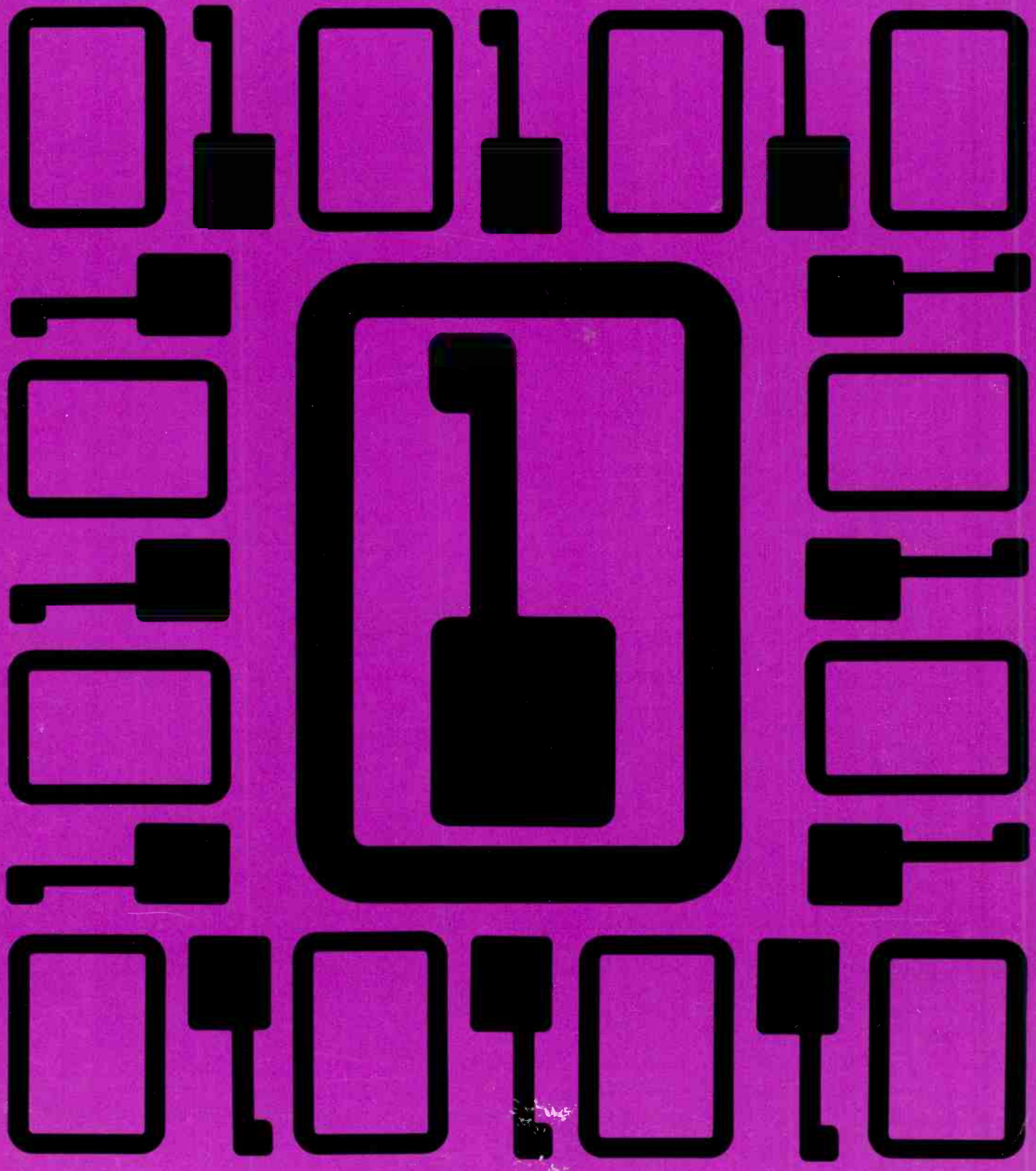
December 1974 25p

# studio sound

AND BROADCAST ENGINEERING



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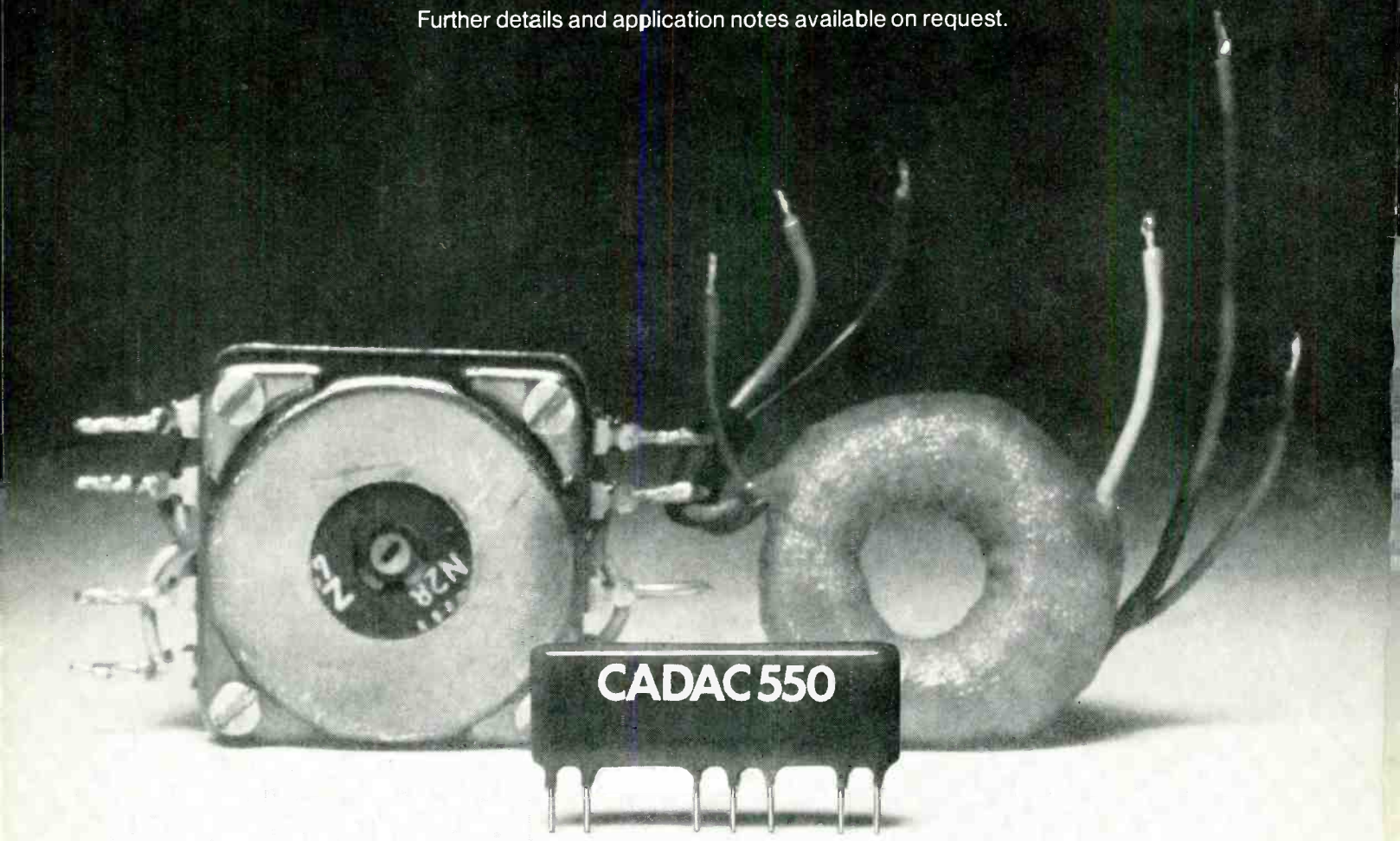


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# studio sound
AND BROADCAST ENGINEERING

**EDITOR** MICHAEL THORNE
**ASSISTANT EDITOR** FRANK OGDEN
**EDITORIAL PRODUCTION** DRUSILLA DALRYMPLE
**ADVERTISEMENT MANAGER** RICHARD WESTBROOK
**MAGAZINE SALES MANAGER** DON BAILEY

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





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**SUBSCRIPTIONS**
STUDIO SOUND, *published monthly, enables engineers and studio management to keep abreast of new technical and commercial developments in electronic communication. The journal is available without charge to all persons actively engaged in the sound recording, broadcasting and cinematographic industries. It is also circulated by paid subscription to manufacturing companies and individuals interested in these industries. Annual subscription rates are £3 (UK) or £3·30 overseas.*

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**WHEN A DEPARTING** Editor sits down to write his departing Editorial, his task may be compared with that of writing his own obituary. Not that this Editor has any plans to fade out just yet. Rather he is moving on to pastures new (*Video & Audio-Visual Review*, price 50p, same address, same telephone number). Before leaving, tradition requires that he emit some 14 column centimetres of wit and cliché, modestly surveying the accomplishments of his reign and declaring his confidence in the regime to follow: the regime of Michael Thorne.

More than 11 years have elapsed since the young Kirk joined Miles Henslow's *The Tape Recorder* in the capacity of Bottom Kneddy, tea-maker and galley-reader. Within a year the journal had lost its *The* and gained a new owner in the collective shape of Link House Publications. As the years progressed, so attempts were made to elevate the technical standard of the medium—unwittingly losing an increasing proportion of our readership to the less demanding and perhaps more entertaining 'hi-fi' press. Which left us, towards the end of the 1960s, with a magazine too obscure for the lay public and almost unknown to the lay recording engineer.

I shall always be grateful to those members of the recording industry who encouraged the original concept of *Studio Sound*—in particular to the late Terence Long for teaching me the basic facts of studio life. Thus informed, it was subsequently possible to withstand the kind of nonsense emitted by one London studio: 'We have our own special method for recording the piano . . . off the record, we go *inside*'.

I would be the last to suggest that *Studio Sound* in its present form has been brewed to perfection. My unattained ideal, shared I believe by Michael Thorne, is an admixture of the *Journal of the Audio Engineering Society* with news of direct relevance to the practical recording industry. There is still a long way to go.

Looking back, I find it ironic that one of the first news reports I mangled in 1963 concerned a low-cost video recorder. The promise of cheap video tape equipment . . . always *next* year . . . was flaunted before the public throughout that decade though not until the 1970s did advance publicity become saleable hardware. The technology that can today store a 3 MHz bandwidth 30-minute programme on a 30 cm disc promises tomorrow to hold a 100-hour long 15 kHz audio programme within that same compact format. Canned audio is on the verge of a revolution at the distribution end of the market; it will be intriguing to watch the effects of these changes at the origination end—the studio.

**David Kirk**


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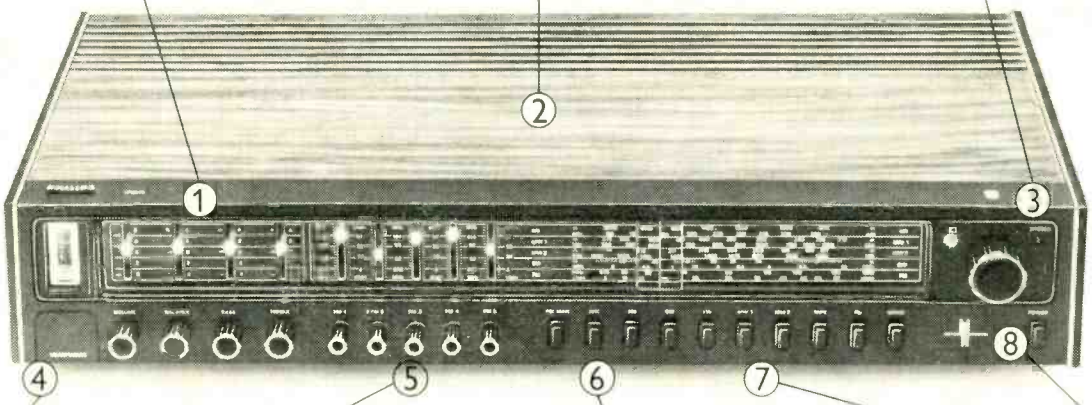
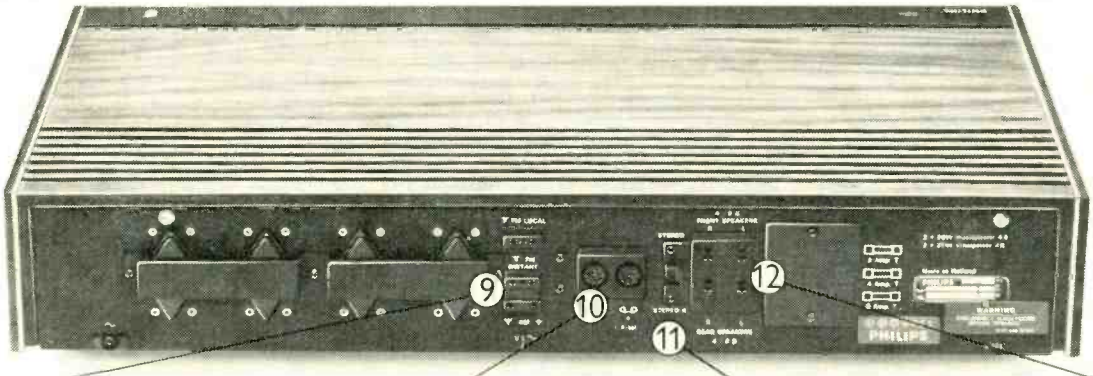
6 ▶

# THE MAGNIFICENT PHILIPS RH 734 TUNER/AMPLIFIER. ALL YOU NEED FROM US ARE THE DETAILS.

With equipment this good, let's not bother with fancy headlines or cajoling words. RH 734 is a radio-tuner/amplifier for the man who wants everything.




1. Illuminated thermometer style scales for visual indication of volume, balance, bass and treble settings.
2. All transistor tuner-amplifier with LW, 2 x MW, SW and FM, fully equipped for reproduction of stereo FM transmissions.
3. FM stereo decoder with automatic mono/stereo switchover device and stereo indicator lamp.
4. Stereo headphone socket easily accessible from the front.
5. FM tuning with pre-selection for easy and quick tuning on five pre-set stations; five separate illuminated vertical tuning scales indicate the pre-settings of the rotary FM station push-buttons.
6. Switchable AFC on FM.
7. Two MW bands for ease of tuning.
8. Hi-Fi specification, meets fully the requirements of DIN 45 500.




9. AM input plus built-in Ferroceptor aerial.
10. Input sockets for M.D. pick-up/microphone and crystal pick-up/recorder.
11. STEREO 4 circuitry for ambiophonic reproduction through two pairs of loudspeaker boxes.
12. Output 2 x 20 W RMS into 4 Ohm load.

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For even more facts, look in and see your Philips dealer soon. The big Philips audio brochure gives more technical details than we can print here.

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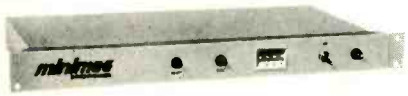

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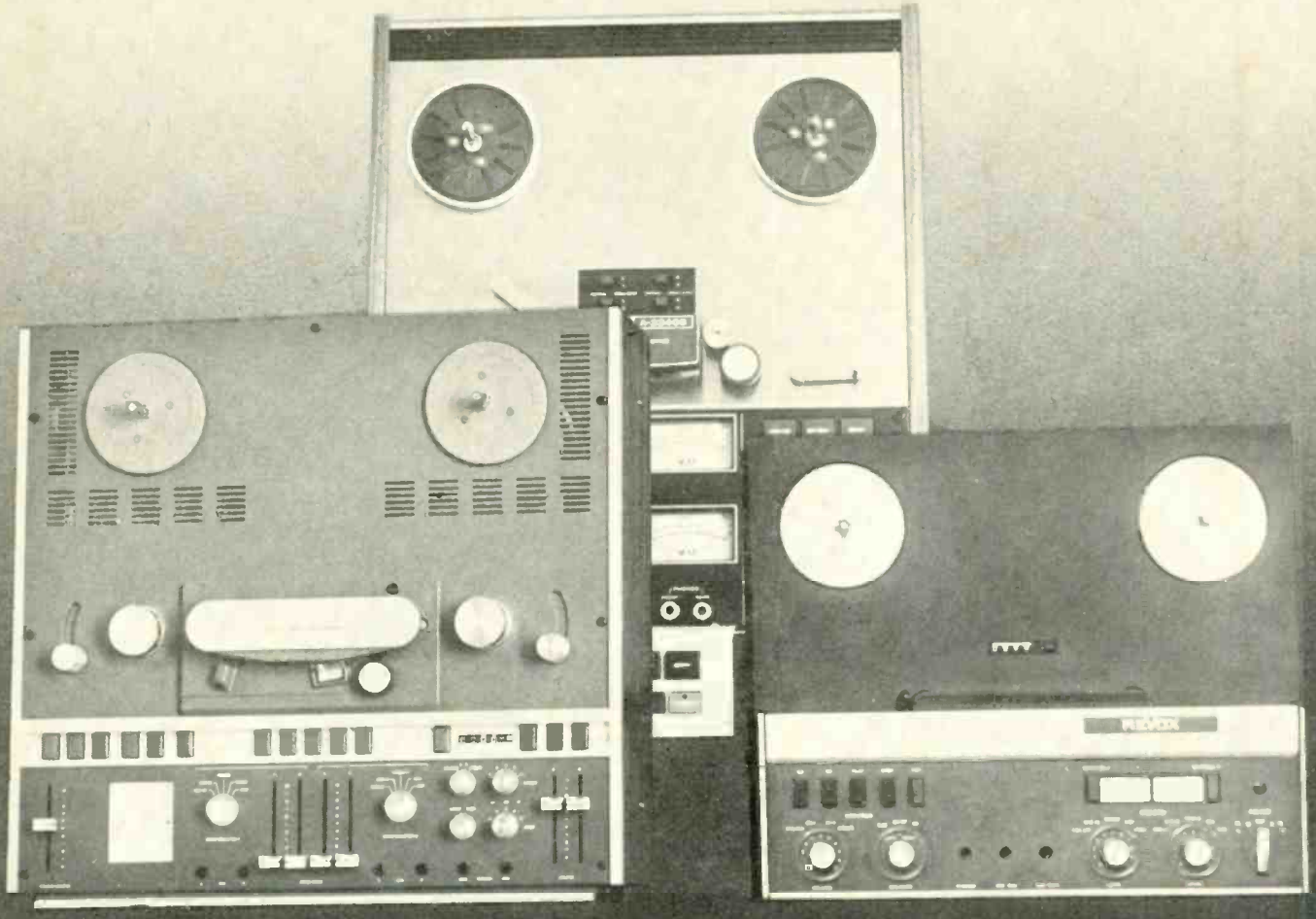

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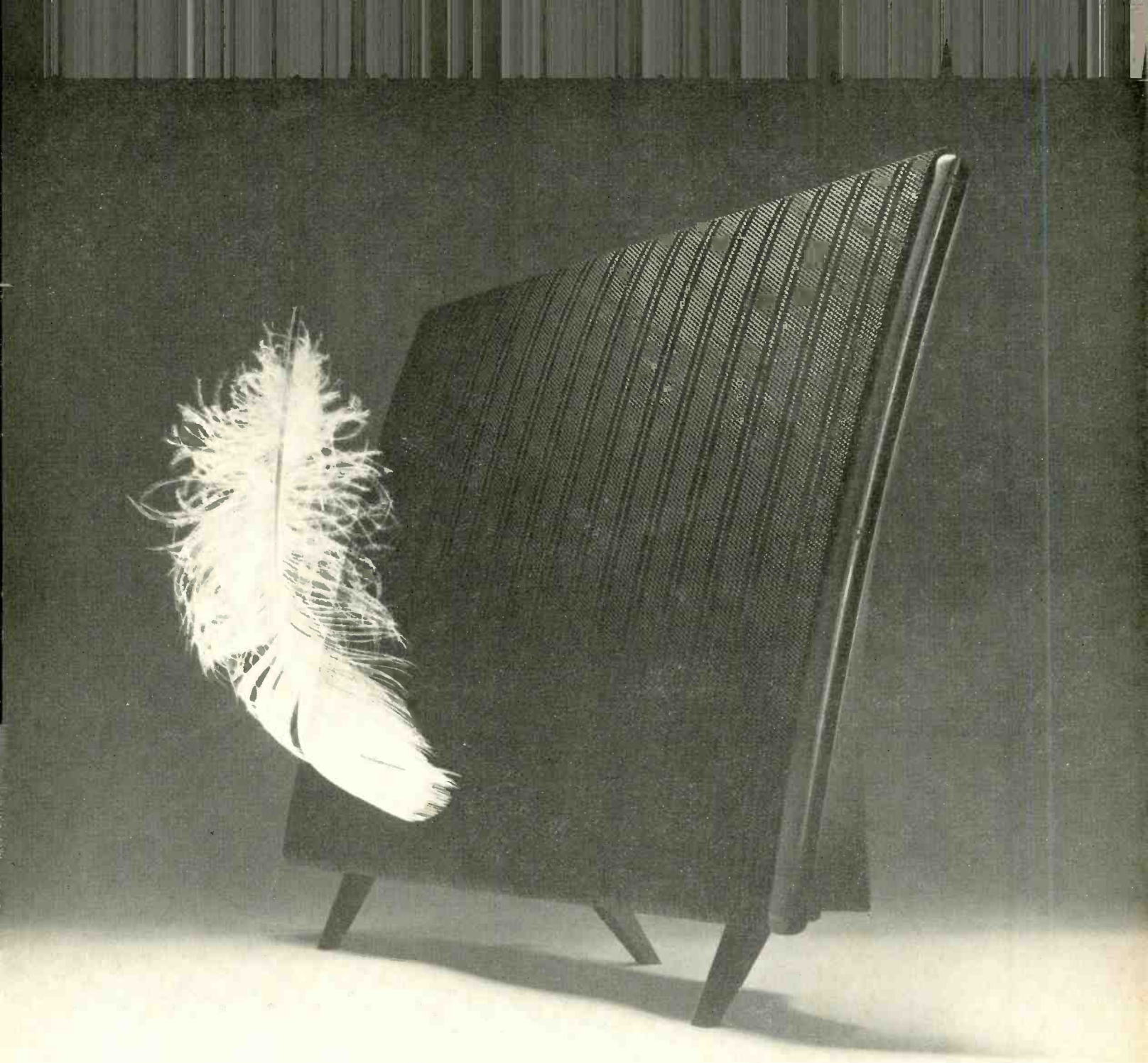

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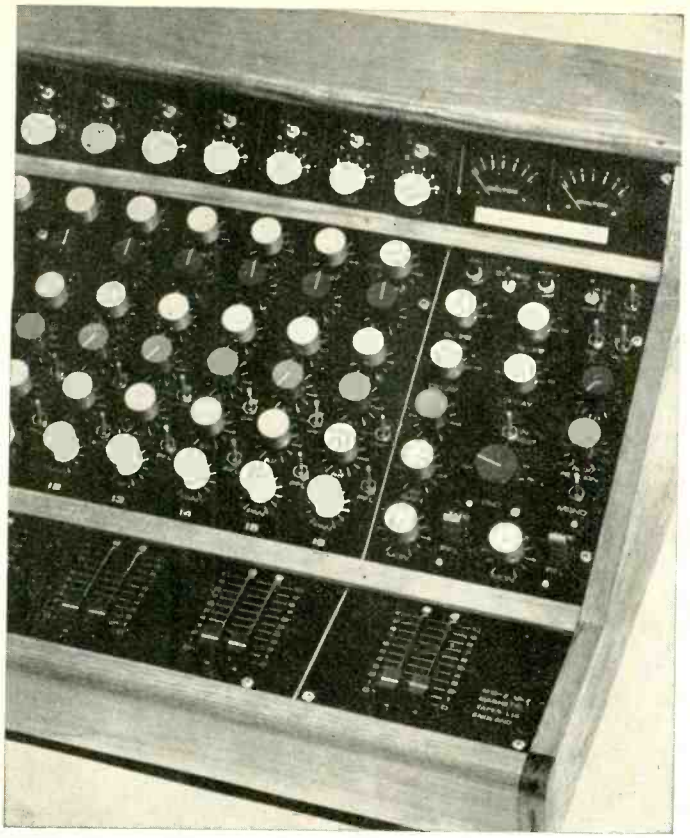

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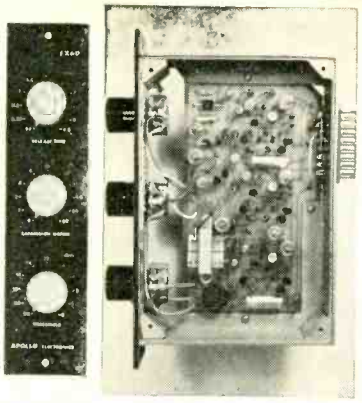

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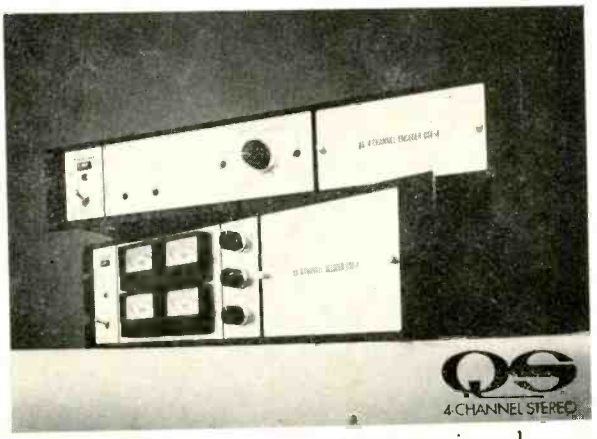


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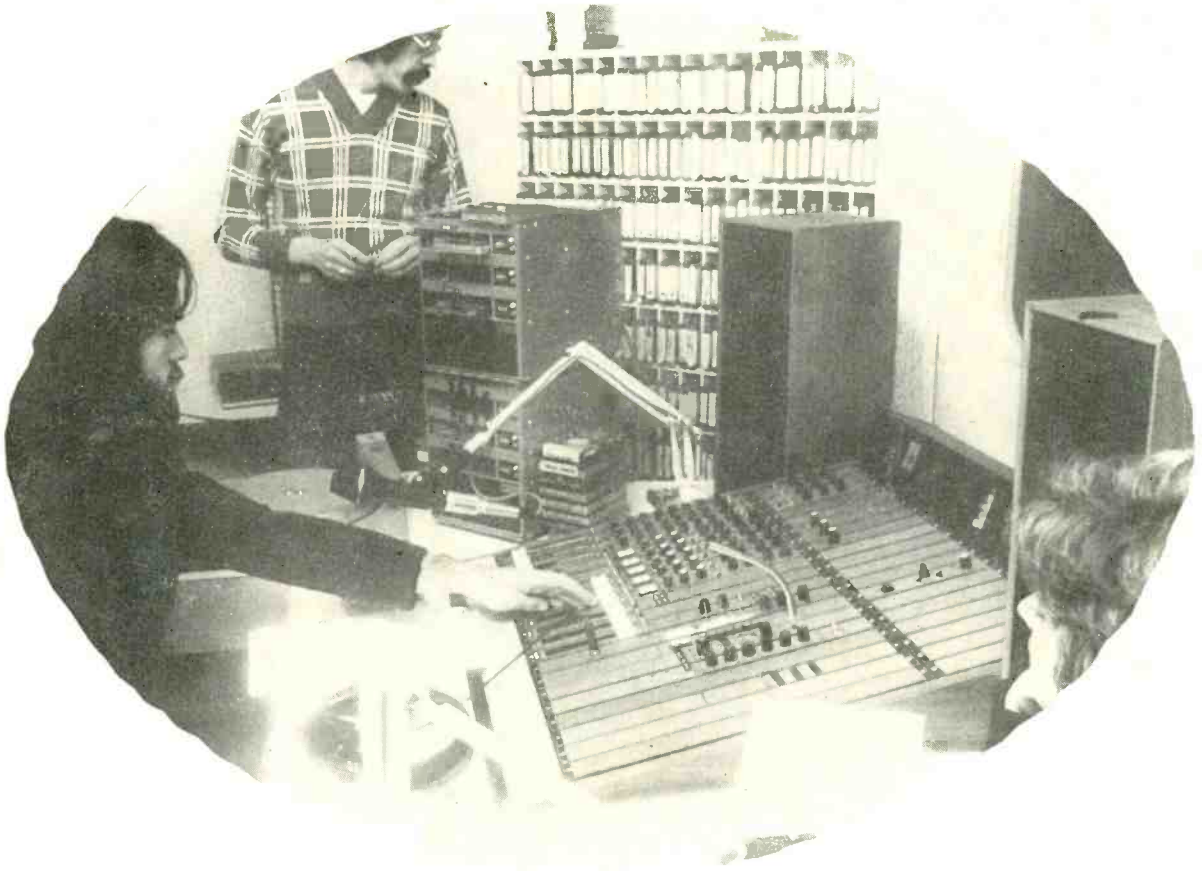

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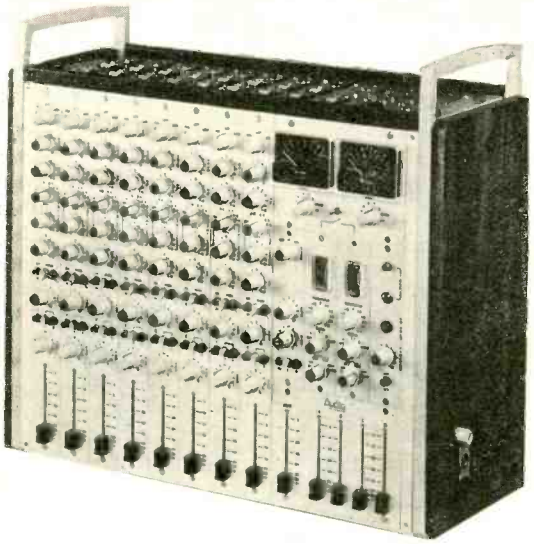

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The Mini Mixer with the professional qualities and the professional performance.

- Battery or external power supply operable.
- 8 Inputs 4 Outputs all balanced into XLR connectors.
- 2 Compressors with stereo link.
- 2 Peak Programme Meters switchable to all channels and groups.
- Auxiliary send and returns.
- Modular construction is used to promote serviceability.
- Inputs extendable to 18 via the Ten Input Extension Unit.

Other facilities include insertion points in each channel and group, a line up oscillator and cue facility. The Extender Unit can also incorporate Talkback and Monitoring at the exclusion of input modules.

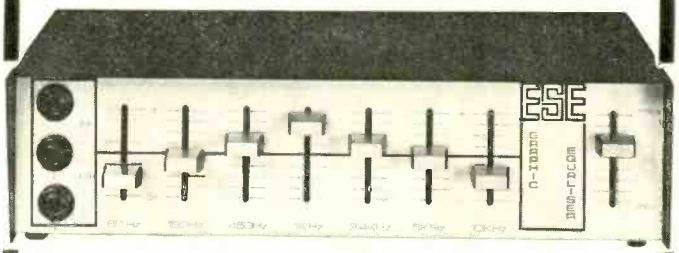
Customers so far supplied have been full of praise for the mixer. They include people in broadcasting studios and the live entertainment field.

Audio Developments

**Hall Lane**
**Walsall Wood**
**Staffs WS9 9AU**

Tel. Brownhills 5351

# NEW FROM E.S.E.




A full frequency range graphic equaliser **YOU** can afford !

**For JUST £30·00 plus VAT**
You can tune out all unwanted noises at **seven** different frequencies!

Bring all your recordings, P.A., discos, lead guitar, bass guitar, organ, **anything** amplified to life at the touch of a **slider**!!

No more annoying amplifier noises—just clear, true sound!

Frequencies from 60 Hz to 10 kHz!

Cut or boost each frequency by maximum of 15 dB!

Hi and lo gain inputs.

Powered by just two PP.3 batteries which last for ages.

Try it and you'll buy it—it will change your concept of sound.

Trade enquiries welcomed.

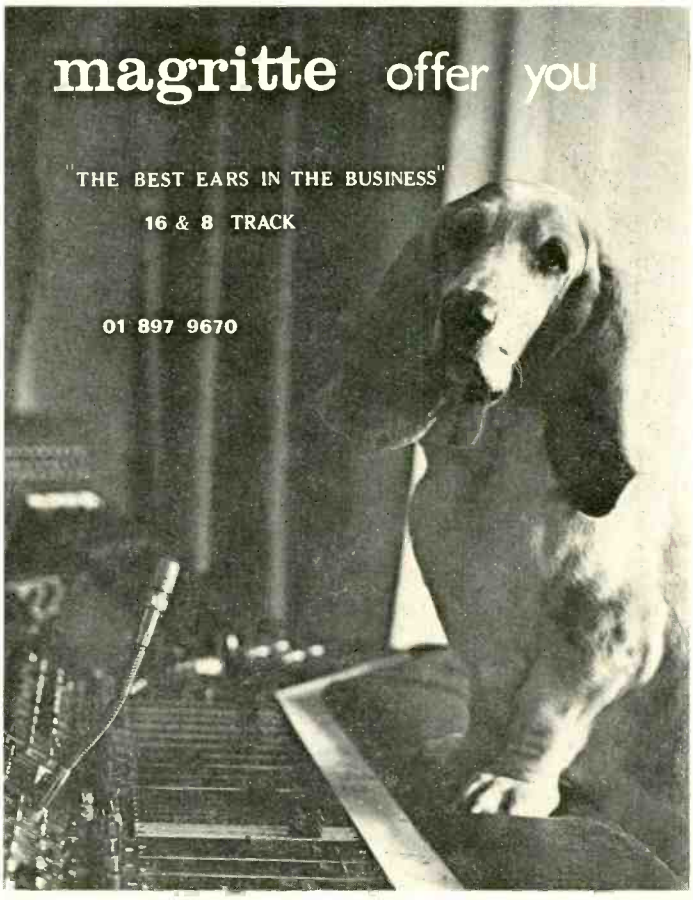
**Condensed Technical Spec.**

**Max. output:** terminated to 600Ω +10 dB> 1. 6 volts peak to peak, 2·5 volts R.M.S.
**Signal to noise ratio:** input terminated with 47K resistor. All filters at max. better than –70 dB.
**Frequency response:** All filters at central better than ± 2 dB.
**Filter slope:** Better than ± 13 dB per octave.
**Filter ranges:** Max. ± 15 dB at 60, 180, 480 Hz, 1, 2·4, 5 and 10 kHz.

To: **E.S.E. Electronics, 2 Upper Fant Road, Maidstone, Kent.**
Please send me ☐1, ☐2, ☐3, ☐4, ☐5 of your Graphic Equalisers. I enclose cheque or postal order for £..... having added 30p for p. & p. on each item ordered and V.A.T. I understand that two batteries are included.

