January 1977 45

studio sound

AND BROADCAST ENGINEERING

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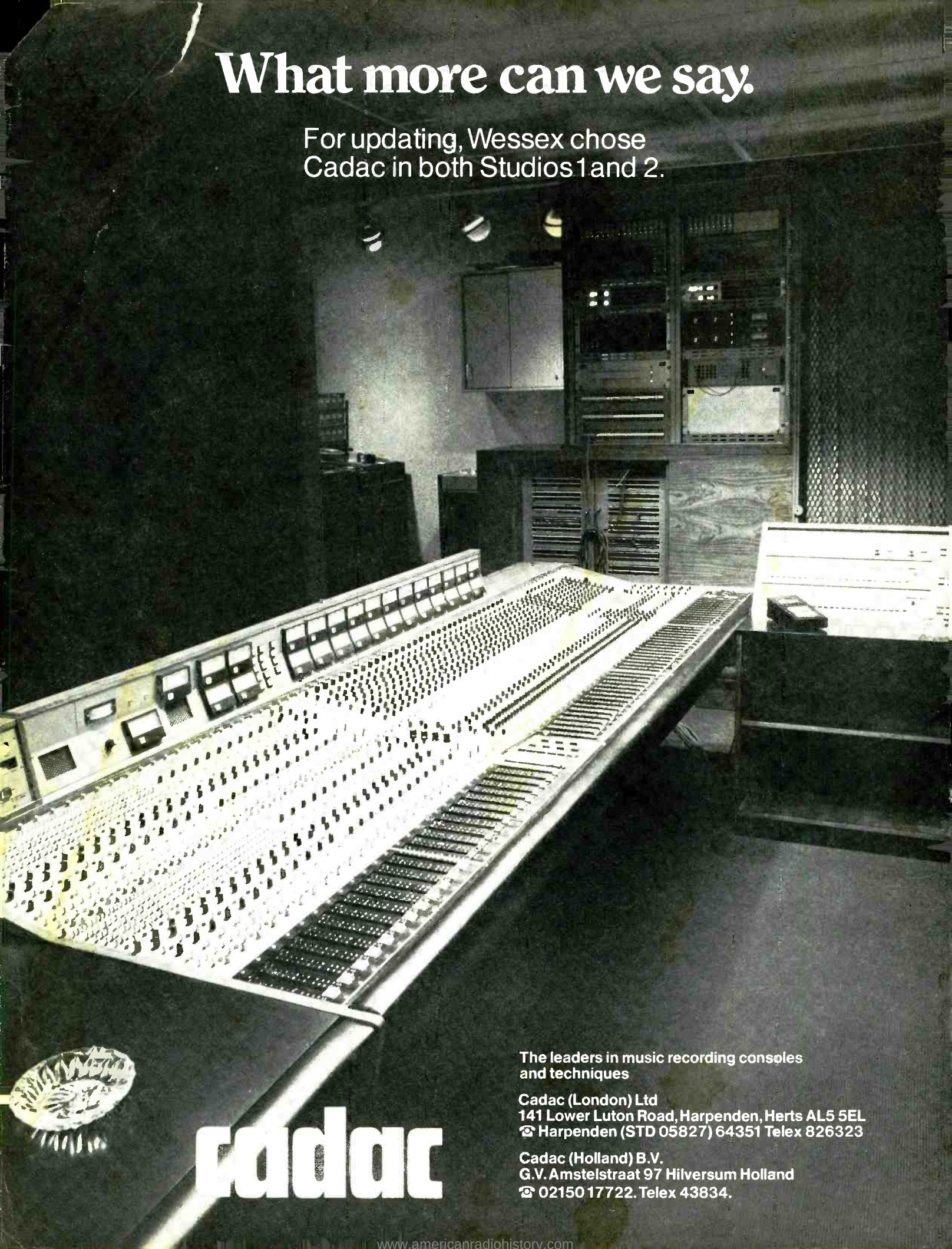

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studio sound

AND BROADCAST ENGINEERING

It's very nearly Christmas and the season of goodwill and over indulgence is once again upon us. For most of the record and recording industry, this means business in the morning, luke warm lager at lunchtime and Southern Comfort in the evening. Not quite Gold, Frankincense and Myrrh but quite acceptable. For those in London and Los Angeles, there are guaranteed to be enough free-for-all Christmas parties to keep everybody in sillies for at least a week, probably longer.

There are other harmonious gestures provided by the recording Godfathers which benefit a wider group of people; the principle of these is the Distinguished Engineers' Audio Federation Dinner, the proceeds of which will benefit deaf people. No one would suggest that binges of one sort or another are given for purely altruistic motives. However, they are probably more open-handed than those of any other industry with any spin-off concerning gentle pr.

It has always been a problem for both new and established studios to spread the good word about. In an industry manned by, in the main, good natured cynics, people tend to fight shy of washing powder publicity; they know that the whiter than white glare is usually a substitute for a workable product. Selling studio time requires the same order of subtlety as the sale of aircraft (not necessarily Lockheed). You can plead technology, economy, performance and airworthiness. In fact almost anything except reputation if it wasn't there to start with. Regarding technology, 24 tracks with automation is more eye-catching than 24 tracks without it, although the end product may be identical. Economy—everyone wants a bargain but it's not always practical to go to the middle of nowhere to get it. Performance. For this, read competence—essential in a resident engineer; however, good freelancers may do most of the work. Airworthiness—pun intended—may not be as important as £15 an hour.

The most important, but by far the most nebulous, is reputation. This can't be bought by Christmas parties, magazine ads or any other sales prophylactic. The most useful aid is a contented client who spreads the word to his friends—the only thing that travels faster round the industry is a bad report.

So at this time of goodwill towards very nearly everybody, lie back and drink the guvnor's Newcastle Brown and Southern Comfort cocktails secure in the knowledge that, if you are being screwed, the chances are that it's being done very gently, with taste and decorum . . . and a merry Christmas to all our readers.

contents

JANUARY 1977 VOLUME 19 NUMBER 1

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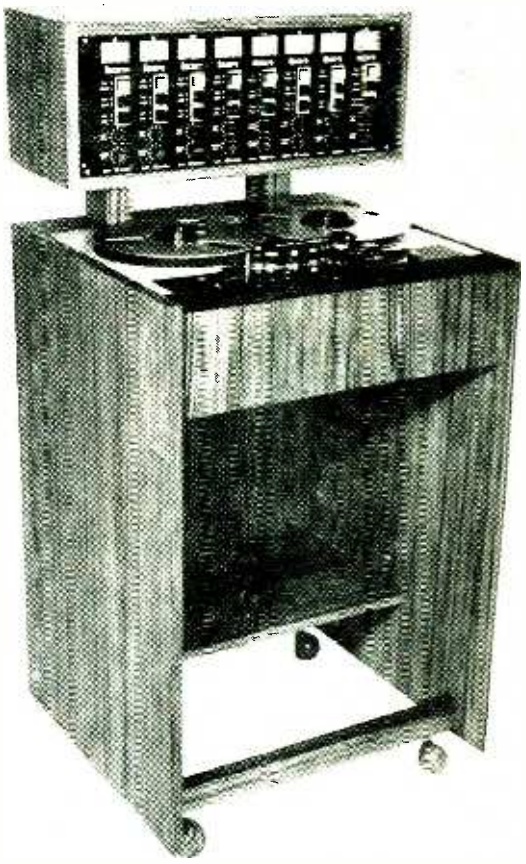

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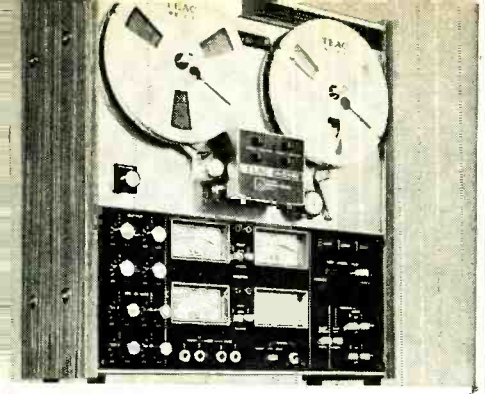

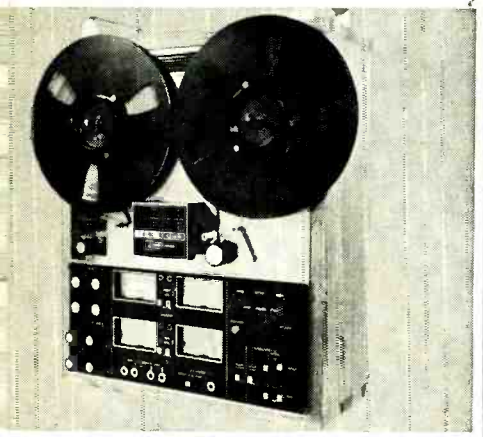

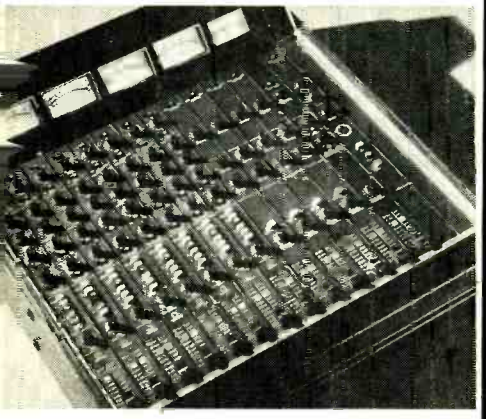

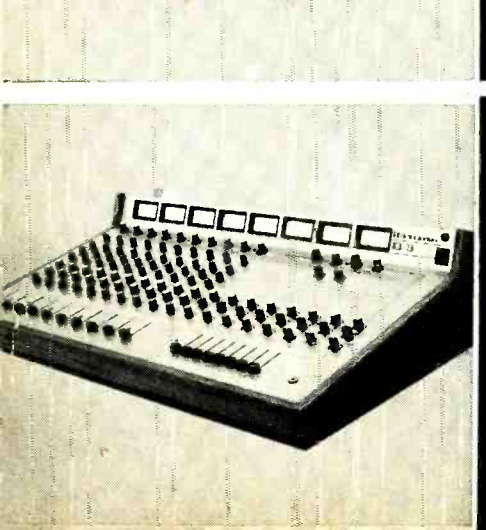

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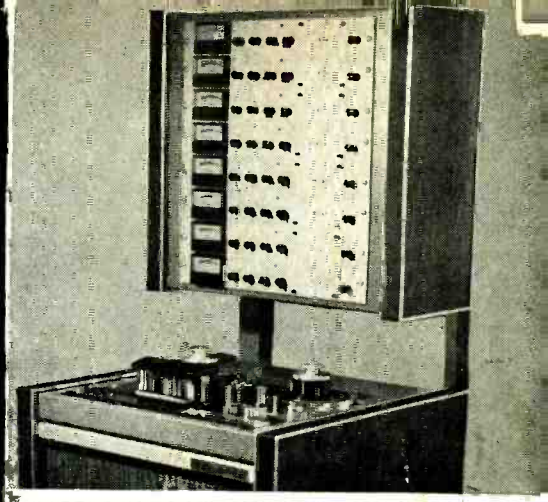

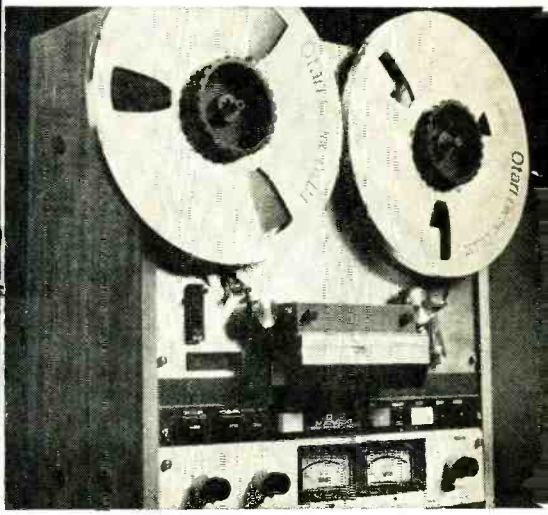

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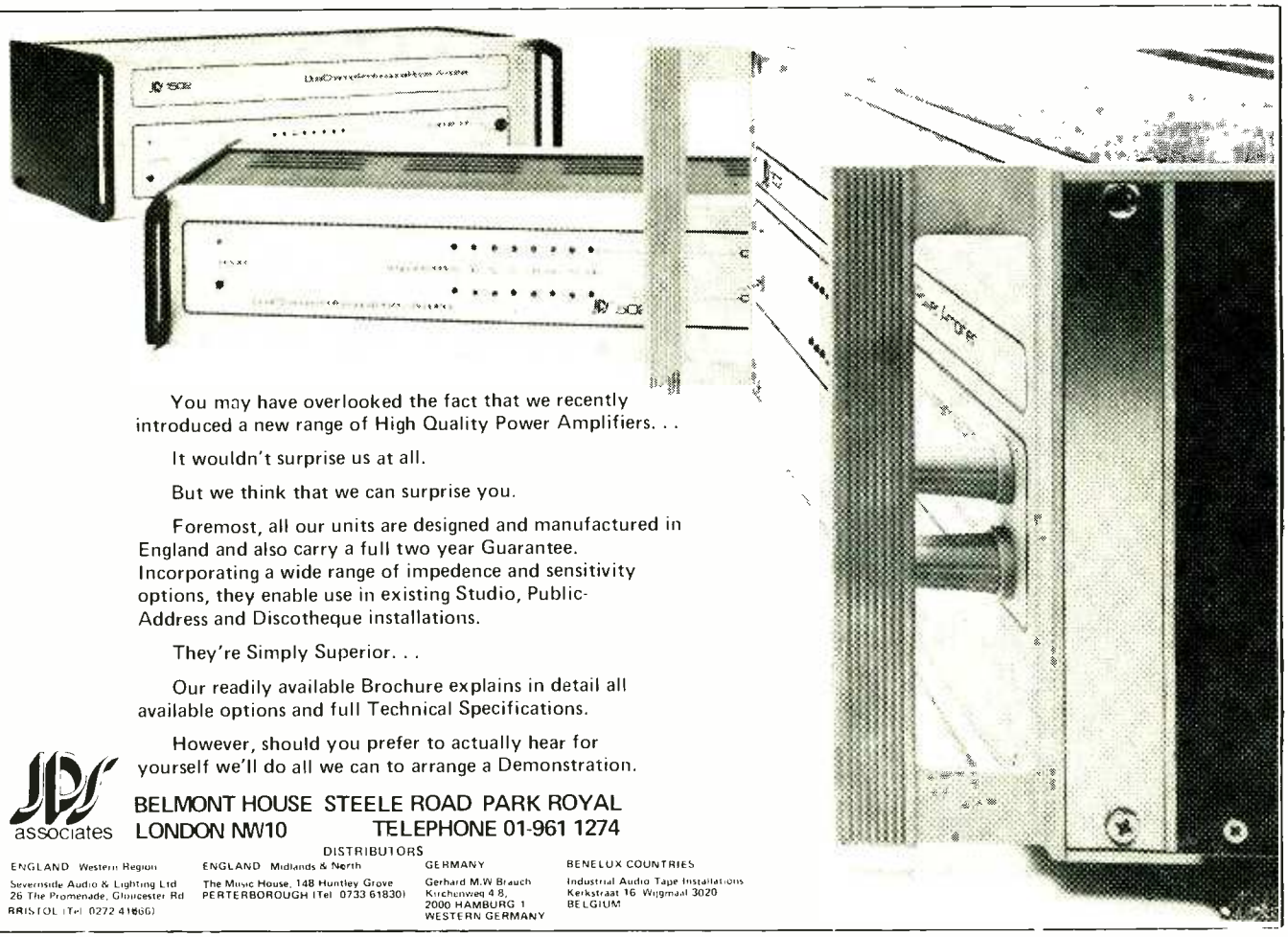

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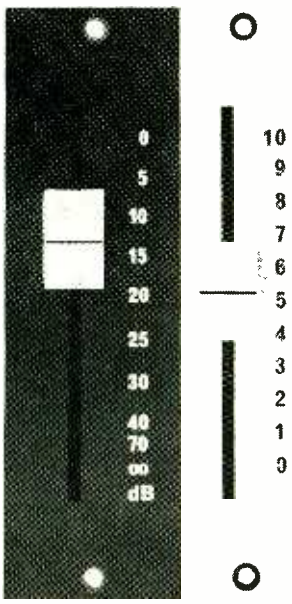

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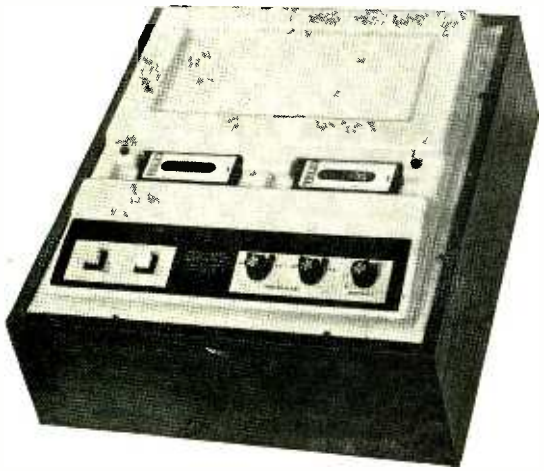

functional versatility, operational simplicity.

The Telex two channel Copier I has earned a reputation for fast, easy dependable use. The new Copier IV now adds the versatility of track selectable, four channel operation.

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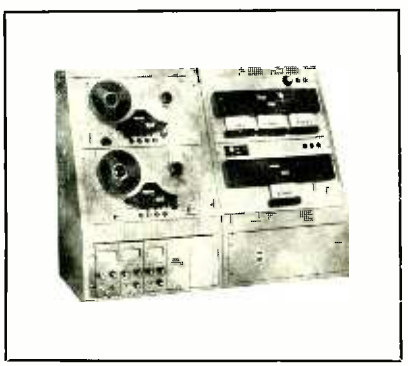
Their compact design and wood grain styling suit the Copiers to desk top use, while optional add-ons can provide up to five copies simultaneously. For higher production capacity, there's the Telex series 300 tape duplicator with modular flexibility to expand as your requirements change.



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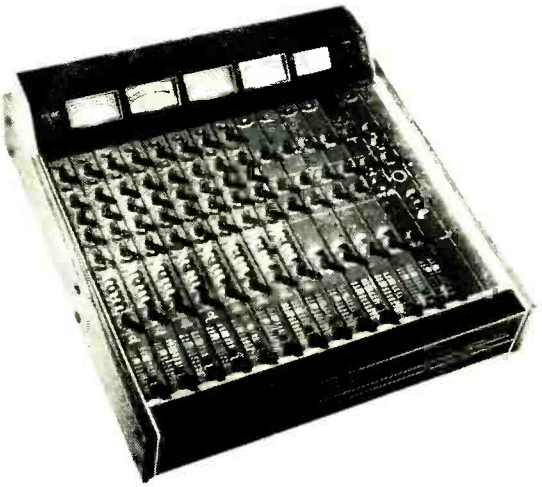

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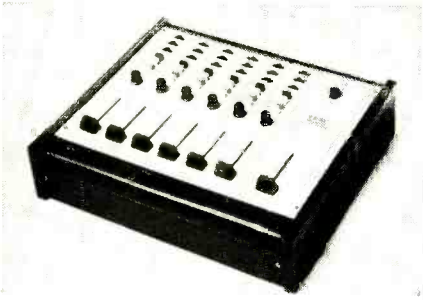

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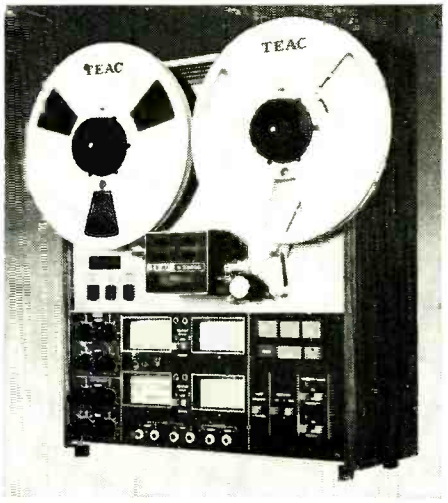

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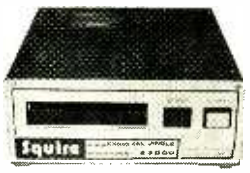

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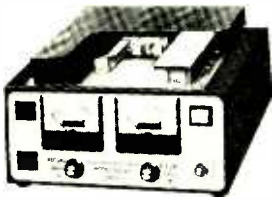

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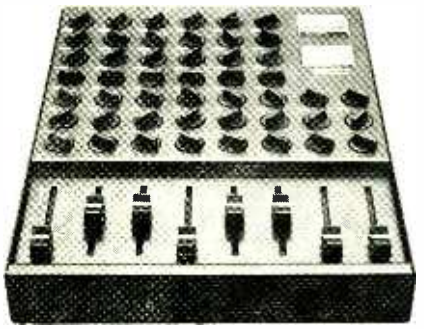

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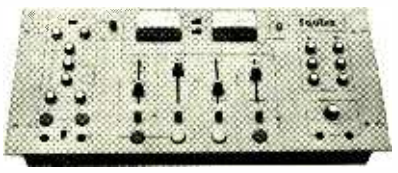

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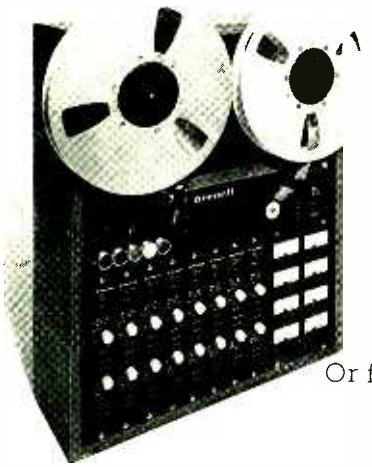

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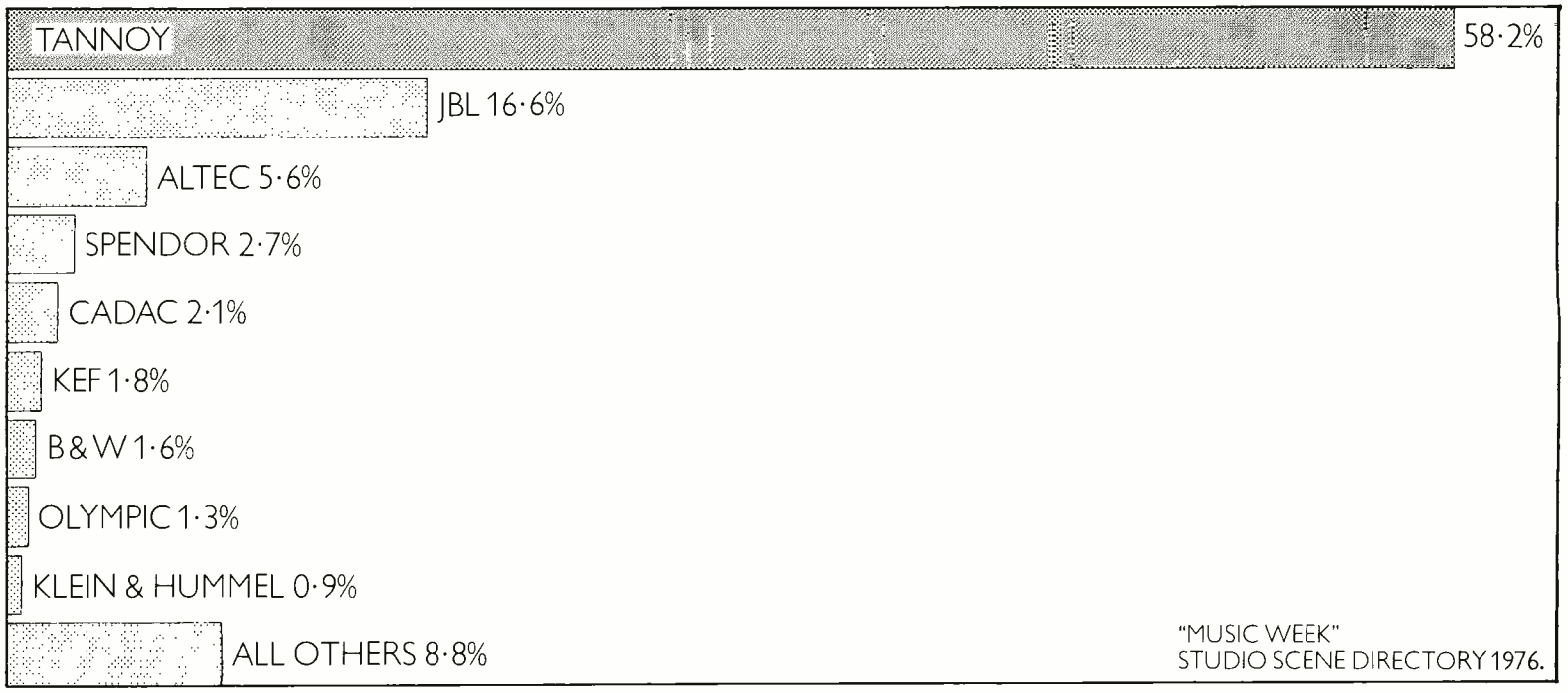
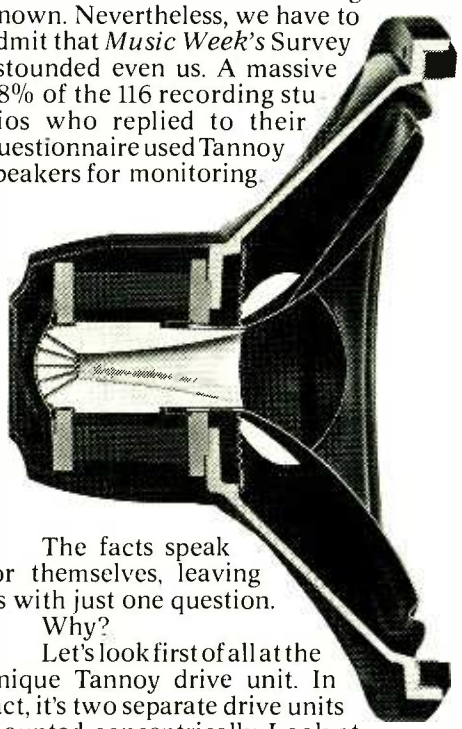
England
Telephone 0723-63298

An independent survey of British recording studios speaks volumes for us.



"MUSIC WEEK"
STUDIO SCENE DIRECTORY 1976.

Among the people who move in those exalted circles, the popularity of Tannoy speakers for studio monitoring is well known. Nevertheless, we have to admit that *Music Week's* Survey astounded even us. A massive 58% of the 116 recording studios who replied to their questionnaire used Tannoy speakers for monitoring.



The facts speak for themselves, leaving us with just one question.

Why?

Let's look first of all at the unique Tannoy drive unit. In fact, it's two separate drive units mounted concentrically. Look at the diagram above.

In the centre is a high frequency compression horn; around it is a direct radiator bass unit – 10", 12" or 15" in diameter depending on the model you choose.

The high frequency unit drives through a phase-compensating throat which ensures that, by the time the sound reaches you, the two units are perfectly in phase. (Tannoy's elegant, 30-year-old answer to a problem which, some would have you believe, has only just been solved.)

Unusually, even our bookshelf speakers combine very high sensitivity (in the Devon, 96 dB for 5 watts at 1 metre) with high power handling.

The secret is the unique Girdacoustic cone (shown above).

The radial struts are carefully placed to stiffen the cone without significantly adding to its weight, enabling it to make larger excursions without break-up. Which, if you know the volume levels used in studio monitoring, is just as well.

