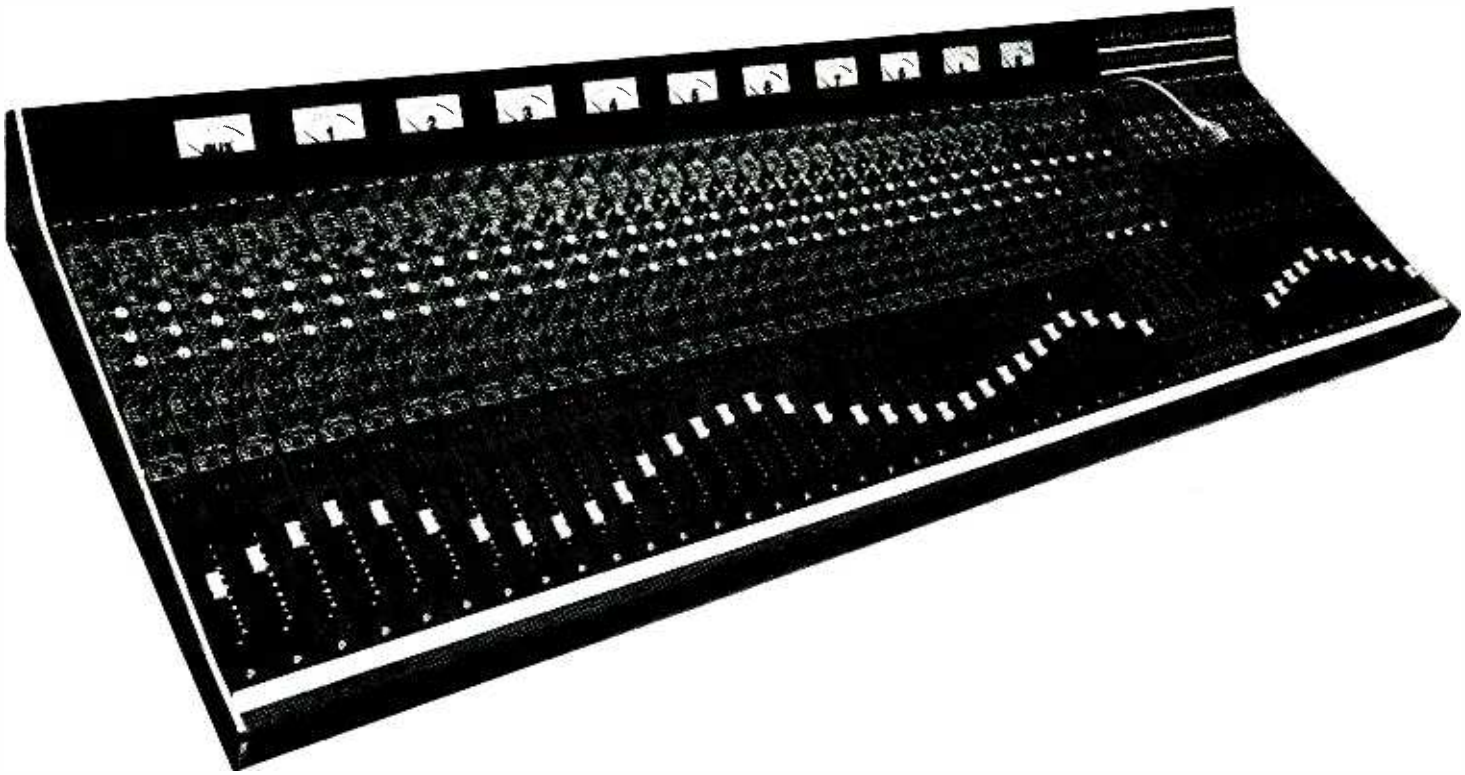

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