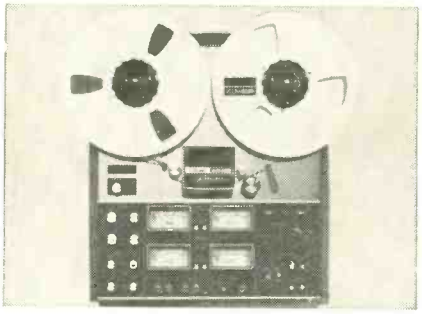
**Name** .....
**Address** .....
.....
.....
**Tel.** .....

S.S.2



# REW AUDIO CONTRACTS

## LONDON'S LEADING CONSULTANTS AND DISTRIBUTORS FOR P.A., STUDIO AND PROFESSIONAL AUDIO EQUIPMENT

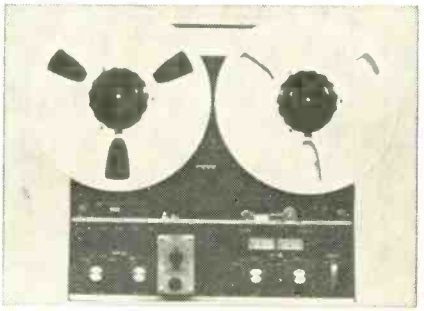


**TEAC 3340**
The Teac A 3340 professional model is a very high quality, 4 track (separate) recorder. Operating at 7½ and 15 i.p.s. with full built-in sel-sync facility. Potential 8 input source (4 line and 4 mic) incorporating separate mixing controls on front panel. In stock.

**NETT PROFESSIONAL PRICE ON APPLICATION**

**AMCRON**
The long awaited Amcron tape deck and latest addition to the REW Audio Contracts Family of mini-studio high quality recorders. REW are able to offer this 800 and 700 series of decks with choice of CX or SX electronics.

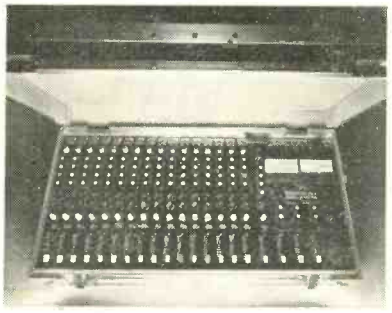
**NETT PROFESSIONAL PRICE ON APPLICATION**



**REVOX A77**
The world famous A77 1102 Series III semi-professional recorder, available in 3¾ and 7½ i.p.s. or 7½ and 15 i.p.s. speeds + sel-sync and varipitch conversions. This machine proves a long standing favourite with the REW Audio Contracts range of mini-studios. In stock.

**NETT PROFESSIONAL PRICE ON APPLICATION**

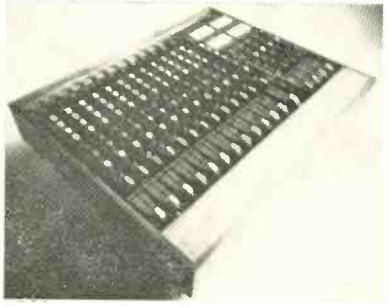
## MIXERS BY SOUNDCRAFT ELECTRONICS



### SOUNDCRAFT 16/2

New 16/2PA. Complete in flight case incorporating 16 mic channels, stereo output channels, foldbacks output plus two echo return channels. Full monitoring facilities; pfl; balanced input; 4-band eq; f/b send; echo send; channel switch; pan pots and faders. Input and output XLR sockets plus 37 way socket for multicore connection.

**NETT PROFESSIONAL PRICE**
**£992 + VAT**

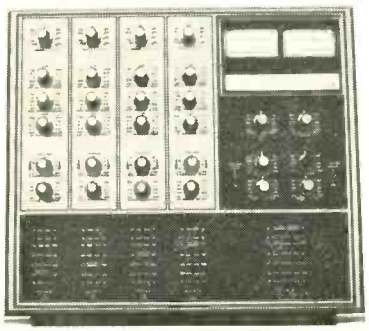


### SOUNDCRAFT 12/4

Just arrived—12/4 Recording Console which is built into a teak case, incorporating 12 input and 4 output channels, output limiters, and full monitoring facilities. All input and output connectors are Switchcraft (XLR equiv.) except line input which are ¼" jack. 200 ohm mic. inputs are balanced. 4 band E.Q.; f/b send; echo send; pfl; channel switch; pan pots and faders.

**NETT PROFESSIONAL PRICE**
**£875 + VAT**

## SCOTCH 207 at very competitive prices.



**LAMB PML 420 MIXER**
This high quality inexpensive 4/2 mixer incorporating 3 band e.q.; pan pots; faders; limiters and echo send controls make it a good starting point for the basic mini studio set-up.

**NOW IN STOCK**

**NETT PROFESSIONAL PRICE ON APPLICATION**

**REW Audio Contracts are able to offer the following microphones at professional prices (subject to stock) to bona-fide pro users.**

| AKG | AKG | SHURE | CALREC | BEYER | RESLO |
|---|---|---|---|---|---|
| D190 | D707 | 515SA | CM652 | M160 | S80 |
| D160 | D900 | 588SA | CM655 | M500 | CABARET |
| D109 | D1200 | 545 | | M260 | S91 |
| D12 | D2000 | 565 | | M101 | |
| D90 | D202E1 | 548 | | | |
| D200 | D224E | SM57 | | | |
| D202 | C451* | SM58 | | | |

Available in DIN or CANNON (XLR) connectors.

***VERY SPECIAL PRICE WHILE STOCKS LAST**

**ALL PRICES ON APPLICATION**
**Full range of mic stands and accessories by KMAL.**

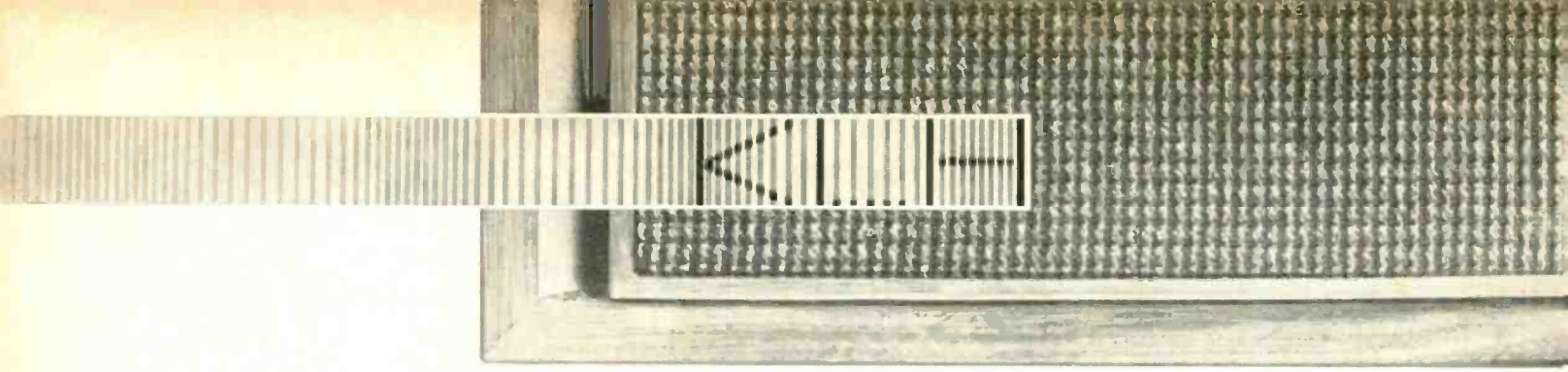
**ALL PROFESSIONAL AUDIO EQUIPMENT AT**

*NOTE REW Audio Contracts and REW Video Contracts are registered trade names and are part of The REW Group of Companies.

**REW Audio Contracts, 146 Charing Cross Road, London WC2. Tel: 01-240 3883**

**VIDIO, INDUSTRIAL AND STUDIOS AT**

**REW Video Contracts, 10-12 High St., Colliers Wood, London SW19. Tel: 01-540 9684/5 Telex 896194**



# The Professional's Choice.

Bob Auger Associates are without doubt one of the leading recording organisations in Britain. They have been responsible for recording a wide spectrum of musical works, from Mahler's 2nd symphony with Leonard Bernstein in Ely Cathedral, Mozart and Bach orchestral transcriptions, to Ravi Shankar and Jacques Loussier at the Royal Festival Hall.

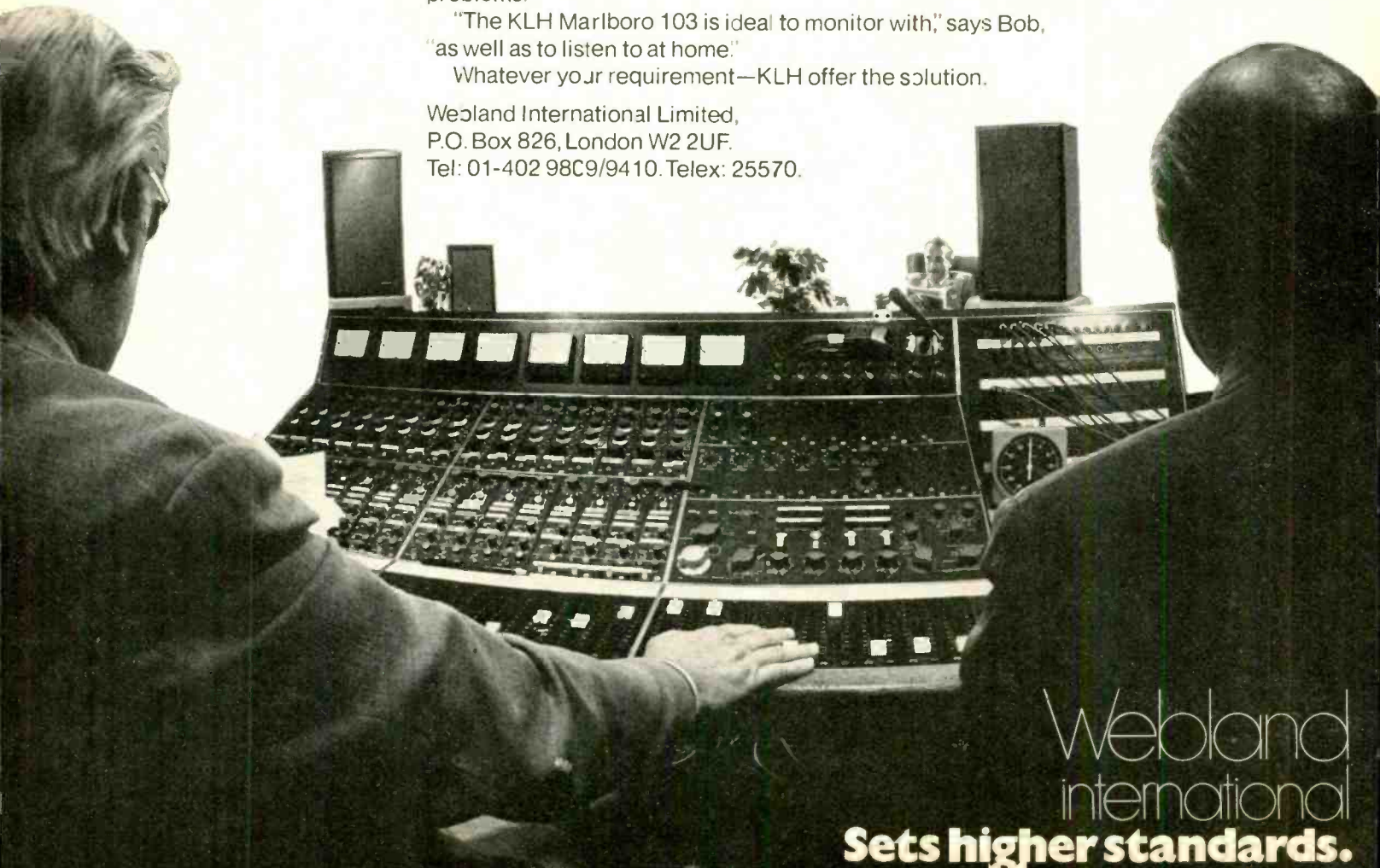
Discerning British studios, such as Bob Auger's, have for some time set standards of excellence which have increasingly attracted International record companies and producers to this country to create their master recordings. To this end, Bob Auger and his engineers are continually developing and adapting equipment to maintain these standards.

The recent introduction of KLH speakers into Britain has provided Bob with the solution to at least one of his professional problems.

"The KLH Marlboro 103 is ideal to monitor with," says Bob, "as well as to listen to at home."

Whatever your requirement—KLH offer the solution.

Webland International Limited,
P.O. Box 826, London W2 2UF.
Tel: 01-402 9809/9410. Telex: 25570.



Webland international
**Sets higher standards.**

# VIDEO RECORDER GUIDE

| Make & Model | Tape Size | Colour | B & W | Mains | Portable (battery) | Edit | Slow Motion | Time Lapse | General | Compatability code | Price £ (At Press) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| IVC 705P (P/C) | 1″ | (o) | o | o | | | | | Will play 525 line 60Hz tapes, 2 audio tracks, stop frame, studio quality. | A | 1968 mono (2270) colour |
| IVC 711P (P/C) | 1″ | (o) | o | o | | | | | 2 audio channels, stop, frame. | A | 1491 mono (1793) colour |
| IVC 741P (P/C) | 1″ | (o) | o | o | | | | o | High quality, 2 audio tracks, stop, motion. | A | 2547 mono (2849) colour |
| IVC 761P (P/C) | 1″ | (o) | o | o | | o | | | Assemble edit, 2 audio tracks, stop, frame. | A | 2170 mono (2472) colour |
| IVC 801PSM | 1″ | (o) | o | o | | | o | | 2 audio tracks, stop, frame. | A | 2124 mono (2426) colour |
| IVC 821P | 1″ | (o) | o | o | | | | | 2 audio tracks, stop, frame, off tape monitoring. | A | 2763 mono (3065) colour |
| IVC 871P (P/C) | 1″ | (o) | o | o | | o | | | Insert edit, 2 audio, stop, frame. | A | 4052 mono (4354) colour |
| IVC 900 | 1″ | (o) | o | o | | o | | | Ultra high quality, broadcast options. | A | 7518 to 20760 |
| IVC 100 | 1″ cartridge | (o) | o | o | | | | | 2 audio channel high performance cartridge loading. | A | tba |
| Ikegami 321 | ½″ | | o | o | | | | | Remote control option. | B | 420 |
| Ikegami 321C | ½″ | o | o | o | | | | | Remote control option. | B | 595 |
| Ikegami 321L | ½″ | | o | o | | | | o | Remote control option, 12 + 24 hours record. | B | 720 |
| JVC KV 350 | ½″ | | o | o | | (o) | | | Mechanical edit, built in SPG. | B | 368 |
| JVC KV360 | ½″ | | o | o | | (o) | o | | Mechanical edit, built in SPG. | B | 432 |
| JVC PV 4500 | ½″ | | o | o | o | | | | Includes hand held camera, mic., mains/charger unit. | B | 745 |
| JVC CR 5000 | ¾″ cassette | o | o | o | | | | | Remote control option, 2 audio tracks, player only. | C | 664 |
| JVC CR 6000 | ¾″ cassette | o | o | o | | (o) | | | Remote control option, 2 audio tracks. | C | 749 |
| National NV 3020E | ½″ | | o | o | | | | | High quality, audio dub. | B | 350 |
| National NV 3040E | ½″ | | o | o | | | | | Remote control option. | B | 495 |
| National NV 3030E | ½″ | | o | o | | o | o | | Insert edit, Audio dub. | B | 535 |
| National NV 1070 | ½″ | | o | o | | | | o | 12 hour record. | B | 590 |
| National NV 3082 | ½″ | | o | o | o | | | | Includes camera, mic., mains charger unit. | B | 750 |
| National NV 5125 | ½″ cartridge | o | o | o | | | | | Cartridge loading, stop, frame, auto repeat. | B | 595 |
| National NV 3000 | ¾″ cassette | o | o | o | | | | | Complete with off air tuner, monitor, auto colour lock, RF output. | C | 890 |
| Shibaden 610 | ½″ | | o | o | | | o | | Audio dub, variable speed playback. | B | 380 |
| Shibaden 610 KD | ½″ | | o | o | | o | o | | Insert & assembly edit. | B | 620 |
| Shibaden 620 | ½″ | o | o | o | | | o | | Audio dub, variable speed playback. | B | 595 |
| Shibaden 620 KD | ½″ | o | o | o | | o | o | | Insert & assembly edit. | B | 880 |
| Shibaden 612K | ½″ | | o | o | | | | o | 6, 12, 24, 48 hours record. | B | 810 |
| Shibaden | ½″ cartridge | o | o | o | | | | | Cartridge loading. | B | 580 |
| Sony CV 2100 | ½″ | | o | o | | (o) | | | Mechanical edit. | D | 365 |
| Sony AV 3620 | ½″ | | o | o | | | | | High resolution. | B* | 380 |
| Sony AV 3420 | ½″ | | o | o | o | | | | High resolution, complete with camera, mic., mains/ battery charger. | B* | 810 |
| Sony CV 5600 P | ½″ | o | o | o | | o | | | Mechanical edit. | D | 745 |
| Sony AV 3670 | ½″ | | o | o | | o | | | High resolution, insert & assembly edit. | B* | 575 |
| Sony EV 320 CE | 1″ | (o) | o | o | | o | o | | Studio quality, insert & assembly edit, still frame, colour & remote option. | E | 1850 |
| Sony VO 1200 | ¾″ cassette | o | o | o | | | | | PAL/NTSC playback, auto repeat search, 2 audio channels. | C | 640 |
| Sony VO 1810 | ¾″ cassette | o | o | o | | | | | PAL record/playback, NTSC playback, 2 audio channels, search, auto repeat. | C | 735 |

This chart has been compiled by Action Video for your convenience. We are suppliers for all of the video recorders listed above as well as for an even larger range of cameras, monitors, mixers, lenses and ancillary equipment. So if you want video equipment you know where you can get it. Telephone Brian Speck on 01-734 7465/6/7.

**Action Video Limited** 45 Gt Marlborough Street London W1V 1DB

**ACTION VIDEO LIMITED**

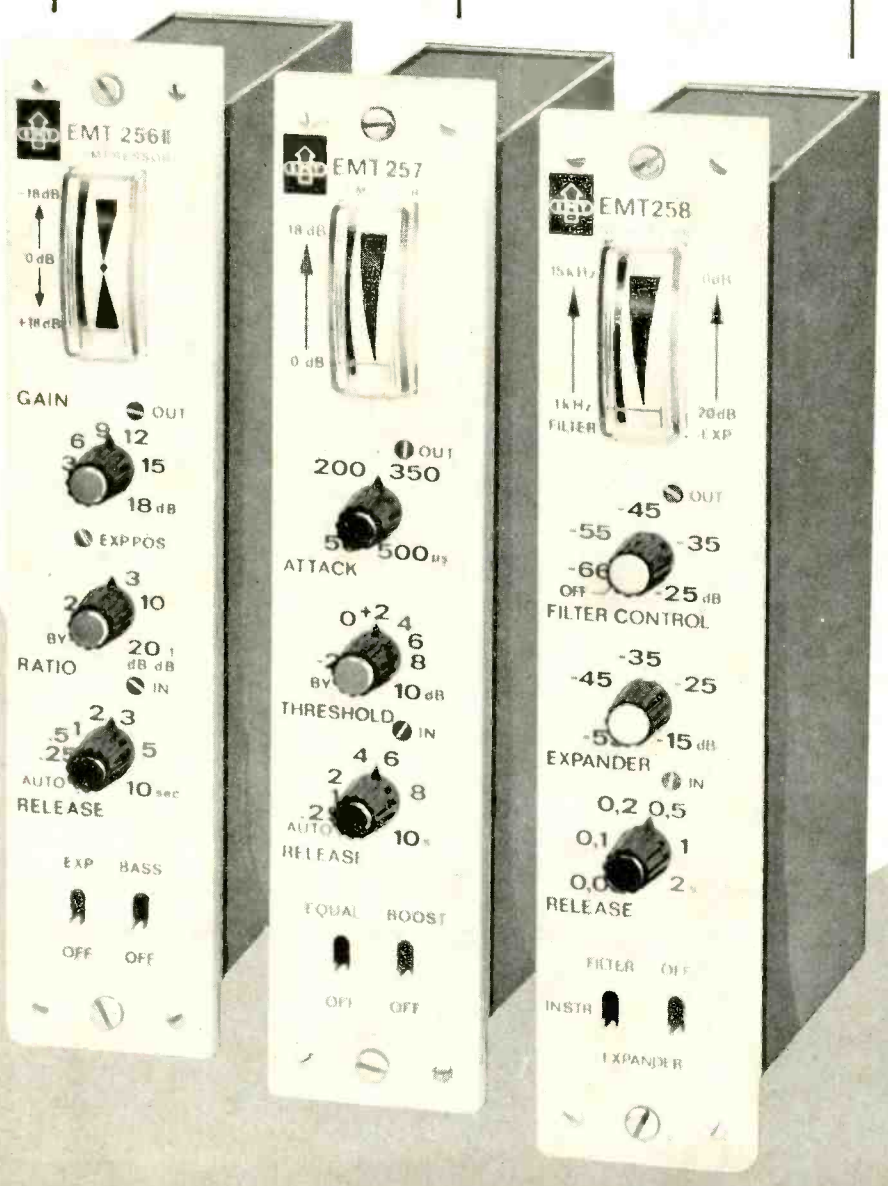
Telephone: 01-734 7465/7

# The Big PDM-Compressor EMT 156 has inspired a new Family of Console Components:

## EMT 256 II
Compact compressor with program dependent release time, low level noise reduction by expander, and compression gain and ratio adjustable over wide range. Uniquely applicable for all types of music and speech program material; directly insertable in the microphone input channel.

## EMT 257
Compact limiter featuring adjustable attack times to 50 microseconds and loudness dependent release time. For automatic, low distortion limiting of program peaks.

## NEW: EMT 258
Automatic noise filter, featuring program controlled low-pass cut-off frequencz and dynamic expander function. A highly up to date circuit principle for suppression of background noise and improvement of signal-to-noise ratio.




**EMT 258 delivery: beginning mid 1975**

**Additional export program:**
- Reverberation units
- Studio turntables and pickup cartridges
- Specialized tape machines for endless loop cassettes and logging purposes.
- Digital audio signal delay units
- Auditorium microphone winch systems
- Electronic tuning fork and polarity tester
- Test equipment for wow and flutter measurement

**FRANZ Vertriebsgesellschaft m.b.H.**
**D-763 LAHR 1, P. O. BOX 1520, West Germany**

# NEWS

## Audio Engineering Society 49th Convention

THE CONVENTION was held from September 9 to 12 in the Waldorf Astoria, New York, and included some 70 papers, four seminars and two panel discussions, in addition to the usual exhibition which on this occasion was mounted by almost 70 exhibitors.

While the actual number of delegates isn't known, the papers all appeared to be very well attended, and were run, in general, on the basis of half-hour individual presentations which in most cases provided adequate time for questions—somewhat better than the organisation at the Copenhagen Convention earlier this year.

On the other hand, a number of exhibitors complained that the attendance at the exhibition was not as good as it might have been, and visitors found considerable difficulty in attending all the papers of interest as well as having adequate time for the exhibition; exhibition hours were limited to 13.00 to 21.00 on two days, and 11.00 to 17.00 the remaining two days.

Apologies therefore to those who should have been mentioned in this summary of the Convention, which is only intended to cover new products of particular interest to readers, and a few of the interesting conference sessions.

From among the exhibitors the following items were considered to be of particular interest:

Allison Research, in addition to its well known expander and limiter, was showing two new voltage controlled amplifiers, the *VCA 2-1* and the *VCA 2-5A*. The former being a single channel device with a control range between 40 dB gain and 130 dB attenuation and 0.05% distortion. The claimed signal-to-noise ratio was 111 dB at unity gain and the maximum operating level +21 dBm. The type *VC 2-5A* is claimed to offer similar performance, but comprises a single audio input and five individual audio outputs which are controlled by two control signal summing junctions. It is intended for quad panning and gain control. In addition, Allison Research was showing *Memory's Little Helper* which is an automated level control designed for fitting into existing consoles using the existing faders, which are utilised to control vcas in the automation system. Both 16 track and 24 track versions are available, with the automation department having a maximum capacity of 128 functions, should such a large capacity be required. Facilities are provided for grouping into five groups and the read, write or update modes of operation can be either individually controlled or controlled by a master control.

Audio Designs & Manufacturing Inc had two new products, the type *ADM 302* limiter, which has an attack time of 10μs and the capability of 40 dB limiting, and programme controlled recovery time between 200 ms and 5s. The second product which may be of considerable interest is the model *560* vue-scan—a 28 channel cathode ray tube level display which gives a bar type indication on a monochrome tube fitted with a red coloured filter coinciding with the peak level. Both peak and average rectifier characteristics are available with a display range from —20 to +8 dBm.

While not strictly in the field of new products Automated Processes Inc was showing what still remains the only automated mixing system to include automation of the equalisation and level, incorporating voltage controlled amplifiers and voltage controlled parametric equalisers. In addition, model *730* dual 150W power amplifier was shown, which untypically has transformer-coupled output stages, the purpose of which is to drive 70.7V lines as well as the common loudspeaker impedances.

A rather ingenious audio spectrum display was being shown by Amber Electric Design Ltd. The display comprised ten arrays of light emitting diodes, each array indicating the level in an octave band between 31.25 Hz and 16 kHz at intervals of either 1 dB or 2 dB. Four switched inputs are provided and the device includes two memories either of which can sample or store the input spectrum. The spectrum display may be used for analysing the input to tape recorders to avoid overload, the preparation of masters for tape duplicating, frequency response alignment and many other applications.

In addition to their models *250*, *500*, *4 x 250* and *1000* power amplifiers, BGW systems was showing two new power amplifiers; the model *750* laboratory power amplifier and the model *1500* 'The arc welder special'. The model *750* is capable of delivering 220W per channel into 8 ohms with both of its channels driven, while the model *1500* is a single channel amplifier rated at 1500W into 1 ohm and is intended for driving multiple bass units in large systems.

In the field of noise reduction systems Burwen Laboratories was showing and demonstrating a number of new systems aimed at both the professional market and at the hi-fi enthusiast. The new systems are signal controlled low-pass filters with differing characteristics according to the intended application. The model *DNF 1100* being the filter with a bandwidth of 10 Hz to 30 kHz, offering between 6 and 14 dB hiss attenuation, switched attack times for use with 33⅓ rpm or 78 rpm discs and tape or ganged operation for matrix encoded signals. The model *DNF 1500* is available in two narrower band versions for use with telephone lines, shortwave broadcasting and other material where it is desirable to enhance the original signal.

Crown International, well known for its high quality power amplifiers, showed a new and more powerful amplifier the type *M600*. As its model number implies, the amplifier delivers 600W into 8 ohms (or 1000W into 4 ohms) with an outstanding specification for distortion and noise. Rather unusually, the amplifier includes a plug-in input board intended for use by the customer to build his own pre-amplifiers, filters or other accessories.

Reverting to the noise reduction front, DBX is tackling the problem of disc noise on the consumer front with the cooperation of record companies. Using a 2:1 compression expansion system, which is linear in order to avoid level matching problems, a 100 dB dynamic range is claimed in addition to the benefit of the disc material being less critical. A further new DBX product is a compressor limiter with a variable linear compression and a threshold control, but little information was available on this new device.

Eventide Clockworks Inc introduced a new digital audio delay unit intended for sound reinforcement systems and similar applications where one or more fixed delays are required. This system utilises plug-in delay cards which are available in 7.5 ms increments with a potential maximum delay of 907.5 ms.

Joseph Associates bore interesting news that Garron Electronics was adding a professional compact cassette unit to their range of *Rapid-Q* cartridge machines. Both triple playback and record/replay machines operating at a fixed speed of either 9.5 cm/s or 4.75 cm/s are catalogued with the possibilities of remote control, fast start and automatic operation.

JVC America was demonstrating a new memory level meter which incorporates a plasma display for showing four simultaneous channels. Either peak or VU modes can be switch selected with the added facility that peak levels may be held in the internal memory. A reference oscillator is included for self calibration.

La Salle Audio was showing the Orban/Parasound range of electronics including a spring type reverberation unit which is claimed to have eliminated the normal unpleasant sound associated with spring type unit. Also shown were Joel Electronic Products hardware including a simple 'A' weighting filter for use with virtually any electronic voltmeter and the Joel programme phasemeter.

Lexicon Inc introduced a further digital audio delay device with a claimed dynamic range of at least 90 dB(A) available in three models offering two different bandwidths and different maximum delay times. The main frame can contain up to eight delay modules, each module having switched delay time in 5 ms increments. The main frame is provided with led level indicators at 10 dB increments from the overload point down to –40 dB.

United Recording Electronics Industries presented the Universal Audio model *560* feedback suppressor intended for the reduction of howl-back in pa systems and similar applications. This device consists of four one sixth octave notch filters which may be tuned to the predominant room frequen-

cies in the range of 60 Hz to 6 kHz. Also shown was the model *540* series modular room equalisation filters—this system consists of a main frame which the required number of filters may be mounted. Only three types of filter are necessary, the difference being their frequency range. Each filter type offers variable centre frequency, variable width and variable cut; it is therefore possible to construct any desired characteristic without the unnecessary expense of unwanted facilities.

A novel box of tricks advertised as a product generator was shown by Wattnott Electronics. This accepts two audio inputs (say X + Y) and multiplies then to produce an audio output (X x Y) giving the opportunity to produce various expansion effects, tone modulation etc.

Finally at the end of the alphabet we come to Xedit Corporation who showed a rather interesting 16 track recorder and a new miniature wow and flutter meter claimed to meet the latest weighted quasi-peak standards and giving indications of drift and wow and flutter with a maximum sensitivity of ±0.1% full scale.

Out of the many papers read, we have selected a few which deserve a special mention. A particularly interesting paper 'Restoration and Preservation of Disc Recordings' was read by Herbert E. Squire of WOR Radio, New York. Mr Squire suggested that the common methods of improving the sound from old 78 rpm discs utilising a variety of filters left much to be desired. Generally the use of filters removed much useful audio information and excessively degraded the potential quality that can be achieved by other means. Mr Squire suggested that great improvements could be obtained by simply selecting the most appropriate stylus, and he used a variety of styli having a selection of tip radii in increments of 0.1 mil and in some cases used styli with a truncated tip so that noise was not generated by the bottom of the groove. Once the subject of reducing rumble and other defects of a mechanical nature great benefit could be obtained by combining the output of a stereo cartridge in differing phase relations. It was suggested that the required equalisation for replaying old discs might vary by up to 10 dB between the inner and outer grooves. Final treatment was done by using a notch filter to remove any unwanted constant tones, and in some cases defects such as clicks were removed by editing a 38 cm/s tape of the disc.

Relating to the standardisation of levels on magnetic tape, John G. McKnight read a paper 'Open-circuit versus Short-circuit Tape Flux Measurement' in which he explained that the reference levels in Europe were determined by the open-circuit method, while in the United States of America the reference levels were determined by the short-circuit method which is a more realistic method as far as practical tape usage is concerned. Unfortunately, the two methods do not agree with each other in that the short-circuit method gives a measured flux 0.8 dB less than the open circuit method. No theoretical explanation has been found for this discrepancy, and it is suggested that the short-circuit method should be adopted for the purposes of International Standardisation and that calibrated heads should be generally available so that absolute flux measurement becomes a simple procedure.

Also verging on the subject of standardisation, Alistair Heaslett of Ampex read a paper 'Noise Measurements in Audio' which with his associated demonstrations gave reasons for the adoption of the commonly used weighting curves as standardised by ASA ('A' weighting) DIN and the new IEC curve. Mr Heaslett gave much weight to the adoption of the new IEC curve, but did not venture upon the subject of meter rectifier characteristics and reference frequencies.

Probably of great interest to all users of recording equipment was a paper 'Frequency-Sweep Test Tapes: Design and Use' read by John G. McKnight of the Magnetic Reference Laboratory. Mr McKnight described a new test tape containing frequency sweeps from 500 Hz to 20 kHz with each complete sweep occupying 125 ms including a 25 ms gap and went on to show how such a tape can be used for quick and accurate replay alignment with an oscilloscope. The readout from the oscilloscope in terms of decibels was facilitated by the use of a preprinted graticule, only the positive half of the replay wave-form used in order to give better resolution. Incorrect alignment of azimuth or individual equalisers was shown to be easily determined from the replayed sweep pattern which provides more information than conventional spot frequency alignment tapes which also require much more time for recorder alignment.

Veering away from formal papers in the direction of politics, there was a panel discussion titled Forensic Audio Engineering. This was chaired by Stephen Temmer of Gotham Audio Corporation who managed to get together a panel consisting of Hugh Ford (Consultant) Dr Gerstman (City University of New York) and John Shattock (American Civil Liberties Union). Unfortunately while the FBI had every intention of participating, the time of the panel discussion happened to coincide with a time when the whole of the FBI was otherwise occupied. Anyhow, Stephen Temmer opened the meeting describing the extraordinary amount of money spent on federal wire taps in relation to their success rate and went on to give some interesting details of the Watergate affair. Hugh Ford spoke on the unreliability of magnetic recordings as evidence, and the disgraceful quality of recordings that are accepted as evidence in Court in the UK. Dr Gerstman, who is an expert in speech analysis and synthesis, took the opportunity to take great exception to the use of spectrographs (voice prints) as a means of identifying a speaker and stated that in his experience, such a use of spectrographs was completely unreliable. John Shattock, speaking from the legal point of view, expressed concern about the way in which tape is used for obtaining evidence and suggested that certain precautions should be mandatory. In conclusion Stephen Temmer suggested that the Audio Engineering Society should take a professional interest in these problems, and could possibly make itself responsible for drawing up a code of practice for the Courts.

The final session of the Convention was a further panel discussion titled 'How Valid are Hi-Fi Equipment Tests' moderated (being the operative word) by Larry Klein of *Stereo Review* with the well known participants Len Feldman (Audio Consultant), Edward Foster (By-Word Corporation), Julian Hirsch (Hirsch-Houck Laboratories), Gordon Holt (*Stereophile Magazine*) and Emil Torick (CBS Laboratories). The session got off to a good start by each panelist stating his philosophy of technical reviews; with the exception of Gordon Holt who relies virtually entirely on his ears, there was general agreement among the panelists that all took a dislike to reviewing transducers; as is to be expected this led to an argument about loudspeaker performance, and in particular the matter of damping factor. This matter was very tidily put to bed by Paul Voigt who happened to be in the audience. However, the meeting really began to need moderation when questions from the audience began to probe the integrity of equipment reviews in American magazines, as it was disclosed that reviews of poor equipment just were not printed.