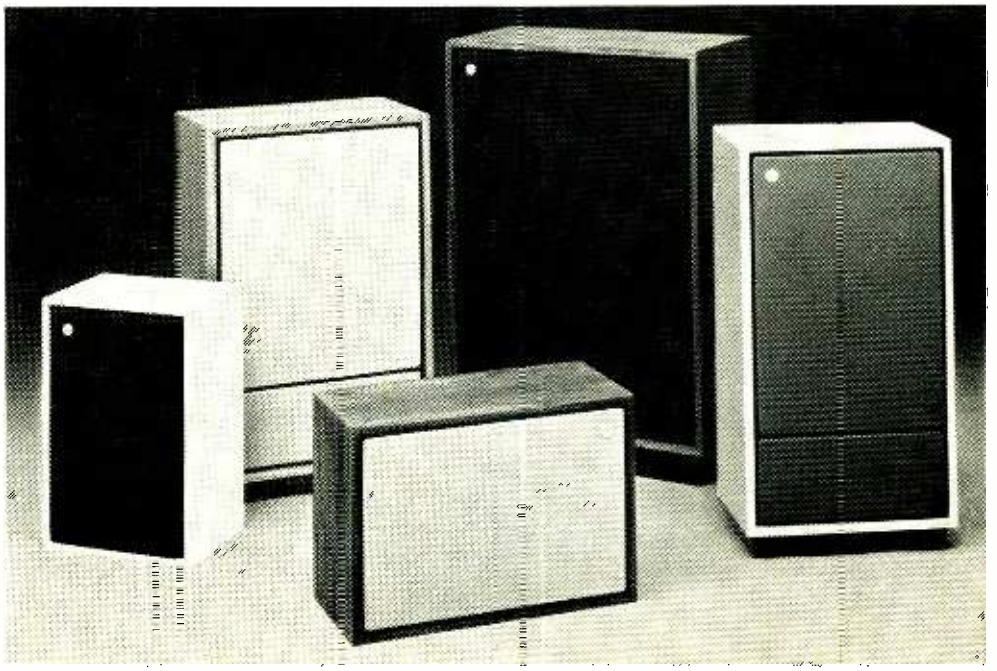
Most remarkable of all, the Tannoy drive units in your local hi-fi shop are identical to the ones in Air Studio's control room.

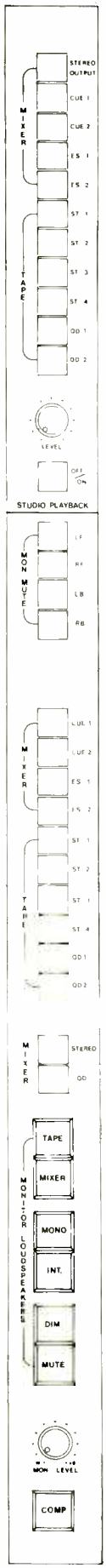
Although we must be honest.

Of the 58% of recording studios who monitor with Tannoys, about a third have them in professional cabinets.

TANNOY®

Tannoy Products Ltd., St. John's Road, Tylers Green, High Wycombe, Bucks HP10 8HR





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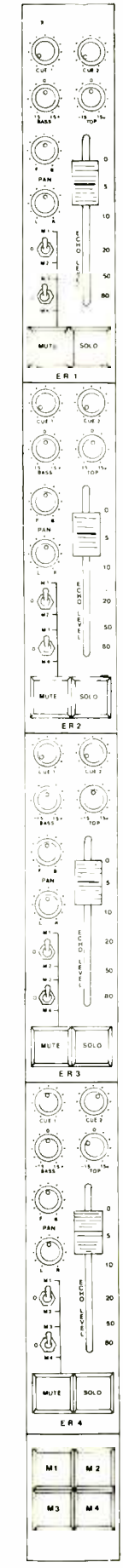

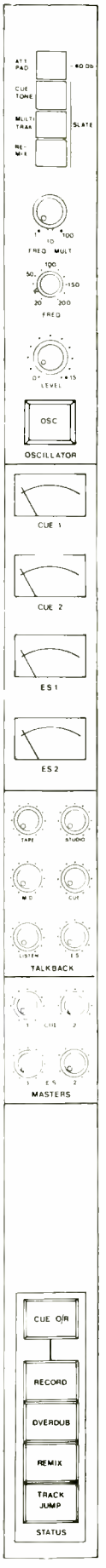

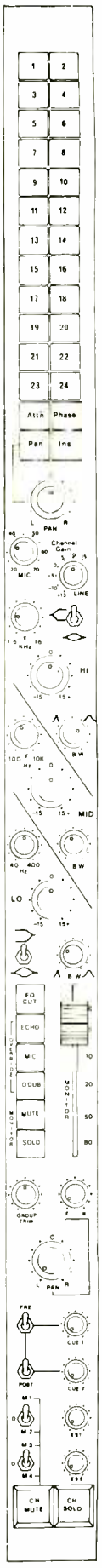

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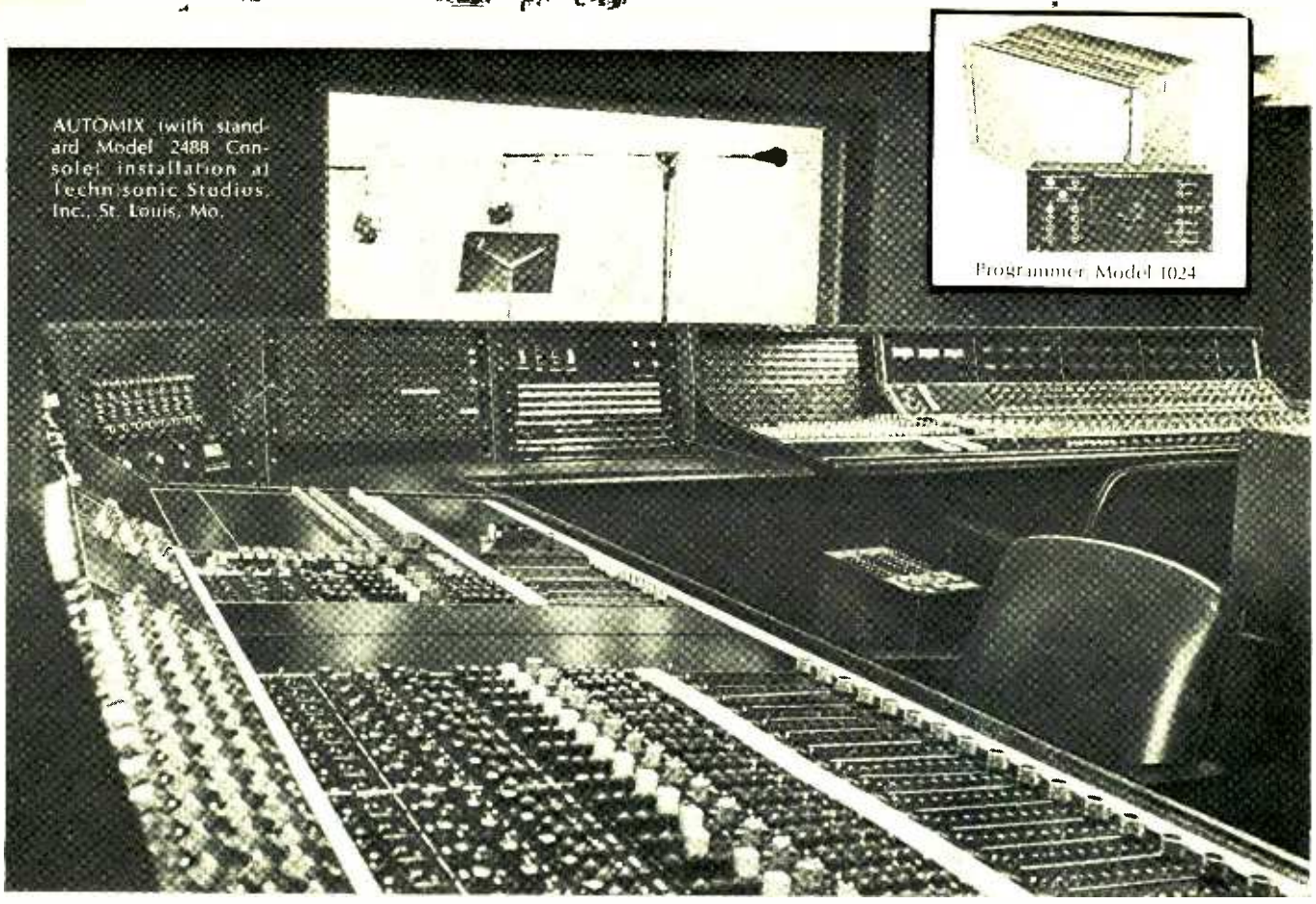

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*THE COMPLETELY PROGRAMMABLE MIXDOWN CONSOLE.

For years, Automated Processes has been anticipating the future by designing and fabricating the most advanced consoles, components and synchronizers for the professional recording engineer.

Now we have combined the incomparable AUTOMIX Mixdown Console with Automated's own Model 1024 Programmer, to bring you total automation . . . a completely integrated system of matching software and hardware capable of extraordinary performance. Yet this ultra-reliable, ultra-flexible system carries a modest price tag.

The AUTOMIX Console captures every nuance and detail of a mix from up to 32 inputs and 4 echo channels. Each element of sound on any track may be improved individually or in combination, and the mix can be repeated as often as desired. Audio paths are isolated from DC control circuits, and voltage control amplifiers and state variable devices provide for all functions . . . level, localization (program and reverb), reverb level, and equalization. AUTOMIX permits optimum artistic capability, giving the mixer total flexibility in improving the mix for each product or media.

The Model 1024 Programmer uses a digital cartridge to store programming information, and therefore requires only one program track of MagLink timecode which will not crosstalk into the program tracks. During playback, data is recalled from the cartridge in sync with program tape or other timing source **with no cumulative time delay** since timing is included in the cartridge data. Data is always retained, together with new data recorded at each updating pass, to permit returning to the previous mix at will. Moreover, up to ten final mixes may be stored for later recall. Spliceless editing between mixes is easily accomplished.

Program tapes made with the Model 1024 are totally compatible from studio to studio, and the programmer can be retro-fitted into present installations.

But the most important Automated advantage is our experience. Why not let us put it to work for you. Contact us for full technical literature. Our staff is ready to discuss your personal requirements.

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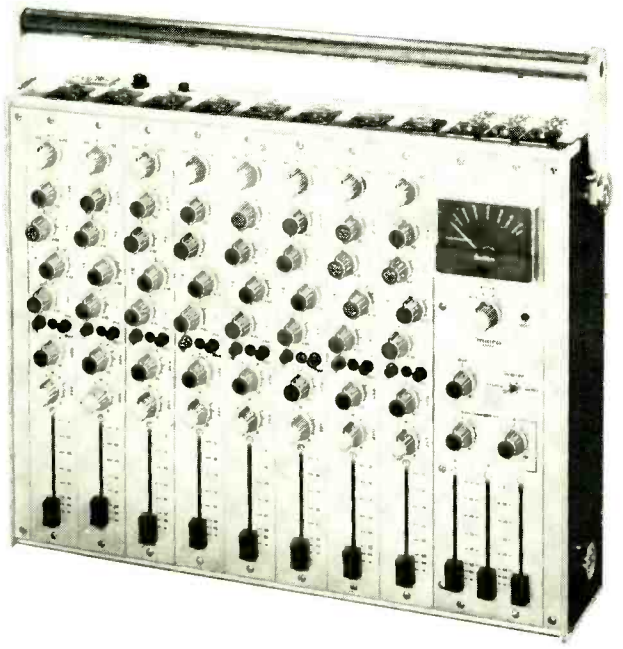

Principal Products:

AD007 MINI Mixer
8/4 battery-powered (with external power option). Modular construction for ease of servicing, MIC or LINE inputs, comprehensive EQ, line up Oscillator, two switched meters and compressor/limiters. Many options including provision for increasing number of inputs to 20 using external unit connected via Extender Socket.

AD031 MICRO Mixer
8/2 1. Generally as AD007 but smaller. Two main groups remixed to give a third—stereo and mono operation at same time. Oscillator compressors, etc are optional extras with AD031 and many others available (including extension).

AD045 PICO Mixer
6/2 powered by rechargeable battery, XLR or DIN versions available. Both with PHANTOM/TONADER mic powering, VU/PPM meter options only.

AD075 SUPER System
Retains most of features of AD007 and AD031 but each module can be used as input or output, facilitating multitrack working. Modules selected as output groups identified by LED numerical indicator. 20 module unit can give 19/1, 18/2, 17/3 or 16/4 working, as well as direct in/out on any module. Very flexible and versatile arrangement.

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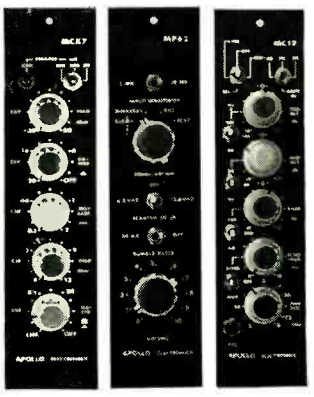

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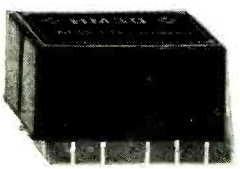

—HM80: general purpose AC control module (with 32 applications free)
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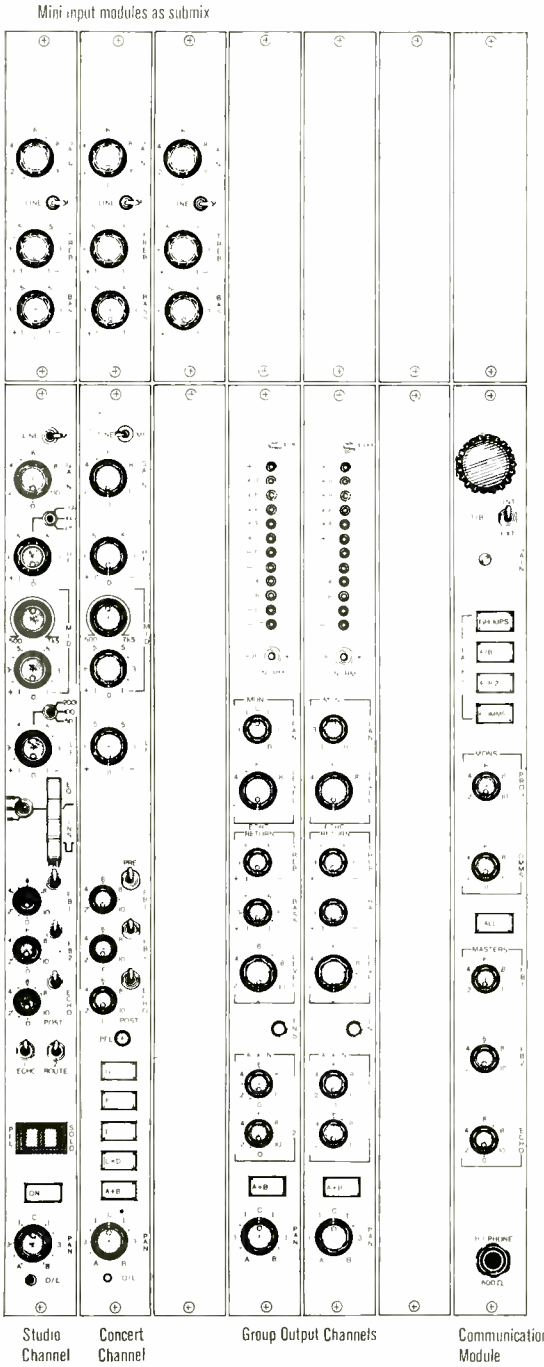
Application data on request/APRS std 22
22 RUE STE AMBROISE-PARIS 75011-FRANCE

An INNOVATION...



INNOVATION is three separate but compatible modular mixers, the Mini, the Concert and the Studio.

INNOVATION is a small mixer, say a 6/2 Mini or anything up to the largest Concert or Studio desk, offering different facilities and prices but all custom made to Broadcast Performance Standards.

INNOVATION is the unique ability to use any module of the three systems in the same frame.

INNOVATION means an end to separate sub-mixers. Mini input modules installed in the upper frame can be mixed via a pin matrix in any combination and patched anywhere in the main system.

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INNOVATION means an end to mysterious overloads, both Studio and Concert channels have LED'S which begin to flash 5dB before clipping and remain on for several seconds after overload.

... truly an INNOVATION

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The Amcron Story

1967

1977

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

The DC300 set new standards of sound reproduction never previously available for bands or studios, let alone the Audiophile (whoever he is). Coupled with the incredibly rugged construction, and small size of this 600 watts amplifier, it is not surprising that the DC300 became a legend in its time.

The designer of this classic is still in charge of the design work at AMCRON despite rumours that he has moved on to at least five other establishments! Indeed, he has since been responsible for the DC300A, the D150A and all the rest of the AMCRON range of superb power amplifiers.

Now in 1977, the DC300A is 'the' amplifier in all the world's recording studios and is still the only choice for bands such as Zeppelin, Jethro Tull and the Moody Blues, plus quite a few others such as Wings, the Stones, the Rollers, Elton John, 10c.c., Pink Floyd, Barclay James Harvest, The Real Thing and so on . . .

Perhaps this is because the DC300A amplifier offers the following features:

★ Total Harmonic distortion at full power, 1Hz-20kHz below 0.05%

★ I M distortion 0.01 watt to 150 watts into 8 ohms below 0.05%

★ Hum and Noise better than 110db below 150 watts

★ Power Bandwidth +1 db, —0 db from DC to 20kHz at 150 watts into 8 ohms

★ Full 3 year warranty on parts and labour

★ Patented Crown Protection Circuitry requires no circuit breakers or relays

★ Designed to operate into load impedances as low as 1 ohm

★ Manufactured by a company founded in 1946 and represented by the MACINNES people continuously for the last ten years!

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Solidly constructed modular self powered mixer with features that make it the ideal self contained control console for 4 and 8 track applications.

* Switchable mic/line inputs, variable sensitivity
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* 4 way logic pan routing and direct out on all inputs
* Peak LED indication on inputs and out puts
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* Separate studio feed with built-in headphone amplifier for cue and programme
* Built-in line oscillator
* Insertion and mixer bussing connections on rear. Microphones on WLR's
* Extensive cue and echo circuits with switchable level meter
* Optional talkback with built-in micro-phone, slate tone and power amplifier

MODEL 3

Three mixers in one, make this console equally suitable for programme production multichannel recording and PA.

8 by 4—features switchable mic/line inputs and equalisation, logic pan routing, direct channel outputs, four gang master fader and VU metering with LED peak indication. Insertion points are provided and 4 inputs are switchable for RIAA sources.

8 by 2— line mixer, normally connected as the echo/foldback mixer for the main system, can be repatched for further inputs complex monitoring or distribution.

4 by 2—simple fine mixer, headphone output normally connected for main system monitoring, but can be repatched for external sources.

TEAC

TASCAM SERIES

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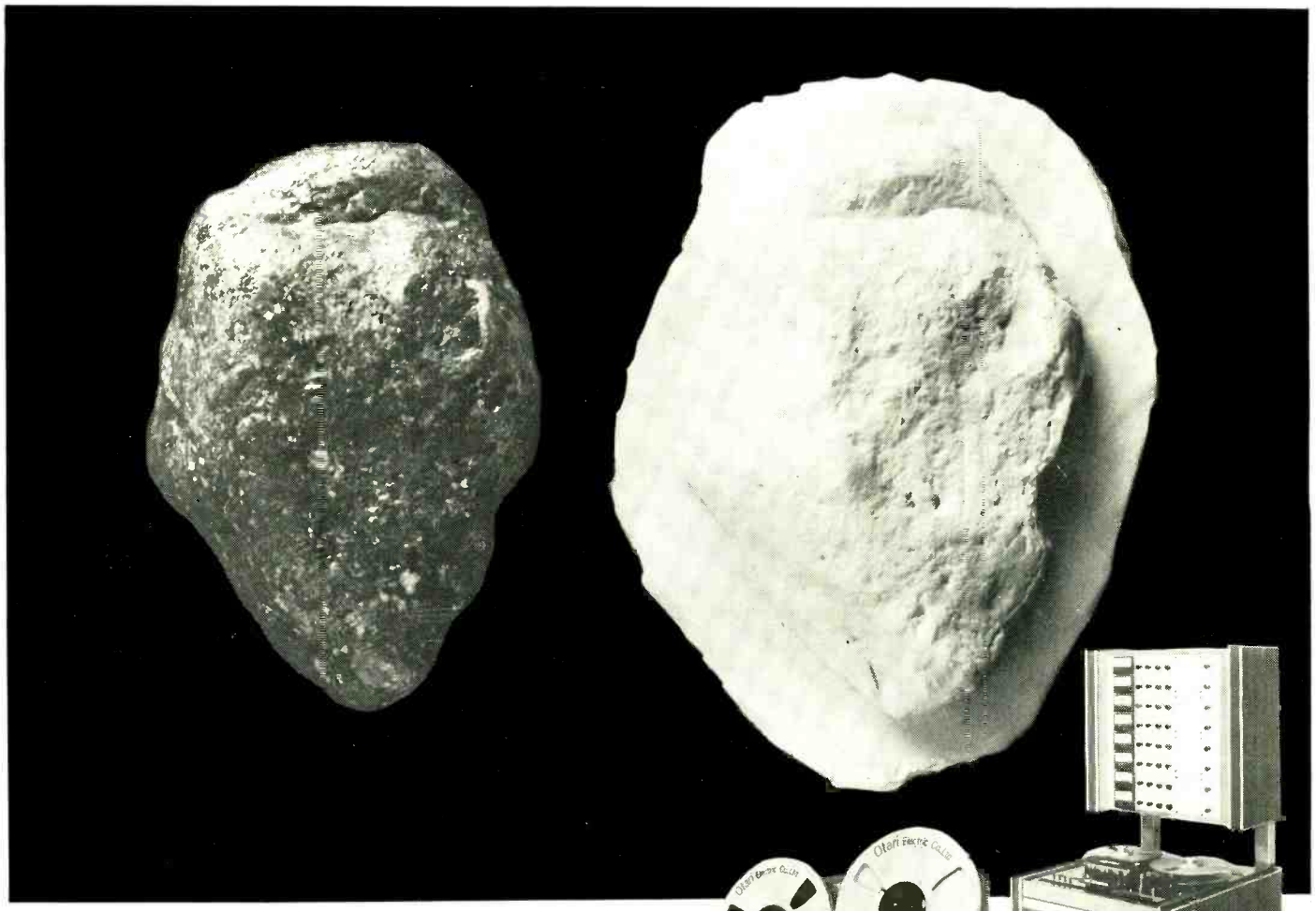
once is enough!



MX-5050-2S MX-7308

Perfect reproduction stems from creating a perfect system and then recreating the memory contents exactly. A plaster cast makes a fairly good replica of an original, but it is far from perfect. To improve the replica, you must improve the cast. It is the only way.
At Otari, it is our fundamental policy to plan on the basis of creating extremely accurate, highly precise data recorders and duplicators. Only by concentrating in this way on the heart of the duplicating process can we provide products which fill the professional's need for the most perfect reproduction of live sound that is possible.

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news

Education

The College for the Recording Arts, San Francisco, has received an accreditation from the National Academy of Recording Arts and Sciences in a letter to the College from NARAS president, Charles Suber. This represents a stamp of confidence and a seal of approval to a school for recording engineers, founded by Leo Kulka two and a half years ago.

The CRA is owned and operated as a tax exempt non profit making organisation; a recent survey claims that over 85 per cent of its graduates have active jobs within the recording industry, many being with major companies. The subjects taught include studio operations and engineering, music for the engineer and producer, legal aspects of the recording industry and general business methods. An introductory electronics course stresses equipment maintenance while a disc cutting course provides insight into the finished product. A special course in synthesisers offers information on specialised technique to would be record producers. There is said to be practical exercise as well as back up theory.

Of his college, Leo Kulka said: 'The uniqueness of this institutional experience is greatly responsible for the success of the students. From the day they enter the school, they are working and functioning in a professional environment — a commercial recording studio. Their instructors are all people who make a successful living in the subjects they teach. Consequently, it is not 'yesterday's' information, but what is happening today that the student absorbs and gets constantly exposed to. Projects of an investigative nature ranging from recording to marketing, distribution, promotion and finances occupy the student's entire life.'

The College for the Recording Arts, 665 Harrison Street, San Francisco, Ca 94107, USA.
Phone: (415) 781 6306.

Eastern promise

Keith Monks (Audio) Ltd, having recently exhibited at the British Marketing Centre in Tokyo together with 19 other British audio manufacturers, told of 'considerable enquiries and substantial orders' received in the course of the exhibition. Keith Monks' products include record cleaning machines, pickup arms, other turntable accessories and microphone stands.

The trip resulted in the Tosy Corporation being appointed sole agents in Japan, while a similar arrangement has been agreed for Revox (Hong Kong) for the Hong Kong area.
Keith Monks (Audio) Ltd, 26/28 Reading Road South, Fleet, Nr Aldershot, Hants.
Phone: 02514-7316.

New products from MicMix

There are several new products from this company:

The *Time Warp* uses an analogue delay to provide up to 100 ms of audio delay in three ranges, continuously variable. In addition, the *TW-1* can produce many special effects including vibrato with control of both rate and depth of deviation, while an external input can offer pitch change.

It also offers an effect called *Polytone*. This produces frequency deviation corresponding to a musical scale, and there is recycling capability with continuously variable control from zero to oscillation on all time ranges for slapback echo and reverberation effects, as well as flanging and adt. The unit claims to offer an 80 dB dynamic range. Price $1195.

The *Master-Room* type *C* reverberation unit has undergone an update in the control aspect of the unit. Designated *Super C*, it offers 3-band eq covering the most useful parts of the audio range as well as variable decay. These facilities were not incorporated in the model which it replaces.

The third new product is a dual channel bar column level meter which indicates over a 55 dB dynamic range. The characteristics are front switchable to either vu or ppm. Further, it incorporates two way routing to remote calibration sources to increase system flexibility — there is sensitivity increase of 10 dB when switching from ppm to vu to facilitate comparative readings from the same source. Price: $595. MicMix Audio Products Inc, 9990 Monroe Drive, Suite 222, Dallas, Texas 75220, USA.
Phone: (214) 352 3811.
UK: Scenic Sounds Equipment, 27/31 Bryanston Street, London W1H 7AB. Phone: 01-935 0141.

MicMix Timewarp

Cadac automation module

Cadac has released advance details of its voltage controlled attenuator, *V-Cat*, which will form the heart of the new automation system due for release soon.

The device, a thick-film hybrid, claims a performance advance on all current electronic attenuators available from any source. It works by sinking current proportional to the degree of attenuation required; with zero control current, it simulates a 15k ohm pot at minimum attenuation (0 dB ±1). At a control current of 1.2 mA, gain is −10 dB with a corresponding noise level of −102 dBV. 2.4 mA gives an attenuation of −20 dB at a noise level of −104 dBV. Terminal attenuation exceeds 90 dB with a corresponding noise level of −105 dBV. Cadac states that the distortion at any output level to −22 dBV will not exceed 0.05% at any frequency between 10 and 10k Hz. Power requirement is ±22V.

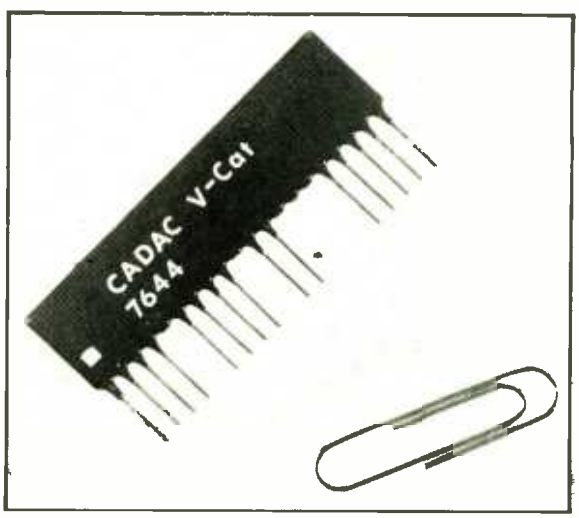
The device is housed in a 20-pin single in-line package, 51 x 14 x 4mm. Cadac (London) Ltd, 141 Lower Luton Road, Harpenden, Herts AL5 5EL.
Phone: 05827-64351.
US: Cara Pacific Sales Co, 3050F Via Alicante Drive, La Jolla, Ca. 92037.
Phone: (714) 452 0813.