This disclosure, which of course many of the audience had suspected, led to some heated debates. The announcement that every review written by Hugh Ford for Studio Sound has been published provoked applause from the audience and a number of excuses from the panel suggesting that they did not have the same problem with advertisers. Informal discussions continued well into the following morning.

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**Reslo to attack world markets**

MR GEORGE STOW, managing director of Reslosound Ltd, is to head a sales drive to North America where he will negotiate for the distribution of Reslo products. He hopes that his visit to the Wescon exhibition in the States will be the start of a world wide campaign. Reslosound Ltd, Spring Gardens, London Road, Romford, Essex RM7 9LJ. Phone: Romford 61926.

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**IBA appointment**

MR TONY STOLLER has been appointed to the position of Administrative Officer (Radio) at the Independent Broadcasting Authority.

Tony Stoller, 27, was educated at Gonville and Caius College, Cambridge; between 1972 and 1974, he was marketing services manager of the *Liverpool Daily Post and Echo Ltd.*

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**Hot air**

THE PRIZE FOR the most irrelevant press release ever to be issued goes to the Village Recorder, the Los Angeles recording studio owned by Mr Grordie Hormel. Grordie, who has clearly missed his vocation as an environmentalist, startled the recording industry by announcing that all the different vehicles (there are far too many types to mention here) operated by studio personnel have been converted to natural gas 'to protect the environment'.

This magazine eagerly awaits the announcement of an all British diesel powered tape transport.

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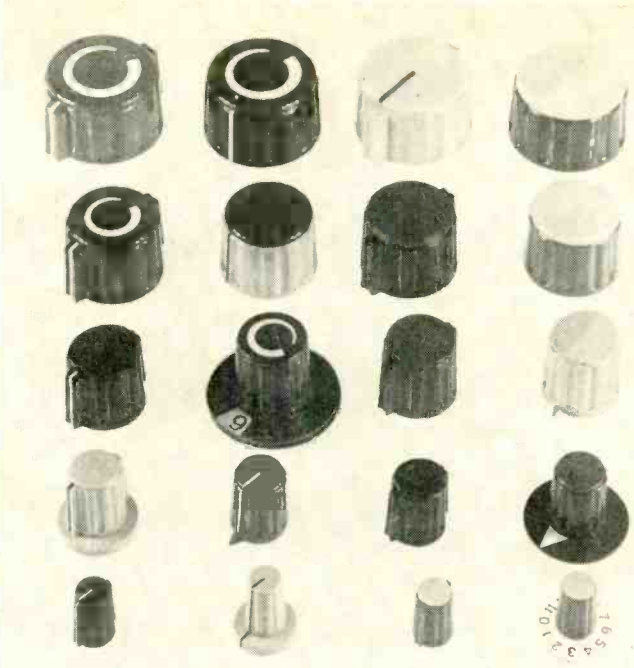
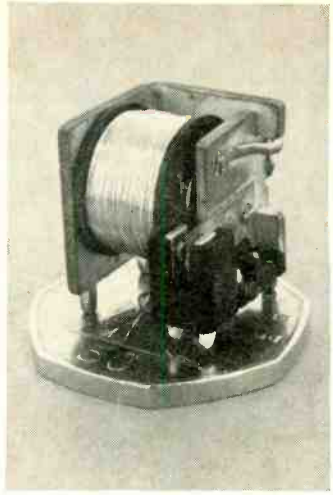
## NEWS

### New Collet knob range

BULGIN HAS INTRODUCED a new range of collet fixing knobs in a large variety of styles. Prices are said to be competitive compared with similar goods on the market with delivery generally ex-stock. The maximum lead time is given as about six to eight weeks for non stock items. A. F. Bulgin & Co Ltd, Bypass Road, Barking, Essex IG11 0AZ. Phone: 01-594 5588.





**Left:** *A selection of Bulgin fixing knobs.*

**Above:** *Type V23033 miniature power relay from B & B Relays Ltd.*

### Bed Pan Alley

A BROADCAST BY the Duke of Edinburgh launched a fund raising drive by NAHBO—the National Association of Hospital Broadcasting Organisations—and officially opened Hospital Radio Week, which this year fell between September 21 to 28. The Duke, broadcasting exclusively to some 100 hospitals, spoke of the 220 voluntary organisations which run hospital broadcasting services; over 100 of these are members of NAHBO.

Other events during HRW included 'bed pushing', an extraordinary pastime that involved the members of the organisation trundling hospital beds 'around the shopping areas of their town' for fund raising. The NAHBO contact is Steve Coote, 35 Chesterfield Road, Portsmouth PO3 6LY. Phone: 0705-64488 Ext 57.

### Professional Ferrograph

FERROGRAPH HAS ANNOUNCED the official introduction of a new mastering machine, the Studio 8 two channel tape recorder. Open for public gaze at the IBC, Ferrograph displayed the machine in console, rack mounted and transportable format. This is a completely new model which bears no relation to any other machine in the Ferrograph range. It boasts advanced digital control of tape transport, servo control of the capstan motor and electric braking with mechanical parking brakes. Constant tape tension circuits are fitted together with internal monitor amplifiers and speakers. The tape timer is claimed to be accurate to 0.1s. To complete the professional image, the machine features plug-in units providing NAB or IEC equalisation. Ferrograph Ltd, Auriema House, 442 Bath Road, Cippenham, Slough, Bucks SL1 6BB. Phone: 062 86-62511.

### Parametric disc mastering equalisers

TWO NEW MODELS have been announced by FWO Bauch, UK agents for Gotham Export Corporation. The first one is the *MES-430* from Gotham, and is claimed to be the first precision tracking equaliser specifically designed to equalise master tapes for disc transfer. When cutting stereo master discs, the unit is said to equalise the preview and programme information simultaneously, 'enabling the cutting system computer to maintain an accurate pitch and depth control for maximum conservation of groove area'.

The 72 discrete band centres divide into three overlapping ranges: 11 to 570 Hz, 120 to 6 800 Hz and 3.4 to 25.6 kHz, with boost or cut up to 12 dB in 1 dB increments. The 'Q' controls select an envelope response variable from 5 to 15 dB/octave on any of the three ranges while maintaining centre frequency amplitude. The shelving section of the equaliser provides ±12 dB of control at corner frequencies of 10 kHz and 100 or 50 Hz.

Also from Gotham is the *ME-230* parametric (in this context, parametric means variable) equaliser. As with the *430*, this is a three band unit with high and low shelving. The band centres are continuously variable enabling special effects such as phasing to be produced. The range of this equaliser is claimed to be from the subsonic to the supersonic range of frequencies. Gotham Export Corporation, 2 West 46 Street, New York, NY 10036. UK agents: FWO Bauch Ltd, 49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ. Phone: 01-953 0091.

### Demo studio for potential customers

FOLLOWING THE advent of low cost multitrack tape recorders for domestic use, there has been an upsurge of interest in creating small multitrack sound studios at home. Such studios are used by gifted or not so gifted amateur musicians who could not afford the required time that has to be spent in professional studios to make good quality demo tapes. With these people in mind, Lindair—the Tottenham Court Road consumer audio firm—have launched a specialist department in their shop whose function is to show what can be done with a small microphone mixer and a versatile four channel tape machine such as the TEAC *A-3340*. To help potential customers along the road to fame and fortune, Lindair will let people use the studio for the sum of £5—strictly refundable if a purchase is made within 30 days. Lindair (Optronics) Ltd, Lindair House, 227-229 Tottenham Court Road, London W1P 9AE. Phone: 01-590 7383.

### High power relay

A NEW MINIATURE power relay has been introduced by B & R Relays Ltd. Designated type *V23033*, this Siemens relay is said to be capable of switching up to 7.5A with a breakdown voltage of 500V rms. Controlling a maximum power of 120W at 30V dc, the coil operates from a voltage of either 6, 12 or 24V. The contacts are arranged for single pole changeover or make and break. B & R Relays Ltd, Temple Fields, Harlow, Essex CM20 2BG. Phone: 0279-34561.

### Life on the ocean waves

HARBOUR RADIO, a new group of contenders for the IBA Portsmouth local radio contract, is offering a stake in local radio. It emerged from a group of local people who wished to create a 'community radio service' that was truly independent. The aims of the new


**Above:** *Inside the Team mobile, Automated Processes desk.*

**Right:** *The Team mobile.*

consortium are to provide a complete local news service with other programmes to be determined from the result of surveys carried out among their potential listeners.

The new group would be pleased to hear from potential investors, or anyone with ideas for exploitation of this new station for the 'benefit of Portsmouth people'. The Secretary, Harbour Radio, 32 Campbell Road, Southsea.

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### £70 000 mobile

TEAM—WHICH STANDS for Trans European Audio Mobile—is the newest adventure for Doug Hopkins, formerly head of sound with Television International. Intended for operation in or out of the truck, Doug refers to TEAM as a 'breakthrough in mobile design'. By any recording studio standards, this mobile is a very advanced piece of engineering; it boasts a desk with 54 inputs mixing down to 24 outputs.

Output from the Automated Processes desk is recorded by two 3M 16 track machines which may run in the master/backup or the synchronised mode. In the sync mode, an AP *Maglink* holds the machines in step giving a potential of 30 recording channels. The noise reduction system is Dolby *M16*. Other equipment includes a Crown/JBL monitoring system, microphones by AKG, Neumann, Shure and Beyer, a twin track Studer recorder and an EMT *240* echo plate. To see what's happening on the location studio floor, there is a cctv monitor.

Also in the TEAM is Don Warren, sound balancer and mixing engineer, an ex-television mixing man who spent two years with Intertel vtr services and has most recently been engaged on freelance film work.

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### Cost philosophy behind TASCAM

THE TEAC CORPORATION of America has announced a new division to manufacture, promote and market a completely new range of studio equipment. To be known as TASCAM, Teac designed this range to equip low capital cost multitrack recording studios with hardware that possesses most of, but not all, the performance of top flight mixing and recording gear. The company refers to TASCAM as a professional range, but qualifies 'professional' by stating that their range could open up professional recording prospects for musicians who cannot afford existing recording costs.

The cost reductions are effected by making some fundamental design compromises; the tape machines use a quarter track format (the 16 track tape recorder uses 25 mm tape) and the mixing modules operate at a —10 dB line level. In spite of this, Teac say that the performance penalty is small, but claim cost reductions which enable a basic 16 track studio to be equipped for the price of a 16 track 50 mm recording machine. The TASCAM range will include battery report machines to studio units of up to 16 tracks; mixing desks will be available in four sizes from six in four out to 24 in 16 out. These products will be offered in Europe early in 1975.

Other new products from Teac include the *7300*, a professional stereo mastering unit available in two or four track format. This machine offers 38 or 19 cm/s speed, servo direct drive capstan motor, dc take up motors and full logic control of tape transport. To help with editing, there is an elapsed time indicator and a memory rewind. The price will be about $1400. The other new models are the *2300S* and the *3300S*, both quality four track stereo domestic machines using identical electronics to the familiar four channel *3340S*. Teac Corporation of America, 7733 Telegraph Road, Montebello, California 90640. Phone: 213-726 0303. UK agents: Acoustico Enterprises Ltd, 6/8 Union Street, Kingston upon Thames, Surrey. Phone: 01-549 3471/3.

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### APAE expo PA 74

PA 74 IS the exhibition for companies within the Association of Public Address Engineers and is to be held at the Parkway Hotel, Leeds on November 14. As well as showing all things concerned with mics and loudspeaker cabinets, there will be specialists on hand to discuss specific problems in pa.

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### Wide tape transports for sale

25 AND 50 mm tape transports are available on six to eight weeks delivery from Amity Shroeder. The company offers these in this form to enable smaller recording studios, with technical design staff, to manufacture a complete multitrack tape recorder for far less money than the ready built equivalent would cost. The units are delivered complete with all necessary control circuitry, but without heads. The performance of these decks returns a wow and flutter figure of 0.05% (DIN weighted) and a long term speed stability of 0.1%. They operate at 38 and 76 cm/s speed. Amity Shroeder Ltd, 3/4 Compton Street, London WC2H 8DD. Phone: 01-836 7811/2/3.

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### Borish to head AR

MARTIN L. BORISH has been appointed president of Acoustic Research, a member of the Teledyne group of companies. Borish, a veteran of 20 years standing in the domestic audio field, has been with AR since 1967 and was mainly responsible for developing the overseas (Europe) markets for AR goods.

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### Consultant acoustic engineers

PARSONS PEEBLES ACOUSTICS has been formed to offer industry a noise and vibration measurement, control and consultative service. This service will cover all applications that require a quantitative evaluation of sound levels and spectral make up.

Facilities for measurement and analysis include narrow band analysers, level recorders, precision sound level meters, full octave analysers, third octave analysers and a portable fm tape recorder. Analysis is carried out by a team of engineers resident in Edinburgh under the leadership of Mr A.

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## NEWS

Tulleth BSc, MSc, C Eng, MIEE. Parsons Peebles Acoustics, East Pilton, Edinburgh EH5 2XT. Phone: 031-552 6261.

### Equipment for call in programmes

TO RAISE THE quality of the remote portion of a telephone conversation, a specially designed interface has been introduced by HES Electronics. Called the *TSV-M* series, these units provide an electronic clean-up of the incoming signal making it suitable for subsequent transmission. Heart of the unit is a telephone differential amplifier which isolates, with negligible side tones, the remote part of any telephone conversation without adjustment between calls. This is achieved by a 'combination of impedance matching using synchronous detection, and preset phase compensation networks'.

The standard model is the *TSV-M1*, a single line interface; for multiway hook ups, the *M2* and *M3* frames are available. A combination of the *M2* and the *M3* would enable up to five lines to be serviced, with stacking and cue facilities provided. Allotrope Ltd, 90 Wardour Street, London W1V 3LE. Phone: 01-437 1892.

### New Dolby cassette deck

GOODMANS HAS INTRODUCED a new cassette deck that has a claimed performance in line with the new second generation machines. Designated the *SCD100*, it has a quoted frequency response from 40 to 15 000 Hz ±2.5 dB at an unspecified recording level. With cassette decks, the generally accepted level to measure this characteristic is 20 dB below that recording level which produces a harmonic distortion of 3 per cent on replay at 1 kHz. The best noise figures claimed for the *SCD100* are —56 dB (weighted) using Cr02 tape, Dolby in. Of interest is the distortion figure which is quoted as 2 per cent at 0 VU. This is about 1 per cent lower than the normal level used to set the base recording level on cassette machines; such a figure tends to place the noise figure in a more favourable light. Goodmans Loudspeakers Ltd, Downley Road, Havant, Hampshire PO9 2NL. Phone: 070 12-6344.

### Salone Internationale

MILAN, THE CULTURAL and commercial centre of the north of Italy was the venue for the eighth Salone Internationale della Musica e High Fidelity, held from September 5 to September 9. The Hi-Fi exhibition, part of a much larger exhibition complex, represents a major European showcase for 238 makes of equipment from 14 countries; the music exhibition displayed 242 makes of musical instruments of all kinds from 21 countries—a musical display that is second in importance only to the Frankfurt Spring Fair.

While there was little of specific interest, the show served well to give the feel of future trends in the music and recording industries; it is very easy for people in the industry to lose sight of the end products of their labours—software and hardware for the consumer. The Yamaha stand did, however, have a very specific interest for all classes of show visitor by way of an A—B comparison between their much vaunted fet power amplifier (see September, p26) and a conventional *CA 1000* power amp. The speakers used in the demonstration were a pair of Yamaha *NS690's;* the result was a very smooth sound with no subjective difference between the amplifiers. It would have been instructive to carry out this test with programme material that contained a higher proportion of treble; the language barrier prevented this. The same could be said of an attempt to find out more about a giant of a cone loudspeaker from Electrovoice, shown on the Mecosmo stand. This must have been about 80 cm across with a power handling to match. Even confirmation of this basic dimension was denied because the scunitsi had ripped off every single leaflet on the stand.

The prize for the best demonstration in the most uncomfortable surroundings must surely go to Bose (Italia). The popularity of the demonstration stemmed from the unusual test material (motorcycles and grand pianos both driven very hard) and the sheer quality of the sound. The hardware used in this demonstration was a Bose *1801* amplifier in conjunction with a pair of *901* speakers; the software issued from a Teac four channel tape machine. The origin of the superb quality is not clear—the credit must be divided between the equipment and the sound engineer who made up the test tape.

In the 'doing those things that we didn't do before' department, AKG has joined the club which manufactures solid state digital delay lines. Called the *TDU 7202*, the AKG unit is different in as much as eight bits are used for quantisation, a further two bits being used to control a compressor which has a step transfer function. The resultant resolution of this system is claimed to be equal to 13 bits from a 10 bit data stream.

Although not on display at the Milan show, Herr Wolfgang John said that AKG had brought out another kunst kopf—dummy head—for the express purpose of evaluating stereo recordings as they would appear to a 'standard' observer. Intended for recording studios, the picture of the kunst kopf reminded one of a wrinkled prune. He went on to say that the wrinkling created a more realistic sound pressure field around the microphone capsules inserted in the 'ears' of the dummy.

For rather less wooden people, the company has introduced a new type of headphone. Designated the *K140*, these headphones are of 'integrated open headphone' construction. This type of construction allows for a regular equalisation path from the back of the moving coil diaphragm to the front, with a

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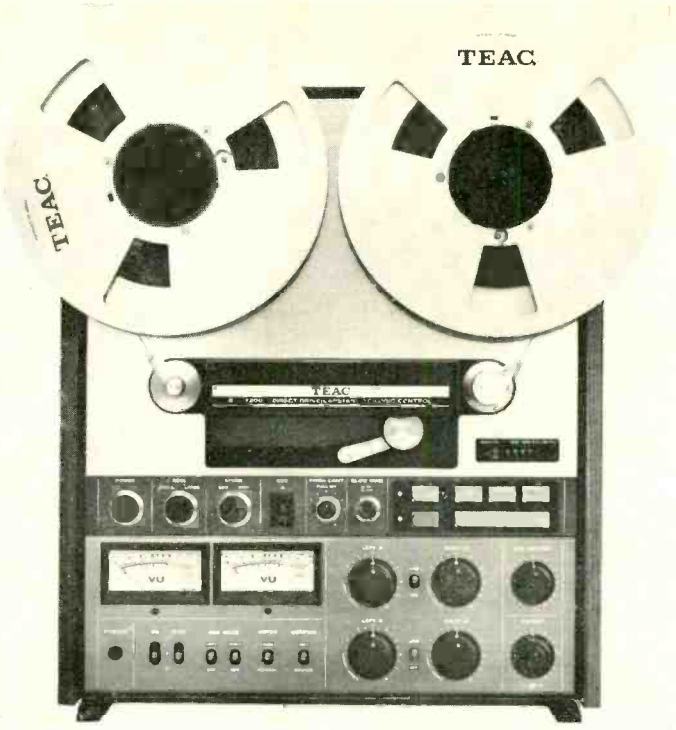
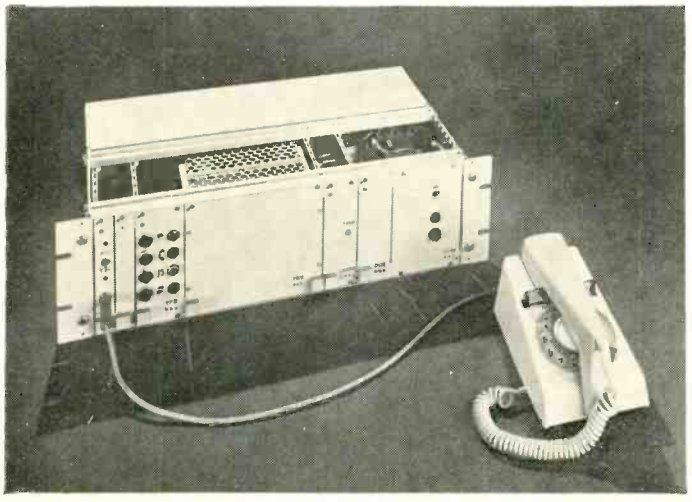
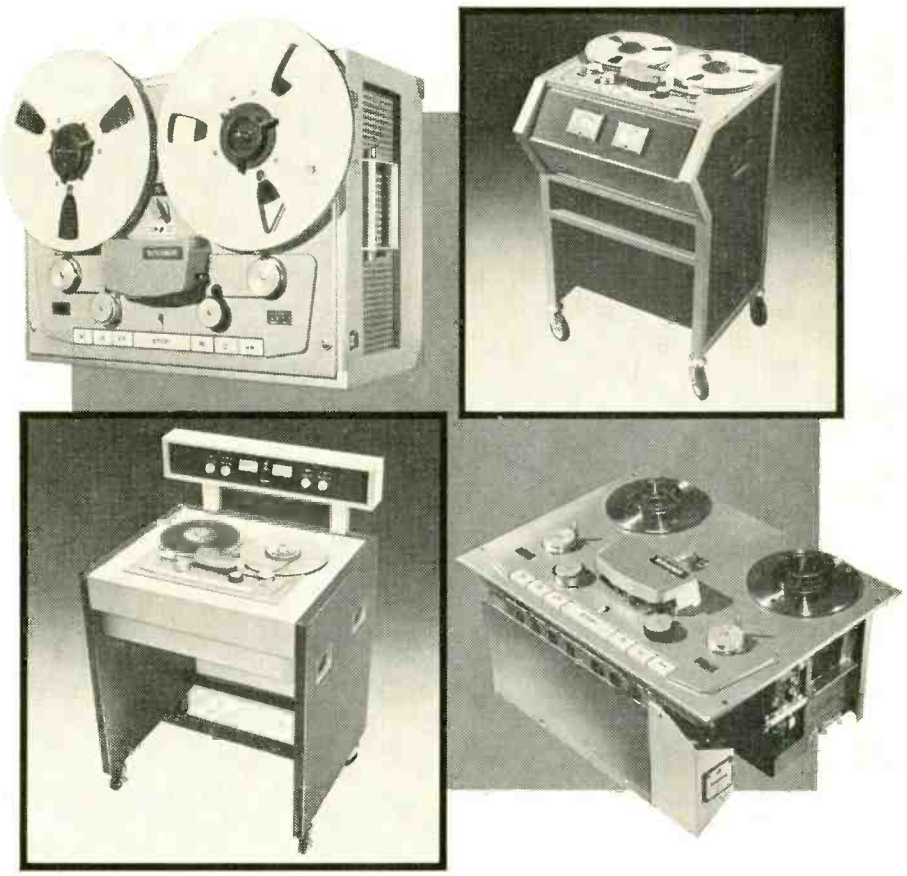



*Model 7300 from Teac.*

*TSV-M series introduced by HES Electronics.*





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passage included that opens the whole to outside world. The effect of this is to stabilise the bass response of the system.

On visiting the Telefunken stand to look at a 50 mm 16 track tape machine, an information embargo was experienced due to the same Mecosmo Electrovoice syndrome noted earlier. This syndrome may also have applied to the Crown stand; fortunately, perhaps, the wares on show had a certain ring of familiarity about them. The Amcron *D60*, *150* and *300a* gave a sense of security in as much as the whole world was not changing after all. *SX 741* four track tape recorder from the Techno subsidiary of Crown looked a likely contender in the four channel mastertape market.

It would appear that a man had visited the show with a can of oil for troubled waters; there was no disc demonstration of quadrophony to be found anywhere. This was very strange since two of the exponents of the quad systems took exhibition space with test booths, even to the point where the booths were rigged out with the relevant hardware. The firms involved were JVC (*CD-4*) and Sansui (*QS*). The SQ system was unrepresented by its CBS promoters but was well catered for by the hardware manufacturers. In every instance, the demonstrations were handled by four channel tape recorders—notably Teac—playing discrete programmes. Asked about this unfortunate state of affairs, the answers ranged from vague statements about the impossibility of show demos to the 'sorry, I don't speak English, old chap'.

A cause of consternation to a generally placid Swiss gentleman on the Nagra stand was an Italian outfit called Steg, on the opposite side of the aisle, who manufacture large loudspeakers to reproduce very high sound pressure levels at public functions such as trade shows etc. It is not known if the ensuing dialogue was recorded on the Nagra *IV SJ*, *IV S*, *4.2* or the tiny little *SN* report series of tape recorders that were on display on his stand.

An unexpected appearance was made by Studer on the stand of Audio Visione. Somebody had gone to an awful lot of trouble to wire up a 16 input Studer desk to a 24 track *A80* master recorder. The reason for this hook up is not clear, but it was certainly a great attraction to the Italian button pushers and knob twiddlers that this sort of fair invariably attracts. The pushing and twiddling was accompanied by music played from a Studer four track master machine.

### Let's twist again

NOVA STUDIOS IN Bryanston Street had an unusual visitor late in the summer months. Uri Geller, famous for most things except singing, came in for a few days to make an album. Production was by Del Newman and Werner Schmid with Herr Schmid providing the original idea and Mr Newman the music. And on this one the music was probably more than somewhat important. Uri may be able to bend forks and keys but he certainly can't sing. The idea was therefore to have Uri talking philosophy over Newman's music and the proof of the pudding should now have emerged because Polydor had the record scheduled as a rush release for November. Richard Dodd engineered and there is no truth in the scurrilous rumour that all his faders are now bent.

Anyone buying a warped pressing can presumably return it to Polydor for straightening by the maestro himself.

### Crt multitrack VU monitor

THE ADM VUE scan is claimed to replace up to 28 VU meters in a single instrument. The instrument displays the signal input level information in bar graph form, a rising column providing the reading for each channel. The ballistics of the reading can be adjusted for VU or ppm; a front panel control extends the signal input range by up to 6 dB. The units are available in 20 or 28 channel format with a monitor screen size from 30 to 58 cm. Audio Designs & Manufacturing Inc, 16005 Sturgeon, Roseville, Michigan 48066, USA. Phone: 313-7788400.

### New tape preview machine

L. J. SCULLY manufacturing company of Bridgeport, Connecticut has announced a new machine for tape preview applications. Called the Preview Master, it is claimed to be suitable for up-dating existing disc cutting equipment. Operating with the L.J. Scully closed loop drive system, the preview master features NAB/CCIR equalisation with variable preview times and cue modes.

Priced at $4525 fob Bridgeport, the machine comes in a rack mounting form. For an additional $503, the unit can be supplied in a console with waist level controls. L. J. Scully, 138 Hurd Avenue, Bridgeport, Connecticut 06604, USA. Phone: 203-3682332.

### De Lane Lea settlement

THE STAFF of the De Lane Lea Dean Street Sound Centre have reached a settlement with representatives of the parent company, Humphries Holdings, over Humphries' plans to sell 'all or part of De Lane Lea'. The plan was first made public in the annual report of the chairman of Humphries, Mr William Dravers, who said that the company was still losing money and might be disposed of. The settlement is regarded as a victory for the staff, who were prepared to stage a work-in if any attempt were made to close the premises.

The details of the settlement are that Humphries will continue to run the Dean Street studios; that there will be no redundancies; that a joint consultative committee would be formed to promote co-operation between De Lane Lea and Humphries; and that the current agreements between the Association of Cinematograph, Television and Allied Technicians, the National Association of Theatrical and Kine Employees and the Film Production Association of Great Britain would continue to apply.

According to the reports, the Humphries group gave way when it became clear that the token industrial action on the part of the De Lane Lea staff, which had comprised protests outside the offices of British Electric Traction, the group which owns Humphries, and a five-minute token switch-off of the power to the studio about which clients had been warned in advance, might lead to more serious measures if the required undertakings were not given. Such measures would have affected work on the Otto Preminger film *Rosebud*, and Otto Preminger was a client Humphries did not want to upset. When the staff introduced an overtime ban that would have threatened the picture, Humphries scurried to the table.

Humphries has maintained throughout the dispute that De Lane Lea is losing money, and while it is true that the dubbing and post-synchronising rooms are busy, the main studio, which takes up one-third of the premises' real estate, is hardly ever used. The staff have always said that turnover at the centre has been increasing steadily, as we reported last month. Asked if the studio was still losing money the managing director of Humphries said that it was but he refused to give an interview and would make no comment when asked how it was now suddenly possible to treat the Sound Centre as a going concern. Mr Alan Sapper said, in answer to the same question, that it would be possible, with the benefit of the joint consultative committee, to come to some workable agreement about the future use, for example, of Studio One. Such co-operation would enable the centre to achieve better financial success.

### APRS course

TWENTY-THREE of the 24 students who attended the first APRS studio engineers' course said they would like to attend a follow-up course. Only one student, and he was not directly involved in sound recording, said he would not advise another studio engineer to take the course if he has the opportunity.

The course was held at the University of Surrey, Guildford between September 9 and 13, and was organised by John Borwick under the auspices of the Association of Professional Recording Studios. Denis Comper and Clive Green represented the committee of the APRS and acted as tutors. All the preliminary work for the course had been done by a sub-committee comprising Green, Comper and Ron Thompson of Wessex. Subjects covered during the course included the human ear, the acoustics of musical instruments, room acoustics, microphone theory and practice, control desks, ancillary equipment and reverberation techniques, noise reduction, tape and tape machines, test equipment and equipment alignment, listening and monitoring, dynamic range and the use of limiting and compression, and the construction of loudspeakers and their use.

On each of the five days of the

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course, during which the students stayed at the University, workshop sessions were held during the afternoon and evening. The first workshop was held by John Borwick, who dealt with special effects in pop recording, covering such things as double tracking, echo, delayed echo and phasing and using examples from current pop records and from tapes brought by the students.

In the second workshop on Tuesday half the students recorded a classical trio in the hall and the studio while the other half used the physics laboratory to calibrate microphones. The recordings were made either in the department's mobile control room or in the studio control room.

On the Wednesday evening the students went to Lansdowne studios for a recording session, and the following evening, the students had a discussion session at which they commented on and criticised the tapes they had brought to the course or discussed tape alignment with Werner Wahl of Bauch. The final workshop session was an outline of the progress of quadraphonic recording by John Borwick. In the evening the students had a dinner party at which they met Jacques Levy and Edward Masek, chairman and secretary of the APRS.

Lecturers on the course included Dr John Bowsher of the University of Surrey, Alec Burd of Sandy Brown Associates, Clive Green of Cadac, David Rees, a consultant, Adrian Kerridge of Lansdowne, who supervised the recording session at his studio, A. Hardy of Emitape, Werner Wahl of FWO Bauch, Denis Comper, Mike Beville of Audio Design and Terry Livingston of Tannoy.

The students came from Trident, Eden, CBS, Pluto, Sarm, Wessex, BGS, Draig, Strawberry, Sinus (Switzerland), Studio Center (Brussels), LBC, the Linguaphone Institute, the BBC film department, Granada tv, ATV Boreham Wood, Helios Electronics, and the Institute of Sound and Vibration Research at Southampton. Of the organisations who sent more than one student two were from Trident, two from Sarm, three were from Linguaphone, and three from Granada.

It is a measure of the success of this course that most of the students were still there on Friday night; one or two wanted to get away after not seeing their wives and families for a week but the rest stayed and, after the farewell festivities on the last night, some even went back into the university's well-equipped studio to do some more work. It is reported that, after keeping Clive Green talking until 10 pm on the Thursday night, which had been intended as a night off, this latter group worked in the studio until the security guards threw them out at midnight. 'Then they were waiting,' said Denis Comper, 'for the place to be unlocked the next morning to mix down what they'd been doing'. There has, it seems, been very little late-coming and no one 'fell ill' during the course apart from one poor individual who had just been on a five-day album session before he joined the course.

Around 100 students applied for the course and the places had to be allotted 'to those we thought would best benefit by it'. A questionnaire was sent to applicants asking them what experience they had, what subjects they would like to pursue in the workshops, and whether they could read a score or play an instrument. No preference was given to applicants from APRS members—11 students came from member organisations—although of two identical candidates in other respects one from the APRS would have been given a place in preference to another who was not, a situation which, in the event, did not arise.

The control room at Guildford measures 5m by 5m and is equipped with a Neve 12/4 desk with two echo sends, two foldback circuits, an oscillator, width and pan controls, compressor-limiters, cue and talkback. The machines are a Scully 12.5 mm four track machine, and Studer *A80* and *B62*. There are six HH amplifiers in the rack driving two Spendors, two JBLs or, on this occasion, two Tannoys. The rack also contains four Dolby *361* units. John Borwick said it was the only university in the country with such recording equipment. The control room had just been enlarged for the course and the maintenance engineer had spent a lot of time doing last-minute wiring up.

Borwick mentioned that the Tonmeister students would be completing the acoustic treatment next term: 'We've got plenty of B & K gear—twice over, in fact—and they can squeak the room and mess about with it until it's right'.

The APRS students, meanwhile, seem to have had few complaints. If one told you there had been too much emphasis on the rock music side another would tell you there had been too little and yet another would say that the mix had been just right. The same response would be evident in reply to questions about whether the course had been too technical or not enough so.

The overwhelming benefit of the course seemed to be that the students could meet, exchange views and test their assumptions about basic principles. It is fair to say that no one—students, organisers or lecturers—expected it to be so well received. The impetus should not be lost, particularly when the engineers were so full of ideas—about the way the business they were in should be run.

One person seemed unimpressed: when asked how the APRS was going to deal with the increased demand for the course that was bound to follow from this year's success Mr Masek, the APRS secretary, said: 'I've had a great deal of experience of these things and you usually find that they fizzle out'.

The week at Guildford left one mystery that was never quite solved: how come a man from Switzerland has a name like McTaggart?

# MOTORING BROADCASTS LIMITED

is taking this opportunity for sending their warmest thanks to the following people for all their assistance and guidance in enabling us to put together the most successful Radio Motor Show yet:

| | |
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| Ted Fletcher | Stancoil Ltd. |
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| Martins 1+2 | Audio Ltd. |
| Colin Blackwell | Andrews Industrial Ltd. |
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| Stuart Young | Allotrope Ltd. |
| Julia Flack | Bang & Olufsen |

Rockwool Co. (U.K.) Ltd.

If we've forgotten anyone, such as Frank Snowdon-Pratt of Leevers-Rich Ltd., we do apologize!

Plus our greetings and thanks to Mike Barton and his merry men at L.B.C. for all they have done, B.B.C. Radio London, B.B.C. G.N.S. circuit for carrying our material, I.R.N. circuit for the use of their land-lines, to Hilversum, Ontario, and Persian Radio for their programming, all the B.B.C. local radio stations and IBA local radio stations for their air time and for taking part in our nationwide radio competition.

To Jimmy Young, Roger Moore, Britt Ekland, Jim Pestridge, Dave Simmonds, Richard Vaughan, Nickie Hughes, Paul Callan, all the lads at B.F.B.S., Radio Manx and absolutely everyone for their enthusiasm and support.

Merry Christmas to you all.

# PATENTS

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

**September 4**

**1371045** Sanders Associates Inc.
Cathode ray tube circuit arrangement.
**1371050** Licentia Patent-Ver-Waltungs-GmbH.
Convergence arrangements for multiple beam cathode ray tubes.
**1371197** Orkyo KK.
Detecting the entry of a gramophone stylus into the run-out groove of a record being played.
**1371257** Thomson-CSF.
Simplified edge clamp mounting for orientatable objects and in particular car radio aerials.
**1371291** Coal Industry (Patents) Ltd and University of Surrey.
Radio frequency communication systems.
**1371306** Westinghouse Electric Corporation.
Flowmeter apparatus.
**1371338** EMI Ltd.
Loudspeakers.
**1371355** Sony Corporation.
Colour television system.
**1371364** Defence, Secretary of State For.
Direct view cathode ray tubes.
**1371374** Eastman Kodak Co.
Apparatus for deriving video signals.
**1371447** Saba Schwarzwaelder Apparatebau —Anstalt August Schwer Soehne GmbH.
Protective circuit for television receivers.
**1371499** Nissan Motor Co Ltd.
Time division multichannel on-off signal transmission system.
**1371500** Nissan Motor Co Ltd.
Time division multichannel on-off signal transmission system.
**1371587** Tokai Rika Denki Seisakusho, KK.
Stabilised-frequency circuit.
**1371671** Ampex Corporation.
Magnetic tape transport.
**1371715** Commissariat A L'Energie Atomique.
Radiation detector apparatus for X, γ or β radiation.
**1371719** Indexette Tapes Inc.
Cue marked reelable webs and methods and apparatus for applying the cue markings.
**1371737** Ampex Corporation.
Tape transports.
**1371756** Radiometer A/S.
Distortion measuring device.
**1371773** British Broadcasting Corporation.
Drive mechanisms.

**September 11**

**1371789** Westinghouse Brake & Signal Co Ltd.
Display apparatus.
**1371815** Post Office.
Digital echo suppressor.
**1371848** Columbia Broadcasting System Inc.
Pulsato speaker system.
**1371928** Philips Electronic & Industries Ltd.
Beam current limiting circuit.
**1371935** Hughes Aircraft Co.
Function generator for display system.
**1371974** Matushita Electric Industrial Co Ltd.
Tape drive mechanism in recording and/or reproducing apparatus.
**1371990** Suwa Seikosha, KK.
Liquid crystal display apparatus.
**1372023** Mullard Ltd.
Imaging systems.
**1372082** RCA Corporation.
Record and playback apparatus for pulse width modulated record.
**1372083** RCA Corporation.
Sound records and reproducing apparatus.
**1372101** Matushita Electric Industrial Co Ltd.
Magnetic video recording and reproducing apparatus.
**1372188** Racal Instruments Ltd.
Frequency synthesisers.
**1372195** Muller, E.
Teaching aid.
**1372311** Hell GmbH, Dr-Ing Rudolf.
Apparatus for electro-mechanically producing printing formes.
**1372335** Olivetti & C Spa, Ing C.
Apparatus for recording and/or playing back a magnetic tape contained in a cassette.
**1372352** United Kingdom Atomic Energy Authority.
Transducers.
**1372416** Westinghouse Electric Corporation.
Signal processing and reproducing method and apparatus.
**1372421** RCA Corporation.
Information record and apparatus for producing same.
**1372423** Philips Electronic & Associated Industries Ltd.
Recording and/or playback apparatus.
**1372434** RCA Corporation.
Gamma correction bandpass amplifier circuits.
**1372470** Raytheon Co.
Radar systems.
**1372474** International Business Machines Corporation
Methods of manufacturing and magnetic transducers.
**1372496/7** Columbia Broadcasting System Inc Ravidal Inc Memorex Corporation and Mrx Video Corporation (trading as CMX Systems).
Apparatus for recording and reproducing audio-video information signals.
**1372514** Westinghouse Electric Corporation.
High speed tape dubbing system.
**1372572** Electroacoustic GmbH.
Electro-acoustic transmitters for operation in air or underwater.
**1372579** Pioneer Electronic Corporation.
Reproducing device for artificial four channel stereo.
**1372591** Nippon Columbia KK.
Video signal transmission apparatus having variable bandwidth.
**1372613** Soc Italiana Telecomunicazioni Siemens Spa.
Phase correction system for a synchronous multiplexer for use in pcm systems.

**September 18**

**1372632** Lee, F. F.
Signal processing apparatus.
**1372643** Zellweger Uster Ltd.
Method of and apparatus for remote control.
**1372678** Hughes Aircraft Co.
Dynamic focusing signal generator.
**1372704** Nippon Electric Co Ltd.
Electrostatic recording devices.
**1372728** Matsushita Electric Industrial Co Ltd.
Display devices.
**1372819** Asahi Glass Co Ltd.
Liquid crystal cell.
**1372822** Ted Bildplatten AG AEG-Telefunken Teldec.
Reproduction circuit arrangement for a three colour line sequential colour television signal.
**1372868** Hoffmann-La Roche & Co AG, F.
Optical device.
**1372931** Sony Corporation.
Tape cassette.
**1372964** Olivetti & C Spa, Ing C.
Apparatus for the feed of a magnetic recording tape.
**1372970** Etudes Et Bonneterie SA.
Process and device for controlling the alternate winding and unwinding of a two-ended programme tape.
**1372973** Video Logic Corporation.
Video tape recorder system having means for suppressing video track crossover noise during slow and fast motion operation.
**1372988** Garton, P. M.
Methods of and apparatus for presenting a moving pattern.
**1373062** International Business Machines Corporation.
Method and apparatus for equalising electrical signals.
**1373064** National Research Development Corporation.
Sequential machines and logic elements for such machines.
**1373101** Hitachi Ltd.
Magnetic recording and reproducing apparatus.
**1373134** Pioneer Electronic Corporation.
Amplifier circuit arrangement.
**1373171** Xerox Corporation.
Optical filter system.
**1373206** Deutsche Spielgelglas AG.
Optical indicator element with liquid crystal layer.
**1373215** Olympus Optical Co Ltd.
Electrical attachment devices.
**1373240** Ricoh, KK.
Web drive arrangements.
**1373242** Mitsubishi Denki KK.
Data reproducing system.
**1373279** Sony Corporation.
White balance control system.
**1373298** Philips Electronic & Associated Industries Ltd.
Magnetic device comprising domains.

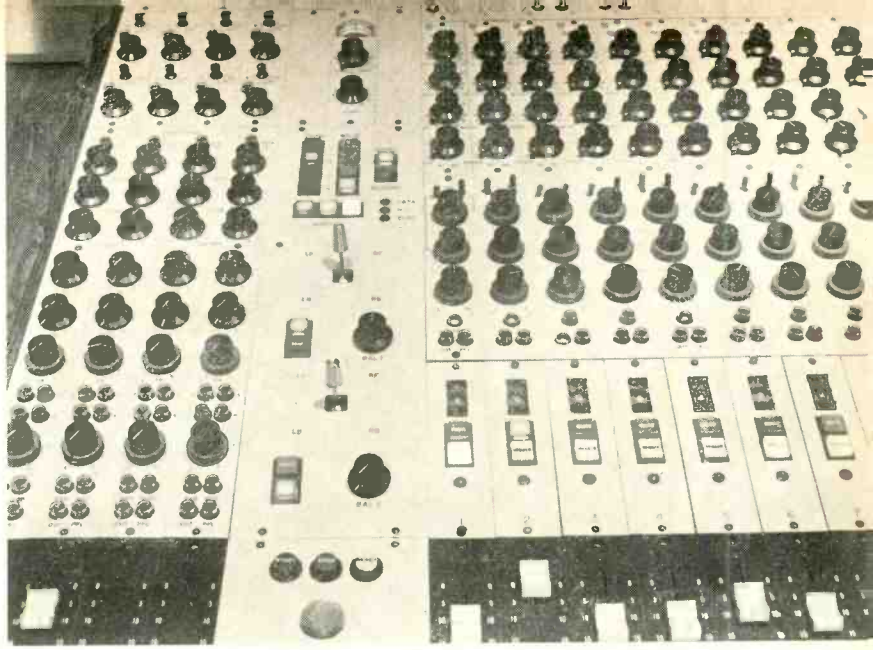
**September 25**

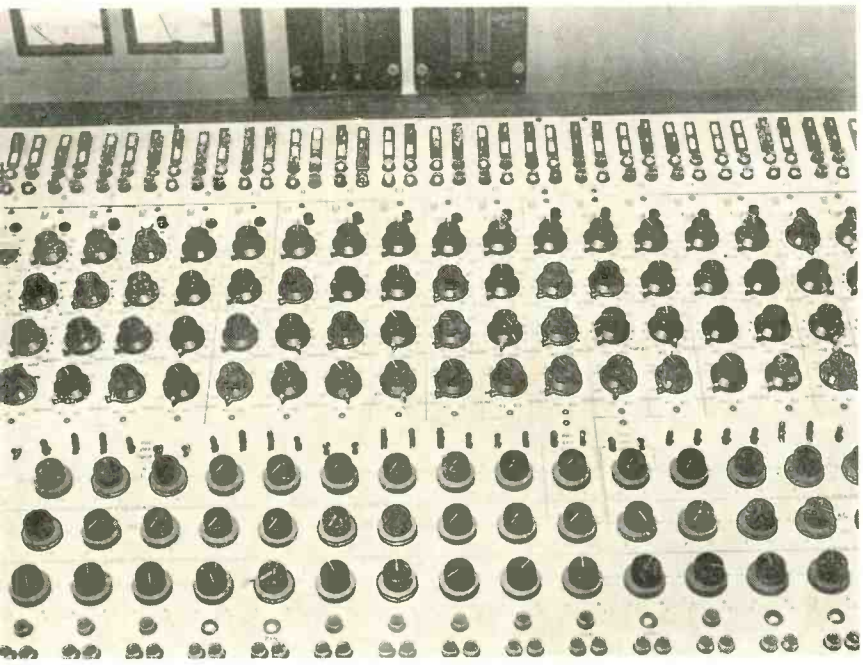
**1373358** Siemens AG.
Radar systems.
**1373360** Michel, A.
Method and apparatus for increasing the full-

42▶

Specifications concluded 74▶

ALL RIGHT
FOR 7 or 8
plus a couple
of
echo returns...





...but how
about when you
get to 16 or 24
or even 32?....
is your memory
infallable?
no one's is....

.... except

**compumix**

it memorises everything
and gives it back to you
faithfully... every time.

**quad/eight** by

FELDON

helps you through the night

**THE BURWEN SYSTEM** of noise reduction is by now well known, but readers may be interested to know that new British Patent 1361539 now protects the system in the UK for the inventor, Richard Sumner Burwen, of Lexington, Massachussetts. The Patent also contains useful source references to prior USA patents concerned with reducing noise in noisy channels, such as tape recordings (USA numbers 3247464, 3350515 and 3458815). There is also a reference to the Dolby system, with a suggestion that the Dolby approach to noisy channels 'appears to be only partially successful in minimising distortion', is 'able to provide only a small degree of compression', and achieves 'a lower overall improvement in signal/noise ratio'. The Burwen patent also states that in the Dolby system, 'significant frequency distortion can result if the signal level recovered from the noisy channel is not carefully adjusted to be identically the same as the signal level applied to the channel'. I am surprised that the British Patent Office (which normally excises any disparaging comments on one patent invention from another) allowed these comments through, irrespective of whether they are justified or not. Be that as it may, the Burwen patent promises that 'these and other disadvantages are overcome' by the Burwen system, which provides compression of a 90dB input range into a 30dB range with expansion to provide the original 90dB signal range on recovery and a consequent 60dB improvement in signal/noise ratio.

It would be repetitive to dwell too long on the theory of the Burwen system which has been previously reviewed in detail. But in brief, and as shown in **figs. 1 and 2,** the Burwen compandor as patented works as follows.

In fig. 1 the compressor, the audio input to be transmitted over the noisy channel (eg tape recorder) is applied on line 12 to equaliser 14, to provide high and low frequency pre-emphasis. The output of equaliser 14 is fed to the numerator or Z-input of divider 16. The output of divider 16 is fed to low-frequency attenuator 18 and high frequency limiter 20. The output of the limiter is applied on line 22 to the input of the noisy channel (recorder) 24. Attenuator 18 trims the audio signal below 50 Hz to reduce the effect of dc transients and limiter 20 prevents overload, such as tape saturation. Its output is also fed to equaliser circuit 26 which attenuates below and above 80 Hz and 9 kHz limits to prevent compression being erroneously affected by noise outside this range.

The output of equaliser 26 is fed to peak rectifier 28, and the rectified signal output is fed to squaring circuit 30. This provides an output control signal to the denominator or Y-input of the divider 16, which varies according to the square of the peak rectified signal. Thus, the signal fed out on line 24 varies over a dynamic range which is substantially the cube root of the dynamic range of the input signal on line 12. Thus an input signal of range 90dB produces a signal on line 24 which varies over a range of 30dB.

As shown in fig. 2, recovery is by means of a complementary expansion system, the output from the recorder or noisy channel being fed over line 32 to a multiplicand or x-input of multiplier 34. The output of the multiplier 34 is applied to equaliser 36, of characteristics complementary to those of the equaliser 14 and also to attenuator 18. The signal is also fed to equaliser 38, of idetnical characteristics to the equaliser 26. The output of equaliser 38 is fed to peak rectifier 40, with its output connected to squaring circuit 42. The output of squarer 42 is fed to the multiplier or y-input of multiplier 34. The output of squarer 42 is directly proportional to the output of squarer 30. Equaliser 36 thus produces an output with flat frequency response and the very marked absence of noise which has impressed most people who have heard the Burwen system in action.

**FIG. 1 1361539**

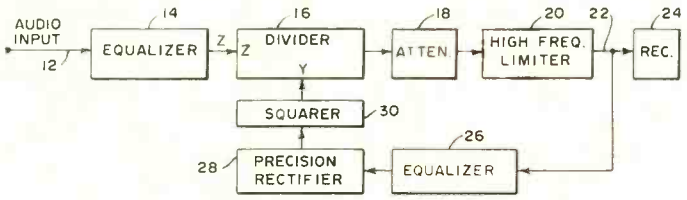
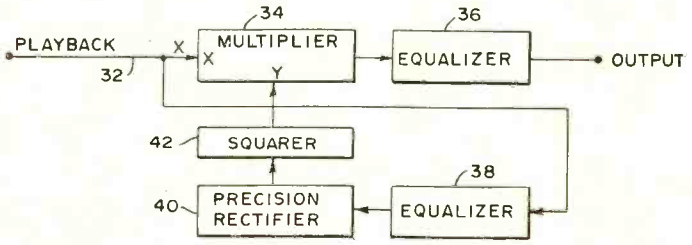



**FIG. 2 1361539**




**WHAT PRICE** a patent covering the Hafler system for connecting up a pair of extra loudspeakers to reproduce the difference signal? If such a patent existed, and it were enforcable in law, Heaven knows how many people would infringe it for there is now a roaring trade in 'synthesiser' boxes for difference decoding in Hafler style. What is more almost every other audio enthusiast seems to have given it a try at one time or another and some manufacturers have either incorporated Hafler style outputs in their amplifiers for extra speakers or printed up special instructions telling users how they can connect up an extra pair across the positive output terminal. Can you imagine the rumpus it would cause if all that activity turned out to be an infringement of a valid patent?

Well it almost has! British patent no 1356843 in the name of Dynaco of Philadelphia, USA (and naming David Hafler as the inventor) describes and claims the use of a centre front loudspeaker to re produceL+R (X2)+2F and a rear loudspeaker to reproduceL−R+2B. According to Hafler the front signal (F) is added in equal proportions and in phase to each channel and the back signal (b) is added in equal proportions to each channel but in opposite phase. And the arrangement described in the patent for reproducing the rear signal (L−R+2B) is just what is now so well known and widely used.

Fortunately it is possible to set aside the legal niceties of what exactly is and is not an infringement of the patent claims. The basic idea was described by Hafler himself in a lengthy article in *Hi-Fi News* dated August 1970 which ante-dates his own patent priority date by several months. This will come as a great relief to just about everyone but Mr Hafler himself.

The episode has a poignant moral. If you have an idea that you intend to protect with a patent, for goodness sake see that the patent application is filed before you publicly disclose your idea. Although the British Patent Office may allow your application the latter cannot validly protect what you published before your application date. Constructors and designers with a yen to both publish *and* patent must get their priorities right, in all senses of the word.

**Adrian Hope**

# WHO'S RAMPORT ?

# CLEAN FEED

by Cross Patch

**Quadnastics:** Perhaps it is just too simple. There must be a frightful snag lying hidden around the corner somewhere. But it goes something like this. An enormous amount of time, effort and money has been devoted to solving the problem of storing and retrieving four sound channels using existing apparatus with the minimum of modification and amendment. For some inexplicable reason the four-plus-four channel cartridge has been largely ignored as a medium although there have been great sales efforts to increase the disappointing market share of the four-times-two channel cartridge. To have concentrated on the cartridge as the standard medium for quad would have solved a lot of problems and prevented the proliferation of rival systems not one of which can be entirely satisfactory or the others would have disappeared. Now agreement has been reached on the standardisation of video-discs, anyway between Philips and MCA, and all the other manufacturers seem very likely to join soon. What about looking to the video-disc system, then, as the medium for quad or any other format of musical information for that matter? The consumer cost of a video-disc system, it is said, will be about that of a good hi-fi system. If enough information can be packed on to a video-disc to produce colour pictures then to put a few sound channels on should be dead easy; there would have to be sound to go with the pictures in any case. Just one system to replay pictures and/or music, a groovy idea without the grooves. Someone thought of it already? Splendid! Then let's get on with it, or is there a hold-up? Not technical problems surely, with innovations popping like pea-pods in August it can't be technical problems. Too much capital already tied up in conventional pressing plants perhaps? Like the sad story of the plastic milk bottle, investment can put a brake on progress. So come on all you clever guys, just outside the lab window there is a great big market to be won. And remember the bonus—video-discs don't have to be made of PVC.

**Exhibitionism:** If all present plans bear fruit, next year will see a positive plethora of displays of recording equipment to tempt the eye and stretch the pocket. The resulting strain on manufacturers' promotion budgets hardly bears thinking about, except by the already hard-pressed manufacturers. After all, in present and forward economic conditions it is extremely difficult to make a profit in real terms and any transaction hitherto qualified as essential expenditure must be scrutinised and analysed with hatchet in hand. However attractive and cheap exhibition organisers make their shows appear by the time the exhibitor has added up all the costs the total can be relatively large. Accurately to relate those costs directly to sales benefit is impossible, but the proportion of the price attributable to sales must be known precisely and be constantly monitored. Now, is it not about time that the manufacturers who serve our industry got together to rationalise the exhibition scene? It is said it has been tried before and efforts have failed to achieve any result. Never mind what the reasons have been now is the time to try again only harder. Rising costs and a depressed market demand action. The poor old customer is well aware that it is he who is expected to foot the bill in the end. The poor old customer is having to count his pennies these days and he is entitled to wonder how much of the price of the goods represents the cost of expensive exhibitions. The paradox is that those studios earning enough to afford new equipment are too busy to spare the time for more than one exhibition a year. They know what they want and are not likely to buy on impulse. So, how about taking a quiet half hour to do a cost/effectiveness exercise on the Sales, Promotion and Advertising budget . . .

**Straight curves:** During the recent APRS Course Dr John Bowsher demonstrated how to produce test results for a cheap and cheerful domestic mic to compare favourably with the very best professional job. Not by clumsily falsifying the figures and taking diabolical liberties with the truth. Nothing like that but simply by carefully choosing the right method and conditions. The object was not to imply that any maker of repute is ever likely deliberately to cook a spec. Not at all, it was to ring round the importance of customers being able to understand what test figures and specifications really mean and to be able to ask the right questions. Ace engineer, Fred Stinge, still thinks azimuth is something to drink.

**PVC:** Shortage of the stuff still worries the record pressers. The increase in the price of it is even more worrying. The health hazard said to be connected with its manufacture doesn't help future prospects. There have been rumours that the US authorities might stop it being made and we would have to follow suit. If that happened who would be hardest hit? Well, in the UK last year 2 000 people made 400 000 tonnes of it. 244 000 tonnes was used to make all sorts of things from 30 000 miles of drain pipes to 70M pairs of shoes. A mere 21 000 tonnes was pressed into 140M gramophone records and 135 000 tonnes seems to have been exported to countries where they pay even higher prices than we do. So, if there were to be no more PVC we would all be struck drainless, be trolling around in our socks, and the tape duplicators would be overwhelmed with orders.

**Hear, hear:** A fascinating academic discussion has been going on lately with all the speed and clamour of a postal chess game. Triggered by Murray Schafer's paper 'The Music of the Environment' published by UNESCO, the question at issue is the precise effect on the human psyche first of the high level of continuous ambient pink noise suffered particularly by city dwellers, second the phenomenon to which Schafer applies the elegant term 'schizophonia'. It is passively accepted these days, almost from birth, that the sound heard can be, and usually is, totally split from the original source of the sound. It is accepted as quite natural to be accompanied in the elevator by an invisible dance band, for a symphony orchestra to be heard playing in and between two small wooden boxes, and for a voice to come not from the hole in the head but from behind a grille offset by a good 30 cm. Again, audiologists can produce numbing statistics to prove the very high proportion of young children with deficient hearing to be found mainly in densely populated urban areas. A sad footnote to that situation is in the fact that many such children can feel oppressed and frightened by the silence, to them, of the countryside. Can all this explain the demand for popular music to be played through loudspeakers at high levels? Will this technique eventually have to apply to all contemporary music, and to the classical repertoire as well? If Mozart were writing today would it be for amplified instruments? After all, in his time Vienna was so quiet the alarm could be raised by the firewatch shouting from the roof of the Stephansdom. Poor Beethoven was born too soon.

**Spy stranger:** Ever noticed how those not intimately acquainted with our recording business can easily fall into the trap of making odious comparisons and coming to the false conclusion it behaves just like any other business? It can seem to be the same and indeed it does bear a superficial resemblance enough to fool the ignorant. They forget, or have never realised, that it is people who are the business, and people are very different each from the other and from group to group. May it always be that way. The recording business is a very special group of people with the very special quality of dedicated and fanatical enthusiasm. An overstatement did someone say? All right then—who else works the hours, under the conditions, and for the money without more than the rare mumbled grumble?

**Silly question:** If a piece of equipment was bought three years ago for £100, is written down straight line over five years and the cost of replacement has risen to £400 over the shorter period during which the value of money has depreciated by 17 per cent, studio hiring charges have remained static due to adverse market forces and profitability has been eroded by increased taxes, rates, rent, wages, cost of electricity, gas, water, raw materials and interest charges together with a reduction in demand for services influenced by a steady evaporation of national disposable income in line with the downtrend in the GDP, what is the name of a good psychiatrist?

# THE BEST IN STUDIO SOUND — THAT'S WHO

**When you record to our high standards, and with the type of equipment we have available, a professional enlists with us first.**

**Join the professionals at Ramport.**

CONTROL ROOM.

**Desk:** Helios Electronics – Quadrophonic 32 Channel desk inc. 6 Helios compressors – patch board – 4 x patchable Aengus EQ modules – 4 echo sends – dual concentric quad pots on all channels – Audiotek quad (joystick) pan pots – 3 fold backs and full stereo and quad monitoring with echo.

**Recording machines:** 3M 24 track, 16 track and 2 track (M79s). Studer 16 track, 8 track, 4 track and 2 track (A80s). All variable speed plus 7½, 15 and 30 I.P.S. Revox 2 track A77 and A700. Teac (cassette) Model 450 prof.

**Ancillary equipment:** Goldring deck – Quad 33 pre-amp – Eventide digital delay and phasing units – Stereo multitrack, ITI and Acousta-voicette equalisers – Teletronics levelling amplifiers – Universal audio limiters – Alice noise gates – Full Dolby or DBX in line – Stereo E.M.T. echo plates – AKG BX20 Reverb.

**Monitoring equipment:** Amplifiers by Ram, S.A.E. and Quad – 12 J.B.L. 4320 and 2 J.B.L. 4310 monitor speaker enclosers.

**STUDIO.**

For 40 musicians plus separate vocal and piano booths.

**Microphones:** Neumann, A.K.G., Sony, Shure, Sennheiser.

**Speakers:** Lockwood Tannoy enclosures.

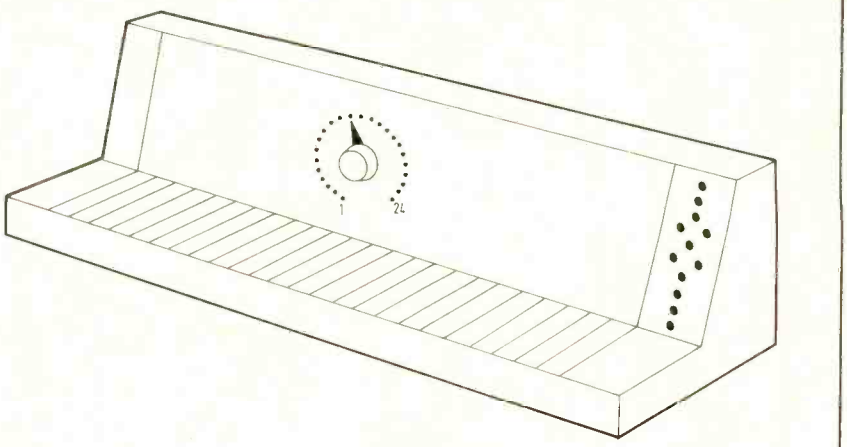
**Headphones:** Koss, Beyer.

**Other facilities and equipment:** 110v. – 50 and 60 Hz. ring mains. 250v. – 50 and 60 Hz. ring mains. Bösendorfer piano – Hammond B3 Organ – Ludwig drum kit and timpani – Fender Rhodes Piano – assorted percussion instruments – etc.

**Ramport Enterprises Ltd, 115 Thessaly Road, London S.W.8. Telephone: 01-720 5066/7/8.**

*Much has been written about advances in digital electronic techniques in recent years. The same advances will, in the next few years, radically change the design and operation of sound mixing equipment. The author puts forward ideas based on his own sound mixing experience together with descriptions of the mixing system on which his company is working. A practical system is proposed together with suggestions for future applications.*

FIG.1 REDUCTION OF PRESENT MIXER FORMAT




# An alternative approach to sound mixing

STEPHEN BROWN*

**THE INTENTION** of this article is not so much to state dogmatically or to propose set ideas as the right solutions to the present problems of large mixer design, but rather to provoke the thoughts of people who will be operating and maintaining the sound desks of the future. Such desks will doubtless have extensive setting storage facilities, extending the current fairly limited range available of such devices. As yet there is no accepted common, interchangeable code. So another reason for writing is to mention the need for compatibility between future systems of different manufacture so that, for example, a balance set up on one desk can easily be transposed to another. The often difficult movement of master tapes between different studios operating on familiar analogue principles is already witness to the need for the long overdue arrival of common standards at points of interchange.

What is proposed is overall digital control of working sound processes. We have already seen its useful application in automated mix-downs; there is no reason why this should not progress naturally to cover all the controls on a conventional sound desk, not only for mix-downs but for any straightforward operation.

Let us, for a start, make a simple analysis of a conventional, current 24 channel desk from the operational point of view. The channel faders are obviously an essential part of the operation of the desk, and there is no reason for changing their function. But as we can see later, there is no reason why they cannot take up less width, and as a result enable the sound balancer to discard his wheeled chair. Since we are initially on a course of simplification, the other 600 controls present a great deal of room for improvement. As a first logical step, let us condense all those channel modules to a single control strip and have a 24-way switch to direct the instructions to the relevant channel. Clearly this presents problems. To adjust a channel, all controls would have to be arranged at their previous settings before the channel could be updated.

A conventional pot or switch must be considered in logical terms as a memory, and also provides some way of indicating to the operator all his settings. But replacing such units is not such a huge problem as would first appear. A single eight-pin ic memory will hold all data for two channels, which can include two graphic equalisers, six auxiliaries with post or pre, quad pan, coarse gain and still have room for more facilities as required.

The display system of the prototype uses a colour television raster to indicate all the settings concerned with the channel selected (**fig. 2**). Auxiliary levels appear as bars, their colour depending on whether they are post or pre. Frequency response appears graphically as a horizontal line. VU or ppm levels appear as vertical stripes whose colour changes on overload above a selected level. Graticules are electronically generated.

The maintenance engineer will also be quick to see the advantages in this system. Although he would have to learn about new circuits, generally his job should be easier. There are many present sources of trouble. The best pots still tend to be noisy after extended use, and operation of switches while recording is still liable to be fraught with clicks. The present forms of these are eliminated.

Clearly, with such a system, there is no need for the audio signal to go near the control point; the expression 'sound-desk' soon becomes a mis-nomer. A rack houses all audio analogue circuits in closely-packed cards. However, the single module and switch I have proposed doesn't stand up to much critical inspection. Having accepted the general principle of digital control, a keyboard provides a much more satisfactory input terminal. In the prototype 11 named keys, ten numeric keys in standard format and two control faders are all that is necessary to give total control over any number of channels.

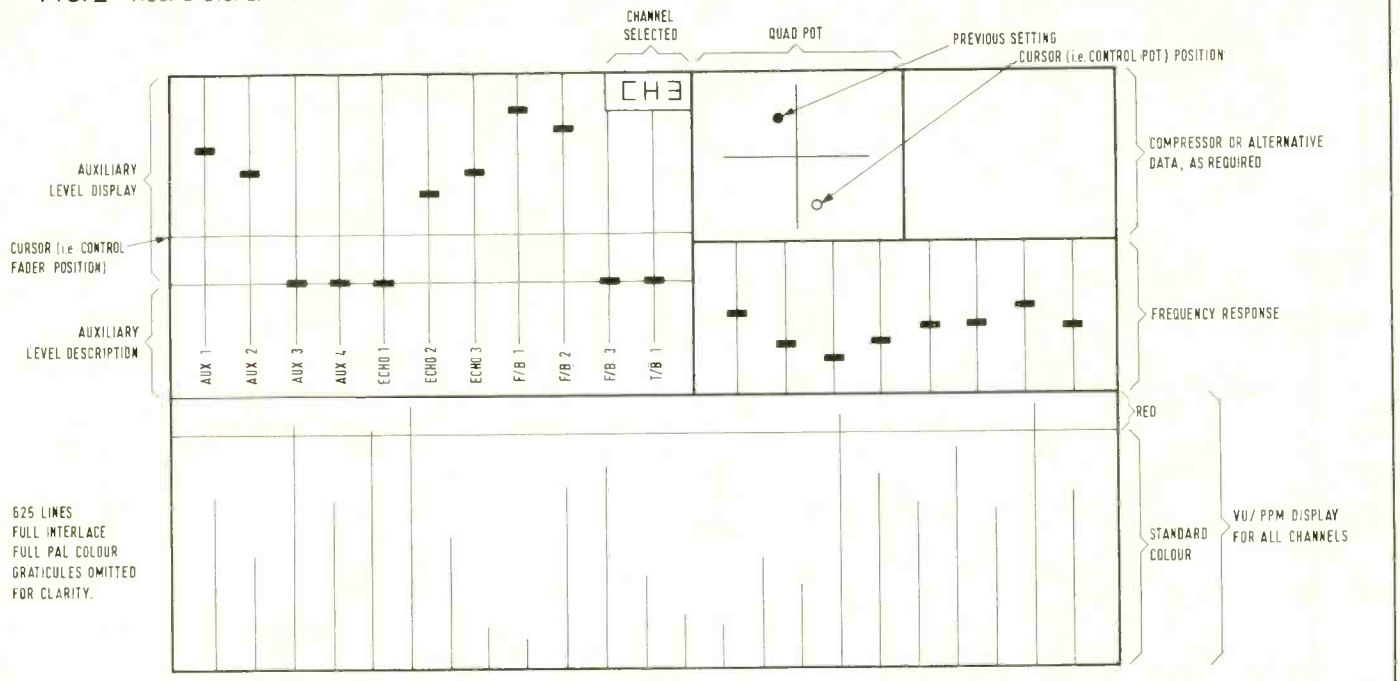
The arrangement shown in **fig. 3** is sufficient to control all functions at present associated with a large mixer, and because of its simplicity and compactness would doubtless lend itself to the further development that the size of present designs has tended to inhibit. The channel functions provided are as follows:

**1.** Channel select function. This selects the channel and its set of parameters, displays it on the screen and accesses the control store.

**2.** Type of control. This can be frequency response or, more particularly, the frequency

*Digital Timing Systems

FIG. 2 VISUAL DISPLAY UNIT




that is required to be adjusted; it may be auxiliary routing, or any other type of control such as pan or grouping.

Let us at this stage take some examples. Imagine making the following adjustments first on a conventional desk and then on the keyboard. 'Channel eight needs four stops of bass cut at 40 Hz.' On this digital system, all frequency adjustments are based on one 'graphic' equaliser per channel, which can be programmed to provide a variety of slopes. Indeed, there is here an obvious opportunity to revert to such simplicity (which, because of the cost of such modules in conventional sound format has tended to be obscured). With the convenience of switched equalisers we have tended to adapt to these and lose sight of the basic function. Each frequency point is allocated a number from one to eight, and is separated from its neighbour by an average of two octaves. The possibility of programming the digital processor for different slopes around a specified frequency means that one operation will provide a required characteristic. Contrast this with the operation of a conventional graphic whereby adjacent sliders must be adjusted to give the slope required, the actual slope (Q) of each tuned circuit being fixed.

The operation of the keyboard is as follows:

**CH 8** Monitor system selects channel eight output. Visual display unit (vdu) shows all data for channel eight.
**F2** 'F2' represents 40 Hz.
**—4** Minus four stops.
**Enter** Key inserts data into memory.

The new instructions are entered into channel eight memory, and the signal processing is automatically changed. In practice, channel eight could be allocated more than one memory, the contents of which could be switched alternately to channel eight audio circuits.

Take another example: 'Channel seven needs to be selected to auxiliary one. It is required prefade and the level needs to be critically set.'