Review blunder

Bach-Simpson have asked us to point out that they do provide vu meters strictly to the *ASA C16.5-1954* spec, contrary to the impression given in the September issue of the magazine. The review concerned a model with a white scale background rather than the official yellow/cream colour. If you want the bona fide article from Bach-Simpson, then there should be no problem.

Output meter

The *1810A* audio output meter from GenRad offers power measurement from 0.6 to 32k ohms over the range 0.1 mW to 20W. As such, it is primarily intended for use in balanced line applications and signal level situations. The makers claim that the unit will indicate



Studer A68

true rms with as much as 20% second and third harmonic present. Power measurement accuracy is stated to be within 1 dB between 30 Hz and 10 kHz. The maximum power rating can be extended with indications provided from a long scale meter.
GenRad Ltd, Bourne End, Bucks. Phone: 06285-26611.

Survey boobs continued
It would appear that our survey of studio consultants—August 76, p34—raised yet another misapprehension.

Colorado Nashville Inc reported that they specialise in ElectroVoice *Sentry* loudspeakers rather than the equivalent JBL unit. Bone of Contention took issue with the guarantee for the JBL units. CN offers clients the latter on a sale or return basis while they retain the full guarantee offered by JBL. The original survey suggests that if anything was wrong with a JBL loudspeaker purchased from CN, then nothing could be offered from that firm to rectify the situation.

Don't believe everything we print . . .

Industrial furniture
Actually, we aren't hard up for relevant guff to fill this column; the correct choice of furniture (which takes in chairs, tables, equipment racks, trolleys and sedentary software) for use in recording studios is awfully important. Therefore, you might need the new 32 page catalogue from Kaymar Industrial Furniture Ltd, Brookhill Road, Brookhill Industrial Estate, Pinxton, Notts NG16 6NS. Phone: 810107.

Studer power amplifier in UK
The *A68* power amplifier has been available to other markets for a considerable period of time but has only recently become available in the UK. It offers 100W/channel into 8 ohms, claiming under 0.1% thd at all power levels. The manufacturer states that the unit is fully protected, both thermally and short circuit, by continuous power dissipation monitor and scr crowbar. Overall signal-to-noise ratio is quoted as better than 100 dB. Price £515. FWO Bauch Ltd, 49 Theobald Street, Borehamwood, Herts WD6 4RZ. Phone 01-953 0091.

Milan—hopeful signs
The 10th Salone Internationale della Musica closed its doors leaving the instrument manufacturers with a general upturn in orders; it is stated by the organisers that many had done more business than was expected.

On the international side, most deals seem to involve Europeans, predominantly West Germans, French, English and Swiss. Interest centred mainly on organs, guitars and wind instruments—these are all areas where the Italians possess a large manufacturing capacity. Naturally, it is difficult to forecast business predictions in the short term from a single show; however, transactions appear to have increased 40% over last year in spite of the lack of activity from the US market.

Similarly, the hi-fi sector, which the show also represents, reported an increase of 50% in turnover compared to SIM 75 — after inflation, this means an actual increase of about 30%.

Which centenary?
1977 promises to be a bumper year for the audio engineer and enthusiast; it's the centenary year for the invention of the gramophone and thus the whole business of recorded sound. Already there are signs that it will be enlivened by some acid disputes and squabbles over who exactly invented what first, where and on exactly what date. 28 ▶

NEWS

In France, they will almost certainly hang out the flags in April, to commemorate the deposit at the Academy of Sciences of a sealed packet by one Charles Cros (pronounced 'Crose' by some curious logic). The packet contained details of a photomechanical sound recording system devised by Cros but apparently never actually made to work. Some people say the packet was deposited on April 10, but April 30 is more likely the correct date. In any event, it remained sealed, on mysterious instructions from Cros, until December 3. This was three days before December 6 which the Science Museum in Kensington, London, is taking as the anniversary of the gramophone. For it was on December 6, 1877, that Edison shouted 'Mary had a little lamb' at an unsuspecting cylinder phonograph, which then surprised everyone by echoing back the same words in super-lo-fi.

Unfortunately, the Science Museum (despite the presence on its staff of Mr V. K. Chew, an authority on old recording machines) is able to mount only a token exhibition. One reason is that the Museum has all its designers tied up with another exhibition to commemorate the Queen's Jubilee Year. Another reason is that the Royal Scottish Museum in Edinburgh is mounting a full-blown exhibition on sound recording, to coincide with the Autumn Edinburgh Festival. As any British exhibition on recorded sound must inevitably rely heavily on the EMI collection, no two museums could mount competitive exhibitions at around the same time. Ideally, of course, the Royal Scottish display would simply be moved *en masse* down to Kensington from Edinburgh after the Festival, and if this isn't done it will be a tragic lost opportunity. So will the Kensington powers that be please take time off from preparing the Queen's Jubilee bonanza to organise the logistics of co-operative exchange of the Sound Centenary display before it is too late?

Sadly, neither Scotland nor London will see the original Edison tinfoil phonograph that was once proudly exhibited at the Kensington Science Museum. This was originally a gift from Edison but, as the 50-year anniversary in 1927 came close, Edison decided that the gift to England had in fact been a loan. To prevent what was in danger of becoming an international incident, the prototype was eventually ceremonially handed back to Edison by a *Chargé d'Affaires*, with whom the passing buck had finally stopped. Incidentally, the legend that the original machine was brought over to England to satisfy a query by the British Patent Office is untrue. Whereas the USA Patent Office once demanded working models of mechanical inventions, the British Patent Office has always been prepared to take an inventor's claims on trust until proved otherwise in the courts. **Adrian Hope**

Trident equaliser

Trident equaliser

The company has released details of a new three-section parametric equaliser with additional parametric hi and lo pass filters in a rack mounting format. Extract from manufacturer's specification:

Centre frequencies (equaliser): 60 to 700 Hz, 600 to 7k Hz, 3.5k to 14k Hz.

Control range: continuously variable ±16 dB; bandwidth 2 dB to 18 dB/octave.

Filter slope: 0 to 22 dB/octave.

Signal interface: 0 dBm nominal, unbalanced; drive capability +24 dBm.

Distortion: less than 0.05% thd at max output.

Trident Audio Developments, 112/114 Wardour Street, London W1V 3AW.

Phone: 01-734 9901/6.

US: Audiotechniques Inc, 142 Hamilton Ave, Stamford, Conn 06902.

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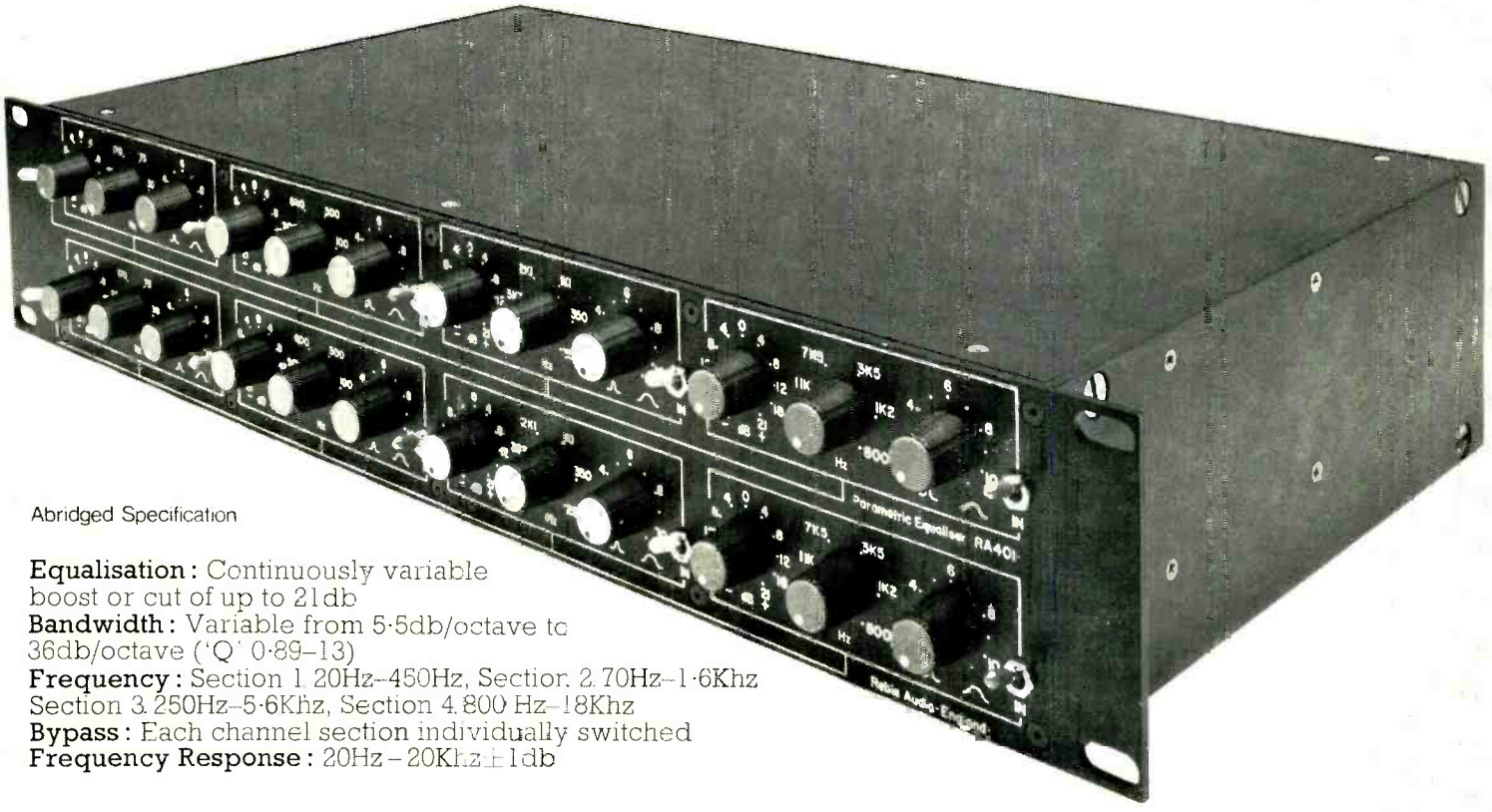

Abridged Specification

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Bandwidth: Variable from 5·5db/octave to 36db/octave ('Q' 0·89–13)
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The economics of multitrack recording

DAVE HARRIES *

Multitrack techniques employed in the majority of recordings satisfy most of the technical and artistic requirements. However they are, in essence, remarkably uneconomic from most points of view.

*AIR RECORDING STUDIOS

IN today's depressed disc market, is it not possible for the rapidly accelerating snowball of technical wizardry to result in a financial 'dropout' when one compares the ever-decreasing record buying public with the very latest self-winding, self-seeking, self-mixing 32-track tape machine manufacturer ?

Are the 'back to mono' badge wearers right? Should we continue to increase our facilities or should we return 20 years to the day when one could record four tracks and produce a couple of number one hit singles all in a three hour session?

Has the 'advantage' of multitrack been advantageous or would we all be better off without it? Assuming that the record industry has its share of shrewd businessmen how was it possible that multitrack did in fact arrive, seeming to be here to stay? This article is an attempt to show that the present-day situation is the product of certain forces being brought to bear on our highly competitive industry by both manufacturers and artist/producers. The financial burden, however, caused by these forces has fallen squarely on to the shoulders of recording studios and record companies alike. Meanwhile, the implications for the sound balance engineer are such that he finds himself in a pig-in-the-middle situation attempting the difficult task of justifying the latest fashionable development in sound recording techniques.

Present-day multitrack technology began its development in the early sixties. At that time mono and 2-track tape machines strived to serve the vast appetite of record lovers in recording studios that were relatively simple and economic to run. Equipment was far less sophisticated and, in general, much larger than today.

REDD 37 mixing console *Photo: Gerry Kelly (EMI Studios, Abbey Road)*

It would certainly have been very uneconomic from a space point of view to construct a 24-track studio with the size of equipment that then had to be contended with.

However, it soon became apparent that two tracks were no longer sufficient. While overdubbing could be achieved by doing transfers, 2-track to 2-track, this was not good technically and resulted in a substantial loss of quality with each stage. Who was it, then, that thought of the idea of keeping the two original tracks complete and providing a third track on which to overdub? The multitrack was born, and this was the turning point of pop recording. The 3-track machine, closely followed by the 4-track, opened up new worlds to performer, producer and engineer alike. This new tool was to change the outlook of everyone concerned with the making of gramophone records. It was to develop in leaps and bounds. First from three and four tracks on both 12 and 25mm tape to eight tracks on 25 mm tape, progressing naturally to 16 and 24 tracks on 50 mm tape. All this in a mere 15 years. It had previously taken over 50 years to achieve stereo. One may then ask what is tomorrow going to bring.

The question is posed as to whether or not studios can keep up. The development of multitrack facilities has caused many a heartache in the recording studio world. With each new step, be it an increase in trackage or added facility of any sort, the studio must find the money to be able either to keep ahead or in step with its competitors. If on the other hand the studio management decide not to update, this could very easily lead to the loss of its favourite clientele. A studio can choose to stay behind its competitors and rely on older equipment most of which can be purchased fairly cheaply second-hand, but naturally, the basic hourly charge has to be reduced to a proportionate level to enable it to attract business. Of course, older equipment can be updated to a certain extent, particularly in the case of mixing consoles. Since they are, in general, modular, no difficulty is presented in adding chunks of additional circuitry to achieve the desired trackage. Tape machines are somewhat less easy to update, unless one happens to be the proud owner of a current machine; the manufacturer is able to supply kits of transport components, head blocks and electronic modules, etc. However, whatever method of updating is chosen, the cost is bound to be proportional to the increase in facilities.

Thus, it is quite possible to increase the track capability of a studio without incurring high capital expenditure. The major advantage of updating equipment by the above method is that the costing can be spread over a long period of time, and is usually essential for the smaller studio that has to re-invest its profits for the purchase of capital equipment.

The expense of re-equipping any studio, be it large or small, must be justified by the requirements of the time. In the case of an increase in the track capability of any one studio complex, several factors enter the argument. These are primarily:

1. To keep ahead of competitors;
2. To update ageing equipment;
3. To satisfy clients' requirements.

These three are usually combined in the case of a complete reinstallation of studio equipment; it is generally the policy of the larger studio to change and update its facilities at one and the same time to reduce the shut-down period and installation costs. Naturally, the studio should be shut down for the shortest possible time during which the majority of equipment is replaced and re-wired. At the same time the building finishes are renewed along with new carpets, redecorations etc. In a one-studio complex, down time can be very expensive—as well as producing no incoming revenue to run the studio, clients have to be turned away to record elsewhere. Calamity! Your client likes his alternative venue and fails to return. These are just two of the possible hidden costs one should consider when deciding to make alterations involving close-down of the facility.

New equipment is very expensive, but it is interesting to note that tape machine manufacturers have managed to keep down the cost of current equipment. In 1970 a 16-track machine would have cost approximately £16 000. Today, however, the current model by the same manufacturer and with 24 tracks costs only £2000 more. It could be mooted that the manufacturer was over-charging in the first instance, possibly through underestimating the size of the market and thus spreading his development costs over too few machines.

The purchase price of a tape machine is not proportional to the number of available tracks, ie track for track the twin track version of a particular machine is far more costly than its 24-track counterpart. There are several common cost factors to account for this:

1. The development cost is common to each machine.
2. The tape transport mechanics vary only by the required height of rollers, guides, etc.
3. The machine logic circuitry.
4. The case.
5. Equipment transportation and storage.

The price of the modern sound mixing console is almost directly proportional to the facilities offered when considering any one manufacturer since many of today's desks are tailor-made to the studio's own requirements. Most manufacturers can produce any combination of modules, faders, meters, frame shapes, etc, to suit today's vast needs. The mixing console, while still basically an extension of those available in 1960, can provide extreme flexibility by virtue of its construction. Development costs in mixing consoles are kept relatively low because most are constructed on a brick by brick principle. These basic bricks are fairly cheap and easy to build and it can be shown that a good console manufacturer can keep the engineering and designing costs of a custom-made mixer down to approximately ten per cent of the total. Many of the components are stores items such as microphone modules, switching modules, eq modules, faders, jackfields and so on—all standard components, each one costing a predictable amount. Further disproportionate costs must be added. The desk wiring buss bars etc are very intricate and can occupy a great deal of time and space. The main frame assembly must be of massive construction to support the vast weight involved. To these components, some tailor-made panels containing monitor switches, talkback circuits, etc are added. Finally, the power supply, which by virtue of its job must be extremely reliable, and is by way of necessity usually mounted remote from the main console. The above items constitute the major costing of a modern mixing console.

So the updating process goes on, costing more and more each time, and added to the increased cost of buying a new tape machine and mixing console are more hidden costs. The technological improvements over the past few years have both added to and subtracted from the previously discussed costs. For example, a large control room is now necessary to house all the equipment. Besides the basic multitrack machine the studio must make room for other stereo machines to cover all aspects of the mixing programme. During a remix session several machines are employed to perform different functions, as well as record the final master mix. Tape echo, double tracking effects and phasing are just three uses which spring easily to mind, each function by necessity being performed by a different machine.

Think back then to 1960. Picture a control room complete with a mixer with maybe eight basic inputs and two or four outputs plus possibly two tape machines and one or two loudspeakers. What then has multitrack brought us? We now need a vast mixing console stretching in some cases almost completely across the control room, four or five tape machines, racks of noise reduction equipment plus four giant loudspeaker cabinets, all of which occupy space which is not only difficult to find but which is also very expensive in terms of annual rental. Technical development has helped here somewhat. Because of modern construction methods and miniaturisation of components, a great deal can now be crammed into a small space. There is a limitation here though as people are still required to operate and maintain all of these goodies. Therefore further miniaturisation is not desirable or possible.

Current technical installations are vast, and specialist staff are required to complete the job within the installation framework. Literally miles of audio wiring are required and a team of competent engineers will usually need to work day and night to see the job completed on time. There are, of course, companies which

24-track tape machine

specialise in the design, construction and installation of the complete studio and control room. Some will complete the whole job from start to finish, thus relieving the studio management of the task of finding sufficient staff for the period of time required. This is probably the best for the smaller studio, but the result may be expensive. There is also the chance that the studio installed in this fashion may become very similar to others, the basic design having come from the same source. The services of a consultant should be considered since their knowledge of both merchandise and techniques is invaluable to the studio owner who does not have the available resources within his organisation.

Regarding the studio owner I have discussed the basic cost of reorganising a studio for today's multitrack needs. Where do we go from here? The studio must make the equipment work to be able to pay back the cost of the installation. The first need is to sell the old equipment. It is interesting to note that the average mixing console will hold its price extremely well in the secondhand market. Less, however, can be said of a tape machine and can be attributed to two main reasons. The cost of producing a mixing console increases annually, in line with inflation, so if one compares the price of a current mixing console with that of one of similar specification built five years ago then the price will be approximately twice as much. A tape machine over the same period would not have increased substantially in cost even though it may be a new model. However, the tape machine's secondhand value now will only be half of its new price five years ago, whereas a mixing console will have the same paper value as when new. Whatever the value, the studio will be in a position to recoup some of its installation costs by putting the replaced equipment on the market.

Further costs, caused directly by the purchase of extended facilities, will become apparent. It is usually necessary for the studio to equip itself with more stereo machines to cover some of the requirements mentioned previously. Savings can be made here by using less expensive machinery for effects where ultimate performance isn't required. However, one make and type of machine simplifies the spares and maintenance situation.

It is obvious that further microphones will be needed in order for the engineer to realise the full potential of multitrack recording. More noise reduction channels will also be necessary—it's important that some sort of noise reduction facility is provided as standard with 24-track recorders since the track width is reduced to accommodate the extra tracks on standard 50 mm tape. This reduced track width increases the likelihood of dropouts occurring on the finished master. A certain body of opinion suggests that dropouts can be reduced by running the masters at 76 cm/s. Other studios, mostly American,

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THE ECONOMICS OF MULTITRACK RECORDING

feel that the same speed results in masters that are sufficiently noise free, thus obviating the need for noise reduction processing; they claim the absence of the latter makes for a cleaner sound from tape. Whatever the motive (whether it does make for a better sound will always be in dispute) more tape is used creating yet another increased cost for the client.

76 cm/s has other drawbacks. Unless the tape machine is equipped for 35.6 cm reels, the running time for a standard 27 cm reel of tape is reduced to only 16 minutes causing much blood to be sweated by the tape operator. Even with larger spools the problem is not completely overcome and the studios are having to give all tape operators free Charles Atlas courses in order to be able to carry the weighty spools satisfactorily.

The finished master tapes are themselves a problem for the modern studio. For the average one-studio unit, up to 800 km of tape will pass through its hands each year. All this has to be stored safely taking into account all the associated problems of both the virgin or the recorded state. It can be seen that this requires quite a large storage area to be made available solely for this purpose. Each master tape must be logged and kept in such a way that it will not degenerate or be subjected to heat or damp, so it is virtually a full-time job for one person to keep tapes stored properly. The service of master storage is one that the studios operate at no charge to the client. They do, however, like to have these tapes off the premises six months after the recording is completed in order to maintain sufficient space for new masters.

Virgin tapes too are a problem—they also have to be stored and the stock must be kept at a level that is adequate to cover all eventualities. As they are relatively expensive the studio must be prepared to keep a valuable stock in terms of money on the premises. This money is of course recoverable, but it may be quite some period of time before payment is made. The direct and indirect costs involved in a multitrack studio can be shown to be:

1. Capital equipment, cost written off usually over five years.
2. Shut-down time, for installation, not recoverable.
3. Cash tied up in tape stocks, equipment spares etc.
4. More rent to be found to cover increased space needed for control room, tape stores etc.

What of the staff? A new breed of engineer has emerged with the advent of 24-track recording. The responsibility for multitrack operation now rests firmly on the shoulders of the engineer, who is the working link between studio and client, and therefore it is up to him to get the best out of the equipment at his disposal. There have been many arguments in the past regarding recording engineer capability. Is it harder to record a group now than it was in 1960? I am voicing many arguments by stating that the engineer's art is now totally different to what it was 17 years ago. As previously stated, four tracks could be completed in only four hours. Admittedly, the engineer had to be on his toes for everyone of those hours because it was necessary to ensure that every possible make-up of the recording was correct throughout the duration of a take. There was to be no going back—the only available alternative to the master was a totally different take.

24-track recording console

Multitrack engineers gained more freedom in their approach but working hours became longer. Gone were the days of a 7 pm to 10 pm evening session; one became expected to work into the small hours as a matter of course. Therefore, more staff are thus needed in order to cover the longer working hours of a studio—in place of a three-hour session came sessions lasting four times as long. Inevitably these had to be followed by mixing sessions possibly lasting for a similar time and thus it is now impossible to accommodate as many artists in one studio over a given period of time. With the coming of 16-track in 1969 there was a considerable explosion in the studio market—many new independent studios have opened since this date, thus providing a greater number of available recording hours.

As today's equipment becomes more sophisticated, the technical engineer must adapt and a higher standard of maintenance is needed now more than ever before. As well as a more complex installation programme, the engineer is faced with larger mixers to maintain, and more tape machine tracks to line up, although the latter problem is greatly reduced by the very high standard of recording tape on the market. The tolerable limits of manufacture now obtained result in a remarkable consistency throughout the entire length of a tape, as well as within the available batch number. Also, variations between batches are very small indeed and this simplifies the engineer's problem. This indeed is fortunate because re-alignment of a modern 24-track tape machine can be a very long and arduous task requiring a great deal of skill and patience on the part of the engineer. He is the backbone of the recording studio and failure on the part of the studio to attain a first class standard of maintenance and installation can only lead to ruin. Balance engineers also need to rely heavily on the technical engineer to get the equipment to concert pitch and enable it to work correctly up to specification. These then are the studio staff most affected by expanding studio facilities and between them they make it all possible.

But in these days of soaring inflation can a studio make multitrack pay? I genuinely consider that present studio rates are not adequate to maintain the industry at a safe financial level. When one considers the vast re-equipping and re-investment programme undertaken by the majority of the larger studios during the last few years, and the fact that studio rates have really risen only marginally during this period, it is a wonder that some of these studios still exist. The buying power of the pound in this country has halved since 1970. Studio rates have risen maybe ten per cent in that same period of time. The recording industry has therefore absorbed some 90 per cent of the real price rise, through greater productivity and efficiency, while at the same time totally re-equipping its entire facility once, and maybe twice in some cases, throughout that period. This is a record to be proud of some would say, but one could also comment that studios are lining the pockets of the record companies through their own stupidity.

Unfortunately, studio rates cannot be cost orientated in such a competitive business. A new complex seems to open every month, providing greater opportunities for the client to shop around. The available market dictates the price. How much will the client pay for an existing facility up to modern-day standards? Top facilities and finest available equipment command top prices and it can generally be shown that a studio will continue to re-equip—not to justify a price rise but to remain technically competitive with others. This is the technical rat-race that studios have made for themselves—some will be able to afford it, some, regrettably, will not.

As far as record companies are concerned, the very latest multitrack techniques appear very uneconomical. The previously-mentioned three-hour session of 1959 cost approximately £36 in studio time. This produced two 'A' sides and two 'B' sides, both of which went to the top of the singles charts. Recently the same producer had a similar success with a hit single which reached number three in the charts. However, it cost over £600 in both recording and remixing studio time. In this instance, modern techniques have raised both the hourly cost and the time required to make a similar record, although today's final product is an improvement both from the artistic and production point of view as well as being technically superior.