**CH 7** Monitor system selects channel seven output. Vdu shows all data for channel seven.
**AUX 1 PRE** Set control fader to required level.
**Enter** Key inserts data into memory.

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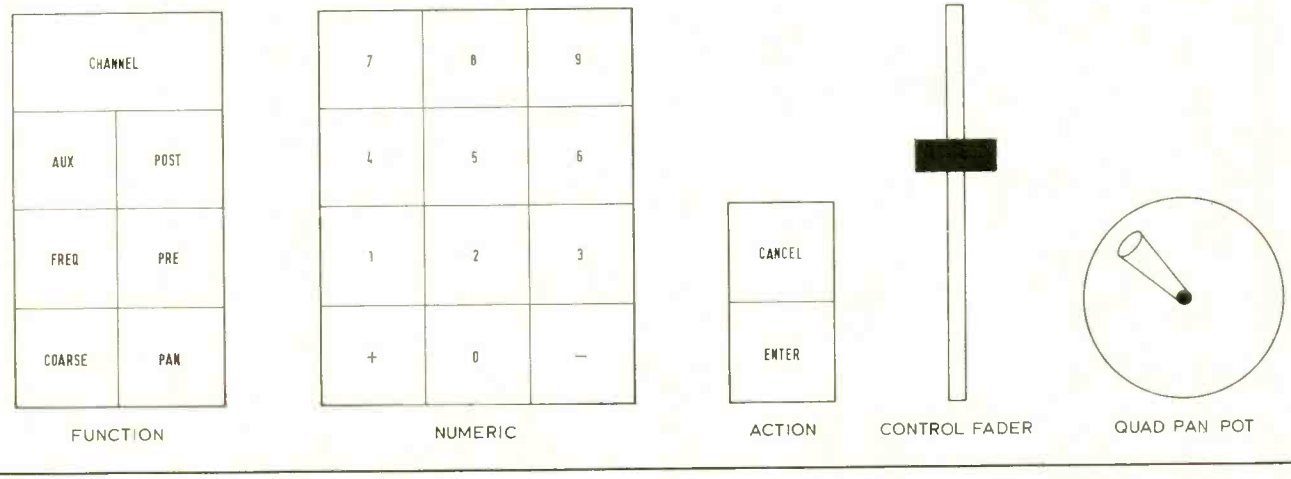
FIG. 3 SUITABLE KEYBOARD ARRANGEMENT



In practice the 'enter key' is incorporated in the master fader so that a pressure on the knob will enter the new data into the memory. Had channel seven already been selected to AUX 1:

**CH 7**
**AUX 1**
(Post-pre setting remains unchanged, if no further instructions.)

Set control fader to new level and press 'enter key'. Keep pressed in order to adjust level. Once released, the data is committed to the memory. To avoid sudden changes in level, the control fader can easily be arranged to take over control only when its cursor crosses the existing level.

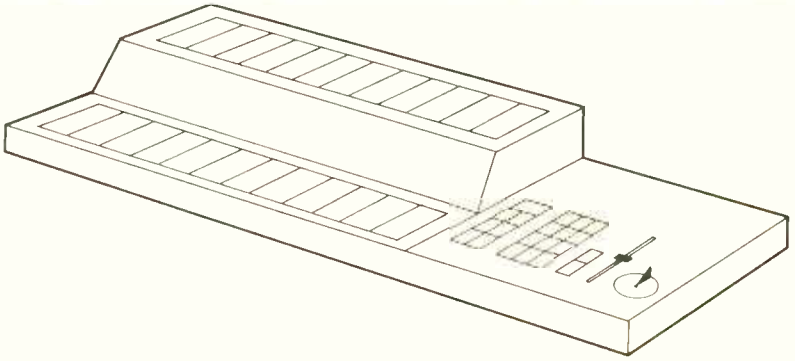
Coarse gain settings can be made in a very novel and interesting way by using the channel fader itself. With this approach the 'straight line' of faders can be achieved by pressing the 'coarse' button for each channel. Finer aspects of balance can lead on from there.

**CH 3**
**Coarse** The control fader will detect the fader position and adjust the coarse setting accordingly.

A keyboard, although providing a fast entering of data, is not necessarily a good control in a panic. There would be a place for a number of conventional 'contingency controls' for, say, auxiliaries feeding pa where there is a risk of sudden howl-round. These might take the form of an uncommitted bank of faders which may be allocated as the situation demands. The keyboard system I have described will, in this scheme, only be a part of what will literally be a computer.

On the semiconductor market there are now devices such as the Intel *8080* micro processor chip which can handle and store huge amounts of data, and as mentioned before this can apply to far more than just channel controls. At the present time, sound desk manufacturers build a large number of facilities into a desk to specification by their customer. In future, all instructions for specialised features, such as monitoring, talkback routing and telephone distort, will be stored within a single programmable 'read only' memory which will be permanently programmed on delivery. The natural sequal to this is the gradual disappearance of the cumbersome jack field. The space which was previously taken up by channel modules is now free to take scripts or music sheets; in short, the mixer begins to resemble a working table with a few attachments. There is even room for a second tier of faders so that the desk begins to look more like an organ.

FIG. 4 POSSIBLE MIXER ARRANGEMENT INCORPORATING KEYBOARD



At this point let us look more closely at the electronics of the system. The cable between the mixing point and the remote bay through which the analogue signals are channelled carries a digital code. This code is so designed that it can be recorded on magnetic tape, and the long-term storage possibilities that this opens out are enormous. At the same time, though, this advantage would be largely lost if manufacturers devised different codes only compatible with their own equipment. It would be helpful if firms involved in this kind of work can get together, without giving away trade secrets, to create a certain amount of common ground so that interfacing between different systems can be brought to a minimum or even in some cases eliminated altogether. The work done by the BBC and IBA in ensuring compatibility between their alpha-numeric data transmissions Ceefax and Oracle, is a good example of what can be done. There is also a fair amount of common digital language between computers of different manufacture especially with regard to data recorded on magnetic tape although the historical difficulties in this area directly parallel those under discussion. Tape is the very medium that now carries gain settings for automated mix-downs and will in future surely carry much more.

Let me give as an example the possible organisation of the data within our memory system. I mentioned earlier an eight-pin ic memory; the device I referred to is the *2506* dual 100 bit dynamic shift register. As can be seen below, the channel data can be organised into ten words of ten bits each.

There is plenty of room for expansion. The four bits in part one of each of the words give $2^4$ or 16 gain points. In the case of panning (words nine and ten, bits one to four) there are 16 left-right points and 16 back-front to choose from. The auxiliary 'words' contain five bits, and each thus gives 32 gain points. Each word is accompanied by a single bit to instruct on post or pre. The coarse gain has five bits which

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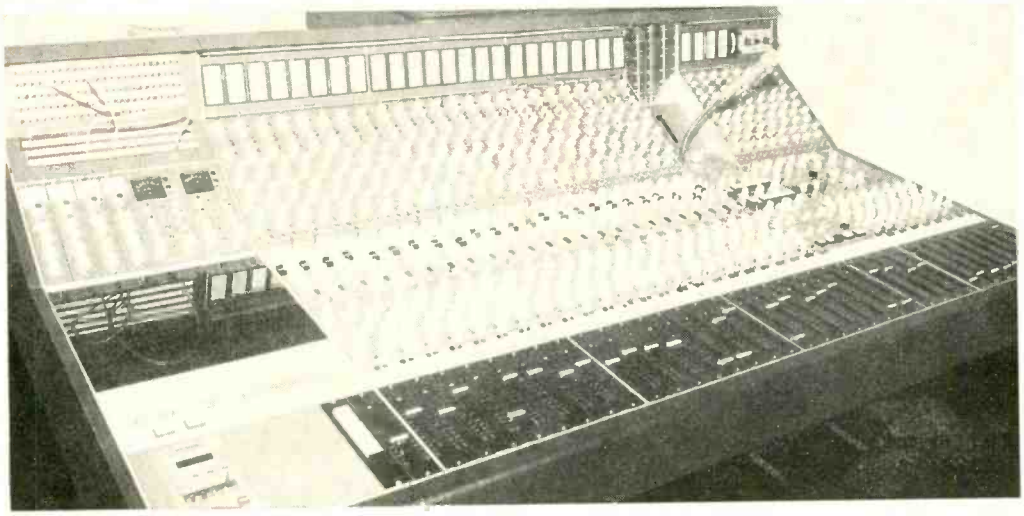
# CUSTOM CONSOLES BY HELIOS

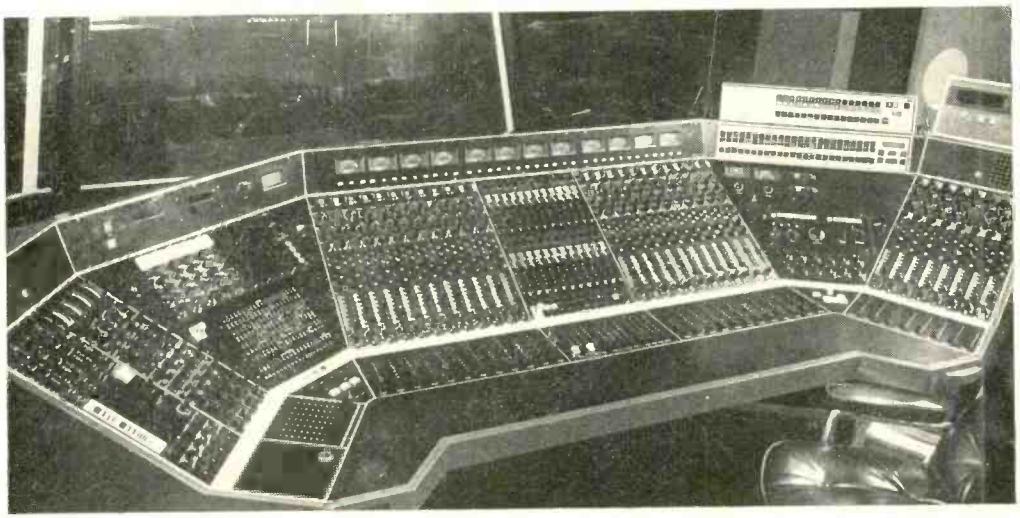


**Barbarossa Studio—Munich**

This compact 32 channel console for 24 track recording was designed and built to meet special operating requirements and control room space limitations. It is less than 2m long but has a sophisticated specification with parametric equalisation on all channels, comprehensive compressor/limiter/expanders, LED column main meters and yet is uncluttered and easy to operate.

**Island Studios—London**

This, the 5th console supplied to Island, has the now classic Helios wrap-around format affording easy access to all controls by one engineer with space for a producer to sit alongside, if required. 32 input channels are provided for 24 track recording with quad monitoring and quad mixdown. Some of the many features incorporated for Island include special equalisers, digital channel assignment display, and very comprehensive echo and foldback facilities.



**The Company:** is based on a team of enthusiastic engineers, many with backgrounds as balance engineers who have a totally flexible approach and the ability to put theory into practice. Now in its sixth year of operation, Helios has an international reputation for excellence with consoles installed in Africa, Europe, the U.S.A. and the West Indies.

**The Product:** sound control consoles for use in recording, broadcasting, film dubbing and top PA which are exactly right for their application, have "state of the art" performance and are eminently practical to operate.

**Your Choice:** buy a console you don't really want, pay a premium for "bells and whistles" you'll never use, or come to Helios and tell us what you need: the best is usually the most cost effective and certainly the most satisfying.

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*For an unfinished studio that hasn't yet opened, The Who's Rampart set up in Thessaly Street, Battersea, is doing very nicely, thank you.*

# Where, when what and why the who record

ADRIAN HOPE

**THE WHO CHANGE** their favourite pa system and their favourite recording studio like other people change their clothes. When they came off stage recently after a characteristically long, live set, someone from the press told Pete Townshend how great they had been. 'We weren't up to standard', grunted Townshend. 'Nonsense' said the pressman. 'You're too self-critical.' 'That's why we're still the best fxxxxxx rock 'n roll band in the world, replied Townshend.

They are the best band, they are self-critical and that's why they've tried out, been happy with, then moved on from just about every top recording studio (and PA system) in the world. Years ago when I interviewed Townshend, he told me that what he hated about most studios was being surrounded by little notices which exhorted musicians to 'Leave this studio as you would wish to find it' and issued pain of death warnings to artists, engineers and producers alike such as 'Do not on any account turn up this gain control more than half way'.

It was in 1972 that the Who told John Wolff (their long-suffering road sound manager) to go out and build them a private recording studio in London. Most of the group have something in the way of a home-grown set-up to record on (Townshend's is probably the best equipped) but none was large enough for full scale album recording. They gave Wolff £40 000 to play with and waited for the studio to appear.

'£350 000 later . . .' said bass-guitarist John Entwistle gesturing at the Rampart Studio as it now is. But actually it's cheap at the price and money well spent.

John Wolff was hunting round for a warehouse to store the Who's stage gear when he saw an advertisement for a Church Hall and Mission, St Andrew's, for sale in Battersea. He fixed an appointment to see the vicar and thought it was the Who's lucky day when he saw a brand new new building signposted 'St Andrew's' as he arrived.

"I'll buy it' said Wolff, pointing to the new Hall.

'Not likely' said the vicar. 'That's not the hall that's for sale. The St Andrew's you can have is round the corner.'

When Wolff saw the St. Andrew's that was on the market, all thoughts of it being the Who's lucky day were dispelled. A derelict building (put up in 1908 according to the foundation stone) complete with broken windows and leaky roof, it was empty except for an antique piano stool that now remains as a treasured relic in the studio that was finally built there. Wolff bought the hall (and ridiculously cheap it was by current prices) and used it as a warehouse for a short while.

The local council had no objection to the mission hall being used as a warehouse but when the idea of converting it into a recording studio was proposed, they took very unkindly to it—especially a studio owned by a group with the Who's reputation. Well it's not every band that declares its drummer as being overproof on duty free brandy when asked by the Customs if they have anything on which duty is due.

To cut a long story short, the local council did finally come round to the idea of St Andrew's becoming a recording studio and it seems that no-one has regretted the decision. The hall stands just off a housing estate opposite that is fast becoming the new Covent Garden market. The local kids are thrilled to have Rolls Royces parked in the street outside (session musicians will be pleased to know there are no parking meters yet) and there have been no broken windows since the double-glazing went in. The local shops and pub (especially the latter) aren't grumbling either about the increased business and when the housing estate had an open air carnival the Who lent some of their pa. I'll bet it was the loudest and highest-fi street gathering in the history of man.

And when some local children were injured in Thessaly Road itself, it was Keith Moon who dressed up as a lollipop man and rolled out a portable zebra crossing they'd had made specially to fit Thessaly Road. The event made the national papers and the council took action. But instead of providing a zebra crossing, they simply shut off half Thessaly Road. So now the studio is a little harder to get to but the local kids are a bit safer.

One of the reasons why the local council was originally reluctant to license the change of use from warehouse to recording studio was a vague suspicion that all manner of loud pop noises would be roaring out at all hours of the day and night. But as John Wolff pointed out to them, if sound can get out of a studio, it can also get in and we don't want your local noise on our recordings, do we? The soundproofing, in fact, was particularly important because the studio lies directly under the flight path into Heathrow. It's for this reason that there are plans to paint studio advertising slogans on the hall's flat roof for the benefit of record producers flying in from the USA, but that's another story. So also is the massive radio-controlled model helicopter which Roger Daltrey is building to fly off the roof (when he can get an English translation of the Japanese instructions that came with the kit).

Soundproofing proved to be less of a problem than at first seemed likely. The hall was built the way they don't build them any more, with 457 mm thick walls. The roof presented most of the problems, being V-shaped and thus providing all manner of unwanted sound reflections. A flat false ceiling did the trick, which then left a mass of triangular attic space up above for storage. The only problem was that the metal girders of the original roof got in the way. John Wolff was about to cut some of them away with a hack saw when he realised that the roof would then have slipped gracefully off down each side. So he built a catwalk over the girders instead. Perhaps a fitting opening ceremony for the studio will be for Keith Moon to cut through the girders instead of a white ribbon.

The studios and the control room are built out of what was the original main church hall. There was also a smaller hall, used in the building's heyday for weddings and such like, and this is now 'Reception' and a workshop. Upstairs, what was once a caretaker's flat, is now the office and a small kitchen and bathroom. The bathroom was briefly a sauna but pressure of space has put an end to that glorious luxury. Tape storage will be in the roof triangle once the catwalk is finished. When the wood panelling, which is going up everywhere, is also finished, it's all going to look very impressive. 'Quite apart from that,' said John

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Wolff with a grin, 'it'll make a nice blaze for the insurance if times get hard'.

He is joking of course, because already the studio is running 24 hours a day and making money. But this is not even what the studio was originally intended to do. The Who saw it as their own private place to record in when they wanted, as they wanted, and with whom they wanted. But as the original estimate of £40,000 started to look like pocket money, and the bill crept up over the quarter of a million mark, it became quite apparent that the only way the Who could have the kind of studio they wanted was to run it on a commercial basis. Already the Who's album *Quadrophenia* has been recorded there, as has the music for the soundtrack of the film *Tommy*. Chip Taylor, Joe Cocker, Spencer Davis, Bryan Ferry, and Sparks are among those who come in to make records and quite a few, even so far, have turned out to be hits. And although the studio isn't particularly large, they have had 40 strings in at one time. The *Tommy* soundtrack is being mixed there; the *Quadrophenia* album, however, was mostly mixed out at Pete Townshend's own studio at Goring. It started off as a quadraphonic recording but was never issued that way or even finally mixed into four channels. It is no secret that the Who are not inclined to waste unnecessary time mixing into four channels when it won't be issued that way on disc, not being endeared to any of the available systems. Wolff is also pretty cynical about the whole four-channel quadraphonic pantomime, feeling that either the *raison d'être* of four-channel is to produce ambience (which can be done perfectly well from two channels) or that the end product is confusion for the listener, who keeps turning round wondering why on earth someone is playing behind him. Of course it's all great fun if the mood takes the listener that way, but it's not exactly a way of hi-fi life.

'I found the best way to listen to quad is lying flat on my back in the middle of the floor', says Wolff. 'And there are limits to that as a social possibility.'

Although there is not much quadraphonic enthusiasm at Ramport, the control room is in fact completely quad capable. The desk was made by Dick Swettenham at Helios, and has 32 channels in and 24 out. There are four pairs of JBLs, one in each corner of the room for quadraphonic listening, with a bank of four single JBLs in centre front, and a pair of smaller JBLs at front left and right for checking at more domestic levels. For chucking at transistor radio levels (which after all is how most people listen to records) there are a couple of Eagle 12 cm speakers left and right on the desk.

The monitors first used were Lockwoods, the group and Wolff liking their generally warm sound. But they felt the Lockwoods could not handle the power levels that the Who sometimes want to use for monitoring or on playback so they bought the JBLs. But then with one JBL in each corner of the room they found the sounds a bit too bright. Hence the current set-up of a pair of JBLs in each corner, but with the HF horn of one JBL of each pair switched out. This way they get a warm sound like the Lockwood, but power providing anything up to 128 dBA in the centre of the control room. Normal top monitoring levels are around 120 dB. Just a passing thought but this puts the control room of the Who's studio at 24 dBA above the legal limit set by the Leeds Local Authority. To paraphrase the old song title 'There will never

be another Live at Leeds' album.

To pursue that passing thought for a while, although the Who are notoriously loud as a group, and Wolff has worked with them on the road for around a decade, he is obviously not obsessed with noise for the sake of noise. Neither, incidentally, was Entwistle, who while I wias there was remixing with fair restrain old Who tapes dating back to around 1963 for the forthcoming abum of previously unissued Who material (not illogically to be christened *Odds and Sods*), The tapes are mostly four-track masters made around 1963 at what was then the Fontana Studio at Marble Arch.

cope with 2 kW per double horn. The sound pressure level at the mouth can rise to around 140 dBA and although these will solve a lot of problems for groups like the Who that use around 4000W of stage amplification (Crown amplifiers and a Mavis desk from International Entertainment Services), such gear just has to be stacked high enough to project over the heads of the front score of rows of the audience.

Incidentally all the research work and text-books to date suggest that men like Wolff working regularly with high level sounds should be showing signs of permanent deafness by now, and it makes medical sense that they

walls. The control room is also panelled like a study and although the studio is panelled with sapele ply, the control room is clad with tougher wood to avoid rattles. The control room thas a fixed reverb time of around 1s and the ceiling is reputed to have been put up and taken down around 30 times before it was adjudged right. There is now a fairly wide area of reasonable listening (2m or so rather than a single quad seat) and everyone seems happy with the sound—for the time being at least. The Who, incidentally, like a pretty live studio sound and usually record with all the carpets up and out of the way and the reverb

Wolff has horrifying tales to tell of venues with odd acoustics, such as the Civic Auditorium, San Francisco, and the Town Hall, Sheffield, where sound traps exist, often under balconies. It is in these sound traps that heavy sound pressure levels can build up, even to the point of causing the listeners' ears to bleed. But Heaven help anyone in those traps if any irresponsible pop groups ever get hold of the Cerwin Vega horns which Wolff is currently wondering about using for the Who's live performances. The low frequency horns (handling frequencies up to 250 Hz and costing around $2 000 each), have 14.5 kg magnets that can

should. The confusing fact is that so far I've never yet encountered the problem face to face (even though I deliberately talk quietly to anyone normally involved in high level sounds to check their reactions).

The Ramport studio acoustics are adjustable between a reverb time of around 1.2s and 1.8s. This is achieved by the simple expedient of laying down or taking up carpet over the wood parquet floor. There were originally plans to automate this carpet laying, but in practice it could never have worked. The uncarpeted brightness of the studio is largely due to the floor and the wood panelling over most of the

time up at around 1.8.

Most of the electronics were put in by A. J. Watkins ('We were lucky and found him through the yellow pages', says Wolff) and for me one of the most interesting features of the studio is that all the power points offer either 240V 50 Hz, or 110V 60 Hz mains. This way, musicians from the States can plug straight in with no problems. Also, the studio is full of American equipment, most of which has been brought back from the States by Wolff after Who tours there.

'I was caught a couple of times bringing

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*A report on the International Broadcasting Convention, held at Grosvenor House, Park Lane, London W1 from September 23 to September 27.*

# IBC 1974

JOHN DWYER

**DEPENDING ON** point of view, this year's International Broadcasting Convention could be interpreted as either a last desperate burst of profligacy before the economic candle finally goes out, or as a gaudy but magnificent gesture of defiance which showed the entertainment industry's determination not to allow itself to be talked into recession.

Certainly the observer at IBC was confronted with a series of paradoxes, whether he was comparing the drizzle outside the Grosvenor House Hotel with the clammy artificial warmth within, or the decline in colour television sales in Britain's shops with the degree to which colour television was being promoted at the show, or the new attention to radio in British homes with the scarcity of such attention in Grosvenor House, or the imminence of world economic collapse, assumed to have been brought about by the Arabs and Joe Gormley, with the hotel's plushness and the number of exhibitors prepared to shell out for go-go dancers who must have been earning . . . well, a little more than a miner.

For the broadcasting industry and for a great many others this is the biggest British event of the year. Perhaps that is why the event had, at times, more the air of a motor show than that of a serious technological convention, as evidenced by the inability of some exhibitors to refrain from curious lapses of taste in demonstrating their equipment's superior reproduction of flesh tones.

Most exhibitors seemed to detect few effects of the economic situation on their order books. One of broadcasting's distinguishing features is that it is run in many cases with public money, and since the present economic situation has been described by Freedman and others as mainly attributable to governments' printing too much of that commodity it is not surprising that the broadcasting organisations that are state run have not felt the pinch too seriously.

One exhibitor expressed genuine bewilderment that things were going so well both for his own organisation and those of the other people he had spoken to: 'I just do not understand it. We've never had so much business. The electronics industry has never been in better shape and yet electronics shares are being clobbered just like all the others.'

Another exhibitor commented that there was little sign of any slackening off in orders, though he noticed that peripheral items, such as the odd spare compressor-limiter, were less objects of attention than they might have been at other times. Yet another said that people had told him they were interested in buying what he had to exhibit but that they would be unable to do so for periods varying from three months ahead upwards, depending on the cost of the item.

A number of firms announced orders during the show. Marconi sold two ob vans worth £½M to Czechoslovak TV, who now have five. They also sold £41 000 worth of transmitting equipment to the Lebanon, four *B6122* 250 kW transmitters to the BBC and one to the Qatar Ministry of Information. The BBC units will be used in Jamaica. Qatar had also ordered a substantial amount of colour camera equipment from Marconi.

Swiss broadcasting bought $330 000 worth of RCA colour telecine systems for its new tv centre near Lugano, to be operational in 1976. Link got business worth £2 000 000 from the BBC for an open university full colour mobile and eight cameras. Link Electronics' *110* colour cameras were shown for the first time at IBC. The mobile will also contain an RCA *TR61* vtr, Michael Cox mixer, Neve sound console and Prowest picture monitors.

Matthey sold its first VITS automatic video equaliser *2503* at IBC to an Australian tv station. Three Sydney firms bought a total of seven vtrs from RCA, all the *TR70C*, and another Sydney outfit bought a *TG61*. Prowest were awarded the contract to supply Singapore television studios with equipment worth £428 000 to convert the studios to colour. The latest contract is worth £92 000, adding to a previous contract worth £336 000. Radio Television Singapore also bought at least £200 000 worth of mobile from Link. The van will have a staff of up to 14 to operate six colour cameras, two Neve sound consoles, Microwave Associates dual microwave links, Thorn 20 channel lighting system, 19 Prowest picture monitors and an Aston character generator. The doubling up allows for the need to broadcast in any two of four languages at a time.

Roger Arnhoff's Studio in Norway has bought a £34 000 two-camera vehicle, again from Link. Cetec's CEC division has sold studio equipment worth over $400 000 to the Government of the Republic of Uganda, much of it made by another Cetec division, Sparta. Also southbound is equipment from Rank to Zaire through contractors Thompson CSF. New Zealand Broadcasting ordered three 16/4 Neve consoles and took an option on seven more. Neve has already sold them four *BCM10/2s*. Michael Cox will be sending 75 PAL coders to ABC Australia, bringing the total up to 400. Less firm but good news all the same was that Video Electronics received 200 enquiries for their *VEL* miniswitcher and minimixer units. EMI also did well, they say, with their new pattern generator, capable of 5 000 different patterns.

However, there were indications that things are not what they were. Among the exhibitors there were some absentees, big ones like Pye, Mullard, Schlumberger and Dolby who,

FIG. 1 2 SPEAKER PLAYBACK FOR ARTIFICIAL HEAD RECORDING

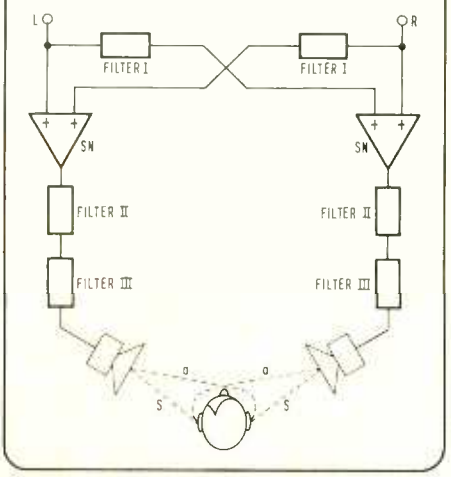
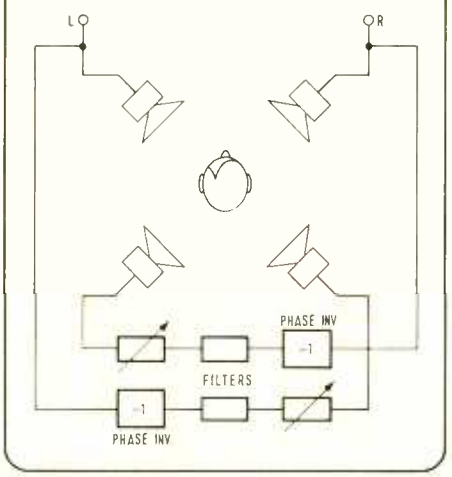



FIG. 2 4 SPEAKER PLAYBACK FOR ARTIFICIAL HEAD RECORDING



although they weren't there last time either, have just launched their broadcasting system. This year, as in '72, there were 61 exhibitors. The number of registrations was a record. In 1972 there were about 1 300 registrations, this year there were just over 2 000, although at least one character registered twice.

One exhibitor said that he noticed fewer parties of Russians and Japanese than in previous years. A check through the list of registrations revealed that there were some Japanese, a few Hungarians and Poles, dozens of Yugoslavs, but no Russians.

According to the Press office the stands were booked up months in advance, which indicates that if more space had been available the number of exhibitors would have increased in the same way as the number of delegates, despite the significant absentees. Perhaps, since space seems to be so restricted, it would be a good idea in future for exhibitors to be restricted to one stand each. An excellent example was set by Link, Prowest, Autocue and Neve, who together took two stands and staged a separate but merging show on the space—all in a prominent place and at lower cost to themselves.

Space does not, unfortunately, permit an account of the exhibition stand by stand. Just like the pre-election statistics we were being subjected to a few weeks ago, the number of exhibitors varies according to how you work out your arithmetic. IBC make it 64, but then they count the four Rank companies, who were all on one stand, separately, as they do the two French Thompson-CSF companies. There were also two Marconi companies. One organisation that was at IBC for the first time was the Guild of Television Cameramen, who were the first people you met as you came down the stairs.

The Guild also presented their first annual award, to W. Vinten Ltd. The function of the Guild is to recommend to manufacturers of television camera equipment changes that would improve the suitability of their products for the people who use them. For example, they published a recommended specification for the design of portable cameras which, they say, was drawn up 'by three of the most experienced users of hand-held or portable cameras in the UK. It does, therefore,' they continued, 'to a great extent represent a criticism of the current generation of this type of camera'. Strong stuff; we ought to have more of it in other areas, and we would have if some organisations weren't run largely by manufacturers. The Guild of Television Cameramen is not a trade union and has no ambitions in that direction. It is concerned solely with providing feedback to makers from users. Considering it was only formed in 1972 it's doing remarkably well and they say that its presence at IBC '74 has been useful in establishing new contacts with manufacturers. Their membership is currently around 200.

The award was made to Vinten's for their Fulmar camera pedestal. Vinten say sales of the Fulmar in the last two years have paproached £300 000. Vinten also had two new types of pedestal on show, the Kestrel and the Petrel.

The booby prize, in more senses than one, goes to Prowest etc for saying it had something to announce at a press conference to be held at 4.00 pm sharp and hadn't started by ten past. When things began to move it turned out that any announcement would have to wait until she stopped moving, and there was at least one pressman there who decided that lust would have to give way to productivity; one advantage of these things is that they leave the other stands free of jerk-happy delegates.

**Above:** *Ferrograph's new pro machine*

**Below:** *IBA's Oracle display*

**Below:** *Studer mixing desk*


Interesting items from the other stands were the Pearl *CL3B* tieclip microphone that really looks like a tie clip; the Scully Metrotech pipe and cable locator—the EECO SMPTE edit code system; Tektronix vision mixer; the UREI Sonipulse acoustic analyser; the Studer fully quad desk; the Ferrograph professional machine (of course); Audix's studio consoles (at least they look a little different); Ballancroft's soft lighting; Aston's new character generator; ITT's new Klystron (no Chilean parts); Spotmaster's *330* record/replay stereo three deck cartridge machine; Marconi's automatic tv transmitter monitoring system; Stromberg of Finland's Novalit custom-built lighting control units; the EDS portoprompt, which was developed with the BBC from the 3M overhead projector—it has foot-hand speed control and costs £400; Sparta's CCIR/IEC stereo tape cartridge machine and Centurion 2 stereo/mono compatible 8/12 channel console; Telemation's Plumbicon telecine unit; EIL's caption colouriser which can derive colour captions from a monochrome camera; Decca's distribution exchange system; Barco's CTVM, of which there were 72 scattered round the exhibition; the amazing Marconi vision mixer with digital pattern generator—a paper was presentedon this; RCA's portable VTR; EMI's *7100* special effects generator; Thorn lighting's Q-file *2000;* IVC's editing recorder and control system; Evershed's control systems for news and presentation cameras; Ampex's new *AVR2* videotaperecorder—a helical scan machine with digital timebase correction; Neve's Kelso 10/2 radio broadcast desk.

The most significant development at this year's IBC was the introduction of the digital display systems, Ceefax and Oracle, developed jointly by the BBC and IBA. Remark of the month must go to a gentleman on the IBA stand who, when asked what the difference was between Ceefax and Oracle (rather like asking what the difference is between an IBA and a BBC picture) replied: 'Well, ours is in colour for a start'. Ask a silly question . . . Of course the two systems had to be developed jointly, otherwise the viewer who wished to receive the information would be in a similar position to a man having to use one tv set for ITV and another for BBC programmes. The pages of information are transmitted during the field blanking periods of a normal transmission.

A paper has been published jointly by the BBC, the IBA and the British Radio Equipment Manufacturers' Association specifying the standards for the system. Up to 100 pages of information can be transmitted on each channel and each page can take 24 rows of up to 40 characters a row. The digital pulses required to transmit the system are added at a clock pulse frequency of 6.9375 MHz to lines 17 and 18 in one field blanking period and 330 and 331 in the next. Each line contains the information for one row of the Ceefax/Oracle display. There are 50 fields a second and two rows are trans-

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mitted per field so 100 rows can be transmitted a second, so it takes 0.24s to transmit a full page of 24 rows.

Up to 100 pages can be transmitted in a 'magazine'. Up to eight magazines can be accommodated. Pages can be used in three ways: singly, with continual updating, as for news headlines; as rotating pages, in which a sequence of pages is allowed to remain on the screen for a minute, after which they are followed by the next page in the sequence; or a page may carry information which does not need frequent updating and might only be transmitted once a day, in which case the viewer preselects such a page and the page is stored for viewing at a later time. The system could also be used to superimpose subtitles on to the normal television programme, a facility which could be used by a deaf viewer or those who wish to have foreign language subtitles.

The development is one of the most exciting for years. Its development was first announced by the BBC in October 1972 and test transmissions began the following March. Earlier this year a new unified standard was agreed between the IBA, the BBC and BREMA and first transmissions using that system began on May 24 this year. Demonstrations and launches followed at the EBU Conference and various provincial centres and, on September 18, 1974, the government said they would allow a two-year series of experimental broadcasts. In a rather strangely worded statement issued on the first day of the International Broadcasting Convention the BBC said: 'A Home Office announcement says the purpose of the experiment is to enable an assessment to be made of the demand for a Ceefax service, to determine what form it should take, and to estimate the scope for the manufacturers of the equipment'. The Ministry of Posts and Telecommunications is now part of the Home Office.

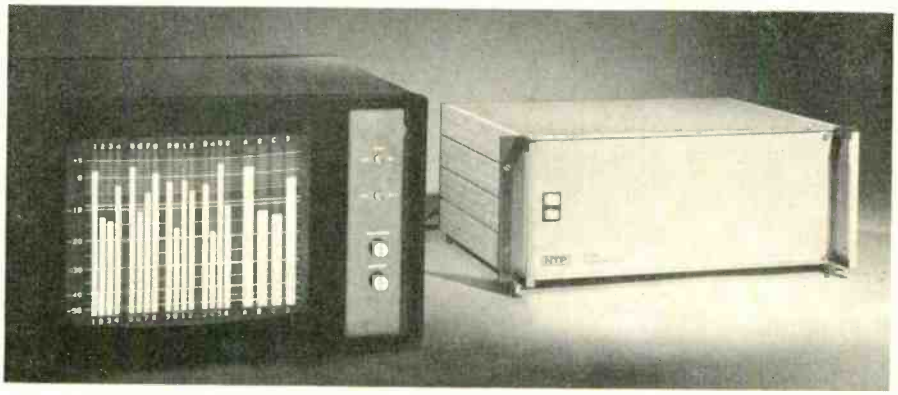
A paper on the unified system was presented during the technical sessions by P. Rainger of the BBC and W. N. Anderson of the IBA, and another by B. S. Barnaby of GEC and G. O. Crowther of Mullard. A problem cropped up in the latter paper in that the authors tried to avoid the use of the words Ceefax and Oracle in order to be seen to favour neither system, preferring the use of the word Teledata instead. It subsequently turned out that this was a registered trade name and someone was small-minded enough to complain to the programme committee about its use.

Considerable attention was paid to digital techniques this year. Of the 45 papers about a dozen were concerned with some form of digital control, transmission or display device or application. Two of the sessions concerned quadraphony, two papers being presented on quad, one on artificial head stereo and a discussion session being chaired on Thursday afternoon, about which more in a moment.

The digital papers concerned such things as digital pattern generation, telecine control by frame counting and a memory unit, digital techniques in television waveform generation, video analogue to digital conversion, digital transmission of colour signals, video bit-rate reduction by pcm, digital sound links, digital fields store television standards convertor, digital tv recording and digital time base correction. The BBC's digital television

**Left:** *The latest BBC television outside broadcast for Open University which has been designed and built by Link Electronics. The vehicle is part of the Open University's plans to go over to full colour and is engineered to a complete colour television studio and control room facility.*

**Below:** *NTP multichannel display, 24 inputs and four master channels.*



recorder, by the way, uses 42 tracks on 25 mm tape. It operates as a data recorder, travelling at 29 cm/s. The BBC Designs Department Liaison Unit has published an excellent short summary of the uses, advantages and disadvantages of digital techniques in various broadcasting operations in a handout called Digital Equipment in Broadcasting.

The other major digital equipment to be seen was the IBA's Digital Inter-Continental Conversion Equipment (DICE), which was developed last year by IBA research engineer John Baldwin, who won a Royal Television Society Award for the work. The latest version, occupying two 2m racks, converts 525 line NTSC colour tv signals at 30 pictures a second to 625 line, 25 pictures a second colour separation signals which are then converted to PAL or SECAM in an analogue encoder. The IBA say the new process is 'to all intents and purposes free of distortion'. The converter is bi-directional and is provided with a picture freeze switch.

Four channel sound seems as much of a damp squib as ever, though it seems to be keeping some people amused. The discussion session near the end of the week was almost brought to a standstill when after a long discussion during which the assembled engineers seemed to adopt seriously the proposition that producers should not expect to reproduce sounds from the sides, someone got up and said that any system restricting the producer in such a fashion would be unsatisfactory. The silence was deafening, and the chairman got out of the situation by announcing a teabreak.

At four o'clock on Monday Mr E. M. Tingley of the United States' National Quadraphonic Radio Committee told delegates something about the committee's work. The NQRC has to report to the FCC on the seven quad systems which have been put forward by five companies. 'Early publication of the results in a technical journal in advance of the report to the FCC is anticipated.' Closed circuit tests have been finished and on-air tests are now being conducted. Note that the seven systems represent means of encoding four channels for broadcast, and are not related to the disc matrix systems. What the systems have in common is that there is a second subchannel broadcast in quadrature with the suppressed subcarrier that carries the stereo difference signal and the differences between the systems lie in whether there is a fourth channel, how it is treated, and whether subsidiary information such as that used for Musak distribution or talking books for the blind can be transmitted. No details of the tests emerged during the paper other than the way in which the tests were conducted.

Artificial head techniques have aroused considerable interest of late, particularly since Sennheiser released their two demonstration discs. Mr D. Stahl of RIAS Berlin presented a paper immediately after E. M. Tingley's entitled 'Artificial Head Stereophony—First Application in Broadcasting'. He said that dummy head recording has been rediscovered partly because engineers began to experiment with truly ear-like and head-like structures in which to mount their recording apparatus. Since then they have discovered that artificial head recording (AHR) offers the following advantages: sounds are outside the head; various distances from the head varying from a few cm to 100 cm are reproduced correctly; timbre corresponds to distance from sound source; there is natural reverberation; sounds

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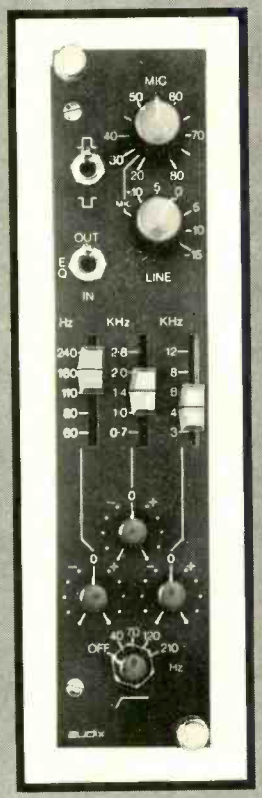


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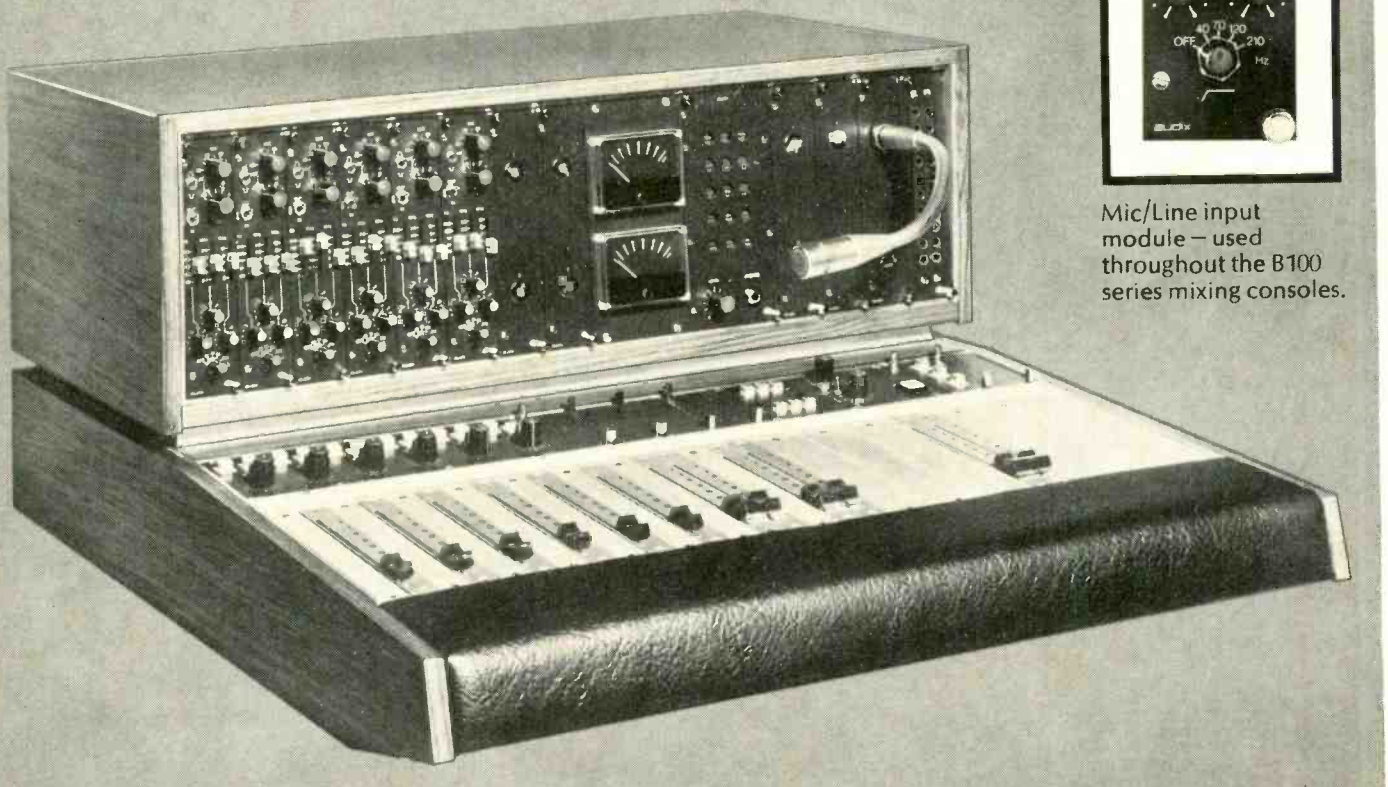

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## THE WHO

stuff in unannounced' admits Wolff. 'But now I've gone straight and have a good relationship with the Customs.'

Along with EMT plates, there are both Dolby and DBX noise reduction systems, Eventide digital delay and phasers, Teletronix levelling amps and Universal Audio limiters. The studio is kitted out with Ludwig drums, Ludwig tymps and vibes, along with a marimba, Fender organ, Hammond and more or less anything else American you can think of.

'Pete Townshend's forbidden me ever to go in Manny's music store in New York again' bemoans Wolff.

There is method in the apparent madness of bringing in both electronic gear (such as a whole range of Gain Brain and Kepex modules) and musical instruments direct from the States. First of all it is cheaper to bring them in direct and pay one-off duty; moreover it is quicker, especially when Wolff tours there with the Who anyway. And the point of having masses of USA gear in the first place is that the Battersea studio becomes compatible with USA studios. Many of the artists and producers using the studio (including some of the Motown artists) for overdubbings and mixings are using tapes that have been recorded in the States using USA studio equipment. Obviously any British studio that can offer equivalent musical and electronic gear for matching sounds is in the one-up position.

Just for the record, the tape machines used are four Studers, one 16-track and three 6.25 machines. There is also a 3M 24-track. The power amps used are home grown 500W jobs put together by A. J. Watkins (and christened Rams) to replace SAEs which showed some problems, largely due to the unavailability of spares and servicing in this country. That of course is one problem with bringing in USA equipment on a one-off basis, and worth bearing in mind for anyone tempted to emulate Wolff's magpie tendencies. His full title, incidentally, is Studio Director, with John Janssen (JJ), Cyrano and Anton Mathews as full time assistants. Janssen is ex-Record Plant and Electric Lady Land in the States, and Mathews ie ex-Olympic. Maintenance is by Gerry Leitch, who also just for the record happens to be Donovan's brother.

Despite all this and more (a piano booth with an Imperial Bösendorfer, with the extension at the bass end which is something of a rarity) the studio doesn't really have a name yet. 'Ramport' is the Who group holding company and it seemed logical to call the studio Ramport until a final name was decided. When it all still looked like something out of a Hammer horror film there were moves afoot to call it 'Thessaly Mansions'. When the *Tommy* recordings were under way and food and drink was on tap 24 hours a day, there was a move to call it 'The Kitchen'. Battersea Dogs Home is round the corner, which presented a few ideas, and Battersea Power Station is just over the road, which made someone suggest that Battersea Power might make a good name. The trouble is that everyone now knows the studio as Ramport and so Ramport it is. A few musicians who have never been there have written it off as too far out of central London to be usable for sessions, but actually it's no more than ten minutes from the West End—across Chelsea Bridge, first left and first right.

When the vicar sold Wolff the hall he told him there were two things that couldn't be done.

'You can't call it St Andrews' he said 'and you can't pray in it.'

I don't think anyone has any serious intention of doing either, and apart from one bit of excitement on New Year's Eve, when the boiler blew up and burst the gas main, there have been no supernatural occurrences. Unless of course you count the incident when a water pipe burst and flooded the control room while Ken Russell was in there helping mix down the 'Watery' sequence of *Tommy*.

The Who has something of a reputation for wrecking studios, not to mention hotel rooms, and if any building can contain them, it looks like being an ex-mission hall with two feet thick walls that has survived two world wars.

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## IBC 1974

can be correctly attributed to any direction in three dimensions; the original sound field is reproduced.

Interestingly, Mr Stahl said that any type of headphone having a flat frequency response would be suitable for reproducing signals recorded by AHR. There is a problem with some listeners in that they think the sound is coming from a greater elevation than is in fact the case. Some correction has to be applied for the fact that the sound has travelled through two frequency dependent auditory canals, that of the dummy head during recording and that of the listener during replay. An inverse frequency characteristic filter has to be introduced so that the effect does not introduce distortions in the sound.

A further refinement would be that as the listener turns his head the sound image through his headphones will be swung in the opposite direction.

The crucial question, of course, is what happens when the listener wants to use loudspeakers. Two important things here are that the acoustics of the listening room will be superimposed on those of the recording room and that each of the two signals will reach both the listener's ears.

There is nothing to be done about the first effect and the second introduces crosstalk. 'Filter III is needed to eliminate the frequency dependent transmission function s(ω) between the loudspeaker and the corresponding ear. By means of the filter I . . . the signal which travels from the lefthand loudspeaker to the right ear is also fed to the right ear from the righthand loudspeaker but with opposite sign, so that the unwanted crosstalk signal at the right ear is also cancelled. However the compensated signal also arrives at the left ear. To avoid this, filter II is inserted. Moreover at several places delay lines have to be incorporated into the filters (**fig. 1**). The amount of electronic equipment required for the two loudspeaker arrangement is considerable.' It's can be used to reduce the cost. Limitations are that the reverberation time of the listening room has to be low, and sound sources originally close to the recording head cannot be accurately reproduced.

The four loudspeaker system is as shown in **fig. 2**. The two rear speakers are fed by signals out of phase with the front signals and filtered to account for the shadowing effect of the head. No delays are necessary 'because the signal is delayed when it travels from the rear speaker to the ear of the listener'. Stahl said that the arrangement remains satisfactory even when the listener moves from the central listening area: 'The actual directions of sound incidence are changed but the special (sic) impression is maintained even over a large margin'. The system has the additional advantage that, after paying for the two extra speakers, the additional circuitry is cheap.

RIAS Berlin produced a play using the system which was broadcast first at the Radio Exhibition in September 1973 and then by all the other German radio stations. It seems that 98 per cent of the listeners' letters and telephone calls received after the broadcast were favourable. Eighty-five per cent said they were prepared to use headphones for this kind of programme—Germans have bought over 5M sets of headphones over the years. Music critics have been a great deal more sceptical, according to Mr Stahl, and although many German radio stations are now producing dramas using the new technique there has yet to be transmitted a music programme. This is strange when you consider that, when Sansui demonstrated their matrix at a hotel in London some time ago, the BBC engineers present were favourably impressed by the system until the drama section of the tape came up. Many regard drama as one of the most difficult programme items to reproduce satisfactorily.

The organisers are to be congratulated on making all the papers presented at the Convention available in a single bound volume. It is not hard to bring to mind other events at which this would be an advantage. The previous papers, from IBC '72, are also available from the IEE's publication Sales Department, IEE, Station House, 70 Nightingale Road, Hitchin, Herts SG5 1RJ, England. IBC '72 papers are IEE conference publication 88, and IBC '74 papers are conference publication 119.

The organisers of IBC, which was sponsored by the Electronic Engineering Association, the Institution of Electrical Engineers, the Institute of Electrical and Electronics Engineers, the Institution of Electronic and Radio Engineers, the Royal Television Society and the Society of Motion Picture and Television Engineers, have already announced the dates of the next IBC, which will take place from September 20 to 24, 1976.

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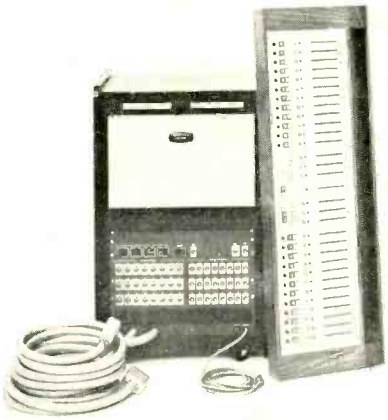
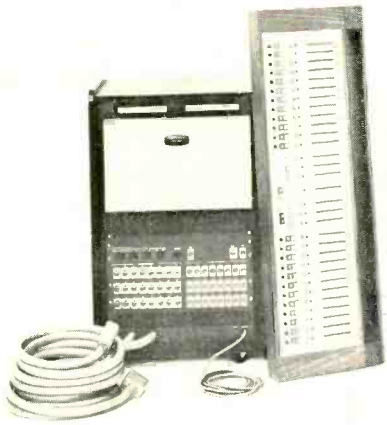


A&M Records
Hollywood



Jack Clement Recording
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Neil Young Studios
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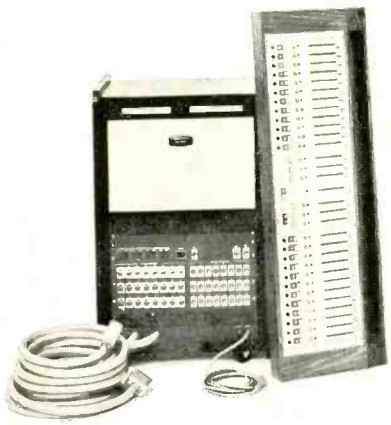

King Records
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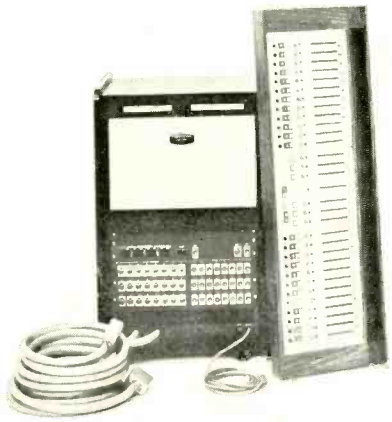

Sound Labs
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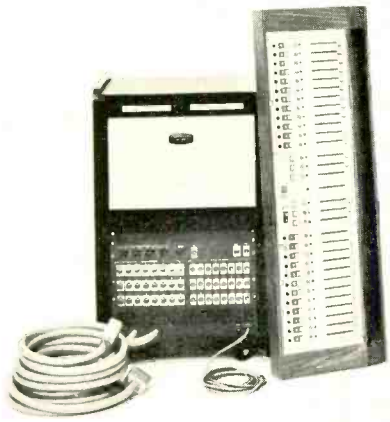

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*A disadvantage of multimicrophone recording technique is that it usually gives stereo images that are only heard correctly by people sitting in the 'stereo seat'. This means that a producer can be assured with a high degree of confidence that most consumers having good stereo equipment will not hear the mixdown with the intended stereo effect. In many circumstances, a recording can be made or modified to have a stable stereo image that may be heard even by a very off-centre listener.*

# Stabilising stereo images

MICHAEL GERZON

**MANY READERS WILL** recall the brief battle in the pages of *Studio Sound* in early 1971 between multitrack technique (defended by Bob Auger) and coincident microphone technique (defended by the present writer). That controversy was entirely concerned with classical music, and clearly a high proportion of musical effects desired in pop cannot conceivably be obtained with any sort of purist technique. Nonetheless, the creative flexibility of multitrack is bought at the expense of sacrificing certain desirable qualities of sound; as always in technical matters, one never gets something for nothing. It is worthwhile reviewing some of these losses, as they are not always understood by engineers. This analysis of defects of multimic is not in the nature of a dirge to the effect that all who dabble therein are damned, but to offer constructive comments and suggestions as to how some of these technical defects can be cured. For too long, recording has been considered as purely an art, and its science, its systematic principles, need to be presented.

Consider a Blumlein pair, a crossed coincident pair of figure-of-eight microphones angled 90° apart (see **fig. 1a**). Suppose that a relatively distant sound is picked up from 22½° left of front as illustrated. Then, even presuming that the microphones are *precisely* coincident and that their polar diagrams are accurate, the direct sound is picked up in the stereo image in a fashion identical to a mono sound fed to a panpot set to half-left (**fig. 1b**). This illustrates that coincident microphone recordings and panpot recordings differ technically in only one way, namely that coincident microphones also panpot the reverberation and reflected sounds in a precisely defined fashion. As far as direct sounds are concerned, and assuming a 'perfect' multimic balance, the two techniques are identical.

Yet when one performs a comparison between a Blumlein and a multimic recording, one is struck by their essentially different behaviour in the listening room. We may enumerate several points of difference. Musical lines balanced very quietly relative to others playing at the same time are almost inaudible and impossible to follow in multimic (a fact that all good balance engineers learn to cope with with great skill), whereas such a line remains clearly audible through the others in a Blumlein recording. The quiet passages of a multimic recording tend to be obliterated by high noise levels in the listening room, whereas corresponding quiet Blumlein passages can still be followed by the listener. The differing spatial positions of closely spaced artists are clearly separated in a Blumlein recording, whereas sounds panpotted so closely together are often indistinguishable in position. One can judge the relative distances of different sounds in Blumlein recordings with almost the same accuracy as one can live, whereas this information can rarely be simulated convincingly in multimic. Lastly, and very importantly, stereo images stay stable and well-centred with Blumlein recordings for most listening positions, whereas multimic recordings tend to hug the nearest speaker away from the stereo seat.

This list of properties of Blumlein recordings is certainly impressive, but we must warn the reader of certain provisos. We require that the recording be made with a crossed pair of figure-of-eights angled between 85° and 90° apart, and suppose that microphones with reasonably accurate figure-of-eight polar diagrams are used. As we shall see, the benefits listed cannot be obtained with arbitrary coincident techniques—coincidence is not of itself a magic prescription of goodness as some of its more dogmatic proponents would suggest. We also suppose that reproduction is via speakers with a particularly good phase response at mid frequencies (such as Quads or Tannoys), as poor phase response tends to mangle the effect of reverberation. (We note in passing that many cheap single unit speakers are good in mid frequency phase behaviour, leading to the apparent paradox that the cheapest equipment can sometimes give superior stereo effect over some of the most expensive equipment.)

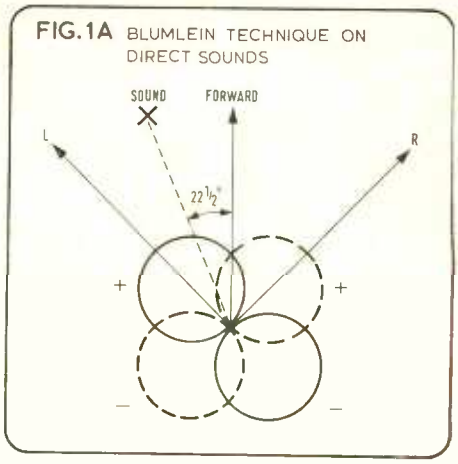
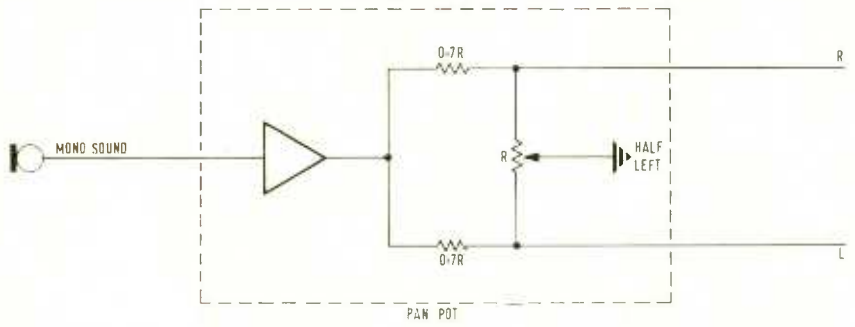


FIG. 1A BLUMLEIN TECHNIQUE ON DIRECT SOUNDS

The fact that the 'magic' properties of Blumlein recordings are solely due to their handling of reverberation is easy to demonstrate. I have heard Blumlein recordings made in the open air in the middle of fields (with windshields!) and these non-reverberant recordings are as unstable in their stereo effect as any panpot recording.

Having established that certain types of stereo reverberation can lock and stabilise stereo images, the next thing is to enquire what properties of the reverberation are being used by the ears to produce this effect. Once we have this knowledge, we can try and recreate the same advantages artificially on multimic recordings. We are handicapped first of all by the fact that we really have no understanding whatsoever of how the ear uses the directional qualities of reverberation, even though this was the whole *raison d'être* for stereo in the early days (1930-1958) when much research on directional hearing was done. This ignorance becomes somewhat less surprising when one asks oneself how on earth one would conduct experiments to isolate the effect on the ears of reverberation with various controlled directional characteristics. We simply cannot provide a listener with such controlled reverberations for two good reasons. We cannot set up a simulation of very complex multidirectional reverberation outside of the most sophisticated computers at great expense or reproduce it without literally millions of amplifiers and speakers. Neither can we take a very complex spatial pattern of reverberation

FIG. 1B BLUMLEIN TECHNIQUE ACTS AS A PANPOT ON DIRECT SOUNDS




and characterise it by a few parameters. It is clearly necessary to be able to give a *simple* description of reverberation's essential properties if we are to study the effect of varying these in a small number of experiments!

Having pleaded profound ignorance, there is a way in which the effect of the directional properties of reverberation can be studied. This is to take recordings of a known reverberant room using various stereo microphone techniques, and to use mathematical analysis to compute the theoretical directional distribution of reverberation energy within the stereo recording. One can then attempt to correlate this distribution of reverberation with the subjective reactions of the listener.

A problem arises in computing the theoretical distribution of reverberation energy for stereo recordings. The computations themselves are somewhat lengthy but quite feasible, but in order to know how much of the reverberation energy lies between two given reproduced directions, one also has to know the precise apparent reproduced direction of a sound recorded in each panpot location in a stereo image. Strange to relate, given the billion dollar nature of the stereo industry's turnover, there is no agreement as to what the reproduced direction is of a sound recorded so many dB up on one channel relative to the other channel. Different experimenters get wildly differing answers (see ref. 1).

For this reason, we shall not describe the apparent distribution of reverberation energy versus direction for various types of stereo recording. Instead we shall describe the distribution of reverberation energy versus the direction of stylus motion. Each position within a stereo recording corresponds to a direction of motion of a stylus tracing a gramophone record of that recording. A front centre sound (see **fig. 2**) corresponds to a stylus motion that is horizontal, a sound on the left channel causes a stylus motion 45° above horizontal, an out-of-phase sound causes a stylus motion 90° above horizontal (or −90°), and a right-channel sound corresponds to a motion −45° from horizontal.

The computed distributions of reverberation versus direction of stylus motion for various coincident microphone techniques are shown in figs 3, 4 and 5. These results were first reported in ref. 2. **Fig. 3** shows the distribution of reverberation energy for crossed pairs of figures-of-eights, angled apart by 120°, 90° and 60°. **Fig. 4** shows the distribution of reverberation energy in a stereo recording made with MS technique using a cardioid for the M signal. The three curves given correspond to different S gains, corresponding to an acceptance angle (ie the angle around the microphone between a sound picked up only on the left mic and a sound picked up only on the right mic) of 90°, 141° and 180°. **Fig. 5** shows the reverberation energy distribution of angled cardioid microphones for intermicrophone angles of 180°, 120° and 90°. Note that, as is to be expected, cardioids pick up no reverberation that is out-of-phase. All these curves show the reverb energy in arbitrary units, and assume that the microphones are coincident (by which we do *not* mean spaced 20 cm apart!).

Now the interesting thing about these curves is this: the best stereo image stability and sense of distance behind the loudspeakers is always obtained if the reverberation distribution curve of the microphone technique is as flat as possible. Thus the pure Blumlein technique (90° angled figure-of-eights) as in the centre curve of **fig. 3** is particularly good in this regard. The MS technique using cardioid M and an acceptance angle of 140° (central curve of **fig. 4**) is also pretty flat for in-phase positions, and gives the best image stability and depth

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FIG. 2 STYLUS MOTIONS FOR VARIOUS STEREO POSITIONS

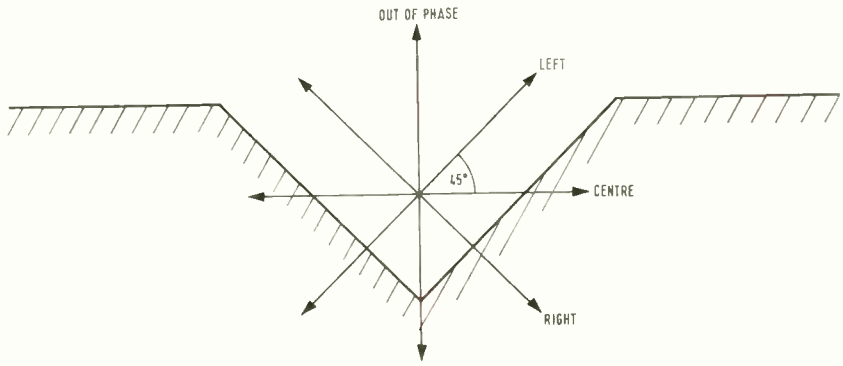
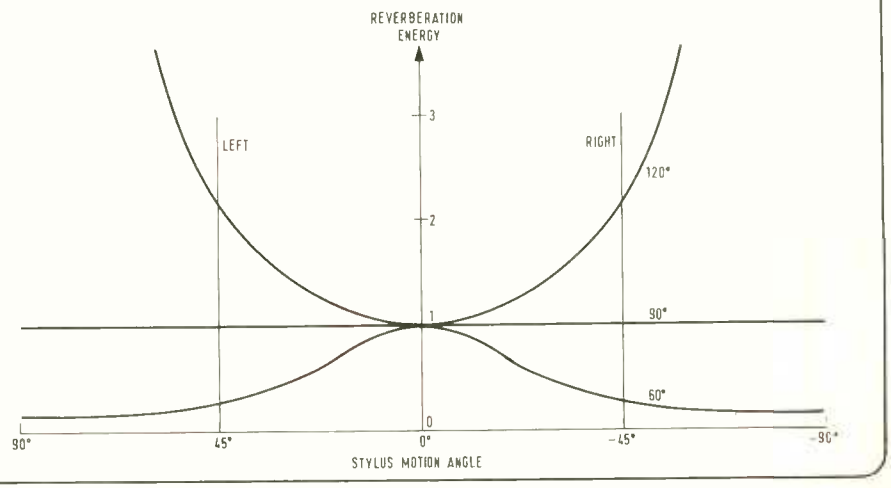



FIG. 3 FIGURE-OF-EIGHT REVERBERATION DISTRIBUTION



## STEREO IMAGES

for MS techniques, although the stability is not as good as pure Blumlein technique. 120° angled cardioids have the flattest reverb distribution curve available for cardioids (see **fig. 5**) and so is the best behaved cardioid technique (which agrees with some BBC findings).

On the other hand, if reverberation distributions occur which are somewhat emphasised at the edges and the out-of-phase positions (top curves in figs 3, 4 and 5), then the reverb tends to be concentrated at two 'pools' near the two loudspeakers, leaving a nasty hole in the middle with poor image stability. Conversely, if a somewhat centre-biased reverb distribution occurs (lower curves in figs 3, 4 and 5), then the sound tends to be somewhat 'close' and mono-ish. In practice, it is found that the optimal reverb distribution is fairly critical; an error in the difference gain of about $\pm 1$ dB being the maximum before the advantages of optimal reverb start disappearing. Thus it is hardly surprising that there is so much disagreement about the merits of coincident microphone technique, and it must be considered the hand of a smiling providence that the 'standard' Blumlein technique, recommended by Blumlein in 1931 (see ref. 3) happens to be optimal in stereo stability and accuracy of stereo positioning in depth as well as width (see **fig. 6**). Indeed, the surviving first-ever experimental disc of Blumlein using this technique from the early thirties is distinguished by a quality of stereo imaging that most modern recordings cannot rival.

Presumably other factors besides reverb distribution come into play, but at present we have only the most rudimentary idea of the role of such factors as the delay and direction of arrival of the first few initial reflection. We know that they are of some importance, but not much else.

We can clearly get the advantages of Blumlein technique in multitrack work by using Blumlein technique for laying down individual stereo 'tracks', and where this is practical (eg for a folk singer with guitar only, or for a backing chorus that would in any case be mixed down to one or two tracks) it is in fact a good idea. Blumlein technique, however, does not take kindly to subsequent processing (artificial reverb, compression) or to mixing with spot mics trained on the *same* group of musicians at the same time. Also, Blumlein technique requires at least a tolerable quality of acoustic. Naturally, to take advantage of reflected sounds, the Blumlein mics should not be placed *very* close. Those who have tried Blumlein technique in multimic work under these conditions report that indeed most of the claimed advantages are realised, namely the ability to hear 'inner lines' very well to obtain a wide internal dynamics, and improved stereo imaging and stability.