Multitrack recording can be said to have created a conflict of interest between the record company on the one hand and the

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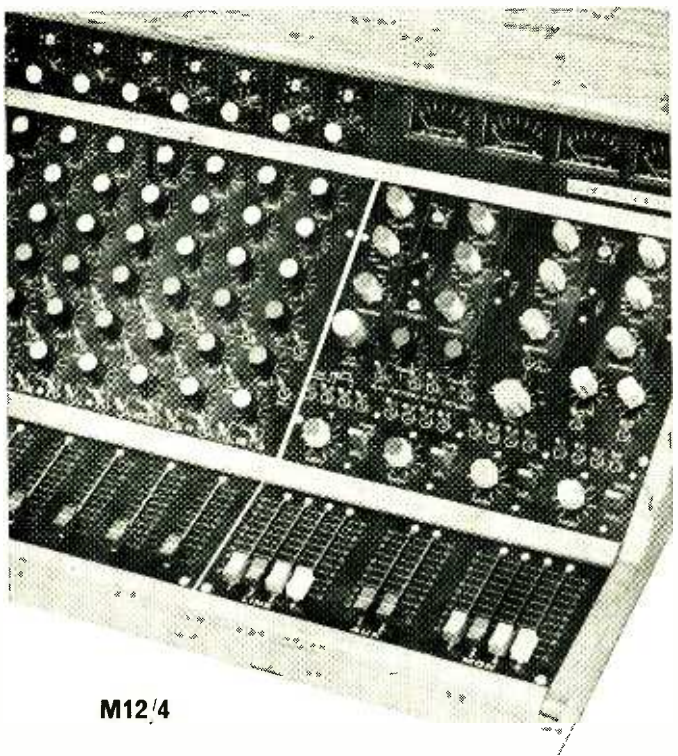

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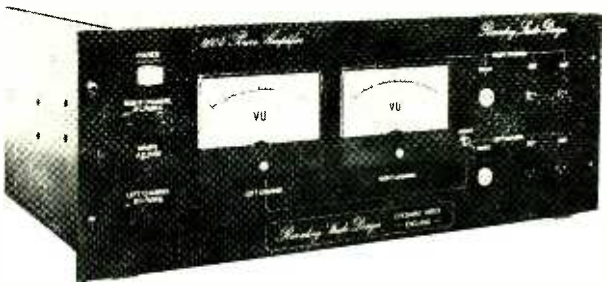

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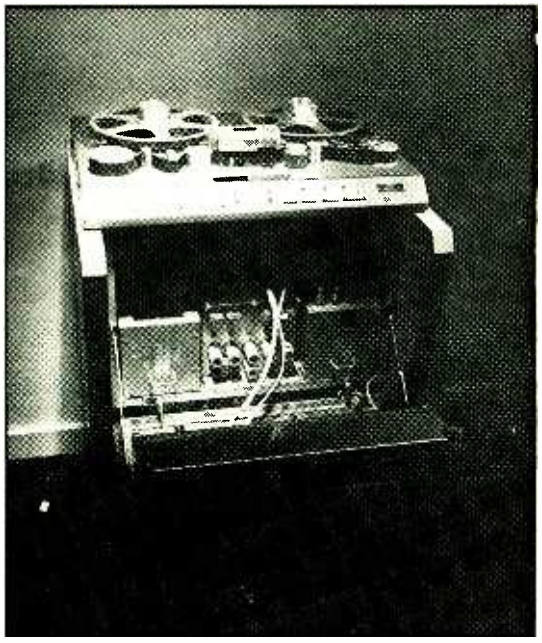
THE ECONOMICS OF MULTITRACK RECORDING

record producer on the other, a conflict that possibly would not have existed during the days of mono and twin-track recording. Producers have an artistic responsibility to all recordings and the multitrack machine and mixing console give him the scope to express this to the full. However, if he is to complete a recording to match today's artistic and technical standards, he invariably will use long recording hours in order to fulfil both his own and the



J37 as used with the REDD 37

artist's wishes. In many cases this will make the cost of studio time very high, obviously to the displeasure of the record company who are interested in the product only from the selling point of view. Thus the situation exists whereby there is usually a budget limit on most recordings, but in these days of low record sales, is it still not possible that the latest recording techniques will reach a point where they become uneconomical? Fortunately there are many artists who will safely sell many records in the face of all competition and it is on these artists that the record companies rely to boost their profit figures. They are allowed to record in the very best studios and the record companies are deeply interested that the final result is beyond reproach in any possible way.

Recently again, due to falling sales, both record company and producer alike have been looking to ways of economising in studio costs. For a company to break a new artist in today's depressed market it has proven very expensive and it is a gamble whether a number of these albums will in fact sell at all. Thus they have been cutting budgets in an attempt to cut productional costs. All this in the face of most recording studios having recently re-equipped their facilities at great expense. Is there then a case for record companies to ask studios to restrain from further expansion in order to keep their expenses down?

The reduced budget situation has resulted in some ill-advised producers recording their basic tracks in cheaper studios, using fewer facilities. They then move on to the high-class studio to complete the project with over-dubbing and mixing etc. In this way, the producer and artists still have the time to use their talents to the full, knowing that the final result will all come good in the end. In practice, however, this method fails for several reasons, not the least being that two different engineers should never work on the same album, particularly if they work in separate studio complexes. All engineers mix in different ways and confusion reigns come the remixing stage of the recording.

Technical compatibility, too, is a problem, and it is grossly unfair that a major studio should be subjected to correcting the mistakes of the lesser and cheaper one. Top studios use every effort to ensure high efficiency and technical superiority and are asked in some cases to wave their magic wand over such recordings in order to achieve the required result. Why should a top studio bail out the smaller one in this way? The album is released with full studio credits, possibly with technical limitations for which the larger studio will inevitably be blamed. In this case, the end result can effectively cause a reduction in studio costs, but with certain limitations in the final product. The record company now is in a very difficult situation; however, I feel that the superb service given in various ways by the leading studios, wholly justifies the increased costs of today's albums.

But will the record producers ever be satisfied? A record producer will use the modern multitrack facility to suit the medium he is recording. The current groups demand 16 or 24 track recording to fulfil their artistic talents, as well as offering a safety net on remix. It is essential for a producer to have the fullest confidence in the capabilities of his engineers and to know that he can rely fully on the equipment provided by the studio. Multitrack has been a godsend for the producer and artist alike, and they like to use the latest facilities to the full, provided of course that the subject warrants it. Nowadays some producers have become so accustomed to 24-track working that they would find it virtually impossible to return to 16-track. Indeed, many are now using 32-track recording techniques, and possibly more. One may well ask where will it all end.

With the recent expansion from 16 to 24 track working came the opportunity for the producer to compile a more complex stereo picture in the final mix. It is now possible to record several instruments by stereo pair, giving greater perspective and depth to the sound. Stereo drums have been with us for quite some time and now we also have stereo piano, organ and percussion. Multitrack increases choice; people often record up to four versions of one vocal line and leave the choice until the final mixing stage. Often a composite track can be made by bumping down from the four originals to capture the ultimate from the vocal performance and very often the recording time of an album is reduced by utilising 24 tracks instead of 16, as variations are made available. The over-dubbing stage is a case in point, as it is now possible to record alternative instruments or vocal lines and once again leave the choice until later. This of course extends the mixing time needed, so what one gains on the swings . . .

With regard to an orchestral recording, once again modern multitrack techniques have led to vast changes in methods. As the final orchestral balance can now be made at leisure, without the pressure of a studio crammed with expensive musicians, a greatly improved final sound results. The producer is now able to work with extreme care on each instrument in turn, fashioning the sound to his own satisfaction. Even classical music producers now realise the value of these techniques, primarily in the case of vast opera productions. One should not forget here, too, that the 24-track recorder is essential for modern-day productions such as mobile recordings of live concerts and public performances. Many producers and engineers would be totally lost without the facility of returning to an environment that they know in order to complete the final balance.

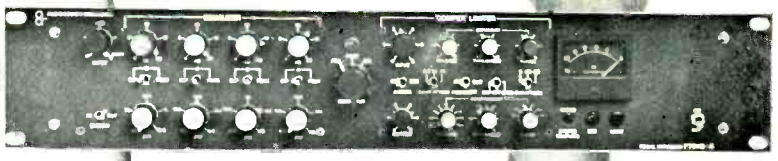
In these days of restricted budgets the producer still doesn't think of economy. While on a project, he becomes totally involved with the artist and engineer in order to achieve the result that is satisfactory to everyone concerned. Multitrack recording techniques now give him the freedom and flexibility to achieve the result that fully justifies the cost.

Summing up, there would appear to be only two major parties that agree that multitrack is economical. These are both the manufacturer and the producer, along with his artist. The manufacturer achieves profits and the artists achieve further artistic expression and freedom. It would appear that, as facilities increase, there is less chance of both recording studios and record companies maintaining realistic profit margins in the present situation. However, progress is progress and that costs. Multitrack recording techniques are here to stay and will continue to advance with ever-increasing rapidity. It is up to the industry as a whole to ensure that the march of progress is allied to the practical and financial limits at its disposal.

The author wishes to thank John Burgess, Managing Director of Air Studios, Tom Bradley, Financial Controller of Air Studios and John Punter for their generous help in the making of this article.

Christmas Stocking Fillers ~

Merry Christmas



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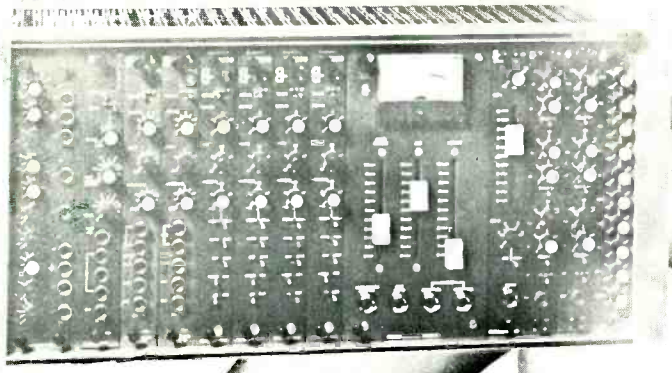

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AES 55th Convention, a report

RAY CARTER

The 55th Convention of the Audio Engineering Society was held between October 29th and November 1st 1976.

JIMMY CARTER flew out of New York on the same day the AES 55th Convention opened, and with voting due the day after it closed the potential election fever of New York was something to be reckoned with. This seemed as though it would marry with the promise of a good conference to generate quite an experience for the attending AES delegates.

But New York was going about its business seemingly unperturbed by the election, and in fact concern was far more for the state of the pound than the president. As one Irish barman in South Manhattan put it: 'I don't understand how the English economy can be in such a state considering the amount of Scotch we import into America'.

However cold it may have been outside, the Waldorf Astoria is a place unto itself and likewise the AES Convention. The continuing success of the AES was adequately indicated by this, 'the best New York meeting to date'. More than 4000 people attended to digest information concerning their own particular interests available from 85 exhibitors and 83 papers, 57 of which were preprinted and are available for the asking from the AES, Room 449 60 East 42nd Street, New York, NY 10017 (complete set: $30, post paid. Single papers: $1.50 to members, $2.00 to non-members). And all the exhibition space is already booked for the Paris convention.

Meanwhile back at the Waldorf the exhibition was being held in the ballroom on the third floor—a venue which generated a very congenial atmosphere by virtue of a compact exhibition (minimising legwork) but with potential claustrophobia alleviated by the three-storey high ceiling. The basic feeling of the show seemed to be one of relief prompted by the recovery of the American economy. There wasn't very much that was new but this was in no way a part of the 'consolidation of the recording industry' that we've all been talking about for the last couple of years. It was more a relaunch of previously shown but excellent equipment at a time when the industry can afford to buy. And the comments by exhibitors at the end of the show about the success (ie orders placed and hopeful enquiries) confirmed this.

While it is unlikely that many people are going to place orders at a show for large recording or mixing consoles it was nevertheless very apparent that the manufacturers consider attendance of paramount importance, and justifiably so. Although the sheer complexity and price of a console suggest that there should be a wide variety of designs, this just isn't the case. The rapport between the engineers and manufacturers, generated by the custom building situation prevalent in a relatively small industry, has led to the overall functions of the equipment being very well defined. Few customers now are really concerned with the 'electronic' specifications. Quite simply, they're all good. Decisions are made on small ergonomic points: routing, sub-grouping, eq capabilities, etc, and with custom building still the order of the day even some of these can become irrelevant.

And so the large consoles were on their large stands manned by many staff. Any avenue for tipping the balance in a potential customer's mind was being explored.

The API offering was a relatively compact 24-in, 16-out recording/mixing console (destined for Jimmy Page) indicating size and layout possibilities. The two functions are split to either end of the console but with the 'output' facilities for both neatly brought towards the centre with the patch bay (see photo). The console is fitted with the latest API elements, including 'Automix' capability, the processor for which should be available at the beginning of this year. The first unit has been built and 24 others are 'on the way'.

The main point of interest on the MCI *500* series console was the new option of the Burroughs plasma display metering system which uses digital techniques (as opposed to RC circuitry) to give individual accuracy and good correlation between all the metres. Besides the possible advantage of the meters following the line of the modules through to the top of the console, the plasma displays offers switchable vu, DIN peak, peak accumulate and vca-dc status readouts—the automation processor is due in May. The popular *528* version of the console was being used to display these meters and also the various modifications that have recently been made to the modules. On the input side is a high-pass filter (18 dB/octave) frequency adjustable between 30-300 Hz, phase reverse capability and a led to show 'channel-in' when the fader is at ∞. On all six sends there is now a mute function and hi-lo eq shelving.

Automation was definitely taking a back seat compared with previous shows. Besides the fact that the West Coast seems to be showing more interest in automation than the East Coast it appeared that the manufacturers were, quite rightly, waiting to see how the equipment performs in 1977 and to determine whether or not it lives up to all the hard selling that the facility has received over the past few years. Anyway most people appear to know the essential information about the available systems and are now interested in listening to engineers' comments on the actual operational advantages.

The Allison team was notable by its absence, but they did have a stand with a message of apology from Paul's (and Allison's) daughter explaining that daddy was extremely busy with production work on the *Mark II* processor.

Even Neve, whom I think most will admit have one of the ultimate in hard-hitting demonstrations, were not pushing automation. Their stand primarily featured the new compact range. This has

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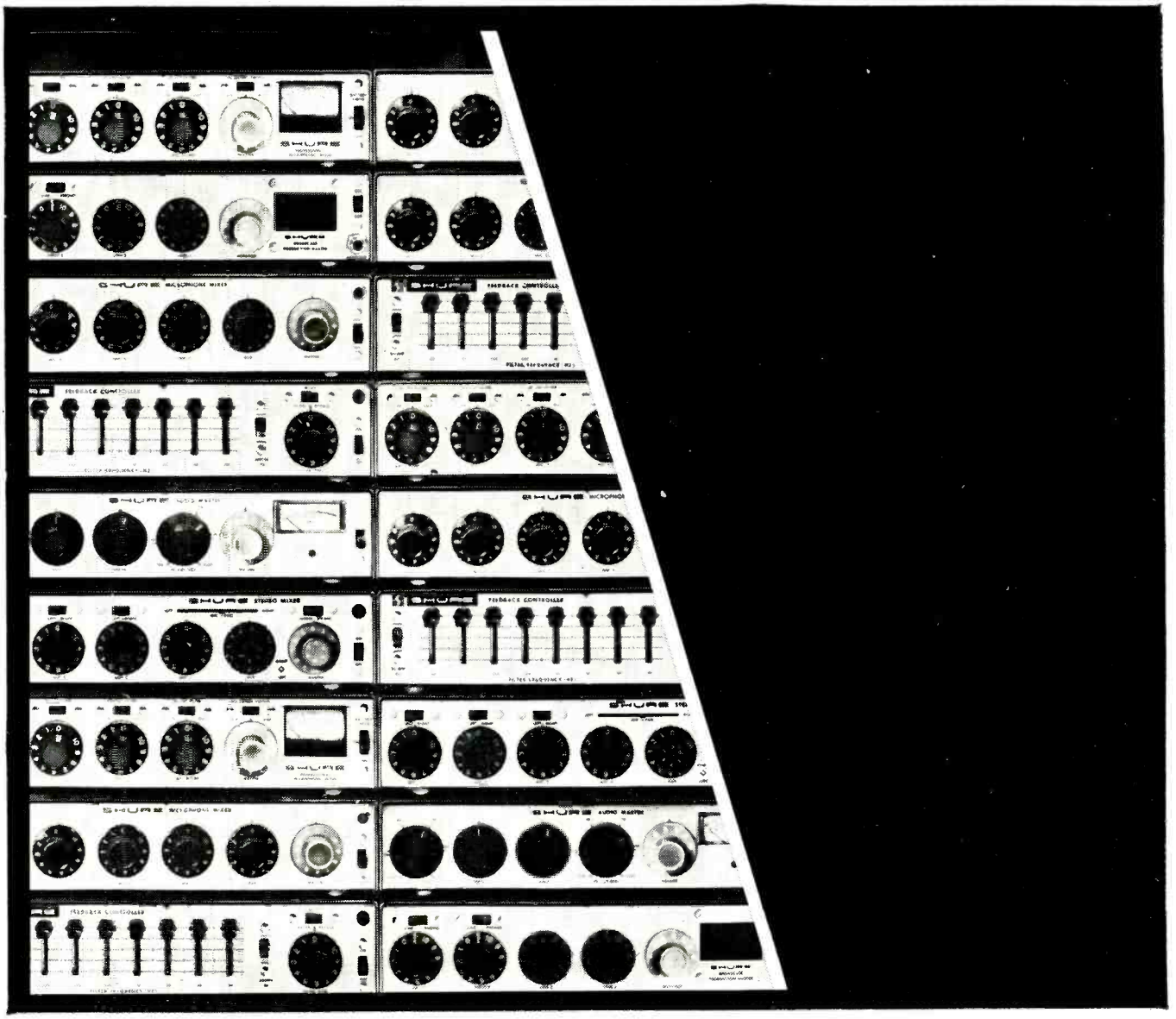

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AES 55th CONVENTION, A REPORT

a 'West Coast styling' and the version on show was the *8068*, a 32/16/32 console which on special order can be extended to 40/16/32 (the other version available is the *8058* which is a 24/16/24).

The *5305* 'fairly portable' console was also displayed, this being mainly aimed at the broadcast market. It is available in 12/4/2 or 20/4/2 format, but also has application in music recording due to the 4-track monitoring facility.

Pandora Systems (now Harrison Systems) had two types of Harrison console on show: a *3232*, the eighteenth off the production line due for immediate delivery to Japan, and the first showing of the new *2824* series in the form of a 28-in/24-out destined for Pasadena. This series of consoles (and the *3624* series) uses similarly designed modules to the '32's' but with some fewer functions; eg 3-section as opposed to 4-section parametric equalisation, high-pass filter only and two instead of four each of the echo and cue sends. Despite the previous comments concerning custom building, it certainly appears that Dave Harrison is a very firm believer in his design and does not come the hard sell concerning customisation, although the usual options are available.

Spectra Sonics are taking an even stronger line against customisation and are trying to break through the 'cottage industry' syndrome pertaining to the recording industry. Off-the-shelf high quality consoles was the prime line being indicated by the new modular *1026-26* console on the stand. It is hoped in this way to keep the price to a minimum—the present largest in the *1026-26* range (26-in/26-out), together with tape remotes, patch bay, etc, will cost less than $40 000.

Their other hard selling point was electronic facts and figures which, while impressive in their own right, can become a bit overbearing at exhibitions, considering the numbers involved in a console.

Down in desk size but none the less important was the impressive demonstration from Teac of a 'complete' 8-track setup. Two years ago the *3340-S* laid open the possibility of 'home-recording' in a big way. This machine has been as successful as it is well known and, together with the *Model 2* mixer, offered excellent 4-track capabilities. Introduced a year ago, the *Model 3* then offered a system update in the form of 8 into 4. And at the same time came the hint for future development in the form of an 8-track 12.5 mm machine—the *Series 70*.

So this show saw the first mass-produced 8-track tape machine (developed from the *Series 70*), the *80-8*—selling at around $3000 (£2000 in the UK), with the option of the special dbx unit (*DX-80*) for less than $1000 extra.

To work on a par with this machine is the *Model 5* mixer (8 into 4) and a patch bay and line amp will soon be available as accessories. The *Model 5EX* was also introduced (to be available some time in 1977) and as the number supposes is an extension for the *Model 5* offering an extra 12 inputs. Further news is that the much-awaited model *90-16*, the 16-track 25 mm format tape machine, is just becoming available at less than $14 000.

As a direct competitor Otari had their complete range on show, except for the *DP-6000* large tape duplicator. The *MX 5050-8* (8-track 12.5 mm) machine, first shown at LA, was generating a lot of interest, and has obviously done so ever since LA as there are plans to greatly increase production early in 77. And in a basically similar design is the *MX 5050-QX*, a 4-channel 6.25 mm recorder with, as one would expect, a very similar specification to the 8-track.

As a progression from the *MX-5050* comes the new *Mark II* which will be available (February 1977) in two versions—2-channel 6.25 mm and 4-channel 12.5 mm—and once again, other than the obvious gains to be had from nearly double track-width, the specifications are similar.

And so, Ampex. Their stand was visually split into four sections—*MM1200*, *ATR-100*, *ATR-700* and tape (*406/407* and *456*). The *MM-1200* was being 'sold' on several new modifications such as meter styling from the *ATR-100*, ie back as opposed to base lighting, and improved signal set-up pots to remove the discontinuity that some people had noticed. Also tape throw has been eliminated in the case of power cuts, and the speed of brake operation increased by the addition of a zener diode in the transport logic circuitry. Further, the tension/logic card has been generally improved by the use of better potentiometers with increased resolution.

The *ATR-100* requires little comment other than to say that the problems mentioned by Hugh Ford in his review (STUDIO SOUND—October 1976) have now been resolved and the associated modifications are 'in production'. However the accessory side has been well catered for by four new items (besides the *VS10* and remote control). A search-to-cue facility, a noise reduction interface, various servicing accessories such as a flux loop and flux loop equalising amp (which are also suitable for other machines) and a disc mastering preview attachment (including heads) which takes about 15 seconds to fit. It is available in two versions: 2-channel for $2025 (approx. £1500) and single channel for $1750 (approx. £1300).

'Twelve fixed guide positions permit preset operation for all disc and master tape speeds when used with the two most popular disc lathe systems. However any required delay, from 25 cm to 147 cm, may be accommodated by adjustment of the lockable sliding guides.'

But the new Ampex machine for the show was the *ATR-700*,

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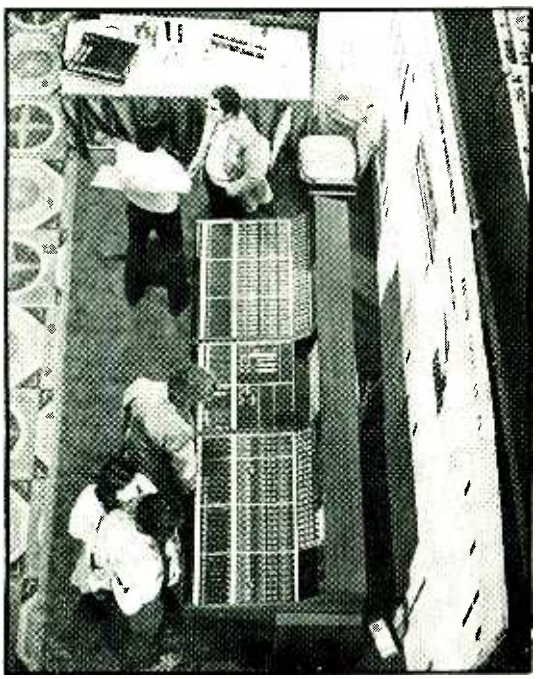
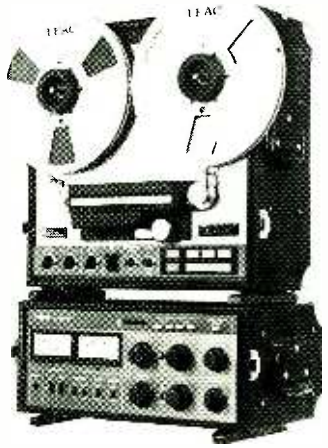


Left: *The API stand*

Right: *Ampex ATR-700 with a known Teac machine (below) for comparison*



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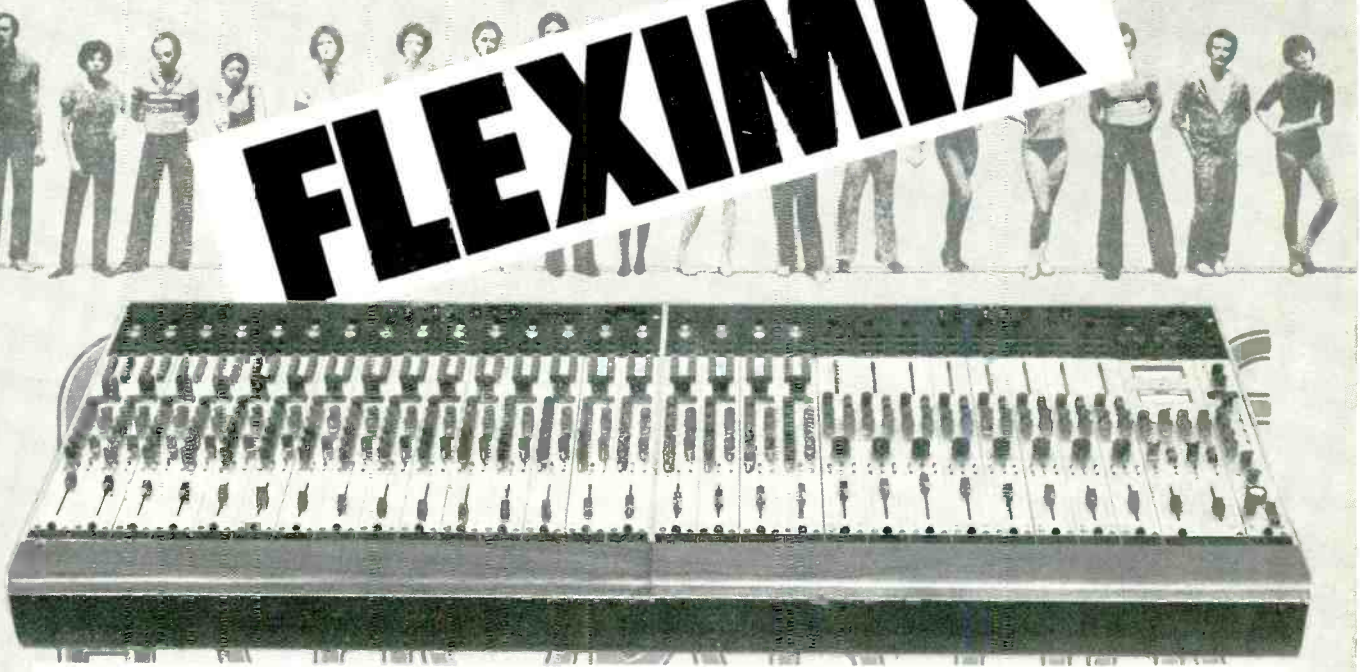

CHOSEN FOR NEW SHOW . . .

Autograph Sound Recording Ltd., the sound consultants for the exciting "Chorus Line" musical, specified the Trident Fleximix portable mixing system to cope with the highly sophisticated sound requirements of this prizewinning show. The unusually comprehensive facilities offered by Fleximix and the ease with which changes in format could be accomplished at short notice made it the obvious choice.

Fleximix has been designed for Studio, high quality Public Address, Bands and Theatre applications and many of its features are normally only to be found on expensive studio consoles. For as little as £2080 (excl. VAT) a 10 input 2 group output configuration may be purchased, which could subsequently be expanded to a system with 10 mixed outputs, any number of input channels and 24 track monitoring. Expansion is simply achieved by slotting-in additional channel modules. When available slots are used up another mainframe is added. Modules may be placed in any sequence. No factory rework or rewiring is necessary. Additional mainframes may be either rigidly or flexibly coupled to the original system and flight-cases are available to accommodate any arrangement. Compressor/Limiter; Quad Joystick; Line Balancing modules will shortly be added to the range.

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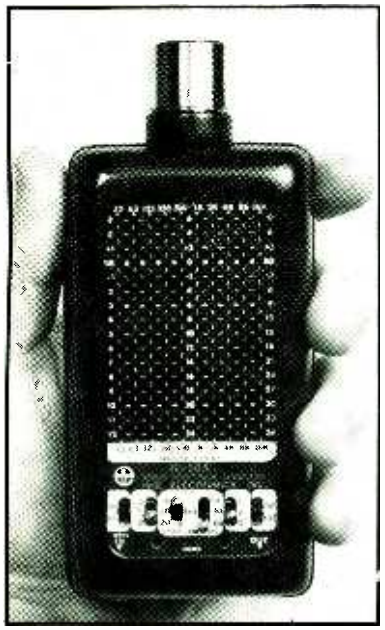

Left: *IVIE IE-10A analyser*

Above: *Otari Mark II*

Right: *JVC prototype headphones*

AES 55th CONVENTION REPORT

supposedly as competition for the Revox (hence the number?). This offers 2-speed operation (38/19 or 19/9.5 cm/s) coupled with electronic motion sensing, switchable eq, full sel-sync and a logic interlock to prevent tape mishandling. *XLR*s provide the signal interface, which also incorporates a 20 dB pad; presumably, both together give the machine double identity for domestic and studio markets. But what about the design? Maybe the photograph says a little more.

It is probably fair to say that the two substantial components of a recording facility, namely the console and tape machine, have now reached a very high standard indeed, such that innovations are hard to come by. But there is little question that life is still full of bright ideas in the peripheral market, especially in terms of doing things at a reasonable price.