Using Blumlein technique is often impractical in multitrack work because of the need for processing, good separation, poor studio acoustics or the lack of a 48 track recorder. So we now describe a technique for adding artificially many of the advantages of Blumlein technique to a panpot recording. Essentially this technique is to add to the stereo mixdown a stereo reverb signal derived via a Blumlein microphone pair. In most cases we do not want to add a bathroom or concert hall acoustic to a pop recording, so that we must choose a room to provide a reverberation that has acoustics typical of a good domestic room,

FIG. 4 MS TECHNIQUE REVERBERATION DISTRIBUTION

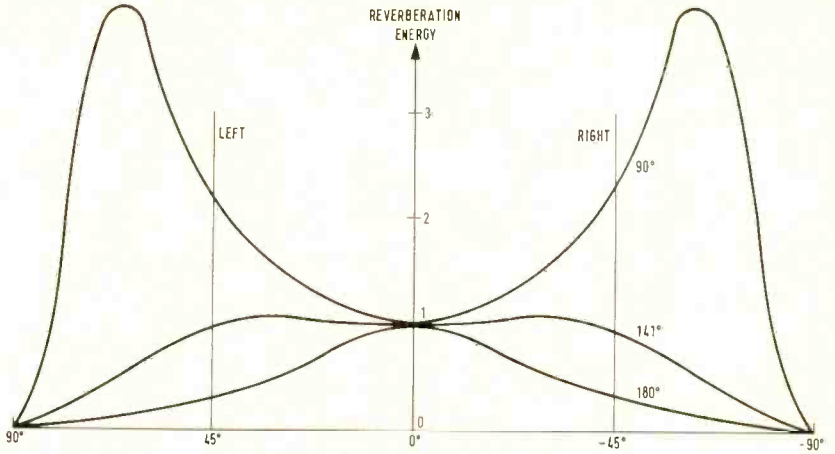
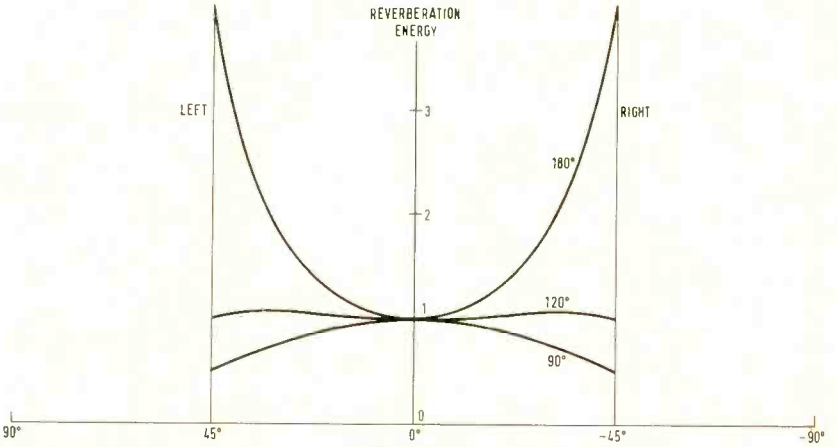



FIG. 5 CARDIOID REVERBERATION DISTRIBUTION



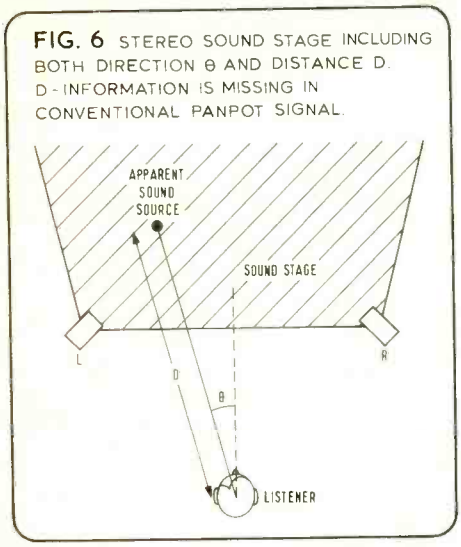



FIG. 6 STEREO SOUND STAGE INCLUDING BOTH DIRECTION θ AND DISTANCE D. D-INFORMATION IS MISSING IN CONVENTIONAL PANPOT SIGNAL.

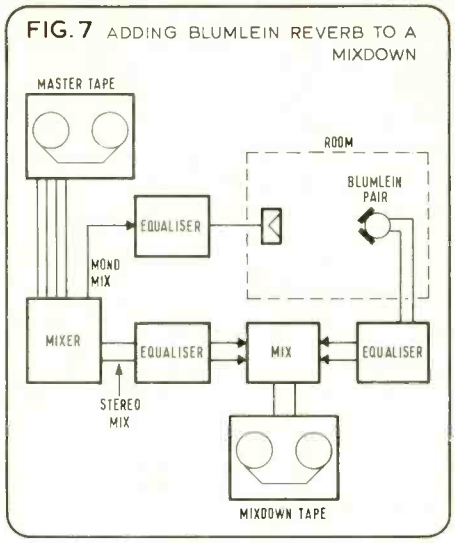



FIG. 7 ADDING BLUMLEIN REVERB TO A MIXDOWN

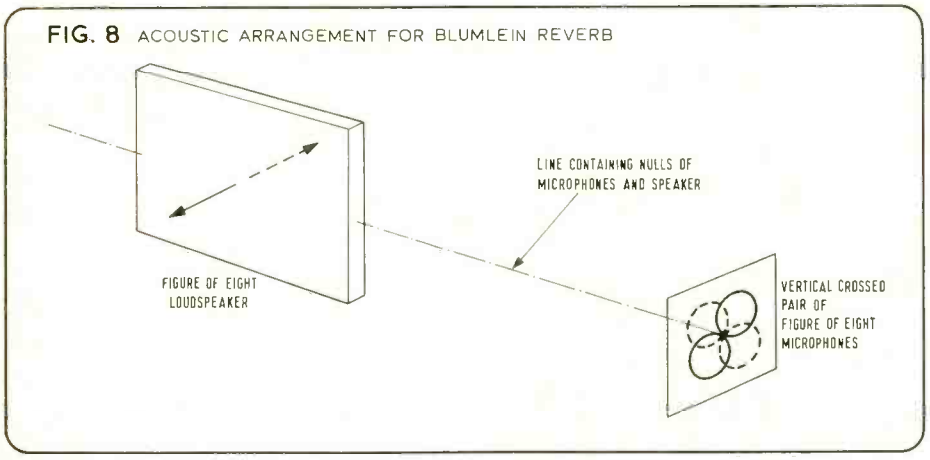



FIG. 8 ACOUSTIC ARRANGEMENT FOR BLUMLEIN REVERB

with a reverb time of around, say, 0.4s. The room must also be quiet and have an uncolored acoustic. A well designed control room might well fulfill these requirements; alternatively one might have to provide a suitable room for this specific purpose. The reflections should not be from excessively smooth or regular surfaces, and a certain amount of reflecting 'junk' scattered around the room is acoustically helpful.

The basic set-up is shown in **fig. 7**, and consists of a loudspeaker fed by a mono mixdown picked up by a Blumlein pair, this to be mixed with the usual stereo mixdown. The speaker and microphone signals may be equalised, as may the direct stereo signal. These equalisations, when used, serve several functions. Firstly, smallish rooms tend to have a somewhat coloured reverb in the bass, and this coloration tends to be worse when the reverb and direct signals are mixed. Thus it is helpful to attenuate the bass in the reverb path, and possibly to boost it in the direct path enough to reflatten the bass response. The situation is somewhat different in the treble, as there is now considerable evidence that the subjective frequency response of sounds in the treble is determined mainly by the direct sound. Thus the direct path should have a flat frequency response in the treble, and the reverb response should be shaped for best effect (normally a gentle treble cut). The equalisation of the mics and speaker should be chosen to ensure best signal-to-noise ratio for the power handling capacity of the speaker at moderate distortion levels. Thus if the speaker can handle a lot of bass cleanly, all bass cut used should be in the mic output paths, whereas if they can handle little bass, the bass cut should be in the speaker feed.

The arrangement just described is inadequate in so far as it not only picks up reverberation, but also delayed direct sound travelling between the speaker and the mics. As we commented earlier, the first few reflections or delayed sounds are important for good stereo imaging, and it is clearly undesirable to provide gratuitously such a strong 'first reflection' that is so patently artificial. Also, the interference between the direct feed and first delayed sound will cause bad coloration.

For this reason, we eliminate the direct sound between speaker and mics by using a figure-of-eight *loudspeaker*! There is one excellent such speaker on the market: the Quad electrostatic. If (see **fig. 8**) we place the Blumlein microphone array in the null-plane of the speaker (ie in the plane of its diaphragm), then at least in theory no direct sound can reach the mics. We can reduce the direct pick-up even further by arranging that the common null direction of the two microphones (ie the axis perpendicular to the plane in which the microphones are pointing) points at the loudspeaker's centre. This way it should be easy to get an attenuation of 30 dB for the direct sound path. This good attenuation makes it possible for the microphones to be placed quite close to the speaker, say within 1½ metres of the speaker's centre. This has the advantage that there is not a delay of 10 ms or so before the first reverb sounds arrive after the direct feed. Such a delay would provide definitely erroneous 'first reflection' information, whereas placement close to the speaker provides a more natural effect.

With this arrangement (which should also be suitable for use in ordinary reverb chambers) we may provide quite a reasonable stabilising Blumlein reverberation to panpot recordings. We note the commonsense point that the direction in which the Blumlein pair points should be chosen to avoid channel asymmetrics due to the positions of floors, ceilings and walls. It is useful when setting up to monitor the Blumlein mic output on an XY oscilloscope display, to make sure it has the correct more-or-less circular ball-of-wool appearance, and to adjust the relationship of the speaker and mics to the room till best results are achieved.

The amount of derived Blumlein reverb required to stabilize the image is quite large, and will have larger energy than the direct feed. The exact reverb level is a compromise between inadequate image stability (too little reverb) and an unpleasantly over-reverberant sound. To monitor image stability, a listener sitting in the stereo seat should sway from side to side over a distance of a metre or so, and note whether 'centre' images stay centred. One advantage of adding Blumlein reverb is that a definite sense of wide stereoism is obtained even if the direct sound image is narrow, which gives the producer an option not normally available. 'Blumleinised' recordings are also particularly suitable for regular matrix quadraphonic reproduction.

There are many evident variants of this technique. For example, we could use more than one loudspeaker, placing the various figure-of-eight loudspeakers in different locations around the microphones, taking care to ensure that all the speaker nulls point at the microphones (**fig. 9**). This arrangement requires that each loudspeaker be fed with different tracks contributing to the mixdown, the diversity of speaker positions contributing a diversity of reverberant field. Two points should be borne in mind: firstly the overall levels of the balance will be determined mainly by the levels fed to the speakers. This is because the reverb contributes most of the energy, and because the level picked up by the microphones does not depend on the speaker distance, there being no direct sound path. Secondly, the most convincing effect will be

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## POSTSCRIPT: STELLAVOX APS/APS7

By Hugh Ford

**MANUFACTURERS' SPECIFICATION**

The ac-line-power-supply *APS75* (110 to 240V, 50 or 60 Hz) furnishes power for the operation of the *SP7* recorder or mixer, and also recharges the incorporated batteries at the same time. The charging current is indicated by the APS white lamp (charging time is approx 18 hours for normally discharged batteries).

The *APS75* can power the following combinations of equipment when the charging facility is not used:- one tape recorder plus one mixer, two mixers, or two tape recorders.

**Price:** £45.

**Manufacturer:** Stellavox G. Quellet Eng. EPZ, 2068 Hauterive/NE Switzerland.

**UK Agent:** AV Distributors Ltd, 26 Park Road, London NW1.

IN MY EARLIER reviews of the Stellavox professional recorders and of the Stellavox mixer I criticised the type *APS* and the type *APS7* power supplies on a number of scores, including that of electrical safety.

My criticisms have been taken to heart by Stellavox, and the new power supply type *APS75* incorporates many modifications, while retaining the original dimensions of 166 mm long by 50 mm square. The incoming mains connection in the form of a standard IEC connector together with an incoming mains fuse in each pole occupies one end of the 'tube' in the form of a single plastic moulding, on to which the fuse values and the serial number are engraved.

The other end of the 'tube' is occupied by the power supply output in the form of a five-pin DIN socket and a rather neat mains voltage selector covering the voltages 260, 240, 220, 150, 130 and 110V.

Other features which show a considerable improvement are the pilot lights, which were in the end of the earlier power supplies and not identified, have now been located within the body of the unit and show through identified holes in the side of the unit.

There are further improvements in the internal construction such that I am now very much happier about the electrical safety of the unit. However matters could be improved even further if the solder tags on the mains voltage selector (and for that matter on the output connector) were sleeved. This would also improve reliability of the connections by giving some support to the somewhat thin wires which lead between the mains voltage selector and the mains transformer.

I am now happy with the standard of construction of this power supply with the minor reservations stated above. Furthermore, testing of the electrical performance in conjunction with a Stellavox mixer showed that the hum levels were also a very great improvement on the earlier samples, with the output hum from the mixer at full output gain being at least −65.5 dBm for all mains frequency harmonics, the second harmonic being the worst offender.

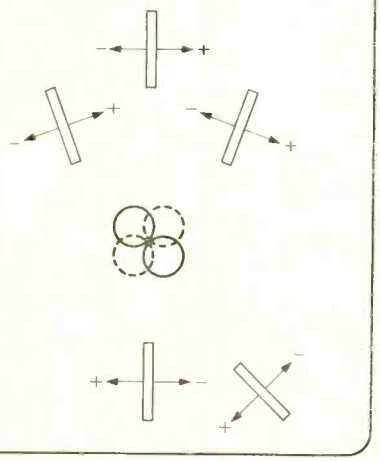
## STEREO IMAGES

obtained if each loudspeaker is placed in that direction around the Blumlein pair (which may now be horizontally-pointing) that corresponds to the same stereo position as the panpotted position of the same sounds in the direct-feed mix. This way, some illusion of spread in space will be obtained, although whether the effect is worth the trouble may be doubted by many. Ideally, the speakers should be 'phased' (fig. 9) so that some sounds do not have reverb of one polarity, some of the other.

The same technique may evidently be used for quadraphonic recording using a properly designed quadraphonic microphone (such as the sound field microphone the author is now developing with the NRDC and Calrec Audio), but here the choice of 'good' microphone technique is even more critically dependent on the correct technical parameters of the microphone system. Although I doubt if it would work, one might also try adding 'dummy head' reverb for headphone listeners in a similar manner.

While the author has conducted some tests with the technique of figs 7 and 8, he does not have a sufficient range of experience with a wide range of conditions to guarantee the results in all cases. To some extent, the technique of image stabilisation for off-centre listeners must be still regarded as somewhat experimental. It is in order to encourage others to try it and its varients out that this article has been written. Undoubtedly some 'debugging' is still required for practical use. However, one must regard the fact that the effect heard by the public is almost never that intended by the producer as being one of the industry's most serious artistic problems, and anything that may help to overcome this problem deserves an airing.

FIG. 9 MULTISPEAKER BLUMLEIN REVERB ARRANGEMENT (SEEN FROM ABOVE)



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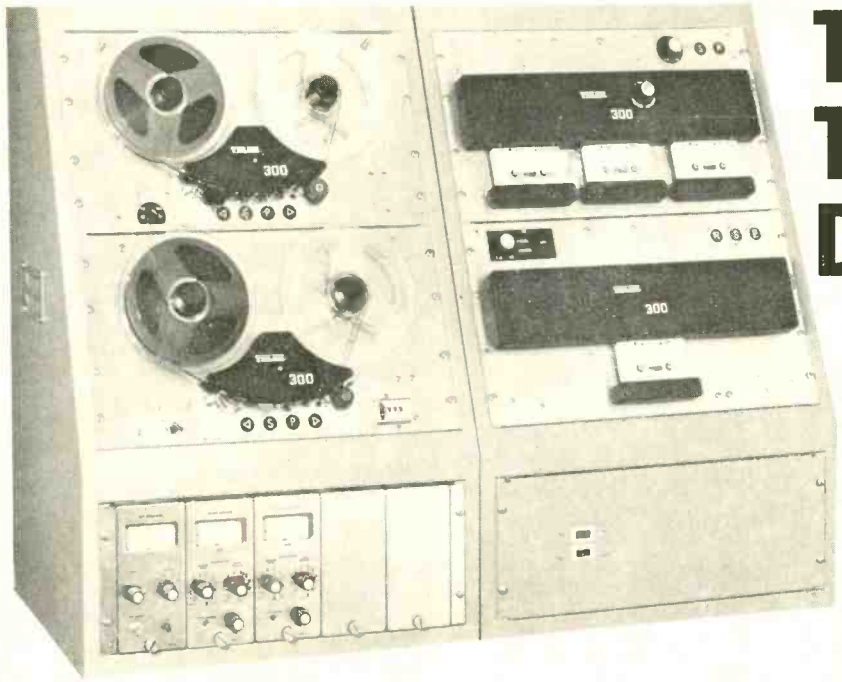

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# AUTOMATED PROCESSES MIXDOWN SYSTEM

By Hugh Ford

## MANUFACTURERS' SPECIFICATION

**Model 256 Programmer**

**Number of functions:** 16 to 256 expandable in groups of 16 by means of plug-in circuit cards.
**Updating rate:** 800 µs/function.
**Accuracy:** ±0.2 dB, 0 to —40 ±2 dB, 0 to —60 +0, — ∞ to —80.
**Bandwidth required:** 5 kHz (35 dB S/N).
**Recording level:** —20 VU to —5 VU (actual level or level variations have no effect).
**Drop-out and splice protection:** Any such occurrence of sufficient magnitude to cause decoding error causes device to hold prior information until error signal is removed.
**Compatability:** (System to system/studio to studio, etc): Compatible within ±1 dB. Decoder automatically senses the number of encoded functions present and adjusts its cycling rate accordingly. Decoder also displays (via led array) the number of encoded functions as an aid to determining the degree of automation on tape of unknown origin.
**Packaging:** Decoder and encoder separately packaged for remote control applications. Decoder: 133 mm x 483 mm rack panel. Encoder: 133 mm x 483 mm rack panel. Both units 254 mm deep. Self powered.

**Model 940 Programmed fader**

**Maximum input:** +20 dBm.
**Attenuation range:** at least 90 dB.
**Frequency response:** 20 to 20 kHz ±0.1 dB.
**Equivalent input noise:** less than —90 dBm.
**Input impedance:** 600Ω.
**Output impedance:** less than 1Ω.
**Distortion (thd):** 0.1% 30 Hz to 20 kHz.
**Master Control output impedance:** 100Ω maximum.
**Master control attenuation:** 20 dB per volt.
**Automatic tracking accuracy:** ±0.5 dB, 0 to —50 dB.
**Null accuracy:** ±0.5 dB, 0 to —50 dB.
**Power requirement:** ±5V dc, 55 mA ±?V dc, 50 mA.

**Model 554P Programmable Parametric Equaliser Controls**

**HS level:** High frequency shelving—variable to ±15 dB, 6 kHz corner frequency.
**HB level and notch:** High bandpass — variable to ±15 dB, notch filter switch at —15 dB position.
**HB frequency:** High bandpass—variable 500 Hz to 15 kHz.
**LB level and notch:** Low bandpass—variable to ±15 dB. Notch filter switch at —15 dB position.
**LB frequency:** Low bandpass—variable 50 Hz to 1.5 kHz.
**LS level:** Low frequency shelving—variable to ±15 dB, 100 Hz corner) frequency.
**In/out switch:** Silent action pushbutton, no level change when actuated.
**Group switch*:** Transfers HB and LB functions to remote master control.
**Read/write switch*:** Transfers HB and LB functions to Automation Programmer control.
**Null switches*:** Part of HB and LB controls. Press to determine previously programmed settings.
**Notch filter switches:** Part of HB and LB level controls. Detented switch actuates at —15 dB position.
***Indicators:** LED null indicators show read/write level status and extinguish when in/out switch is out. Write led indicates when automation data is being programmed.

**Specifications**

**Input impedance:** 10000Ω resistive, balanced (accepts floating or unbalanced sources).
**Output impedance:** 100Ω transformer coupled (600Ω load nominal).
**Nominal level:** 0 dBm to +8 dBm (+28 dBm clip level).
**Insertion loss:** ±0.5 dB (600Ωload).
**Frequency response:** ±0.5 dB 30 Hz to 20 kHz (unequalised).
**Noise:** —90 dBm, unequalised, 20 Hz to 20 kHz unweighted.
**Distortion:** Less than 0.35%THD, 30 Hz to 20 kHz at +28 dBm.
**Control voltage*:** 0 to +5V dc (compatible with Allison/Automated Processes Programmer).
**Power requirement:** ±15 to ±18V dc at 70 mA, +5V dc at 30 mA.
**Dimensions:** 38.1 x 133.4 mm panel; 152 mm deep.
**Weight:** 680g.
**Price:** Programmer: £2500. Fader: not given. Equaliser: £200 manual, £279 automated.
**Manufacturers: Automated Processes, Inc, 80 Marcus Drive, Melville, New York 11746, United States of America.**
**UK agents: 3M United Kingdom Ltd 410 Taunton Road, Greenford Industrial Estate, Greenford, Middlesex.**

THIS REVIEW OF the Automated Processes mixdown system is based on my rather short experience with a four channel demonstration unit and also on a recent visit to the Automated Processes Inc factory. During this visit I spent much time discussing this and other systems with Louis Lindauer and Saul Walker, who I should like to thank for their time and assistance.

At the time of writing, the Automated Processes Inc (API for short) system is the only automation assisted mixdown system which covers not only level control and switching functions, but also provides the facility for programming the equalisers.

In operation, the mixdown is done in the conventional way, with coded information about control settings being recorded on a data track on tape. When the tape is replayed, the original control settings are automatically re-instated from the data track on tape. It is then possible to up-date the original mixdown on to a second track on tape, which may then be further updated on to the original track, or on to a third track if required. Direct comparison of two or more mixes can then be made by switching between data tracks, and if required it is possible to record separate mixes for say stereo and quadraphonic versions of the original material. These facilities can take much work out of a complicated mixdown, and have the further advantage that it is unnecessary to record (on paper) all the control settings if a session has to be abandoned—replaying the tape when the session starts again will automatically recover the original settings of switches, level and equalisation.

The demonstration unit was a rather untidy device in many senses of the word, but it had clearly been built to demonstrate that a great variety of functions can be automatically controlled. A short description of the demonstrator will not therefore come amiss before going into some detail on those individual parts about which information was available.

On the input end, the demonstrator was equipped with four channels of programme-controllable faders which could be either operated in the conventional manual mode, or operated in the automatic mode. The choice of the mode of operation could be either by individual controls on each fader or by a master control in the case of the read/write data recording. Each fader fed a fully programme-controlled unit which had the facility for grouping the four input faders into any of three possible groups, only one group (automated) fader being fitted. This same unit had full panning facilities which could be monitored by two meters (left/right and front/back indicators) in either the read or write data modes. A further facility was a programme-controlled echo send level. The switching in or out of the pan and echo send facilities was also automated, and the panning could be transferred to a joystick type control in lieu of the left/right and front/back rotary potentiometers on the units.

An identical unit to the above was installed in the echo return, its settings also being recorded in the data. The settings of a bank of illuminated pushbutton switches in each channel for switching echo and equalisation in or out of circuit was furthermore programme-controlled.

The demonstrator was in fact fitted with four channels of equalisation, but only one channel was fitted with a programme-controlled equaliser, the remaining three being other types of conventional equaliser manufactured by API.

The final and very important facility was a bank of interlocking illuminated pushbutton switches for exercising overall control of the system. Four buttons controlled the mode of operation: 'local' control of individual parts of the system; 'safe reading' of the data from tape without updating; 'master writing' of data; and also automatic/manual operation of individual parts of the system were the major control functions. Three further buttons selected one of three tracks to be read from the tape as data.

In normal operation the system is switched into 'master write' and 'automatic' and the first mixdown done in the conventional manner while recording the available data tracks on tape. The system is then switched to 'safe read' and the tape re-run in the replay mode on all channels while reading the data from any of the recorded data tracks from the sync head; the mixer then reproduces the original mixdown. Once it has been decided where the original mixdown requires modification, one data track is put into the record (write) mode and the original data recording on this track updated at the required points. The same procedure may be repeated any number of times.

One obvious limitation of any form of programme-controlled mixdown is that audio tracks on tape have to be made available for the data tracks. However, API also manufacture synchronisers for locking tape machines in accurate synchronisation—it is then possible to record some or all the data tracks on a separate recorder and thus preserve the full complement of tracks on one machine for audio.

Although this is a rather short description of the type of facilities that API provide in the demonstration unit, I hope that this gives some idea of the possibilities that the system offers for a custom-made console. In this context it is important to explain that the installation of the API system can be taken in steps, and that it is completely unnecessary to install a complete new console in order to take the advantages of the automation system. For instance, the programmable faders can be substituted in an existing console and used as manual faders until such time as the processor is installed; one might then follow with programme-controlled equalisation and finally switching—all of which can be operated in the conventional manual mode without the automation assistance.

Having covered the overall system, I now propose to give some details of the sub-sections of the overall system.

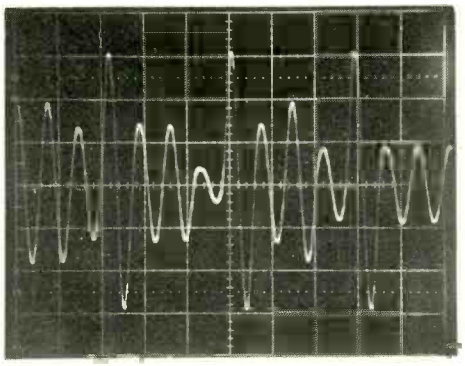
#### The programmer

Because the sub-sections of the overall system are based on voltage-controlled amplifier techniques, with the exception of switching functions which are purely on/off signals which are inherently of binary nature, the task of the programmer is generally to convert dc signals from the control lines into a coded format for recording on the tape data channel in the write mode of operation. In the read mode of operation the programmer must recover these dc control signals with adequate accuracy.

In the API system the analog gain resolution has been set at 0.5 dB from 0 to −50 dB attenuation, and thence 2 dB resolution to −100 dB, which means that each analog function requires 125 information steps which must be capable of being up-dated at frequent intervals so that there is no audible time lag when controls are automatically operated—this updating time has been set by API at 100 ms. It follows that the data rate is 1.25 kHz per channel, and considering that the programmer offers some 256 channels one comes to a data rate of 1.25k x 256=320 kHz for the overall system; on the face of it this would be impossible to record on a single track of an audio recorder. It is here that the cunning of the programmer sorts out the problem.

While I do not have any detailed information on the modus-operandi of the programmer, I assume that the 256 channels are multiplexed in either analog or digital form and produce the aforesaid 320 kHz data rate at the stage before the signal is encoded for recording on to tape. This encoding is into quinary form, which I will explain with reference to **fig. 1**, which is an oscillogram of the data for four channels as recorded on to tape. It is to be

**FIG. 1.**



seen that the recorded sinewaves have five discrete amplitudes of approximately ±3 divisions, ±2, ±1½, ±¾ and ±½ division; thus each cycle of the sinewave can take five discrete values. In each data 'block' the first cycle is a reference amplitude (as at the centre of the figure) which is followed by three cycles of data in quinary form, the first of which can take the decimal values 0, 25, 50, 75 or 100, the second cycle 0, 5, 10, 15, 20, and the third cycle 0, 1, 2, 3 or 4. It follows that some 125 steps are recorded in four sinewave cycles (including the reference level cycle) on tape which are adequate to control one analog gain function.

In practice the programmer can be fitted with up to the maximum capacity of 256 functions in steps of 16 functions from the minimum of 32 functions with which the demonstration unit was fitted, the sinewave data rate to tape being 8 kHz. **Fig. 2** shows the complete set of 32 functions recorded on tape, the start of each set being identified by a four cycle burst of the 8 kHz sinewave at full

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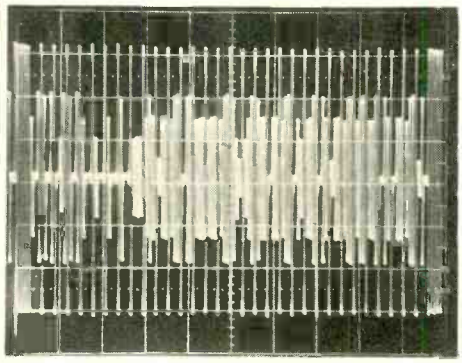
amplitude. I understand that this burst and also the first cycle of each function 'block' are used for dropout detection, and if a dropout is detected the last data is held until a correct scan is restored, the dropout being indicated by an led indicator on the programmer. Also shown by led indicators is the number of available functions in the coder, and in the case of the decoder the required number of functions as determined from the data track on tape. It is therefore possible to determine if a given programmer is fitted with sufficient functions to decode fully unknown data tracks from other studios.

FIG. 2.



The code/decode accuracy within a system and also system to system is claimed to be ±0.5 dB with non-cumulative errors in the updating processes as a result of the use of narrow windows in the level detecting circuits in the encoding process.

The recommended recording level for the data tracks is between 0 VU and −20 VU with a signal-to-noise and crosstalk requirement of a minimum 35 dB.

In practice it was found that the system could tolerate very wide variations in signal level without excessive dropout indications, and that no errors were introduced by dropouts so far as the overall performance of the audio section was concerned. Using good quality tape the number of indicated dropouts was small, but the use of old and well used tape gave frequent dropout indications—again without apparent data errors.

It will be noted from the specification that the maximum capacity of the programmer is 256 variable (analog) functions or 1440 switching functions, or any combination in blocks of 16 variable or 90 switching functions. These ratios suggest that switching functions use more than one discrete code, and are probably offered some extra protection against data errors. Also, those who have done their sums on the overall data rate will notice some small discrepancies in the figures.

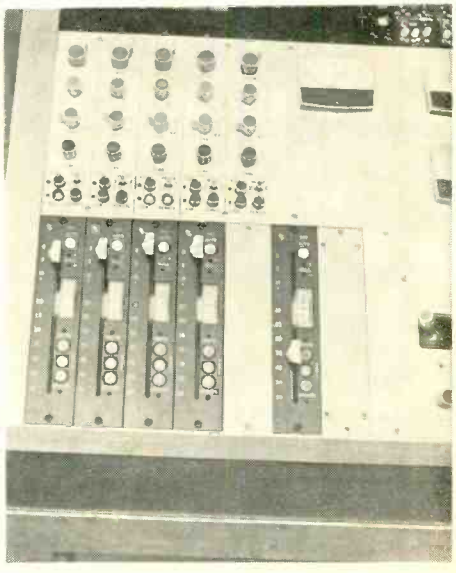
**Type 940 automated faders**

In the manual mode of operation (as selected by a pushbutton switch) the audio signal passes through the conductive plastic fader element as in a conventional fader, but once the 'auto' mode is selected the audio signal is controlled by a voltage-controlled amplifier, which is in turn gain-controlled by a number of dc sources as shown in fig. 3. In the write mode, dc is supplied by the fader element to the voltage-controlled amplifier and also fed to the encoder section of the programmer—the system is entirely controlled by manual operations as in a conventional desk. When the read mode is selected the voltage-controlled amplifier is supplied by dc from the decoder only, so the gain is automatically controlled by the recorded data on tape. In the third mode of operation, the update mode, the dc applied to the voltage-controlled amplifier is the sum of the incoming dc from the decoder as recorded on the data track on tape and the dc produced by the manual setting of the fader. This updated dc level is used to control the gain of the voltage-controlled amplifier and is also recorded on to a second data track on tape, thus recording an updated mix.

By means of a second summing amplifier which is inserted in the dc control line in the update mode it is arranged that the −15 dB point on the manual fader represents the 0 dB (unmodified gain) setting; it is therefore possible to boost gain by up to 15 dB in the update mode. In all cases a small meter indicates the current effective fader setting being the sum of the setting from incoming data and the mechanical setting of the fader.

A further useful facility is two led indicators which indicate if the mechanical setting of the fader is above, below or at the incoming setting from recorded data. It is therefore possible to set the fader to the identical level of the recorded data and then cue into the update mode without any shift in level greater than ±0.5 dB.

Because the gain of the fader is purely voltage controlled, it is a simple matter to effect other controls such as panning by simply feeding a further dc control voltage to the fader and adding this to the existing dc control, in which case the overall gain is simply the sum of the applied dc control levels. This versatility makes the voltage-controlled fader a very attractive device in a conventional



manual console, because it means that very little audio signal distribution is required, with its attendent problems of hum, crosstalk and other well known difficulties.

**Type *554P* programmable parametric equaliser**

In common with the fader, the programmable equaliser can be operated in either the manual mode or in the programme-controlled mode, in which case some but not all of the available functions are controlled by the dc signals from the programmer.

High and low frequency shelving is provided as a purely manual function, both controls being conventional potentiometers with a calibrated ±15 dB range about the flat position. The high shelving control has a nominal corner frequency of 6 kHz, while the low frequency control's corner frequency is 100 Hz.

The automated functions are the high bandpass and low bandpass filters, each of which has two controls in the form of normal potentiometers. One is for the centre frequencies, the other for the cut or boost which is variable over a ±15 dB range and also offers notch characteristics when the control is turned just beyond the −15 dB position. These four potentiometer type controls are programmable and are voltage-controlled functions similar to the faders; furthermore, a push-button switch is provided for grouping a number of equalisers. While the equaliser does not have an update facility similar to the faders where a revised zero point is established, it is possible to establish any of the original equaliser settings when reading the data from tape by pressing in the appropriate equaliser control and turning it until two 'null' led indicators are illuminated. This facility means that original equaliser settings may be established during replay of data from tape, and that the original settings may be updated on cue without abrupt changes in equalisation.

**Summary**

It is hoped that this review of the API programme-assisted mixdown system will give readers some idea of the facilities that can be offered by the system. The descriptions here are based on an unduly short experience of the small demonstration unit which, while it performed all the automated functions to my satisfaction, was unsuitable for undertaking measurements upon the performance of either the complete system or upon its component parts. The reason for this was that not only had I little time to prepare this review, but that little information was available upon the configuration of the demonstration unit; furthermore its output was very noisy, containing both hum and code breakthrough.

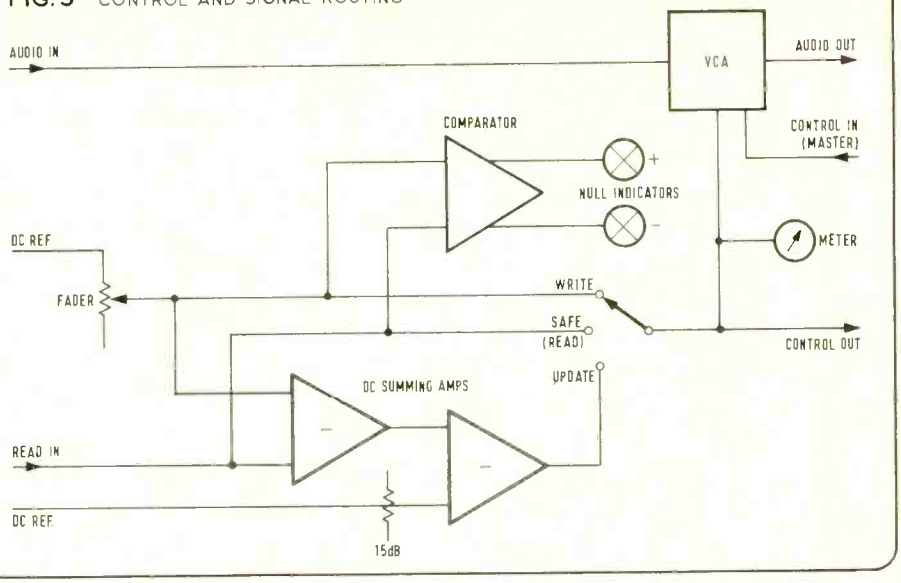
There is of course no reason to assume that this is a system 'bug' and I see no reason why this type of fault should occur in a properly built console.