Two manufacturers were getting particular mention in the show gossip. Firstly Shure, with their new *M615AS* 'complete equalisation analysis . . . in a flash'. Basically, it comprises a pink noise source and a set of octave filters, the outputs of which are compared with the pink noise reference level. If the individual band levels are above or below parity level, then one of two leds illuminates to indicate the direction of the response error. Each unit is supplied with a calibrated microphone. The octave centres chosen (from 32 Hz to 16k Hz) correspond to the frequency centres of the new Shure *SR107* room equaliser, but presumably any graphic equaliser could be used provided the centres matched those of the analyser. The inclusive price for the *M615AS* is $430; the *SR107* costs $250.

Secondly, and still on the topic of response measurement, Ivie Electronics has produced a beautifully engineered and miniaturised pair of instruments for *in situ* response analysis. The first is a 10 octave band hand-held analyser using a led matrix for readout. It offers any scale of 16 divisions, each with a value of 1, 2 or 3 dB per step. The *IE-10A* incorporates a condenser microphone and a rechargeable internal battery. The *IE-20A* is a self-contained pink noise generator which can be plugged easily into any line. It uses cmos circuitry to generate pseudo random noise. The analyser costs $487 and the generator $147.

While on the subject of analysis, conversation confirmed that the first production models of the Amber *4400* test set are now available. We hope to review one next month.

The Xedit Corporation have repackaged the wow and flutter section of their drift and flutter meter model *15P* ($345), which has been in production for the last eight months. The new model *10*, at $260, has been designed in a small package for convenience and is battery-powered so that it can be easily placed near the machine that requires checking. Although tape transports are always being improved, most tape machine accessories are liable to degrade the performance to the extent that the demand probably still exists for this kind of equipment check.

Also new from Xedit is a 50 mm editing block which supposedly overcomes the criticisms of the two usual versions.

Moving on from testing to signal processing, there were several new units in evidence. Roger Mayer Electronics was showing the *RM68X* noise gate, which is purely a repackage of the recent *RM68*, offered as a direct replacement for the Kepex. It has an incredibly fast attack time of 150 ns which should make for inaudible operation. Physically, it fits a Kepex slot from both the electrical and physical aspect. A new limiter *RM58* from the same company offers stereo operation, variable threshold and the rest of the usual functions, in addition to which there is a gain riding function, similar to those found in am broadcasting.

MicMix, the well-known Master Room reverberation unit manufacturers, were offering several new products. Particular among these was the *Time Warp* time delay unit and effects generator at the respectable price of $1195, and a new column ppm—the *Master Audio Meter* (for further details see News, p 26).

As well as the large equipment, Audio and Design Recording were showing their well advertised Scamp range including three new equalisers: the *SO3* sweep equaliser, *SO1* parametric equaliser and *SO7* octave equaliser. There was also the new *SO1* compressor which has six selectable ratios 1, 1.5, 2, 3, 5 or 10:1. There is three-position attack (fast, medium or slow), infinitely variable release time and the standard auto function. A five-led column is used for monitoring and there is a peak limiter (at + 16 or + 22 dB) with separate indication.

Two prototypes were on trial—the *S18* musician input instrument amp which, besides increasing level, provides echo send and main channel fader; and secondly the *S19* musician output mix amp which has three inputs, namely line, echo return and auxiliary. The output is then available at either studio level or back down at low level for feeding the musicians normal amplifier.

There were several new models in the amplification market such as the *Model 100* from BGW. But SAE were certainly letting the new models fly. The *Mk 3100* integrated amp with 200 + 200W rms and led display on the output, which is effectively a combination of the *2400* power amp and *IX B* preamp excluding eq, at less than $1000. The *Mk 2100* 2-channel parametric rack-mounting preamp basically containing the circuitry of the *2800* (see below) with 3-band parametric eq, a modified dbx expander and compressor and a new phono section, again for less than $1000. Further, the *Mk 4000* stereo active electronic crossover (two-way) at $2000 and the *Mk 2800* 4-band 2-channel parametric equaliser (rack mounting) at $550.

While on the subject of equalisers it should be mentioned that the Klark Teknik range is now being imported (into the US) by

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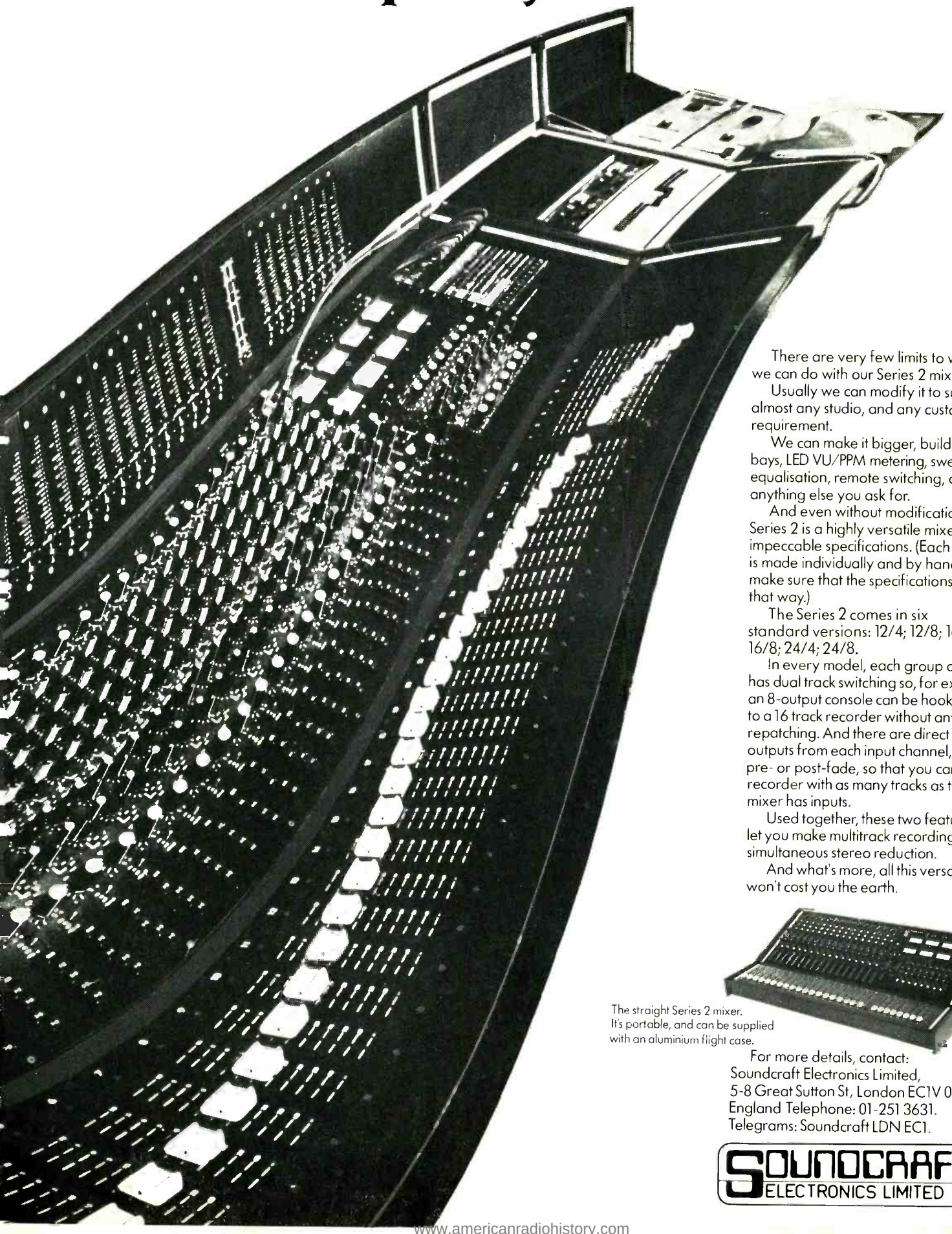
Some of our customers' orders drive us completely round the bend.



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And even without modifications, the Series 2 is a highly versatile mixer with impeccable specifications. (Each model is made individually and by hand to make sure that the specifications stay that way.)

The Series 2 comes in six standard versions: 12/4; 12/8; 16/4; 16/8; 24/4; 24/8.

In every model, each group output has dual track switching so, for example, an 8-output console can be hooked up to a 16 track recorder without any repatching. And there are direct line outputs from each input channel, either pre- or post-fade, so that you can use a recorder with as many tracks as the mixer has inputs.

Used together, these two features let you make multitrack recordings with simultaneous stereo reduction.

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Reference levels

HUGH FORD *

Engineers often find the proliferation of recording standards, and their relationship to control room meter readings something of a technological jungle. This article hacks away at the undergrowth.

* HF ENGINEERING, MIDDX.

OPERATING level, Dolby level, zero vu or 1% distortion on Brand X which you can't buy and is safely locked away somewhere for posterity are all common tape or machine specification parameters which have been carefully devised to utterly confuse everyone!

While some of these obscure levels have almost disappeared, the confusion which they created has now been replaced by 'headroom' for a given tape type with associated variants in 'Dolby level' which may be applied if the maximum capabilities of a given tape-type are to be utilised.

What is this really all about? Well, all that is really required is a known magnetisation on tape which can be used to adjust record levels, set level meters, and to specify noise and distortion in relation to the known magnetisation.

There is no problem in measuring the recorded flux on tape (more to come) in physical terms, so one might fondly imagine that a standard reference level in terms of physical units could be used for all tape measurements which involve an absolute recorded level. Unfortunately life just isn't that simple!

To start with different tape speeds involve a different recorded wavelength for a fixed frequency, and at shorter wavelengths a tape can't take such a high recorded level before it saturates—so, a single standard reference level must be at a low level if it is to apply to all tape speeds. Such a suggestion provokes instant complaints because a low level just isn't right to give a useful deflection on someone's level meter, furthermore most of us consider 1 kHz as our alignment frequency—but, at low tape speeds, this frequency is not a good choice because it's not on the flat section of the equalisation curves.

So in Europe we end up with two well established reference levels, 1 kHz at a recorded flux of 320 nWb/m at high tape speeds or 250 nWb/m at 333 Hz at low tape speeds. Actually 333 Hz was a bad choice because it's not one of the preferred frequencies for acoustical measurements defined by the International Standards Organisation (ISO/R226), and this frequency should be changed to 315 Hz, but I don't think anyone has got down to this yet!

These two levels happened to be very convenient when using 'old fashioned' tapes and peak programme meters because peak level was always only a few decibels above the reference level, but then people started to replay stereophonic recordings on monophonic machines.

Now, a stereophonic recording does not occupy the full width of the tape, so a stereophonic recording at say a flux of 320 nWb/m track width will not give the same output on a monophonic machine as a full track recording at the same flux density. The result of this complication is yet another reference level of 510 nWb/m at 1 kHz for the tape speed of 38 cm/s, and to complete the European scene there is also a reference level of 160 nWb/m at 1 kHz for use at the tape speed of 76 cm/s.

Somewhere half way across the Atlantic we find another level called 'Dolby level' which is specified as a flux of 185 nWb/m which is, in fact, the same thing as 'operating level' as is to be found on Ampex calibration tapes. But a little research will show that 'operating level' is not 185 nWb/m but is specified by Ampex as 200 nWb/m—are you confused yet?

There are two ways of measuring fluxivity, one, which is known as the 'open circuit' method, uses an instrument known as a vibrating sample magnetometer, and the other known as the 'short circuit' method uses a calibrated head. For some mysterious reason the two methods give 0.8 dB difference in measured flux, and this accounts for 'operating level' being either 185 nWb/m or 200 nWb/m.

In practice the calibration tapes of European origin are related to open circuit flux measurement (contrary to some of the manufacturers' specifications) and American 'operating level' tapes have a fluxivity of 185 nWb/m when measured by the open circuit method, or 200 nWb/m by the short circuit method.

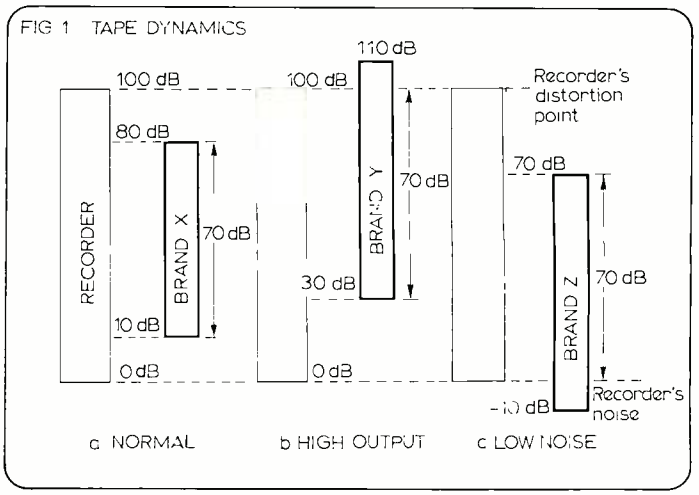
The standardisation of a single reference level for professional recording is currently being debated in International standardisation circles, and it seems likely that a fluxivity of 320 nWb/m as measured by the open circuit method will become standard. It is this fluxivity that is currently used on the DIN monophonic calibration tapes for use at 19 cm/s and 38 cm/s. These tapes are available from Agfa or from BASF, and the same reference level is to be found on EMI Test Tapes *SRT17* and *SRT18*.

Recorder performance related to reference levels

One of the prime aims of any recording system is to achieve the maximum dynamic range which, as such, is controlled by both the basic noise in the system and by the maximum 'undistorted' signal which can be recorded—commonly known as 'signal-to-noise ratio'.

Unfortunately many recorder manufacturers only tell us the achievable signal-to-noise ratio when a given tape type is used, and this is not always a great deal of help when one considers alternative tape types.

Fig. 1a shows the use of Brand X tape which has a dynamic range of 70 dB on a hypothetical recorder which has a dynamic range of 100 dB! In this illustration the tape noise is 10 dB



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Elektronik, Mess- und Tonstudiotechnik (EMT)
Tel: (07825) 512. Telex 754319

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UNITED KINGDOM: Scenic Sounds Equipment
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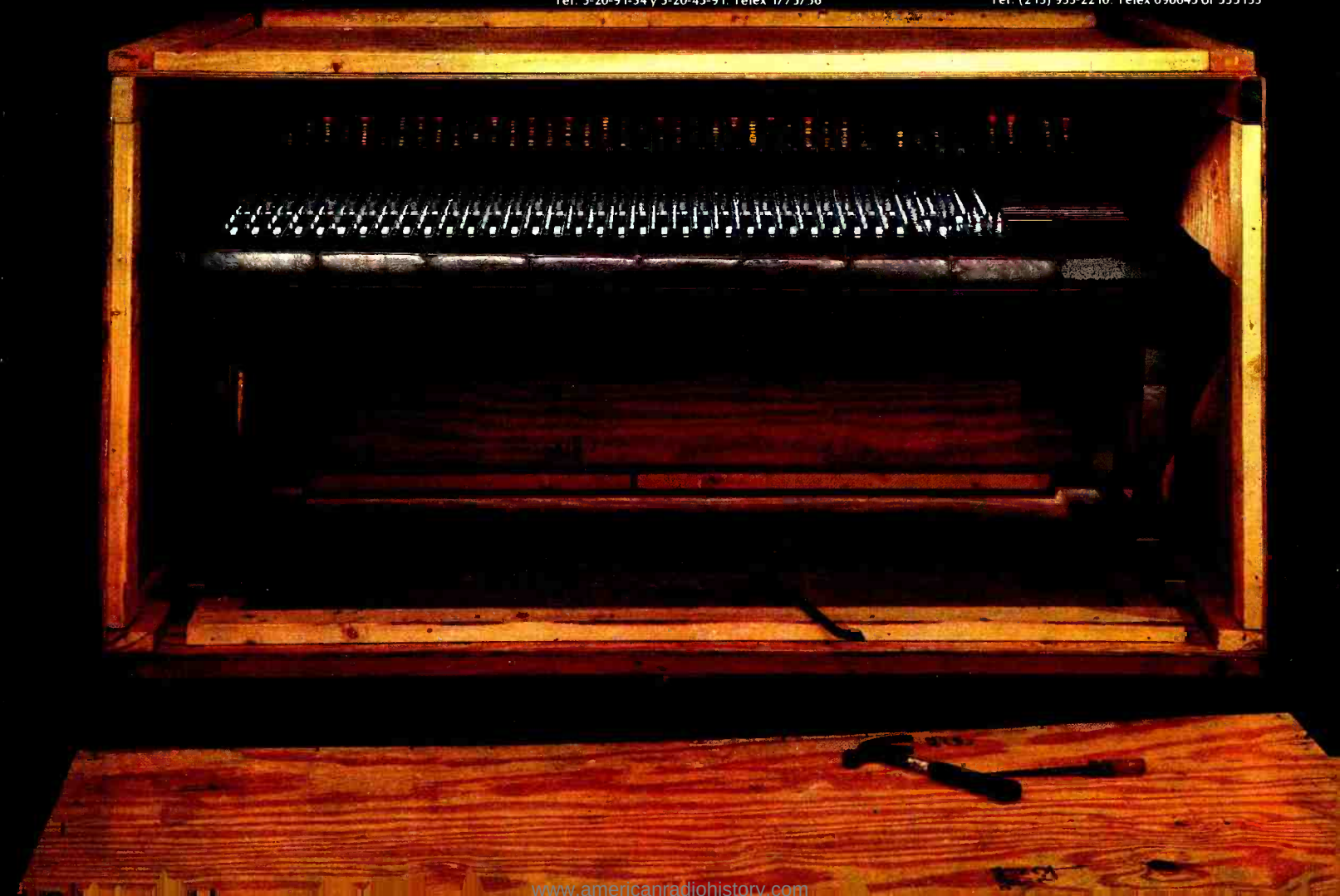


above the inherent recorder noise and the tape distortion point is 20 dB below the recorder's distortion point.

Referring to **figs. 1b** and **1c** in both cases a better tape with a dynamic range of 80 dB is being used, but the final result is still a dynamic range of 70 dB in spite of a tape with 10 dB better potential performance.

While this example is rather exaggerated, it goes to show how meaningless a machine specification can be; that is, unless the inherent machine noise is related to a reference level which is known in physical terms. Likewise a machine's drive capability can also be related to the same reference level, and as is now becoming a problem area, the overload capabilities of the replay amplifier should be related to a known fluxivity on tape.

If both the machine manufacturer and the tape manufacturer provide us with a reference level to noise ratio and also a reference level to distortion point ratio, we then have all the information which we require to compare a machine performance directly with a tape performance so far as levels are concerned. We can of course also derive the available dynamic range by adding the reference level to noise ratio to the reference level to distortion point ratio.

In view of the number of different reference levels currently in use, it is quite likely that we will need to compare reference levels in terms of decibel differences, but this is a very simple matter as we can treat fluxivities just like voltages. Thus the difference between two fluxivities is simply:

$$\text{difference (dB)} = 20 \log_{10} \times \frac{\text{Flux Level 'A'}}{\text{Flux Level 'B'}}$$

Of course if the fluxivities are measured by the two different methods we must add or subtract the magic 0.8 dB to convert short circuit flux to open circuit flux or vice versa.

Just specifying dynamic range is rather like saying that it is 10 km from the top of Mount Everest to the bottom of the ocean; this tells us nothing about how far we must go up to climb Everest, or how far down it is to the bottom of the ocean—the reference level of 'sea level' tells us the whole story just like a number of Webers tells us the magnetic story.

Level meters, distortion and headroom

Programme level is always controlled by some sort of meter and ignoring some peculiarities there are two distinct types of meter in common use. In Europe it is normal to use a peak reading meter which has a fast response time and a slow return time. Such a meter responds accurately to programme peaks such that a steady state tone which gives the normal maximum programme indication is at the same level as the peak programme signals.

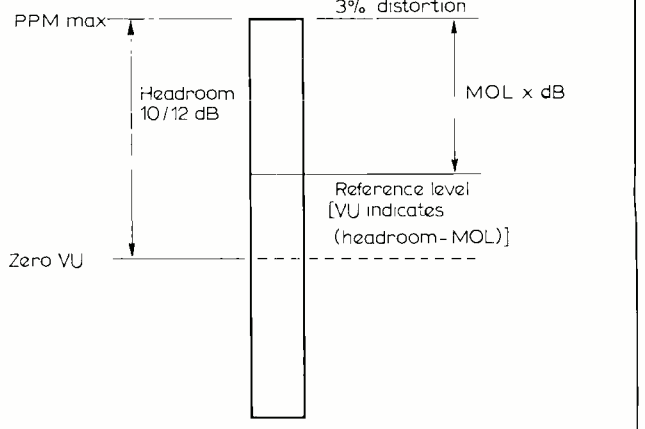
In complete contrast to the peak programme meter there is the vu (volume unit) meter which originated in the United States and the performance of which was originally standardised in America as far back as 1942. The vu meter is a relatively slow instrument which was originally designed as a volume indicator as opposed to a level indicator. Unfortunately there are a lot of so called vu meters which do not perform to anything like the standard requirements, but in all cases zero vu is well below peak programme level. In the case of the genuine vu meter zero vu is around 10 dB or 12 dB below programme peak—the following is quoted from the NAB Standard 'Magnetic Tape Recording (reel-to-reel)':

'It is well established that at least a 10 dB margin is required between the sine-wave load handling capacity of a system and the level of programme material as measured by a Standard Volume Indicator (ASA Standard C16.5—1961)'

In order to relate meter readings to the performance of a particular tape type we need to know how much signal we can put on to tape before excessive distortion occurs. Most tape manufacturers specify the relation between the signal level at which 3% third harmonic distortion at 1 kHz occurs and a reference level—this is frequently known as the MOL (Maximum Output Level) for the particular tape type at its optimum bias. Beware of 'specmanship' in the choice of reference level.

Armed with this information and a calibration tape which includes a reference level recording, it is simple to arrange for a peak programme meter to indicate peak level when 3% third harmonic distortion is being recorded—just work out the MOL in terms of your reference tape and adjust the programme meter gain such that the indication *below* peak when the reference level is being replayed corresponds to the MOL referred to your reference tape. This situation is shown in **fig. 2** together with the problems of adjusting the vu meter.

FIG 2 HEADROOM



In the case of the vu meter the first thing to realise is that with modern tapes the optimum performance will not be obtained if zero vu is adjusted to correspond to the Ampex 'operating level' of 185 nWb/m (open circuit fluxivity). This setting may still be required for programme interchange purposes, but it is no longer an optimum level.

Recently the expression 'headroom' has crept into the tape manufacturers' literature, and one translation of 'headroom' is the difference in level recorded on tape between a steady tone which gives a zero indication on the vu meter and a steady tone recorded at the MOL (Maximum Output Level for 3% third harmonic distortion). I have already quoted the NAB Standard which recommends a 'headroom' of at least 10 dB, but for those who like to see a vu meter permanently in the red, more headroom may well be advisable. However, increasing the 'headroom' lowers the maximum recorded fluxivity and naturally reduces dynamic range, so there is a compromise situation.

Reference to fig. 2 shows the relation between zero vu, headroom, MOL and reference level—thus, in order to determine that correct level setting for zero vu, we subtract the desired 'headroom' from the MOL to derive the difference between our reference level and zero vu.

We must then of course make any necessary corrections for the difference between the reference level on the calibration tape we are going to use and the reference level used by the tape manufacturer to specify his MOL.

Having done these sums it will be found that replaying our reference level may be required to give a positive or a negative indication on the vu meter which, with luck, will be within the range +3 vu to −7 vu where the readability of a vu meter is good. We may however find that we need to set the vu meter for a reading of more than +3 vu when we are replaying our reference level.

Some recorders are fitted with a 10 dB attenuator in the vu meter circuit to overcome this problem, but there are several other methods of obtaining the required setting provided that a calibrated attenuator is available. All that is required is to record a tone, a known level below the reference level recording on our calibration tape, and then to replay this and use it to adjust the vu meter sensitivity.

A common error is to set zero vu to correspond to a reference level or to an operating level without giving consideration to the capabilities of the tape type in use; that 10 dB margin between zero vu and the maximum output level for 3% third harmonic distortion is the key to making full use of a tape without excessive noise or distortion, but the practical methods of reading a vu meter on programme material may dictate a larger headroom than 10 dB. ■

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Survey: multitrack recording consoles

This is the second part of the mixer survey, dealing principally with large desks intended for multitrack recording applications. The first part (December 76) was concerned with consoles for broadcast and sound re-inforcement use.

ALLEN AND HEATH (UK)

See December survey listing for address, agents etc. The company manufactures a 'complete range of studio mixing consoles from 6/2 to 24/8.'

Modular II

Fully modular mixing console 'with full range of studio facilities. For example, the series incorporates parametric equalisation of all inputs, three auxiliary outputs per channel, eight mix busses, sixteen monitor returns with full overdub facilities and sel-sync mixing'.

AMEK (UK)

Amek Systems and Controls Ltd, Islington Mill, James Street, Salford, Lancs M3 5HW.
Phone: 061-834 6747.

M series

Modular mixers constructed from the following basic modules: *M2001* input channel with mic and line inputs, comprehensive eq with hf shelving at three switchable frequencies, low pass at 10 kHz and 15 kHz, mf peak and dip at three frequencies, low and hi q, mf/lf peak and dip at three frequences, low and hi q, lf with shelving at three frequencies, hi pass at 40 Hz and 80 Hz, two echo send, two foldback, thumbwheel routing, channel overload indicator, panpot. *S1001* input channel features mic or line inputs, then similar to *M2001* but without switchable shelving and selected frequencies on eq section. *M2002* echo/foldback channel features level hf and lf for foldback out, level for echo send, level, hf, lf, foldback, pan and routing for echo return. *M2204* group output features slider fader for monitor mix with foldback and panpot, also provides tape out and return facilities. *M2003* monitor control is switchable between foldback and echo send outputs, stereo remix output, stereo remix playback, normal (monitor mixer or pfl solo). *M2005* ancillary module provides talkback and oscillator. For sound reinforcement (as supplied to Wembley Conference Centre) the following additional modules are available: *S1005* subgroup module, *S1005A* live performance master output.

Prices: 24/16 with *M2001* channels and overdub facility £10 025. 16/8 same facilities £6605.

APOLLO (FRANCE)

Acousmat / Apollo Electronics, 22 Rue Ste Ambroise, Paris 75011, France.
Phone: 357 16 97.

Range of plug-in modular units of standard dimensions 190 x 45 mm, with Penny & Giles *1520* series faders. Modules may be used for scratch-built consoles or for incorporation into present desks. All are constructed on moulded castings, supply needed 24V. In addition are three hybrid modules: *HM80* general purpose ac control module, with applications book, *HM70* low noise preamp and *HM30* compressor/limiter.

Additional services include auxiliary power amps, special effects units, and other studio equipment.

AUDIO DESIGNS (USA)

Audio Designs and Manufacturing Inc, 16005 Sturgeon, Roseville, Michigan 48066, USA.
Phone: (313) 778-8400. Cables: Audex.

NRC Series

8-16-24 track recording consoles, in identical design but format as appropriate. Pcb mother board interconnection reduces cost of hand wiring; simultaneous quad, stereo and mono mix-down, 'total' op-amp circuitry; Vue Scan metering; full talkback and slate; four cue, two solo systems; four quad joysticks; sync interface. Prices eg 28/24 $62 800, 16/8 $38 850.

1641

Remix console for simultaneous four, two and one channel mix from 8/16 source. Sixteen dual concentric quad pots, four joysticks, with full group routing; four remote tape controls; solo on all inputs; quad matrix break points; four es. Price $29 500.

RMX 921/1721

Remix consoles with 16 or eight line inputs plus single mic channel. Prices $14 300 and $21 400.

AUDITRONICS (USA)

Auditronics Inc, 207 Summit St, Memphis, Tennessee 38104, USA.
Phone: (901) 276-6338.

Consoles for multitrack recording applications.

Grandson II, Model 110-8

New expandable, modular console for recording, remix and broadcast purposes. Designed 'for budget eight and 16 track' and expandable to 24 (48 inputs overall) in approx 1.3m width. Complete metering; two echo send/receive; talkback and fb; eight or 16 channel monitor matrix; test osc; monitor submix; patch bay. Model *110-8* comes with eight group output with associated vus. Monitor and mute are ttl logic controlled: may be programmed by owner to meet specific requirements.

Channels include: linear attenuator; stepped line control —70 to +20 dBm; three position/six frequency eq at 80/150 Hz, 1.8/4 kHz, 7.5/12 kHz, in/out switch with led indicator, hi/lo cut filter. Stereo control channels provide for one line level pair, mono switchable mic/line. Solo/cue.

Son of 36 Grand, Model 501

Expandable, modular record/remix console for 24 track recording and quad mixdown. Up to 26 channels, mic/line, with linear slider, mic gain, input off/on switch, solo, two cue mixes, echo from monitor or channel, four es, four-way eq, full monitor control, with sync interface, quad pan, quad source (matrix/program). Independent assign to main 16 output channels. Sixteen vu meters, switchable around groupings, phantom power supply built-in tb, slate, osc etc. Electronic switch functions.

Grandson II, Model 110A

Console for recording and broadcast. Thirty-six inputs in less than 1m width. Complete metering, two es/return, tb, osc, monitor etc. 'Full capacity system at moderate price', to fill gap between conventional broadcast consoles and large recording desks.

AUTOMATED PROCESSES (USA)

Automated Processes Inc, 789 Park Ave, Huntington, New York 11743, USA.
Phone: (516) 427-6024. Telex: 960-247.
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Phone: 01-574 5929.
France: 3M France, 135 Bd Serurier, 75 940 Cedex 19e, Paris.
Phone: 331 202 8080.
Canada: Audio Acoustic Labs, 2 Thorne Cliffe Park Drive, Unit 22, Toronto, Ontario.
Phone: (416) 425-7655.
Chromacord Corp, 2343 43rd Ave Lachine, Quebec H8T 2K1.
Germany: 3M Deutschland GmbH, Carl-Schurz-Str 1, D-4040 Neuss 1.
Phone: 49 2101 141
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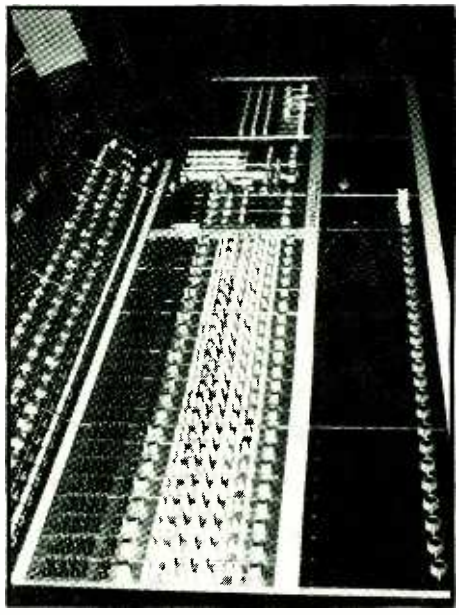

SURVEY: MULTITRACK RECORDING CONSOLES

8, 6301 Zug.
Phone: 411 355 050.

Modular systems for any requirement, based on sections including the following: *312* preamp, balanced in for 150/600 ohm, 15-65 dB gain, reverse polarity and overload protected; *544* input assign module; *840* slate/tone; *544* echo send/return; *846* fb; *325* line booster; *330* eq preamp; *440* fader, plastic track, illuminated scale, multigang within 0.5 dB; *475* fader with precision metal wiper; *480* joystick quadpot; *525* complimiter with threshold, output two range frequency dependent release and stereo link; *550* equaliser, hf 5, 7, 10, 12.5, 15 kHz, mf 0.4, 0.8, 1.5, 3, 5 kHz, lf 50, 100, 200, 300, 400 Hz, audio band pass filter switchable, eq in/out; *553* equaliser, hf, mf, lf fixed frequency; *559* nine band graphic equaliser, approx octaves 35 to 16k Hz; *575* sine wave osc, 20 to 20k Hz in 13 steps, low distortion and output meter; *701* 10W power amp for small speaker or can systems; *705* 50 W power amp; *730* 2 x 200W power amp; *940* automated fader, with plastic track and led ± cursor indication, write/safe/update switching; *954* programmable parametric equaliser hf 800, 1.8k, 3.5k, 7k, 16k Hz, mf 200, 500, 1k, 2k, 5 kHz, lf 30, 60, 130, 260, 600 Hz, bell and notch options, with write and in switching, compatible Allison/Automated programmer.

Automix
For typical channel arrangement on Automix fully automated console mixdown system. Console available in 24 or 32 channel options as standard, in conjunction with Allison/Automated programmer. All functions automated, including eq, subgroups and pan. Multiple led indications of status and related functions.

1604
Supplied standard as up to 16/4 console using various standard modules. Includes standard es, fb, monitor and metering options.

2483
Supplied standard as up to 24/16/24 console with extra capacity for particular requirements as necessary.

2824
Up to 28 inputs each with direct output and quad or stereo panning, 16 mixing busses, up to 24 vu meters, four echo busses comprehensive monitoring, two *model 525* compressor limiters, wired for four.

3224
Up to 32 inputs with 16 groups, eight echo busses.

3232
32/16 with up to 32 vu meters, four echo busses, monitoring to 32 tracks, two *model 525C* compressor limiters. Typical prices: manual console with *550A* equalisers, 28 inputs, 24 monitor £39 398, 32 inputs and monitors £42 827. Manual console plus vca grouping 28 inputs 24 monitor £45 782, 32 inputs and monitors £49 548. Automated console (less programmer) 28 inputs 24 monitors £47 819, 32 inputs and monitors £52,102. Complete programmer comprising programmer, control panel, data cartridge record/playback system, power supplies and one 32 function card £6737.

CADAC (UK)
Cadac (London) Ltd, 141 Lower Luton Road, Harpenden, Herts AL5 5EL.
Phone: 05827 64351. Telex: 826323 CADAC HARPENDEN.

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SURVEY: MULTITRACK RECORDING CONSOLES

Cadac continued

USA: Irving Joel Associates, 528 River Road, Teaneck, New Jersey 07666.
Phone: (201) 836-8741.
Also agents in Australia, Belgium, Eastern Europe, Finland, France, Israel, Italy, Japan, Portugal, South Africa, Spain.

E range
Multitrack recording consoles for up to 32 tracks. Inputs, equaliser and routing are fitted into a single 30 cm module. Offers 'top quality and compact size at an economical cost'.

Custom Quad or Stereo range
Separate input equaliser and routing module per channel, group re-routing facilities. Very comprehensive: full equalisation on echo sends and returns, compressors, joystick modules and many more features.

Automation Ready Quad and Stereo
As per custom quad and stereo range except that in lieu of group re-routing, grouping on inputs is provided using the Cadac Voltage Controlled Attenuator *(V-CAT)*. These consoles are automation ready, for fitting of Cadac Automated Remix equipment *(CARE)* processor and store.

Compact Automatic
The latest addition to the range featuring inputs and outputs in line; routing to multitrack outputs is via a central programming selector with four track numerical readouts on the respective channel module. Grouping on inputs, parametric equalisation and very compact. Automation ready.

CARE
Cadac automated remix equipment is available on all new consoles and may be retrospectively fitted to existing models—even if it is not of Cadac origin.

FAIRCHILD (USA)

Fairchild Sound Equipment Corpn, 75 Austin Bvd, Commack, Long Island, New York 11725, USA.
Phone: (516) 543-5200
UK: Jacques Levy Professional Recording Services, 6 Carlisle Mansions, Carlisle Place, London SW1.
Phone: 01-834 9248.

FPC
Portable, flat console available in formats between 8/2 and 16/8. Balanced mic input with gain, lf, hf boost/cut, peak selectable. Vu metering on groups, balanced out; 25 hours operation on one set 'C' batteries; solid aluminium construction. 72 x 62 x 5 cm, weight 12 to 19 Kg depending on format.

FIC
Flexible modular system for recording. Input module includes level, select and pad switches, input fader, es and gain pre/post, compressor, hi and lo eq, fb, vu. Output module includes slider, echo return, compressor, eq, vu meter. Monitor modules includes 10 x 10 select matrix, slate, tb.

HELIOS (UK)

Helios Electronics Ltd, Browells Lane, Feltham, Middx TW13 7ER.
Phone: 01-890 0087/8/9.
USA: Every Thing Audio, 7037 Laurel Canyon Blvd, North Hollywood, California 91605.
Phone: (213) 982-6200.
Canada: Noresco Manufacturing Co Ltd, Professional Products Divn, 100 Floral Parkway, Toronto, Ontario M6L 2C5.
Phone: (416) 249-7316. Telex: 06-217876.
Norway: Slv Ing Benum & Co, Boks 2493, Solli, Oslo 2.
Phone: (02) 56 57 53.
Germany: Elmus GmbH, D1, Berlin 12, Herderstrasse 16.
Phone: Berlin 312 20 12.
Italy: Audio Consultants srl, 41100 Modena, Via Emilia Est 181.
Phone: (059) 36 79 59.
Portugal: Tecta Lda, Rua Eca de Queiros 20 3° D, Lisboa.
Phone: 56 04 05.
South Africa: General Optics Co Ltd, Film and Electronics Divn, PO Box 2409, Johannesburg 2000.
Phone: 836 4275/9851. Telex: 43-0057.

Custom Consoles
Specialist design and building services catering for desks of about 12 channels upwards. Choice of shapes, formats and facilities using a wide range of standard or specially designed modules. Existing designs available for eight, 16, 24, 30, 36 and 40 track recording. Purpose built automated remix systems available using customers choice of proprietary interface with vca or direct logic faders.

PS series
Frame sizes for 12, 16, 24, 28, 32 and 36 channels. Eight main group outputs with monitoring and metering for eight, 16 or 24 track recording. Choice of number or foldback and echo ways. Choice of vu, ppm or light beam meters. Wide range of ancillary equipment available. Choice of switched or parametric channel equalisers.

MALCOLM HILL ASSOCIATES (UK)

Malcolm Hill Associates, Hollingbourne House, Hollingbourne, Kent.
Phone: 062 780-556.
The December mixer survey (sound reinforcement) failed to mention the above company; it manufactures equipment for both studio recording and pa use.

Non modular mixers
Available with 10 *(M102)* or 1t *(M162)* inputs. Battery powered mixers feature gain, bass treble, foldback, echo, pan and slider faders.

Modular series
There are six series of desks, designated *a* to *f*, which provide facilities in ascending order. For example, the *d* deries comprises pad and trim, four band eq, lo and hi pass filters, two foldback lines, tow echo lines, pre/post eq switching, pan and full routing facilities. Waters' plastic faders are permanently incorporated within the channel module. The basic format for this series is adaptable between four and 16 output groups.
The *e* series offers the same as the above with the addition of Penny and Giles faders mounted separately to the main module. Format is eight output groups. The *f* series offers 16 groups with facilities similar to the above; however, it features 11 band graphic eq per channel.

INTERFACE (USA)

Interface Electronics Inc, 3810 Westheimer, Houston, Texas 77027 USA.
Phone: (713) 626-1190.
Italy: Audio Products International, Via G Spontini 3, Milan 20131.
France: Studio Equipment, 24 rue de l Abbe Groult, Paris 75015.

Series 104 and 108
Consoles for four or eight track or four or eight stereo submasters and up to 32 inputs. Features modular construction, large lighted vus, four pre/post cue/echo sends, monitor only solo. Modules offer line/mic input select, monitor only solo, phase reverse, phantom power, panpot, gain trim, three equalisers, four cue sends, slider attenuator.

Series 300
Consoles for 16 and 24 input, eight track operation. Controls include echo send, preset gain, pan, hi, mid and lo each with three switched frequencies. An oscillator is provided on the master module.

MCI

MCI Inc, 4007 NE 6th Ave, Fort Lauderdale, Florida 33308, USA.
Phone: (305) 566-2853. Telex: 51-4362.
UK: MCI (Professional Studio Equipment) Ltd, MCI House, 54-56 Stanhope Street, London NW1 3EX.
Phone: 01-388 7867.

JH400 series
Audio mixing desk available in two main frame sizes for max 28 or 40 input/output modules. Modular system largely using plug-in board construction. Channel module includes 16 channel assign buttons, with 'direct assign' facility straight through to associated tape track. Led indication. Mic amp pad

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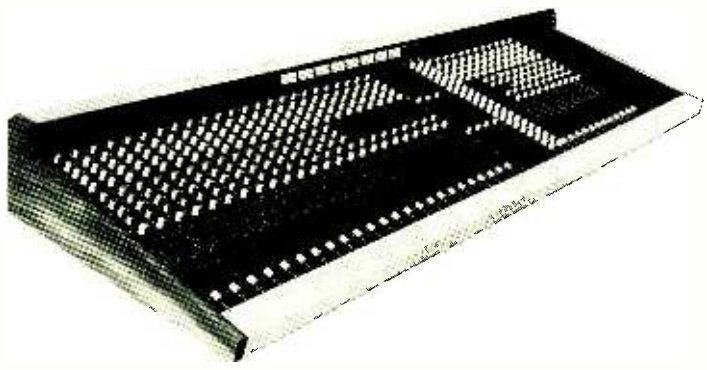
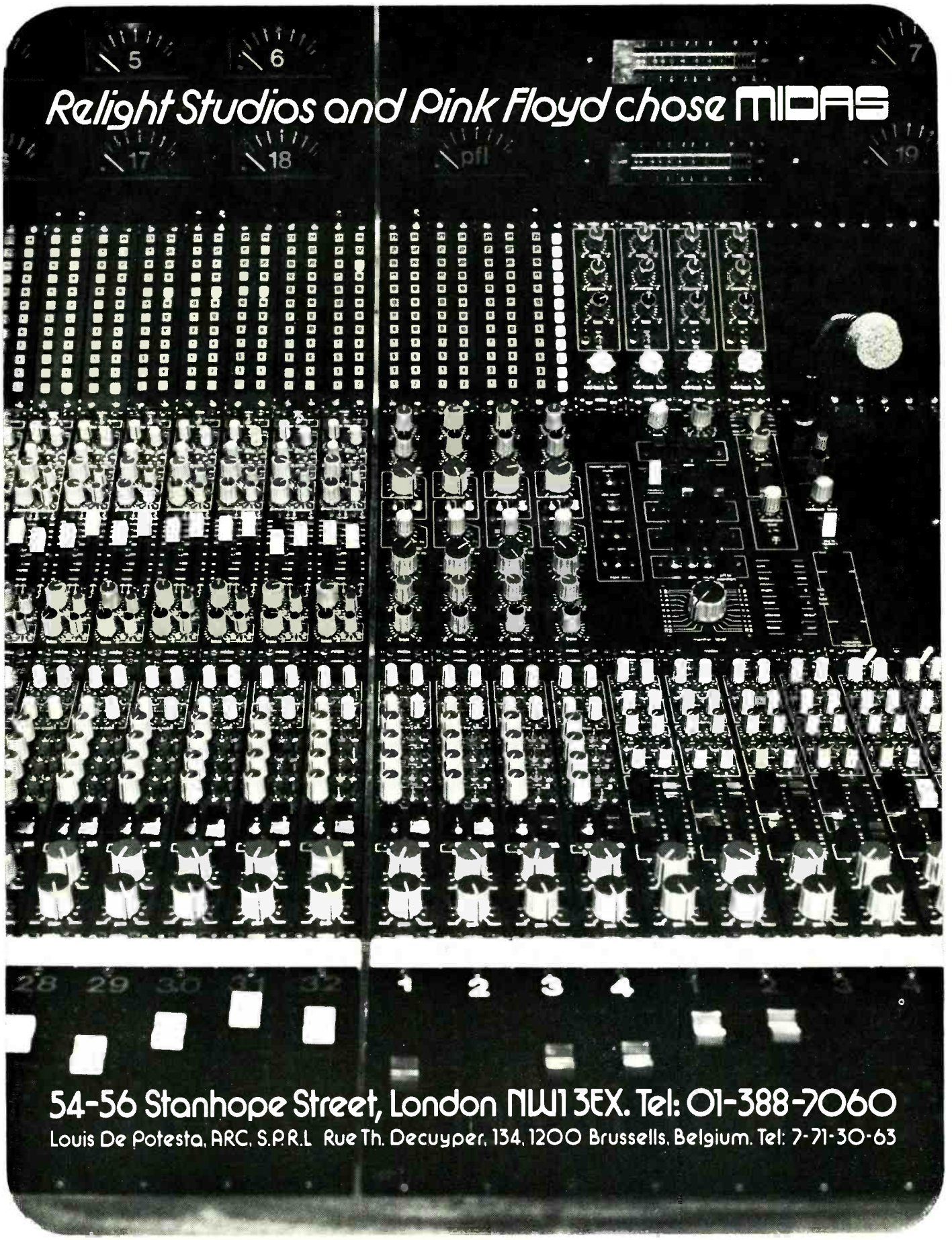
Malcolm Hill





SURVEY: MULTITRACK RECORDING CONSOLES

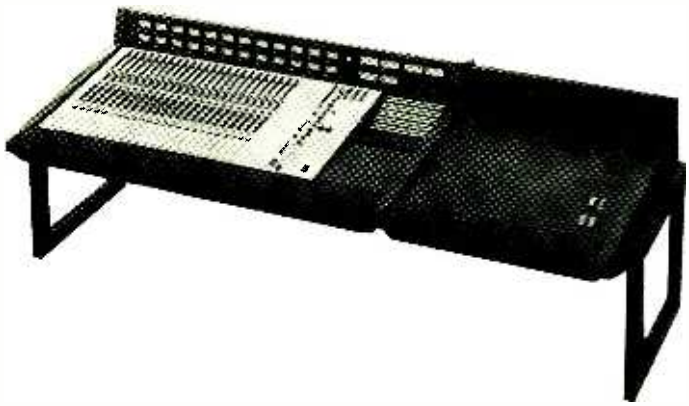
20 dB, max gain 60 dB, headroom more than 28 dB Mute channel; eq lo/hi boost/cut total four frequencies, mid boost/cut half octaves 150 to 7k Hz. Monitor with individual quad pan, separate l/r and f/b control. Four echo sends available at remix, Overall module states mic/tape/remix designated by selector on status module.

Auxiliary module provides cue select, solo, echo level, osc, slate output select, separate tb, fb and slate levels. Master module contains fb and echo sends master, four echo returns and master level fader. Full quad panning as appropriate. Control room monitor module permits quad, stereo and mono monitoring of nine signal sources. Automatic muting of unwanted monitor sends as necessary. Solo trim and master monitor level facilities. Other standard inclusions: monitor select, meter select, vu/peak option, solo indicator and level control monitor channel input select.

MCI Spectra-Vue utilises existing vu or light meters to read half octave spectrum distribution for selected signal. 18 half octave bands 45 to 16.5k Hz. Agc corrects input levels from —30 to +24 dB to reference. Optional standard extras: 24 track buss, phase reverse, tape solo on in/out module, individual es/fb access for tb etc, monitor trim and mute, quad studio monitor, alternate speaker switch, equalised peak reading light meters, 56 extra tie lines, phase meter, etc.

Prices: eg *JH-428-8 VU*, 28/8 standard console $16 785. *JH-440-40 LM* with 24 light meters, 40 channel console $48 941. Sterling prices approx £8500 and £25 000 respectively, dependent on exchange rates.

JH500 series
A completely new design of mixing desks claiming maximum flexibility and with automation ready facilities built-in. Available in two main frame sizes for max 28 or 42 modules. Features include: separate input/output module for each mic input and tape return input, 32 output buss selector on each i/o module, channel mic/line switch permits ping-ponging tracks without affecting monitoring capability, vca's built-in, 10 cm linear faders for vca's, conductive plastic for monitor and sends, all eq controls are switched, hi and lo eq with shelf and peak circuits with boost and cut adjustments of ±10 dB in 2 dB steps, two mid range eq, hi/lo eq on send busses, 'wet' switch to record echo on master tape. Options: plasma display audio meter system switchable from peak to vu modes, accumulate mode allows display to retain highest audio level in addition to transient audio response. *Spectra-Vue* audio spectrum analyser using console meters displaying 21 ½ octave bands from 22 Hz to 22 500 Hz.



MCI JH-400 series desk, JH 428-24 VU plus producer desk (opt)

MIDAS (UK)
Midas Amplification, 87 North Grove, London N15 5QS.
Phone: 01-800 6341.
Belgium: Louis de Potesta, Rue Th Decuyper 134, 1200 Brussels.
Phone: 771 30 63.

Studio
Comprehensive range of modules, with facilities of varying complexity. Typical channel includes eq ±18 dB at 60 Hz, ±16 dB at 700/1k/1.5k/2.7k/4k/7k Hz, ±16 dB at 10 kHz, alternatively ±16 dB at 40/80/160 Hz, ±16 dB on variable control four ranges 30-300, 150-1.5k, 300-3k, 1.5k-15k Hz, and ±16 dB at 7/15 kHz. Hi pass filter 80/120 Hz, 18 dB/octave; two fb and es, forner with pre/off/post; mute, pfl/afl; full pan, monitor and tb facilities. P&G *1820* fader standard, *1520* fitted to special order. Vu or ppm metering as required; led overload optional.

NEVE (UK)
Rupert Neve and Company Ltd, Cambridge House, Melbourn, Royston, Hertfordshire SG8 8AU, UK.
Phone: 0763 60776. Telex: 81381.
USA: Rupert Neve Inc, Berkshire Industrial Park, Bethel, Conn 06801, USA.
Phone: (203) 744-6230. Telex: 969638.
Hollywood: Suite 609, 6255 Sunset Blvd, Hollwyood, Ca 90028, USA.
Phone: (213) 463-4822.
Canada: Rupert Neve of Canada Ltd, 2721 Rena Road, Malton, Ontario, Canada.
Phone: (416) 677-6611. Telex: 06968753.
Germany: Rupert Neve GmbH, 6100 Darmstadt, Bismarckstrasse 114, West Germany.
Phone: 06151 81764. Telex: 0419581.

Necam
A minicomputer based automated mixing system which may be used with existing or new consoles and provides operation of faders and associated mute circuits in its basic form. Full remote control and locate facilities are provided for the multitrack tape recorder and the console uses servo controlled faders with plastic tracks which enable manual override to be performed. The audio tape has smpte timecode recorded on one track with a special wide bandwidth head amplifier to enable this to be read at high winding speeds. Up to 999 points of the tape may be 'labelled for use in automated runs. A small control unit with 16 instruction keys, a numeric keypad and a 32 character alphanumeric display provides full instruction for the computer. Two floppy discs are used to store data.

8014
16/4 multipurpose console providing 16 channels each with line and mic inputs and comprehensive eq, four output groups with stereo and mono modes, two reverb groups, two foldback or cue groups, eight track playback to monitor and playback sync to cue matrices.

8024
24/24 recording and mixdown console with 24 inputs each with an output for multitracking. Also four main mixdown outputs which may be used for monitoring during recording or mixdown during playback. Individual four track, stereo and mono output faders, eight aux for echo or cue, four aux for subgroups, four reverb return channels.

8034
20/4 multipurpose console with 20 channels and four groups. With 16 track monitoring and metering the console will operate with a 16 track recorder, Two reverb sends, two cue or foldback groups.

8036
24/8 professional music recording console with four reverb and four foldback groups, monitoring for 16 track reduction, four studio and four monitor speaker circuits.

8038/8048
24 or 32 inputs, 16 mixing busses, eight reverb returns, 24 track monitoring and metering. Custom designed.

8068/8058/8056
Compact range of multitrack consoles with the following facilities: 28/32 channel, 16 buss, 30 track monitor—24 channel, 16 buss, 24 track monitor—18 channel, eight buss, 18 track monitor respectively. Eight auxiliary busses. 'Neve will repair or replace free of charge any part found to be defective within one year of taking delivery of the console, unless such defect is caused by neglect, abuse or act of God.'

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Week after week, Dolby makes the top of the charts.

Every day 30,000 channels of Dolby A-Type Noise Reduction are in use throughout the world, making recordings sound better.

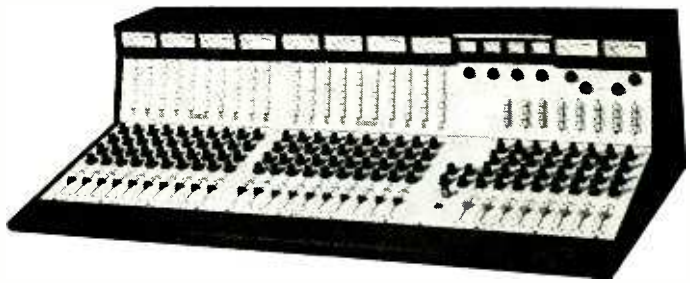
✓ = Dolby system used

DOLBY SYSTEM®

Dolby Laboratories Inc
731 Sansome Street
San Francisco CA 94111
Telephone (415) 392-0300
Telex 34409
Cable Dolbylabs

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

SURVEY: MULTITRACK RECORDING CONSOLES



Opamp 2008-RS recording studio console

OPAMP (USA)

Opamp Labs Inc, 1033 North Sycamore Avenue, Los Angeles, California 90038, USA.
Phone: (213) 934-3566.

1204-RS
12/4 console with four echo busses, and eight track mixdown-monitor system. Inputs for mic or line, echo send, 40 Hz and 100 Hz shelf, 300 Hz peaking, 1.5 kHz, 3 kHz and 5 kHz peaking, 10 kHz shelf. Four vu meters. Price: $8473.80.

2008-RS
20/8 console with four echo busses and 16 track mixdown monitor system. Eq as above: Price: $14 267.80.

QUAD/EIGHT (USA)

Quad/Eight Electronics, 11929 Vose St, North Hollywood, California 91605, USA.
Phone: (213) 764-1516. Telex: 662-446.
UK: Cinesound International, Imperial Studios, Maxwell Rd, Borehamwood, Herts.
Phone: 01-953 5545.
Canada: Century 21 Audio, 654 King Edward St, Winnipeg, Manitoba R3H OP2.
Phone: (204) 775-8231.
Commercial Electronics, 1305 Burrard St, Vancouver, BC.
Phone: (604) 685-0301.
France: Studio Equipment SARL, 24 Rue de L'abbe Groult, Paris 15.
Phone: 224-76-74.
Germany: Auvis Asona KG, Stollbergstrasse 15-17, D8 Munchen 22, West Germany.
Phone: (0311) 225057.
Belgium: Delta Equipment, Lucien Velu, 112 Rue de Calevoet, 1180 Brussels.
Italy: Laboacustica, Via Luigi Settembrini 9, 00195 Rome.
Phone: 381 965/355 506.
Norway: Siv Ing Venum & Co, Boks 2493, Solli, Oslo 2.
Venezuela: Electronica Gramcko, Av Sanz Edif Escar, Local B, El Marques, Caracas.
Australia: Rank Industries Australia, 58 Queensbridge St, S Melbourne, Victoria 3206.
12 Barcoo St, E Roseville, NSW 2069, Sydney.
Japan: Electori Co Ltd, Mondon Building 1-19-3, Kamiochiai Shinjuku-ku, Tokyo 161.
Phone: (03) 950-6266.

Range of consoles offered based on the following modules: *NS 120* noise gate; *EQ712* graphic eq; *2B* compressor, selectable 2:1/4:1 ratio, level, release, attack, variable meter display; *RT6* osc, six frequencies, *LHF-50* filter set, hi/lo pass; *MM71* standard line mixing module, two band eq, es and slider, with mic gain; *MM400* is *MM71* plus 12 frequency eq, insert switch/led, phase, overload indicate, pad, hi/lo pass filters—designed for vca applications, with custom variations available; Compumix *3200* processor for automated level control using tape track as storage; *EQ-312 D* program equaliser, three band, twelve frequency eq. Also available: *LM6200* portable cabinet mixer, 6/2 format, self powered.