In closing I feel that the API automation system offers many extremely interesting features, and to my way of thinking the automation of all normal mixdown facilities is the logical way to take things where it is required to undertake complex mixes of multitrack material.

**PS**

The day after writing this review I received a letter from API emphasising the status of the demonstration unit and underlining the fact that the demonstration unit has been in transit around demonstrations for some five months without being checked-out. In fairness to API I should like to quote the following paragraph: 'The demonstration unit, itself, has been built and rebuilt each time we change our minds about an automation concept and therefore the "System" construction is less than ideal . . .'

FIG. 3 CONTROL AND SIGNAL ROUTING




## COMPUMIX SYSTEM

By Hugh Ford

**MANUFACTURER'S SPECIFICATION**

**Programmable functions:** 504 total.
**Gain (analog);** 24 channels.
**Reserve functions:** 288.
**Scan rate:** 50 ms constant.
(information renewal independent of number of functions)
**Encoding format:** Bi-phase digital encoding.
(bit rate and format compatability with SMPTE time coding)
**Bandwidth (data channel):** 10 kHz.
**Bit rate:** 9600 bit/s.
**Frame rate:** 18.75 frames/s.
**Dropout and splice immunity** (word and frame validation system): Will hold full accuracy of analog (attenuation) settings within ±0.25 dB for 10s drop-out of data.
**Resolution** (voltage controlled attenuators gain function repeatability): Static ±0.1 dB (to —45 dB) Dynamic (stepless).
**System compatability:** ±0.5 dB system to system.
**Level match** (updating control LED indication): ±0.25 dB aperture.
**System bypass:** Processor includes integral by-pass/power keyswitch with LED system status indication.
**Dimensions** h x w x d: Controller 1194 x 406 x 76 mm. Processor 940 x 584 x 635 mm.
**Voltage controlled attenuator specification**
**Maximum attenuation:** 110 dB (control voltage +10V) (20 Hz to 20 kHz).
**Control voltage:** 0-10V dc.

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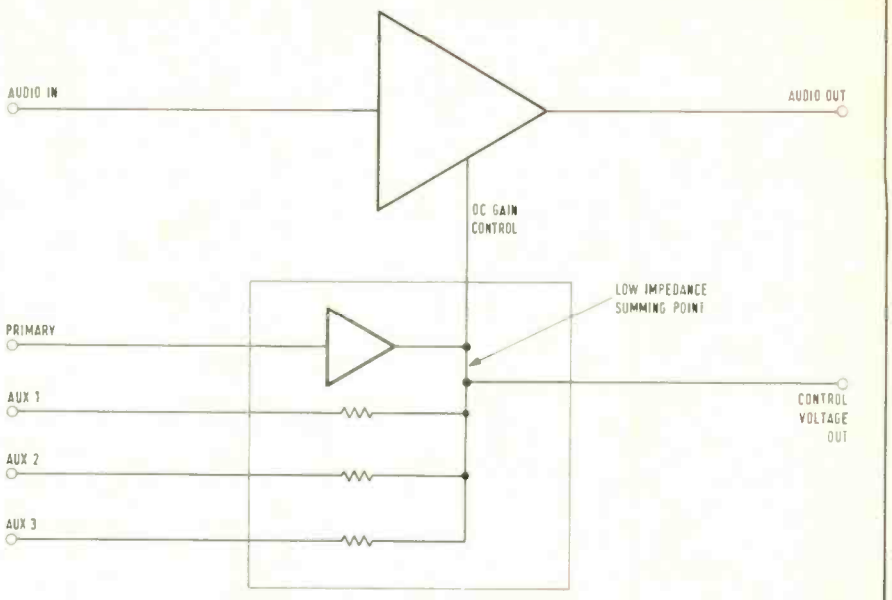
## COMPUMIX

**Control scaling** (all inputs): 5 dB attenuation per volt (up to 45 dB).
**Linearity**: 0-45 dB attenuation. ±0.25 dB.
**Tracking (two or more units)**: Adjustable to zero ±0.25 dB.
**Logic inputs (TTL/DTL/CMOS compatible)**: Hi = +3V min +5V max at 0.5 mA source. Lo = 0V min +0.3V max at −0.5 mA sink.
**Amplification**: Normally 0 dB (unity) at attenuation set = '0', trimpot adjustable approximately ±2 dB. Input resistor may be paralleled for up to 40 dB additional amplification. Summing input available so the unit may be used as a summing amplifier.
**Output power**: +27 dBm max.
**Distortion**: 0.1% at rated output and unity gain (20 Hz to 20 kHz). 0.25% max at any attenuation setting (input +27 dBV or less).
**Output overload**: Protected against up to 150% over-voltage or short circuit with instantaneous recovery.
**Output load impedance**: 150Ω or greater, unbalanced.
**Frequency response**: ±0.25 dB 20 Hz to 20 kHz (−3 dB at 4 Hz and 100 kHz).
**Noise (20 kHz bandwidth)**:

| Attenuation | Output Noise |
|---|---|
| 0 | −92 dBm max |
| −15 dB | −96 dBm max |
| Infinity | −105 dBm max |

**Input impedance**: Audio 47 kΩ. Audio summing input <5Ω. Primary control voltage >20 MΩ. Auxiliary inputs 20 kΩ.
**Maximum input level**: +27 dBm.
**Price**: £9000 plus VAT.
**Manufacturers: Quad/Eight Electronics, 11929 Vose Street, North Hollywood, California 91605, United States of America.**
**UK agents: Feldon Audio Ltd, 126 Great Portland Street, London W1.**

FIG.1 VOLTAGE CONTROLLED AMPLIFIER




MY INTRODUCTION TO the Compumix system was with the courtesy of Advision Studios in London where I was kindly invited to watch Shel Talmy producing a disc for Fumble. This opportunity amply demonstrated that Compumix does not in any way restrict the normal operation of a conventional desk, but in fact makes the handling of a multitrack mixdown a less complicated task. Furthermore, the Compumix system can be easily interfaced with conventional equipment with a minimum of complication.

### What it does

The basic function of the Compumix System is to store fader settings in digital form on to a data track on tape. Thus the Compumix, which contains its own faders, is inserted into the audio channel between a multitrack tape machine and the conventional console. During the initial mixdown the Compumix faders are used instead of the desk faders, and the Compumix fader settings are continuously recorded on to a data track on the master tape.

The resulting mixdown may then be automatically repeated without human intervention simply by replaying the tape with its recorded data track, which automatically adjusts levels to the settings used during the original mixdown.

Using a second data track on the master tape, the levels used during the initial mixdown may be updated and recorded on to the second data track. Subsequent replaying of the master tape provides instant comparison between the two mixes. Further updating may be done by doing read/write (replay/record) cycles between the two data tracks. Alternatively, if further tracks are available for data, a larger number of mixes may be directly compared during replay without in any way modifying the original master audio tracks.

This all implies that while the very basic operation of the Compumix means the sacrifice of one audio track for digital data, the full utilisation of the Compumix requires two data tracks. Normally the two outer tracks on the master tape are used for data, but there is no restriction on the use of other tracks as the Compumix uses a conventional audio channel for data recording.

In addition to the facility for automated fader settings which includes 24 channel faders and six group faders together with a master fader, other facilities are offered. Each of the channel faders and group faders has a muting switch, the operation of which is recorded in the data with automatic muting during replay. Also, there are 24 auxiliary switches whose operation is recorded in the data and the operation of which provides a logic switching level at the Compumix output intended for automating any form of auxiliary switching functions. All this involves less than half the digital capacity of the Compumix, so that it is possible to control many other facilities if the user provides suitable digital logic.

### The Hardware

The Compumix system is embodied in two parts, the processor and the console section. The former contains the power supplies and the main electronics and is in the form of a castor-mounted wooden cabinet into which are mounted four 483 mm standard size rack frames. The rear of the processor cabinet is occupied by the 48 XLR type audio inputs and outputs and various other auxiliary connectors, all of which are clearly identified.

All the electronics are mounted on good quality printed boards which incorporate a large number of integrated circuits, and plug into the rack frames for easy servicing.

On the front of the processor cabinet there are three led indicator lights which indicate the proper functioning of the digital data from the recorded track on tape, and also the power on/off switch which is key-operated and completely bypasses the audio channels of the Compumix when it is switched off.

The console section is connected to the processor by two very large cables. These plug into the console, so that the two sections can be separated by approximately 5m. The idea of this is that the console section may be placed on the existing desk, or conveniently mounted adjacent to the desk.

Layout of the console section is very clean, with the group and master controls at the centre and a set of 12 channel controls extending to either side. The 24 channel faders, six group faders and the master fader are mounted in line with grid lines providing calibration points at 5 dB intervals from 0 to −45 dB, the normal setting of the channel and group faders being at the −15 dB point, and the master fader at maximum gain. These setting points can be accurately determined by means of an led indicator which is mounted above each fader and which is illuminated when the fader is set to its normal position within a specified ±0.25 dB.

Proceeding away from the operator, each of the channel and group sets has a pressbutton muting switch and an illuminated 'update' switch, the function of which will be explained. The channels have in addition the 'Auxiliary' pressbutton switch, an illuminated 'write' switch and a rotary group switch which enables any channel or channels to be connected to any of the six group faders.

The main control functions are performed by a further five illuminated pushbutton

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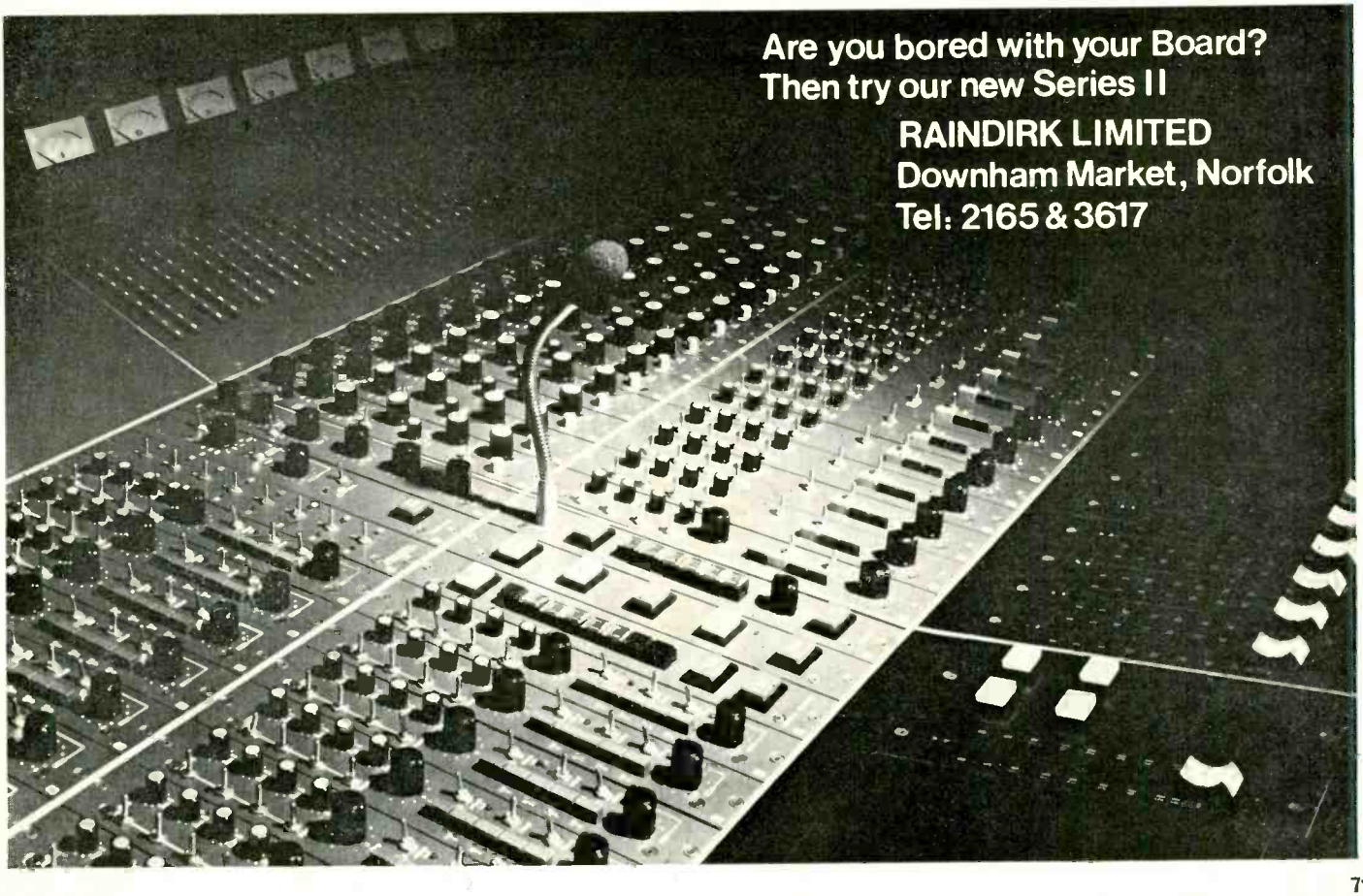


switches, two of which select the read and write functions for the 'Auxiliary' facility. A further two select the main read and write function, and the last is labelled 'hold'. The latter is used in the replay 'read' mode and holds the current mode and settings when it is pressed—reverting to new data when it is released. In other words it is a 'what would it sound like if I hadn't done it' button!

**How it works—the audio section**

The heart of the audio section of the Compumix is 24 voltage controlled amplifiers, one in each of the audio channels. The gain of each voltage controlled amplifier depends upon the dc input level at a number of separate control inputs on each amplifier such that the gain changes at a rate of 5 dB per volt on the dc control input over the range 0 to 45 dB.

Reference to **fig. 1** shows the facilities of a typical voltage controlled amplifier. The application of a dc voltage to the primary input will vary the voltage on the dc gain control line to the amplifier irrespective of the auxiliary inputs. On the other hand, the application of a control voltage to one or more of the auxiliary inputs will produce a dc gain control voltage which is the sum of the auxiliary input voltages. This also appears at the control voltage output.

Auxiliary inputs are used in the Compumix system: one for the master gain control, one for the channel or group fader, and an input for the automated read/replay function. In the 'write' mode of operation only the master group and channel inputs are used, the control voltage out being digitally coded and recorded on to the tape data track. In the read mode, only the read/replay input is connected, while in the update mode all inputs are summed to control the channel gain. The control voltage out is recorded on to the second data track on the tape. It follows that the only audio signal wiring is to and from the voltage controlled amplifiers, which reduces many of the problems associated with conventional gain controls and their complex signal routing.

**How it works—the console section**

Reference to **fig. 2** will assist with an understanding of the simplified process of recording data on to tape. As has already been explained, the dc control voltages from the console section are fed to the voltage controlled amplifiers, which individually produce a summed dc output which is related to their gain. These 24 dc outputs (one for each channel) are applied to an analog multiplex switch, each input having an address. The console 'Auxiliary' switch functions are also fed to the analog switch in a more complex way, as are other optional functions, with a total possibility of 64 addresses.

Each of these 64 addresses is sampled by the address counter in turn at the rate of one address each 0.83 ms. the analog voltage input to each sequential address is fed to the analog/digital converter, which produces eight parallel data lines of binary information representing a possibility of some 256 values. This may be shown to represent a possible error of $\pm 0.1$ dB in gain.

This parallel digital data is then fed to a shift register which converts it into serial form,

FIG. 2 BASIC RECORDING SYSTEM

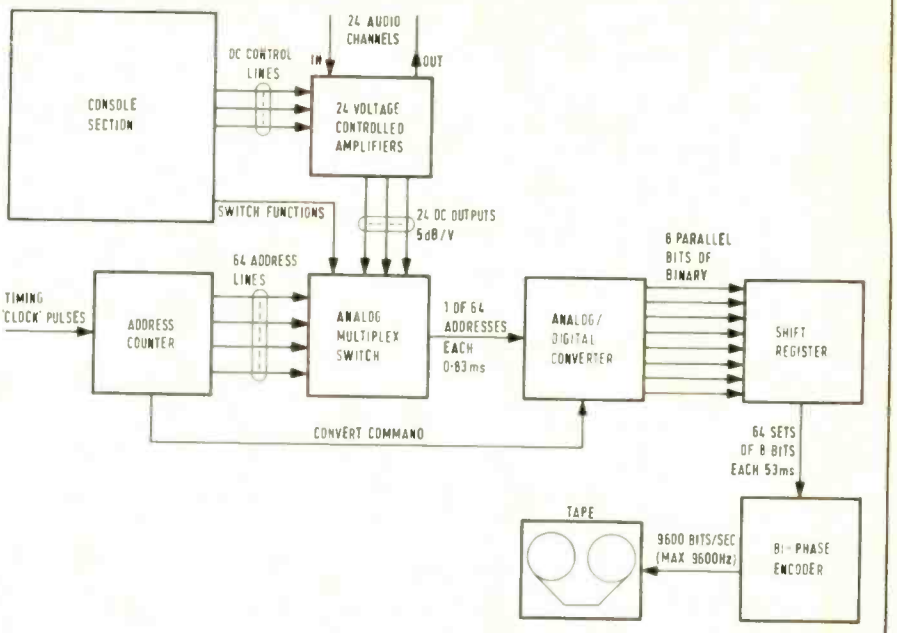
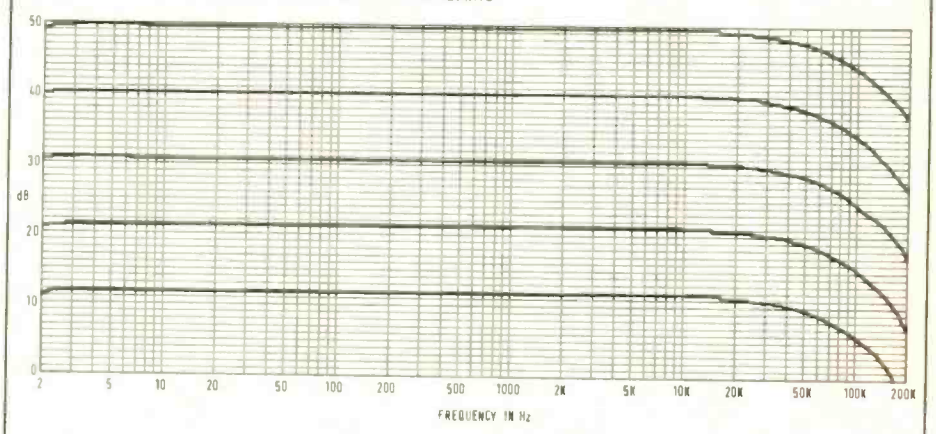



FIG. 3 FREQUENCY RESPONSE FOR VARIOUS GAINS




which is in turn encoded into bi-phase non-return-to-zero recording format and thence recorded on to the data track on the tape.

The recovery of data from tape follows the same scheme, but in the reverse order. Thus the coded data is read from tape, the original clock timing being recovered by a phase locked loop, the data decoded by a bi-phase decoder, paralleled in a shift register, digital/analog converted, de-multiplexed and passed to the voltage controlled amplifiers.

So much for describing the Compumix system, it now remains to evaluate its overall performance.

**Performance: audio section**

Unfortunately the task of evaluating two automated mixdown systems in only a few days work meant that the measurements had to be restricted to only a few channels (in both senses of the word). Fortunately, in the case of the Compumix, the automated function is limited to gain control and all the 24 channels are identical in circuitry. Therefore I have looked fairly closely at the main performance

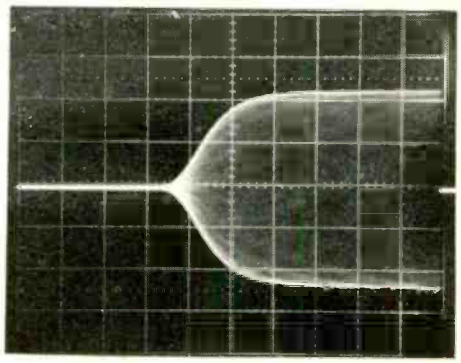


FIG. 4.

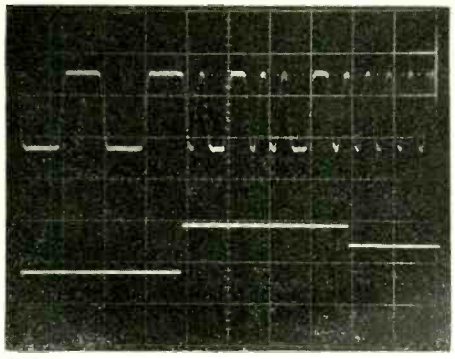


**FIG. 5.**

parameters of one or two channels, and also done some work on matching between channels where this is likely to be critical.

The frequency response of the system loaded into a high impedance and the accuracy of the fader calibration are shown in **fig. 3**, from which it is to be seen that the frequency response is substantially flat from 2 Hz to 20 kHz at all fader settings. Above 20 kHz the output begins to fall off to a −3 dB point at 70 kHz, and it was found that loading the output with 600 ohms introduced a −3 dB point at 3 Hz . . . so all is well in this department. It is also to be observed from **fig. 3** that the fader calibration is reasonably accurate and does not give any cause for complaint. The accuracy of the faders is controlled by not only the fader law, but also by the linearity of the voltage controlled amplifiers which becomes of paramount importance when channels are operated in groups. This matter was investigated on a number of channels, from which it was found that the difference in gain between channels did not exceed a creditable 1¼ dB at any fader setting between zero and −30 dB, below which the differential gain can hardly be considered to be critical.

The maximum attenuation available was found to be in excess of 105 dB below 1 kHz, falling to 95 dB at 20 kHz. The crosstalk between adjacent channels showed a similar pattern with the crosstalk levels about 6 dB higher than the above figures. Grouping of the wanted and unwanted channels made negligible difference to the crosstalk at mid frequencies with the wanted channel fader fully open and the unwanted channel fully shut.

The overall gain of the system with the faders fully open was found to be within 0.1 dB of unity at 1 kHz on the channels investigated. The effect of loading into 600 ohms was little different, thus demonstrating an adequately low output impedance. The measured output impedance was in fact 28 ohms associated with an output clipping level of +27.2 dBm into a high impedance. On the input end the impedance was 43K ohms, also a very sensible value, with an input clipping level of some +40 dBm.

Both harmonic and intermodulation distortion were investigated in some detail, as voltage controlled amplifiers have a reputation for complex distortion characteristics. In fact the Compumix has a very clean record, with the maximum harmonic distortion produced being 0.1 per cent third harmonic between 100 Hz and 20 kHz with a +22 dBm input and a −25 dB fader setting. At other fader settings there was significant reduction in the distortion level, and in all cases the second harmonic and higher harmonics were below the third harmonic.

Intermodulation distortion was measured to the SMPTE method, with maximum gain at four different input levels, with the following good results:

| Equivalent peak sinewave input (rms) | Intermodulation distortion |
|---|---|
| +27 dBm | 0.4% |
| +20 dBm | 0.15% |
| +10 dBm | 0.03% |
| 0 dBm | 0.03% |

On the score of noise the performance was also good with the worst case noise occurring at maximum gain and being −90 dBm 'A' weighted or −83 dBm over the band 20 Hz to 20 kHz. Taking into account the available headroom, a really excellent signal-to-noise performance is available.

The final matter investigated in the audio section was the phase shift in relation to frequency. This was found to all intents and purposes to be constant with fader setting and the total phase excursion between 20 Hz and 20 kHz was less than 10°.

**Performance: control section**

The first matter of interest that came to light was the response time of the faders, which is not instantaneous. **Fig. 4** shows that if a fader is switched instantaneously (for instance by the mute facility) the build-up time is in the order of 100 ms; it is not felt that such a fast response time is likely to give much difficulty in practice. Furthermore, the fall time when a fader is switched out is much faster at around 15 ms.

One of the matters of prime interest in the Compumix is, of course, the accuracy with which levels can be repeated. This was investigated by undertaking a number of read/write cycles of the digital data without introducing and updating; as should be expected, the maximum error was found to be 0.4 dB per read/write cycle—this error can however be cumulative in the worst case, but in most circumstances will remain insignificant.

The other matter which could give cause for concern is dropouts in the recorded data track. The Compumix does in fact contain a dropout detector which holds the previous block of data if a dropout is detected, and I was unable to fool this system with simulated dropouts. Furthermore, even if the digital data track was completely lost for up to 15s the Compumix only introduced a level error of 1.2 dB, and up to this time the restoration of the data track gave a rapid return to the correct level.

In the update mode it was found that the indicated reference point on the faders at the −15 dB calibration (as indicated by a led indicator) was extremely accurate with a total 'window' in the order of 0.3 dB.

**Fig. 5** shows the form in which data is recorded on to tape as in the upper trace, while the lower trace waveform shows the period of time occupied by each channel. It is to be seen that the data waveform which would be in the form of a rectangular waveform has been filtered to reduce the harmonics which might cause trouble in the recorder. The data output to the recorder has an amplitude of 1V peak to peak, with the intention that it should be recorded at −10 VU so that the possible

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## COMPUMIX

crosstalk between audio and data is reduced. The data input accepts any input level between 100 mV and 3V rms from the tape machine and changes in level over this range do not effect the data recovery. However, if the data channel falls outside these limits either the overload light on the processor will become illuminated, or the data light will be extinguished.

**The remote control unit**

In addition to the console and processor units, the review sample was supplied with a remote control unit for switching data tracks on the tape machine, starting it and putting it into record. While the latter functions were not evaluated, the data track switching which consists of two sets of four illuminated push-button switches (one set for record and the other for replay of a possible four data tracks) was a very useful function.

**Summary**

In all respects the Compumix system did all that it was intended to do, and the performance of the audio channels was such that the introduction of the Compumix would give extremely little degradation of the audio channels.

The addition of Compumix to an existing studio does not involve any complications—indeed, it can be considered as a portable unit that may readily be transferred from one studio to another and just plugged-in at the new site. It might however have been to advantage if the inputs and outputs were balanced floating rather than unbalanced, as it is all too easy to produce earth loops with the latter.

The limitation of the Compumix system is of course that it only deals with the automatic adjustment of levels and performs customised switching functions, leaving equalisation to the operator. I leave it to the reader to decide for himself if his application can justify the cost.

**Neve developments**

Rupert Neve & Co advise (October 14) that they have reached an advanced stage of construction of a computer-assisted mixing system designed to meet the needs of music recording and video tape recording studios. It is claimed that the equipment features 'absolutely no degradation in mixing console performance; optimum man-machine interface; control of many of the routine aspects of studio operation during recording and mixdown leaving the operator free to exercise his talents unhindered; unlimited recall of successive mixes.' It is expected that the equipment will be demonstrated early next year, following the current trials.

## SOUND MIXING

give 32 gain points. The memory for 16 channels can be accommodated on a single circuit board; each shift register output is distributed to its relevant channel board where the data is converted first back to parallel form and then to analogue control voltages.

So far I have described a possible replacement for current sound desks. The first application of the new techniques will probably be in a much simpler field. There are many occasions where gigs are held in locations where there are no existing pa facilities. The result is often a huge web of cables interlinking stage mics, the balance engineer and the power amplifiers. With a digital system, the stage microphones can be arranged to feed directly into the pa.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Word 1** | F1 | (4 bits) | **Aux 1** | (5 bits) | **Post pre** | (1 bit) |
| **2** | F2 | (4 bits) | **Aux 2** | (5 bits) | | (1 bit) |
| **3** | F3 | (4 bits) | **Aux 3** | (5 bits) | | (1 bit) |
| **4** | F4 | (4 bits) | **Aux 4** | (5 bits) | | (1 bit) |
| **5** | F5 | (4 bits) | **Aux 5** | (5 bits) | | (1 bit) |
| **6** | F6 | (4 bits) | **Aux 6** | (5 bits) | | (1 bit) |
| **7** | F7 | (4 bits) | **Coarse gain** | (5 bits) | | 1 bit spare |
| **8** | F8 | (4 bits) | **Spare** | (6 bits) | | |
| **9** | Pan X | (4 bits) | **Spare** | (6 bits) | | |
| **10** | Pan Y | (4 bits) | **Group Routing Data** | (6 bits) | | |

The control and mixing of the pa can then be operated remotely from the stage by as great a distance as required, the cabling being a simple twisted pair of wires carrying serial control data. The control unit could still have the same faders.

I hope this article has sown some seeds of ideas about what is technically possible, what is available now, and also what may soon arrive on the scene. They are only my ideas but hopefully at the same time they may promote a certain amount of collective thinking among people involved in the manufacture and operation of sound mixing equipment.

## PATENTS

ness of tone of electronic musical instruments.
**1373379** Maschinenfabrik Wifag.
Method and apparatus for producing newspapers, periodicals for like printed matter.
**1373409** Sony Corporation.
Electro-optic display devices.
**1373420** Bontempi, P.
Musical instrument.
**1373469** Ri-El Ricerche Elettroniche SRL.
Magnetic tape recording and/or reproducing apparatus.
**1373511** Decca Ltd.
Recording in grooves.
**1373512** Decca Ltd.
Recording and playback of a signal.
**1373514** Sperry Rand Corporation.
Magnetic head positioning assembly.
**1373521** Rockwell International Corporation.
Automatic transversal equaliser system.
**1373644** Marconi Co Ltd.
Diversity communication receiving equipment.
**1373687** Gerry, M. E.
Distortionless magnetic components.
**1373696** RCA Corporation.
Endless loop tape cartridge core and platform assembly.
**1373736** Thomson-CSF.
Short-range transceiver.
**1373748** Motorola Inc.
Subaudible remote control tone encoding system.
**1373829** Nuclear Enterprises Ltd.
Apparatus for converting simultaneous x and y amplitude modulated signals into a form suitable for recording.
**1373836** Kockums Mekaniska Verkstads AB.
Method and apparatus for generating an acoustic signal according to a stepwise gliding scale.
**1373840** Siemens AG.
Microphone for simultaneously monitoring heart pulse and heart noise.
**1373881** Gunkel, W. A.
Ultrasonic inspection system and apparatus.
**1373894** Commissariat A L'Energie Atomique.
Colour television system which utilises liquid crystal filters.
**1373940** Ricoh, KK.
Data transmission systems.
**1373943** Philips Electronic & Associated Industries Ltd.
Colour television system.
**1373946** Hewlett-Packard Co.
Optically transparent acoustic wave transducer.
**1373966** Fernseh GmbH.
Method of and apparatus for transmitting colour television pictures.
**1373978** Reliance Electric Co.
Integrating scale.
**1374037** Bosch GmbH, Robert.
Slip frequency control circuit for an asynchronous machine.
**1374043** Philips Electronic & Associated Industries Ltd.
Pulse code modulation transmission system.
**1374085** Instructional Dynamics Inc.
Method and apparatus for producing animated motion pictures.
**1374087** Thomson-CSF.
Image intensifiers.
**1374100** Sumitomo Electric Industries Ltd.
Device for detecting location of moving body.
**1374134** Singer Co.
Position control for a raster scanning a free flowing film.
**1374146** Soc Italiana Telcomunicazioni Siemens Spa.
Automatic insertion system for a stand-by clock signal in a pcm multiplexing system.

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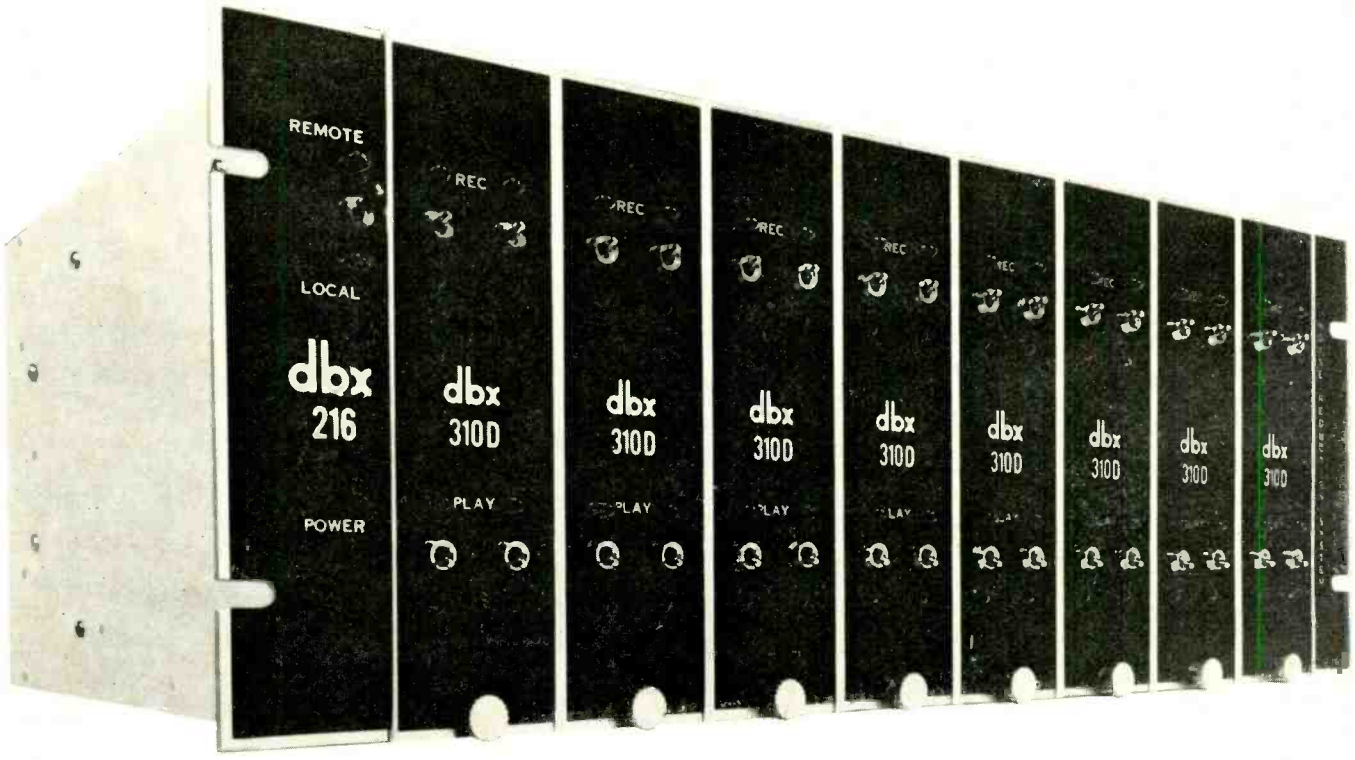


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