QUANTUM (USA)

Quantum Audio Labs Inc, 1905 Riverside Dr, Glendale, California 91201, USA.
Phone: (213) 841 0970.

QA-3000
Flexible larger console design, based on the *QA-3000* input module. Channel includes complete output buss and associated monitor select. Hence versatility in subsequent expansion. Housing contains up to 20 input modules, master module and ps. Add-on to maximum of 28 input position. Comprehensive patch bay. Up to 16 output busses available in addition to four mixdown busses. Channel controls include mute; pan left/right, front/rear; es pre/post; four es busses; eq ±12 dB at 50/100 Hz, 300/800 Hz, 1.5/3 kHz and 7/12 kHz; solo; hi and lo pass filter; monitor source and mix; two cue sends; input select; 20 dB mic pad; gain trim; buss assign. Comprehensive standard group and return facilities.

RAINDIRK (UK)

Raindirk Ltd, 33A Bridge Street, Downham Market, Norfolk, UK.
Phone: 03663 2165/3617.

Mini—4 Group
Low cost mixer in 10/4 format or custom; portable, desk or floor mounting. Up to 24/4 with eight monitor option (including eight meters). Mic/line selection, channel gain, lf, hf, mid (350/700/1.4k/2.8k/5.6k/11.6 kHz), boost/cut, hi and lo pass filters, two aux sends, pan, osc, vu/ppm metering, P & G faders if required. Input channel extension units available.

Mini—8 group
Normally manufactured in console format, providing 18 inputs with four aux sends, hf and lf each at three frequencies and a sweep presence control 400 Hz to 10 kHz, 12 dB hi and lo pass filters, mic attenuator switch, phase reverse on mic, eight group outputs, 16 monitors and a comprehensive jack field. The dual monitors have mounted above them eight equalised echo returns, each echo return may be switched to monitors or groups. Audiofad wire wound or P & G plastic faders.

Quantum range
Available in frames for 24, 32 or 40 input channels. The input section incorporates routing, three section parametric equaliser, hf and lf peaking and shelving and a hi pass filter, two cues and two echo sends. The Master Status module incorporates oscillator and talkback facilities four vu meters, four cues and echo sends, plus four status push-buttons. Master Monitor Module incorporates studio playback monitoring from several sources, plus monitoring of tape recorder, cues, echo sends and control of ls circuits.

REBIS (UK)

Rebis Audio, 127 Soho Hill, Handsworth, Birmingham B19 1AT.
Phone: 021-523 3509.

Designers and manufacturers of studio equipment specialising in multitrack recording consoles built to customers specifications. Ancillary equipment can be supplied in rack mounting form or built into desk—parametrics, graphics, compressor/limiters, expanders. Recent equipment produced: 30/24 quad desk with full eq, joystick quad pans on each channel, graphics, compressor limiters built for Mike Oldfield. 20/16 for Tom Newman Argonaut Studios, London. 16/8 for Outlaw Studios, Birmingham. 12/2 for Fred Frith of Henry Cow, etc. etc.

SOUNDCRAFT (UK)

Soundcraft Electronics Ltd, 5-8 Great Sutton Street, London EC1V 0BX.
Phone: 01-251 3631.
USA: distribution via manufacturer's reps, list available.
Distributors in Holland, Canada, Sweden, Belgium, Switzerland, Australia, South Africa and Japan.

12/4 Series II
Eight track capability, 16 track monitoring, communication and lineup facilities. 105 mm conductive plastic faders as option. Wide range metering faders and quad panning options. Available 16/20/24 channels. £1500, $5289.

16/8 Series II
Format up to 16/8/24; communication and lineup facilities. 105 mm plastic faders standard. Metering options wide. Available 16, 20, 24 channels. From £2200. Channels include: mic/line; pad; mic; gain 4 band eq with hi-pass; two fb, one es; pfl/mute; channel/monitor route.
Prices: 16/4 £1800, $6353. 16/8 £2100, $7363. 24/4 £2350, $8346, 24/8 £2750, $9682.

STELLAVOX

In last month's survey (covering broadcast and sound re-inforcement mixers) we misquoted the identity of the UK distributors. This was after we had given the correct address for a *Stellavox* news item in the same issue. Let it be known that the UK agents are: John Page Ltd, 169 Oldfield Lane, Greenford, Middlesex UB6 8PW. Phone: 01-578 0372.

SPECTRA SONICS

Spectra Sonics, 770 Wall Ave, Ogden, Utah 844041, USA.
Phone: (801) 392-7531.
UK: (modules and components): Sun Recording Services, 34-36 Crown St, Reading, Berkshire.
Phone: 0734-595647.

Custom and standard consoles for recording and broadcast purposes. Various configurations available based on modules including the following: osc with qve select frequencies, gain; hi/lo pass filter 40/70/100 Hz and 10/12.5/15 kHz; electronic filter with various standard frequencies; power amp; simple mic program eq at 100 Hz and 7 kHz; mic/

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Five good reasons

to put your hands on a new Quad/Eight "Modular Series" audio mixing console.

The new Quad/Eight Modular Series mixing consoles reflect the identical technology and quality of their internationally accepted custom console line . . . are priced to fit every budget.

5 NEW MODULAR SERIES MIXING CONSOLES WITH THESE EXCLUSIVE FEATURES

All Console Systems Feature:

- 4 independent, fully equalized echo send/return modules with integral tape delay, meter select, and full program assign.
- Individually switchable insert patch before or after equalizer.
- Dual phantom power with individual on/off.
- Microphone overload indicators with master threshold preset.
- Standard 5¼" and 7" accessory spaces
- Control room monitor, studio monitor, and communications modules.

All multitrack systems feature two solo circuits; input and monitor/mixdown positional.

All Input Modules Feature:

- 33 frequency, 3 band, stepped equalizers.
- 4 independent echo/foldback sends with individual pre/post, on/off switching.
- Conductive plastic full-travel attenuators.
- Discrete amplifier circuitry in primary signal paths.

SIERRA—16 to 36 inputs, plus 4 echo send/return modules, four selectable mixing busses and separate quadraphonic outputs.

PACIFICA—16 to 36 inputs, plus 4 echo send/return modules, eight selectable mixing busses and separate stereo outputs.

VENTURA—24 to 36 inputs, plus 4 echo send/return modules, sixteen selectable mixing busses and separate quadraphonic outputs.

BRENTWOOD—24 to 36 inputs, plus 4 echo send/return modules, 24 selectable mixing busses, separate quadraphonic outputs and VCA design with 6 sub-groups.

BEL-AIRE—24 to 36 inputs, plus 4 echo send/return modules, 24 selectable mixing busses, and separate quadraphonic outputs. Automated fader design with 6 sub-groups, including Compumix III processor.

Please write for complete information on the new Quad/Eight Modular Series.

Quad/Eight Electronics
Quad/Eight International
11929 Vose St., North Hollywood, CA 91605
(213) 764-1516 Telex: 662-446

SURVEY: MULTITRACK RECORDING CONSOLES

program eq ±12 dB at 50/100/200 Hz and 2.5/5/10 kHz; rotary and joystick quad pan; rack mounting and console face complimiters variable 1.1:1 to 100:1, attack 0.1 µs to 1.2 ms, release limiter 0.09 µs, compressor 50 ms to greater than 10s.

1024-24
Available with 12, 16 and 24 group outputs, based on input module including line/mic switch, input attenuate, pfl, monitor submix route, two fb, eq at lo/mid/hi, 4/5 frequencies in each band, shelf curves at 50 Hz and 10 kHz switchable. Usual program assign and monitor select facilities. Prices: eg 12/12 $22 639, 20/16 $29 123, 24/24 $32 965.

SPHERE (USA)

Sphere Electronics, 20201-A Prairie Ave, Chatsworth, California 91311, USA.
Phone: (213) 349-4747.

Eclipse Series
Available with configurations up to 24/24, for recording studios. MIXLOG automation programmer available as option, for which information should be shortly available. Comprehensive facilities and monitoring, fully modular design. Options include 24 track monitor on 16 track console, slide monitor units and seven frequency osc. Prices eg 16/16 $27 802, 24/24 $34 677.

STRAITA HEAD

Straita Head Sound, 7578 El Cajon Bvd, San Diego, California 92041, USA.
Phone: (714) 465-9997.

Custom consoles based on standard modules for music balancing and recording. Any configuration supplied. Typical facilities extend to multiple stereo reinsert, led peak reading vu meters, built in crossover for multiamp operation, three band eq switchable three frequencies in each, two aux subgroups pre-post; pad, phase, hi pass filter.

TASCAM

Teac Corpn of America, 7733 Telegraph Rd, Montebello, California 90640, USA.
Phone: (213) 726-0303.
UK: Teledyne International, High Street, Houghton Regis, Beds LU5 5QJ.
Phone: 0582 603151.

Model 10
Series of competitively priced mixing consoles, based on the following modules: expander; input; tb with slate and integral 5W amp; remote control; monitor mix with pan; quad pan with four joysticks; headphone monitor; mic inputs balanced and unbalanced; line amp. Prices vary 8/4 at $2350 to 24/4 at $5765.

Model 5
Eight in/four out mixer operating at —10 dB level. Offers pad and trim, input mode (mic, line or tape) cue, echo, hi and lo eq shelves, output routing, overload led, pan, four channel monitor and slate. The desk incorporates five vu meters, the fifth being for echo etc.

Model 3
Intended mainly for pa use, the mixer is basically a 8/4 diminuendo of the above model.

TRIAD

Trident Audio Developments Ltd, 4-10 North Rd, London N7 9HN, UK.
Phone: 01-609 0087. Telex: 264773.
USA: Pacific Recorders and Engineering Corpn, 11760 Sorrento Valley Rd, San Diego, California 92121.
Phone: (714) 453-3255. Telex: 695008.
Audiotechniques Inc, 142 Hamilton Ave, Stamford, Connecticut.
Phone: (203) 359-2312. Telex: 06902.

Range of fully modular consoles permitting wide variation in configuration, as required. One year guarantee with each console, with full after-sales services; same-day module repair at factory. Delivery normally 12-16 weeks after receipt of order.

A Series
For large multitrack studios. 16 frequency graphic eq on any channel, four independent fb, six push-selected es subgroups; quad facility, dual scale vu or ppm metering; independent eq of echo and fb circuits; interfaced for automated working as standard option. Desks prewired for future expansion; phantom mic powering; electronic stop-clock and correlation meter standard. Prices £16 000 to £45 000

B Series
For multitrack studios a level below those requiring *A* Series desks. Identical technical specification, for *B* Series modules in console for table top or floor standing operation. Integral pfl speaker/amp and extensive jack bay. Built-in six-way distribution amp and complimiters standard. Prices £4000 to £23 000.

Fleximix
See review in December issue.

CB9066
Equaliser unit with built-in power supply. Hi and lo pass continuously variable filters, three-band eq with variable frequency ans sweep frequency selection. Price £220 per single channel.

TWEED (UK)

Tweed Audio, Rosewood Industrial Estate, Kelso, Roxburghshire, Scotland.
Phone: 05732 2983.
Italy: Exhibo Italiana, 20052 Monza Via F Frisis 22, Italy.
Phone: 039 360021.

P104
10/4 portable mixer now incorporating monitoring and metering on all channels. The system is expandable up to 24 channels.
Price: £2350, $4183.

12/2—4 Standard Portable console
Twelve channels with a choice of two or four track configurations specially designed for portable/mobile use stated as being compact and rugged with a wide range of facilities.
Price: £3680, $6550.

Roxburgh series
124 12/4, *168* 16/8, 'designed with economy in mind but without sacrifice of performance, quality or reliability with adequate facilities combined with compact size'.
Price: 124 £5951, $10 622, 168 £7877, $14 066.

Standard range
Consoles offering comprehensive facilities with full monitoring and metering.
Price: 16/16 £12 375, $22 027, 24/24 £19 875, $35 377

WARD-BECK (Canada)

Ward-Beck Systems Ltd, 841 Progress Avenue, Scarborough, Ontario M1H 2X4, Canada.
Phone: (416) 438-6550. Telex: 0623469.

Model M2484
24/8 broadcast multitrack console. Facilities include two reverb return channels, eight submasters, which act as multitrack outputs 1-8, eight direct outputs which act as multitrack outputs 9-16, four programme master busses, two reverb send busses, four foldback busses, one pa buss, one pfl, one solo, 18 channel mix down selection, two control room monitor outputs, two studio monitor outputs.

WESTREX

Westrex, PO Box 989, Beverley Hills, California 90213, USA.
Phone: (213) 274-9303.
UK: Westrex Co Ltd, 152 Coles Green Rd, London NW2 7HE.
Phone: 01-452 5401. Telex: 923003. Cables: Westelco London NW2.
Italy: Westrex Co Italy, 65 Via Costantino Maes, 00162 Rome.
Spain: Westrex Co Iberica, Avenida Jose Antonio 636, Barcelona 7.
Japan: Westrex Co Orient, CPO Box 760, Tokyo.
Hong Kong: Westrex Co Asia, Room 1302, Luk Hoi Tong Building, 31 Queen's Rd Central.

ST3000
Various input/output combinations according to customer requirements. Modular construction. Typical channel includes: *ST3009* combining panel, with p/b bussing selection; *ST3003* channel control panel with pre/post es/fb selector, send gain cue push button and overload indicator; *ST3001* input amplifier, mic/line indicator, gain, 120 Hz hi pass in/out, phase, fine gain; *ST3002* eq unit, three boost/cut zones at 50 Hz, 0.7/1.0/1.4/2.8/3.5/4.2/5.6 kHz and 15 kHz; *ST3010* fader with slider and bottom of travel micro switch. *ST3001* input amp takes mic between —70 and —20 dB and line between —10 and +20 dB in 10 dB steps.

Westrex ST 3070 8/24

ST3050
Compact mixer for small studio or location work. Available with up to eight input channels and 1/2 groups out. Modules similar or identical *ST3000*; illuminated ppm or vu metering; all components 'fully tropicalised'. ■

AMEK "M" Series is a comprehensive multitrack master recording system. Ergonomic design and superb electronics combine to make a totally creative console, at an undeniably sensible price.

Many formats are available, and the desk can be built with future expansion in mind. Quadrophony, alternative routing facilities, simultaneous multitrack and live sound, are no problem.

We also make a range of smaller desks ("X" Series) and a unique set of electronic crossovers, not to mention tailor-made lighting, stage monitoring and sound reinforcement consoles.

If you have a requirement in sound you think we can meet, contact us for rapid quotation and problem-solving service.

M Series short spec.

M2001 input

Noise: −127dB (20Hz to 20kHz, 200 ohm source)
Max. input, attenuator in, +10dBM
THD, at 1kHz, 0.02% at +10dBM
Response, at +10dBM, 20Hz to 20kHz, +/−1dB
DESK:
THD at 1kHz, 0.02% at +10dBM into 600 ohms
Headroom +22dB above 0dBM into 600 ohms unbalanced

M2001 Input Channel

Connectors:
as required.
Overdub switch now fitted
Insertion points, in and out, GPO jacks.

Inputs:
Microphone input balanced for 200–600 Ohm microphones;
Line input, unbalanced, 10k Ohms;
Insert out, unbalanced, low impedance;
Insert in, unbalanced 10k Ohms.
Insertion points are buffered, pre-fader.

Channel controls:

Microphone amplifier:
Rotary gain control, giving a channel sensitivity of 20 to 60dB in the mic. position; −20 to +20dB in the line position.
Mic/line input select switch;
Attenuation switch with 20dB pad;
Phase switch.

Equalization:
Equalization in/out switch;
HF: +/−18dB shelving, at 3 frequencies: 6kHz, 10kHz, 15kHz
Low pass filter at 15kHz, 10kHz, and cancel;
MF: +/−14dB, peak and dip, at 3 frequencies: 2kHz, 2.8kHz, 5.6kHz
Low or High Q (4dB/ and 8dB/octave);
MF: +/−14dB, peak and dip, at 3 frequencies: 350Hz, 700Hz, 1.4kHz
Low or High Q (4dB/ and 8dB/octave);
LF: +/− 18dB shelving at 3 frequencies: 40Hz, 80Hz, 160Hz.
High pass filter at 40Hz, 80Hz, and cancel;

Auxiliary bussing:
2 separate foldback level controls, pre-fader;
2 separate echosend level controls, with pre/post switch for both controls;

Routing:
Panpot with 2 thumbwheel switches on each channel, for up to one of 16 outputs on each switch;
Channel in/out switch with LED indicator;
Channel overload indicator (pre-fader, post insert), peak-detecting LED set to trigger at +8dBM;

Monitoring:
Pre-fade listen/after fade listen (solo) by switch.

FRANCE: Francis LINON, 72 AVENUE LENINE, GENTILLY (161) 657 0812
LONDON: (P.A. division) Ian JONES, HHB PA HIRE, 16 WALLASEY CRESCENT, ICKENHAM, UXBRIDGE, MIDDLESEX RUISLIP (71) 73271

AMEK *SYSTEMS AND CONTROLS LIMITED*
2nd FLOOR, ISLINGTON MILL, JAMES STREET, SALFORD, LANCS M3 5HW ENGLAND
(061) 834 6747

Nick FRANKS & Graham LANGLEY

The echo of fashion

PETER FELLGETT *

'One finds gross distortion of perspective, for example the whole orchestra apparently inside a giant solo instrument such as a violin or guitar' . . . The author argues for purist recording technique in classical productions.

*UNIVERSITY OF READING

THE pages of STUDIO SOUND have already reverberated to argument for and against multi-microphone and coincident microphone recording techniques[1,2] with further contributions in a lighter vein[3,4] though still with a serious underlying purpose.

The present author's work has brought him during the past two or three years, and particularly in recent months, into contact with a variety of people interested in recording and broadcasting, including professionals in the industry, musicians, and members of the lay public for whom the whole show is provided and who in the end support the audio industry. These contacts have again and again thrown up the question whether the direction the industry has taken since about 1965 is not leading to an artistic and commercial dead end, particularly the trend towards multi-microphone and multi-track working, with the use of close microphone positions requiring pan-potting and artificial reverberation. The discussions have also provided some insight into the reasons and attitudes which underlie this trend, and leave no doubt in the mind of the author that the question which has been raised needs to be considered seriously.

It is distinctly disquieting that so many members of the lay public prefer recordings made by the sort of amateur who does *not* begin by buying microphone *stands*, and when they have the opportunity of hearing such material ask why they cannot buy commercial recordings of similar character.

There is a ground-swell of disquiet amongst musicians. Soloists, chamber groups, and small specialist orchestras and choirs privately voice bitter criticism of what modern studio techniques do to their music. Session players complain of boredom and the lack of scope for their skills, saying for example that there is no point in cultivating good dynamics since all such aspects tend to be preempted by the recording engineer.

Comparatively junior members of the recording industry often express sympathy with the need for a return to more natural methods of recording, but say their bosses will not allow it. Those in more senior positions say it is not company policy. Managers say they would like to revert to more natural methods, but their studios will not wear it. It is also said that musicians accept present methods, and the public demand it.

The public in fact is confused, as always, but seems increasingly dissatisfied. Many people, particularly those who are concertgoers, are reluctant to buy records, or at least express the wish for some alternative to the present conventions in recorded sound. The current popularity of re-issues of material recorded before 1965, and even of 78's, may be a further expression of this reluctance.

Analysis

In attempting to analyse these reactions, it seems at first that there is a kind of conspiracy of silence. Everyone seems to put the responsibility on someone else; the musicians on the studios, the studios on the musicians, producers on engineers, engineers on producers, and of course everyone on the long-suffering public. Further thought shows that in fact this is not so much a conspiracy as exactly the opposite, namely a sense of isolation. Those who have been expressing dissatisfaction are of course, by definition, self-selected, but the striking observation is that so many of them believed that everyone else was perfectly satisfied, and that there must be something wrong with themselves to engender the doubts which they felt. In many individual cases it was a great relief to discover that there was a silent minority of other nuts just like themselves. The whole matter is in need of public ventilation so that the different parties can get together. The official pronouncements of the recording industry often suggest that multi-microphone artificiality is heavily entrenched. Even allowing for observational selection, the author has gained the impression that when everyone speaks their real thoughts the industry will be found to be much more open-minded on the subject than has been suspected hitherto. A large minority, at least, of British record producers appear only too anxious to take up more natural methods of recording if they can be shown how to do this under modern conditions in the industry.

What in fact does the public want? There are two traditional ways of answering this question; marketing men's 'intuition' or Market Research. Neither method appears particularly reliable. It was the admitted unreliability of guesswork that brought Market Research into existence. Consider however a market research questionnaire asking if you would buy trousers that are completely unfashioned, available only in coarse blue denim guaranteed to fade and shrink, with coarse stitching showing and even held together in places with metallic rivets. Add that at extra charge it will be possible to buy these trousers secondhand and already half worn out by Texas cowhands, and clearly the response to the questionnaire will cause any marketing man to turn tail and run, despite the fact that jeans are almost an international uniform for rich and poor, both sexes, and all ages.

In the audio market, the one solid fact is the tautology that the public wants pleasure and satisfaction in listening; but unfortunately the public cannot have the knowledge to know how to express this desire in the terms necessary for practical realisation. Just as with wine the public do well to rely on the trained palates of buyers, shippers and merchants, so in reproduced music they must in the short term rely to a considerable extent on professional critics and reviewers. Unfortunately few of these are able both to hear what is wrong musically and understand it in explicit technical terms (the author certainly does not profess this ability). Moreover the critic needs to have an image of what the public wants, which tends to make the process circular.

The practical outcome seems to be that in the long run the public makes its own collective choice, and the skill of the critic lies in his ability to be a step ahead of current taste, and to lead it into satisfying paths perhaps a little quicker than it would have gone of its own accord, while never allowing himself to lose touch with current public taste. The danger of presuming too strongly that we know what the public wants is that we may thereby remove from the public its freedom of choice within the audio industry, and so leave people with no option but to exercise their long-term choice by seeking other forms of entertainment or recreation. This consideration of itself creates a substantial reason for providing a proportion of recorded material which avoids the artificial methods that are current, and (most important) is labelled as such so that the public can identify it.

Multi-microphone methods

The reasons usually given for multi-microphone and multitrack working are various, and not all of them appear to bear examination.

It is said that time is saved; for example it is quicker to push up a fader than to move a musician forward. It might however be just as quick to ask him to play louder, and moving a musician may be quicker than running out an extra microphone. It is said that multitrack working enables adjustments to be made after the recording session. Certainly this is true in the sense of selection, but it may be doubted if a good result can be obtained if the music was unsatisfactory at the time. Moreover one cannot in post-session editing call up a microphone that was not there at the time.

It is said that conductors, and other musicians, cannot achieve balance without technological aid, and that the financial practicalities of a session demand that recording should begin immediately without prior rehearsal. Here it is pertinent to recall that musicians have been achieving balance without electronic technological aid for several centuries now, and if a conductor cannot achieve this it may be doubted whether he is a good conductor in other ways also. The matter of rehearsal being precluded seems to be mainly a matter of words. The author's admittedly very limited experience of recording sessions suggests that they often consist of continually interrupted sections of rehearsal, all of which are taken down and the good bits spliced together. This hardly seems the way to make great music, and with a limitation of 20 minutes final time for a three-hour session it does appear to the layman that a programme of rehearsal followed by performance might have something to be said for it.

Poor acoustics and appreciable ambient noise level are among the more cogent reasons put forward for close microphoning. No one can reasonably deny that if the acoustic is thoroughly bad, or noisy, then the only recourse is to suppress it. It can equally be said that if the Grand National is run on a flooded course, then it is best for the horses to wear floats on their hooves. Why should a recording engineer or producer accept a bad acoustic any more than a bad microphone, tape deck or mixing desk? The aggregate cost of these items is not necessarily greater than that of building a good recording hall, particularly having regard to the period over which the cost would be amortized, and the hall makes just as important a contribution to the final result. Moreover it is extremely probable that numerous existing buildings giving a quiet and pleasant acoustic already exist, awaiting discovery by an enterprising search. One of the barriers has undoubtedly been the tendency to confine attention to the already well-searched London district, where costs are high and the problems of aircraft and traffic noise particularly severe.

Personal attitudes

The author has however gained the strong impression, which will no doubt brand him as the Margaret Mead of panpot training, that these technological reasons are to a significant extent a rationalisation of personal attitudes which create a predisposition to multi-microphone multitrack methods. There is of course always the danger of believing that technology is good, and more technology is better. 'All those knobs,...we were terribly impressed,' is a remark attributed to a hopeful pop group after their first recording session, but one grows out of this sort of sknobbery at about the age one ceases to be impressed by noisy motor cycle exhausts. Nothing so crude is to be expected of professionals in the industry, but the technology-is-good complex can enter in more subtle ways.

One of these is exemplified by the kind of apologia which begins 'when the music is dissected, it is very difficult and takes great skill and knowledge to put it together again'. Indeed the contention of this article is that it is not only difficult, but usually impossible to do this in a way that is really satisfactory musically. The significant omission from this defence is the initial question of just why the music was dissected in the first place.

Some of those who address themselves to this question answer it in a way that seems to imply the assumption that the job of the engineer is (so to speak) to drag the sound to the listener by the scruff of its neck, forgetting that it might just walk on its own feet. It reminds one of the kind of gynaecologist who seems unaware that babies can be born without induction and heavy drugging, and in fact have been born in this way for a million years or so of human history.

A most interesting observation is that some professionals hear as 'unclear' or 'muddy' any recording which provides a definite sense of the acoustic space in which the performance took place, and this impression seems to be largely independent of whether the recording appears clear or unclear to other ears. It turns out that such people, often themselves, use artificial reverberation units or else mix in reverberant sound from microphones hung up like washing towards the rear of the concert hall. Their objection is not therefore to a reasonable content of indirect sound in the recording, but rather that they see anything which contributes specific information about the recording space and its acoustic ambience as an intrusion which they interpret as confusing. The hidden assumption here is that music should float disembodied, not tied to any place or space or sounding as if it had been performed somewhere recognisable. This is of course a matter of taste, but it is likely to be a minority view as applied to music written for live performance, which is of course the vast majority of the music that has ever been written.

Although matters of taste are necessarily involved here also, it does appear that the proponents of highly artificial recording methods, and the critics who review their records, are attaching undue importance to minutiae of balance, technical perfection, etc, while largely ignoring, and apparently failing to hear, other aspects which arguably are musically of greater importance, including musical continuity and sense of occasion.

In making music the player interacts continually with his instrument, with the other performers, with the acoustic environment, with the sounds that went before or are to follow, and with any listeners who are present. Music is so much dependent on this moment-by-moment control and interaction that little good can come of any artifice which materially disturbs the normal perceptions of the musician, or makes use of what he can neither hear nor instantly respond to. This is a fundamental difficulty in all attempts to pick-up sound for recording in an unnatural way; it shows why editing short sections to achieve technical perfection cannot replace sustained performance; and it is why when the performance is over, all attempts to rectify any but its most simplistic features by mechanistic processing are doomed to failure. It imposes an exacting discipline on what we may allow ourselves to do if we are to record music and not just the noises it makes.

Disadvantages

It cannot be denied that grotesque effects are not infrequently observed in commercial recordings made using multiple close-microphone methods and multitrack processing. There are examples where almost every instrument has been subjected to a different filtering. One finds gross distortion of perspective, for example the whole orchestra apparently inside a giant solo instrument such as violin or guitar. Separate instruments and sections of the orchestra can be heard going up and down like a cinema organ. The apologists for these methods point out that these are examples of their misuse, and do not necessarily imply any criticism of the methods themselves when correctly used. This argument is perfectly valid, except insofar as these examples show how much scope there is for abuses and errors, and how much sensitivities must have been blunted for these blatant examples to have passed the scrutiny of the studio.

Moreover there are distortions which do seem to be inseparable from these microphone and processing methods. A musical instrument has a pattern of radiation in space, and the natural sound of the instrument results from the combination of direct and indirect sound waves blending this whole pattern together. In a recent broadcast[5] Isaac Stern, discussing with Pinchas Zukerman the choice of a violin for the soloist, said that what matters is the quality projected by the violin after the dross has fallen away from the sound in the first few rows of the concert hall. The terms used by Mr Stern are subjective, but there can hardly be doubt about the reality of the phenomena he describes, and we are even learning in recent work how they can be expressed in physical terms. The fact is that a closely microphoned instrument does not sound like that instrument at all, and indeed this is tacitly admitted by the attempts often made to rectify the errors by filtering. In the broadcast discussion the distinguished soloists said quite explicitly that faced with the battery of technology of modern recording methods the true tone is falsified beyond recall; it was sad that they did not seem to be aware that this depends on deliberate choices, and need not necessarily be so. Surely the industry would be unwise to continue to ignore such remarks by musicians of the top flight.

Another inevitable distortion is of dynamic. A trumpet or a violin, for example, played *ff* does not sound at all like the same

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instrument played *mf* and jacked up a dozen decibels or so on a fader. The tonal quality, as everyone knows but almost everyone ignores, is quite different in the two cases. Allied to this effect, but distinct from it, is the distortion of perspective and distance. An amplified instrument, for example a violin, does not give the impression of the instrument being played louder, but of a giant instrument, for example a violin several feet across. Examples of this giantism are all too common in modern recordings, and their effect can be most disturbing. Distortions of distance and of space can be equally disturbing. If stereo is realised with the refinement that Alan Blumlein had already achieved in the early 1930s, it is capable of conveying a remarkable sense of depth and distance. Panpotted images lack these spacial clues (a point to which we return later) and tend to produce images strung along the line joining the two loudspeakers. Particularly strange effects can be produced by mixing stereo-pairs with spot microphones; either different players or sections appear to be playing in separate and mutually inconsistent spaces, or else there are superpositions of space which for example make the viola appear to come from the middle of the piano.

There are also distortions of ensemble and rhythm. Good music making is very dependent on the players listening to each other. Not only are they inhibited from doing this by knowing that they are playing each into his own microphone, but the way instruments blend, and the way in which the players listen to each other, necessarily depend on the acoustic of the hall, as has been pointed out by Sir Adrian Boult[12] and recently emphasised by Bernard Keeffe[6]. When this acoustic is suppressed or distorted, so are important aspects of the ensemble. Gerzon[2] has moreover pointed out that the timing needed in orchestral playing to deliver properly synchronised sounds to an audience is significantly affected by the time of travel of the sound-waves. Good players get used to allowing for this with normal orchestral layout, and subconsciously adjust their attack in accordance with the characteristics of the concert hall, so that a little while is needed before an orchestra can play at its best in a strange hall. All these relationships are distorted by close or multiple microphone techniques, and ensemble and rhythm suffer in consequence.

Reference has already been made to the distortions of musical continuity and creativity by the attitude of trying to take down the music in a literal sense as quickly as possible during a recording session, and then sorting it all out afterwards by adjusting balance and editing different takes together. This applies even to soloists and principals who can to some extent dictate their own terms, but it bears particularly hard on the skilled session players on whom so much orchestral music necessarily depends. No matter how nimble and secure their playing may be, stringing together bits of rehearsal gives them no opportunity to make music, and the result sounds (surprise, surprise!) just like bits of rehearsal strung together; in some recordings one can almost hear the players looking at their watches. All this eventually rebounds on the record-buying public.

Ambience

It is curious that whereas it is universally accepted that a piece of equipment such as an amplifier must be designed with the most careful regard for established engineering principles as well as being finally evaluated by listening, so much microphone and recording technique is treated at a purely empirical level. The resultant errors and misconceptions affect all recording philosophies, but are particularly serious for the techniques that have been described as 'purist', ie those in which an effort is made to give the listener the closest approach to a fine original sound and performance with minimum distortion.

An example is the relationship between ambience and clarity. In many discussions it is implicitly assumed (even by those not having the psychological predisposition already discussed) that these properties are at opposite poles, yet in fact it is well established by experiment that this is not necessarily so at all. Structureless reverberation, whether real or artificial, can only increase the blend between the component sounds, but under suitable conditions ambience information provides an important mechanism of discrimination which greatly aids clarity in hearing inner lines of the structure of music. It provides a kind of labelling on each instrument or voice, depending on the place of origin of the sound in the hall. Moreover this ambience labelling, unlike panpotted directionality, remains partly audible to the mono listener, thus improving mono-stereo compatibility.

It is often asserted that recorded sound needs extra 'clarity' because of the lack of visual clues, and if this argument is valid then it is strange indeed that we are asked to do without these ambience-labelling clues which so much aid discrimination at a live performance. It seems that recent stereo practice has laid excessive emphasis on the crude aspect of directionality represented by the localisation of the direct sound, and has ignored the important role of ambience information in localisation in real life. This indoctrination can of course easily become self-reinforcing if the experience of the recording engineer or producer becomes more and more predominantly experience of artificial reverberation devices, often without him recognising consciously that this is the case. The fundamental distinction between acoustic ambience and mere reverberation then tends to be lost. Reverberation is simply the way in which the intensity of the sound dies away. Ambience, by contrast, refers to the structural relationship between the amplitudes and delays of indirect sounds giving specific information about the acoustics of the performance space. We traditionally recognise how much information about the size, shape and nature of the place in which he finds himself a blind person can derive from the acoustic ambience, but forget that a sighted person uses just the same ability to supplement what his eyes tell him. The structured relationships in ambience information are of course specific to each direct source of sound in relation to its acoustic environment. Structured information of this kind cannot possibly be provided by artificial reverberation devices, or by 'washing' microphones hung in (or pointing towards) the back of the hall; it is no more possible to have separate microphones or channels for the direct and 'ambience' components than it is to have one channel for the intonation and another for the tempo.

An immediate consequence of lack of ambience labelling is that sounds cannot easily be heard simultaneously unless they have nearly the same loudness, and this is the cause of the notorious sensitivity of panpotted recordings to slight changes in balance levels. One record company has actually advertised that they have to adjust fader settings to allow for changes of temperature in the recording studio, and they seem quite unaware of the fundamental reason for the critical nature of the adjustments. Of course there is an early limit to the number of voices that can each be close in loudness to the sum of all the others, and so this difficulty is compounded as the musical texture becomes more complex.

Microphone technique

In retrospect, it can be seen that the justly famous Philadelphia-Washington relay[7] set a whole generation on to a false trail with regard to microphone techniques. Microphones spaced several metres apart are a hopeless way of sampling the wavefronts of the sound at any but the lowest frequencies where the spacing does not exceed half the wavelength of the sound. Over most of the audio range, microphones spaced in this way are able essentially to provide only loudness information with virtually random phase-differences. At any frequency, the information provided is hopelessly inadequate when only two microphones are used. With a multiplicity of microphones, each feeding its own loudspeaker in a corresponding location, superficially quite good results can be obtained, and this has misled people who have failed to realise that by using properly designed engineering methods still better results could have been obtained with so many channels of information available. Spaced microphone stereo has a strong tendency to make the loudspeakers audible as distinct and separate sources of sound, often with some of the instruments appearing to be duplicated in each loudspeaker. The interest in the US of having a central loudspeaker fed with the sum signal, in addition to the normal stereo pair, may be related to the prevalence there of this microphone technique[8].

A variant is to use directional microphones, usually cardioids or hypercardioids pointing at an angle of about 120° to each other, with approximately the same spacing as between the human ears. Like any method that gains widespread acceptance, it goes without saying that this must have some merits, and they include an apparent enhancement of the directional impressions of the listener. Extended listening reveals however that the images are comparatively

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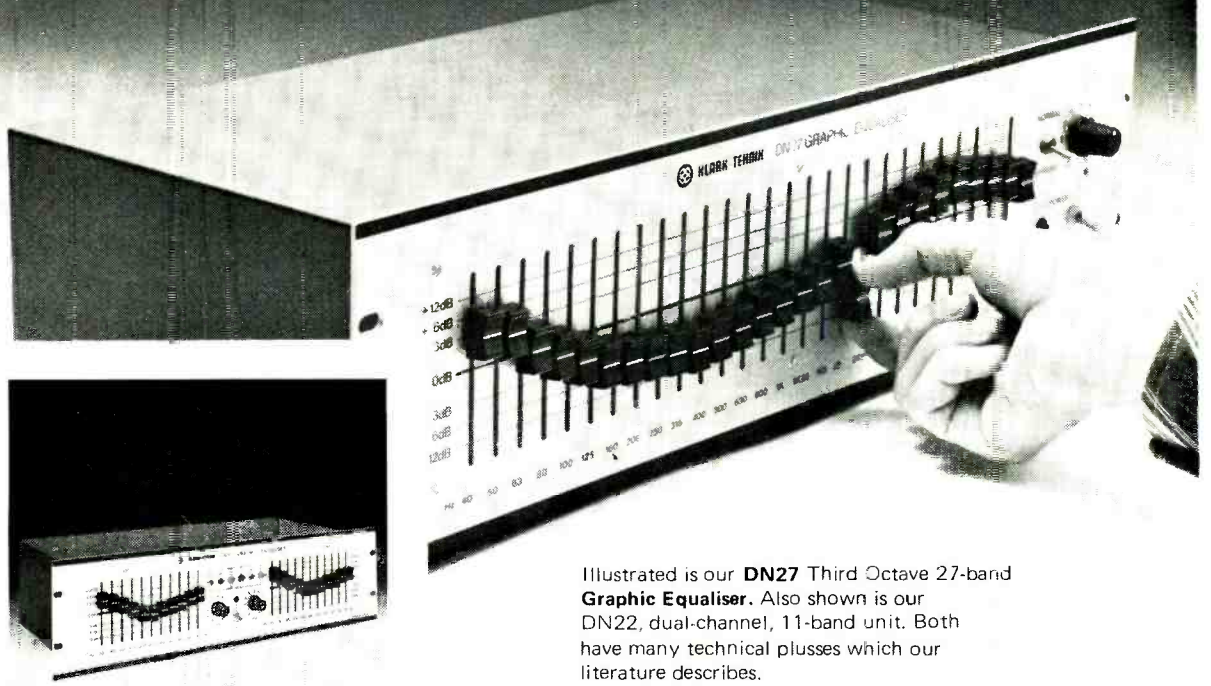

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unstable, and there is a curious four-eared effect. Also, mono compatibility is poor.

Much better possibilities are opened up by the use of genuinely coincident directional microphones. It must be appreciated that the requirements here are exacting. In order to maintain correct phase relationships, the spacing should be small compared with the wavelength at the highest significant frequency. Obviously it is impossible to fulfil this condition strictly with any existing microphones, but fortunately it suffices to obtain coincidence in the horizontal plane by stacking the microphones vertically (as close as possible of course) in the special case of pure figure-of-eight microphones responsive only to pressure-gradient. It scarcely needs to be stated that this is the original Blumlein pair; more than 40 years later we cannot do better using conventional microphones, although we have learnt to understand better why Blumlein's arrangement was such a good choice. Recently a solution has been found by Craven and Gerzon to the problem of obtaining the effect of exact coincidence up to a limiting frequency which can be placed at the top of the audible range by suitable design. This sound-field microphone[9] also provides interesting possibilities for post-session steering of the effective directions of pointing and sensitivity patterns of the microphones, providing the recording is made in a suitable format.

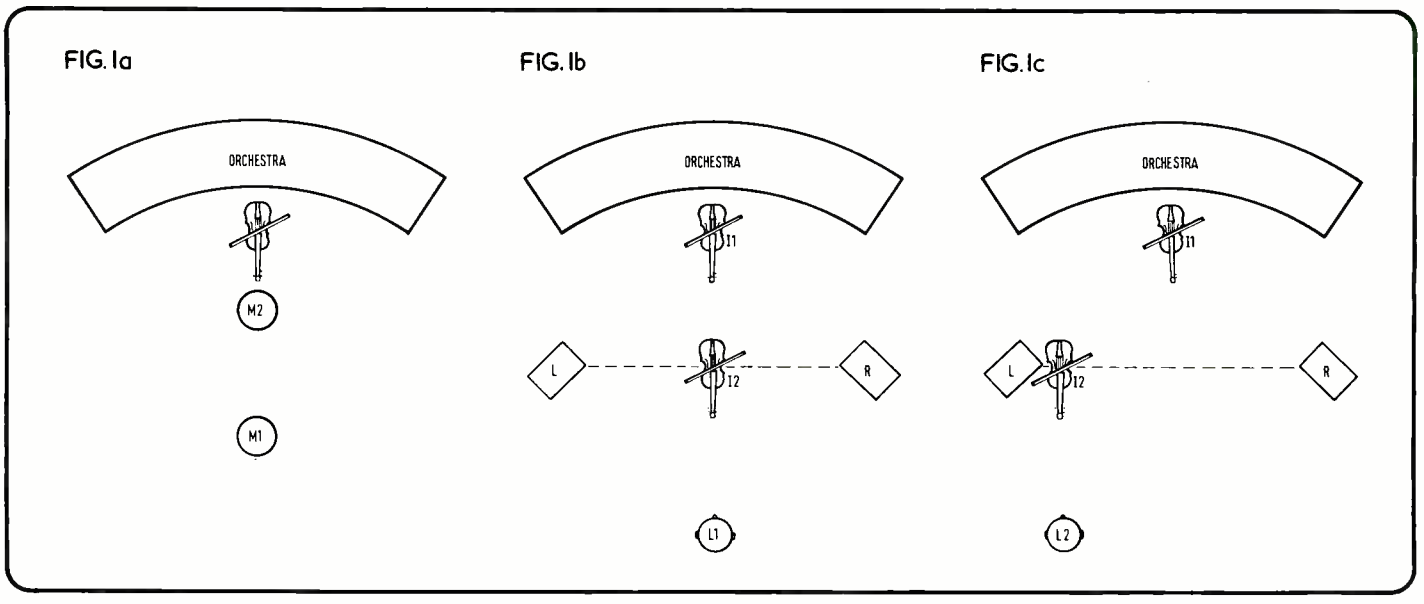
The concept of a 'coincident stereo pair' is in fact almost meaningless without further specification. The ear is extremely sensitive to the distribution of indirect sound. The most obvious effect is a tendency for the ambience to 'pool' either at the stereo loudspeakers or at a point between them. Even more important is the strong stabilisation of the stereo image by ambient information when the correct conditions are fulfilled; a partial theoretical explanation of this has been presented by Gerzon[10]. In order to obtain this highly desirable effect it is necessary for there to be a rather exact relationship between the angle of pointing and the directivity pattern of the microphones comprising the stereo pair. For example, cardioid microphones should point at an angle of 120° to each other. However much the best uniformity of ambience is provided by figure-of-eight microphones angled at 90°; in other words, our old friend the Blumlein pair. Subjective evaluation amply confirms the theoretical expectation that this arrangement is capable of producing recordings of special excellence. Arbitrary alterations in the direction of pointing of microphones in a coincident pair, as is sometimes done in a misguided effort to aim the microphones at particular musical sources, is profitless, and many otherwise excellent broadcasts show signs of this defect. Indeed broadcasts or recordings that sound really correct are so rare that reviewers tend to shy away from them as not fulfilling their expectations of 'hi-fi' reproduction.

Very curious effects can result from yielding to the temptation to 'highlight' particular players or sections by mixing the output of a spot microphone with that of the main stereo pair. As an example, **fig. 1**(a) shows an orchestra and solo violin being recorded with a stereo microphone pair M_1. If all is correct, this will reproduce approximately as shown in **fig. 1(b)**, counting only the image I_1 of the soloist, and where L and R represent the stereo loudspeakers. If now the output of a spot microphone M_2 (**fig. 1**(a)) is added, a centrally placed listener L will hear one image of the soloist at I_1 (**fig. 1(b)**) and a second panpotted image at I_2 approximately on the line LR joining the loudspeakers. The apparent distance between I_1 and I_2 will be approximately the same as between M_1 and M_2. If this distance is small, comb-filter coloration will be heard due to interference caused by propagation delay, whereas if this distance is large the difference in time of arrival of the sound may be directly audible, resulting in a double-image being heard. Moreover the common assertion that a spot-microphone high-light signal is panned into 'exact coincidence' with the direct image cannot be true in general, even in direction, for other than exactly central listeners. If the conditions described above for stereo stabilisation are fulfilled by the microphone-pair M_1, the directions of the direct image I_1 and the panpotted image I_2 will not remain the same if the listener moves off centre. **Fig. 1(c)** illustrates the consequent tendency to double-imaging in direction for a non-central listener L_2. What the listener L_2 will actually hear will depend on how strongly the ambience information from M_1 locks both images I_1 and I_2, and the subjective effect may be of ambiguity or confusion rather than actual double-imaging.

Problems

The foregoing discussion illustrates that many aspects of current studio practice create as many problems as they claim to solve, but this of course in no way implies that a return to 'purist' techniques will automatically solve everything. There remain real problems, and it appears that the adoption of sophisticated methods (in both the good and the bad sense of this adjective), when it is not due to unthinking habit or psychological reasons, is always connected with the attempt to compensate for deficiencies in various parts of the recording chain. An obvious example is that there was no known way of realising truly coincident microphones before the development of the sound-field microphone[9], which even now is not yet commercially available. The best that can be done, as we have seen, is to use vertically stacked figure-of-eight microphones, but knowledge of the special properties of this Blumlein arrangement is not widespread, and this may be seen as the cause of the many more-or-less arbitrary arrangements of semi-coincident, semi-spaced arrays using arbitrary directional patterns and inter-microphone angles.

Of course even the most precise microphone technique cannot produce a result of higher quality than is set by the acoustic at the original performance, any more than microphone technique can 62 ▶



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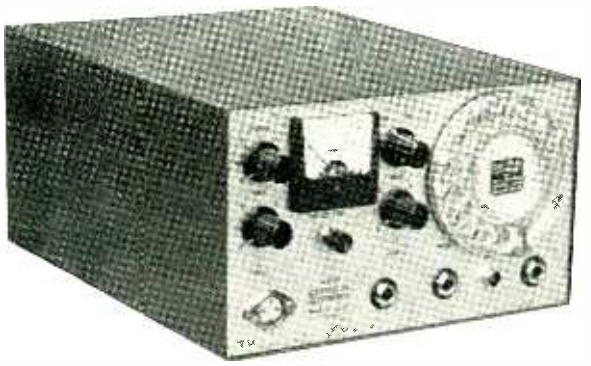

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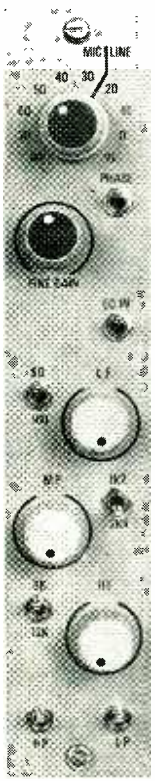

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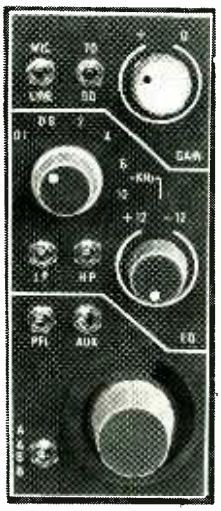

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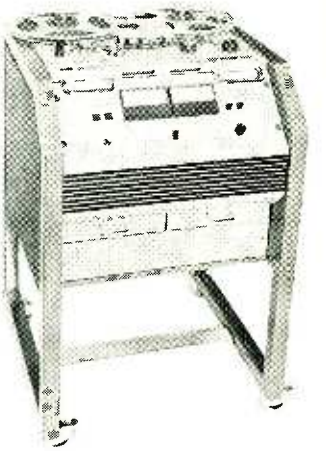

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improve the quality of the musicians' playing. Attempts to compensate for the acoustic are doomed to failure because (as has been pointed out by M A Gerzon) the concert hall has many thousands of significant components, and there is no hope of compensating for the effect of all these with a few dozen knobs on a control desk. It is sad but true that the only recourse if the acoustic is bad is to suppress it, which means close microphoning and all the problems and falsifications which result from this. If the best result that can be obtained in this way is unacceptable, as the author believes it is to many more people than has usually been recognised, then we are driven to find places to record having good acoustics. We ought not to need much driving, apart from the drive out of London.

Probably an unanalysed motivation for sophistication in recording is the attempt to compensate for deficiencies in the properties of magnetic tape: at least it seems suggestive that sophistication (in the sense already defined) mushroomed within a few years of magnetic recording becoming widespread. It scarcely needs pointing out that the dynamic range provided by modern magnetic recording is uncomfortably small. Various kinds of noise-reduction systems are consequently in widespread use, but recently suspicions have been growing that despite the undoubted benefits of such systems they introduce their own peculiar distortions which cause significant subjective impairment; correctly-recorded ambience seems particularly liable to suffer so that it loses its characteristic spacious quality and sounds turbid. The exact reasons are not yet well understood, but may be connected with fundamental limitations in the performance of signal-controlled variable gain amplifiers. Moreover it is by no means certain that limited dynamic range is the most serious limitation of magnetic tape, and other more subtle effects are under suspicion, including the comparatively high level of noise intermodulation[11]. Although a widespread return to direct-cut recording cannot be contemplated with equanimity, it is salutary to recall that recordings were actually made very successfully in those far-off primitive days before magnetic tape had been invented.

Conclusion

In the nature of things, our discussion has not yielded any universal panacea, but it has suggested that hard thought is needed about some matters which are frequently taken for granted, and especially about the artistic objectives of studio methods. In recording, technology is the servant of music, and betrays itself whenever it ceases to be a humble means to artistic objectives and becomes instead something intruding between the music and the listener. However such sentiments, while they may readily evoke lip-service, remain platitude unless we know how to express them in practical terms, which we must confess we do not. There can be no golden rule, but only recourse to hard critical thought and musical judgment. The precept to respect the intentions of the composer is valuable, but would be easier to apply were it not that everyone knows what these intentions are, and everyone's version differs from everyone else's. Moreover composers are only human, and can make mistakes like anyone else. Nevertheless good musical scholarship and experiment can create a living concensus. For example, it is now fashionable to perform Early, Renaissance and Baroque music with original instruments, or reproductions of them, and in what is believed to be the original manner. Whether the direct result is acclaimed as 'authentic' (but authenticity has hitherto inexplicably stopped short of the use of castrati) or disparaged as 'museum performances', it is generally admitted that the indirect results have been musically valuable. We no longer perform the Brandenburgs on full romantic orchestra with piano, nor are performances of the Music for the Royal Fireworks as universally Harty as once they were. Ought we then to help Ludwig out with his orchestration, as one record label boasts of doing? Even if we do decide that such action is justifiable, ought it to be done by technological rather than direct musical methods?

As a final question it may be asked whether it would not be salutary, and in the spirit of this age of consumer protection, informative labelling and trades descriptions, for recordings of the highest quality to state where they were recorded and what microphone technique was used†. Panpotted recordings using artificial reverberation devices should then probably be declared as 'processed'. It is entirely predictable that this suggestion will provoke a chorus of objections on grounds of practicality, just as conclusive and irrefutable as those that were raised against open date-stamping of foodstuffs until Sainsburys and Marks and Spencers (the author has shares in neither) just went ahead and did it. ■

† Hugh Ottaway—*'The Listener'* 1976 November 11 p618.

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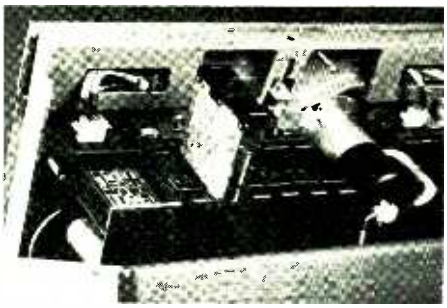

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Multitrack review

KEITH SLAUGHTER*

Suppliers and users discuss eight different studio mixing consoles and the facilities they offer. The outcome tells of the dichotomy existing between US and UK design thinking.

*AUDIO AND ACOUSTIC SERVICES

SINCE starting on the task of preparing and writing reviews of the various large multitrack consoles, one particular fact has emerged: that is the similarity in terms of facilities offered by each of the UK manufacturers' products. There are, of course, differences in appearance, shape and size and subtle differences in techniques. But since most manufacturers will custom-build (to varying degrees) to the customer's own specification, in theory, at least, one could obtain six consoles from six different manufacturers and they would all be identical and excellent—although perhaps it would be advisable not to go too far out on the colour scheme for instance!

The above points really apply to British console constructors but a somewhat similar situation exists with equipment from America, the other principal supply country. There, the format tends to differ from the traditional British one (not API) and custom building is less frequently available, but their consoles do bear similarity. However, to make the choice more difficult, most of the British manufacturers are now producing or planning so-called compact desks along American lines. These consoles are likely to form the basis of new standard ranges although still with a degree of flexibility leaving, for example, blank panel space for special custom facilities.

So why choose one manufacturer rather than another when deciding on a new console. The reasons can be numerous and complex. They might range from purely technical considerations right through to the fact that the studio engineers may have worked for a long period of time with a particular make. Most engineers undoubtedly have a *favourite* type. Over a period of years they will have become well acquainted with the manufacturer and his staff and will have met up from time to time to discuss problems, improvements etc. So that when the time comes to order a new desk as a replacement or a completely new installation then invariably the same manufacturer is chosen.

So the choice will be one of three main options:

The true custom console designed right from scratch. With this there is absolutely no limit except physical size—will it fit your control room (or more important can you get it to and through the control room door). Along with size comes shape, finish, colour etc and in each of the reviews an attempt will be made to indicate degree or limit (if any) of customisation offered by each company.

The second option is the one most often taken: that is a custom design using standard components. Each manufacturer produces a range of standard modules and some standard facility panels, and it is on these items that the decision to use a particular make may be taken. The layout is decided upon, the number of input channels and outputs is fixed, the module types chosen and along with a number of special facilities, a console is produced. Then the client has a new custom-built console but having made use of a large percentage of standard components. The present cost is still fairly high but, because of the use of standard items, is less than starting everything from scratch. Of course, customisation is sometimes taken a stage farther by the introduction of modifications; possibly the most frequent changes here are to equalisers where small mods are carried out to alter curve shapes for instance.

The third option is to go for a standard console and this is an interesting area in itself. Most of the British manufacturers advertise standard equipment but do not often build them on spec, unlike the American companies. The design may have been evolved as an exercise by the company or that of previous clients. Either way, all drawings are prepared and production gets under way very quickly. In the past the standard may only have had a short run before improvements and new ideas brought in a new design, but as has already been mentioned, we now have the advent of the new compacts. In fact these may well have longer runs, rather akin to the American system. In this they tend to mass produce and offer very few options.

American console manufacturers tend to differ somewhat in their approach to their British counterparts. Little or no true customisation is offered, at least not on this side of the Atlantic. Of the three consoles reviewed only API are near the traditional British format, and they do have available a number of options. The other two are much more cut and dried with little variation from the standard product. This standardisation extends also to general appearance and colour. However all of the consoles can be delivered automation ready. MCI and Harrison do not offer limiter/compressors or any other ancillaries—other than MCI's excellent *Spectra-Vue* device, which makes up for a lot—as far as could be ascertained. Other items such as remote control facilities for tape machines and Dolbys did not seem to be in evidence either.

In addition to fitting their own equipment, most manufacturers will supply and install proprietary ancillary equipment. Particularly in the case of limiters and compressors this may be the only choice if the company does not produce its own. These can often be modified to fit into matched panels and modules, and include such items as noise gates, special effects, remote control panels (for tape machines, echo plates etc). An obvious modification, although not carried out very often, is the inclusion of noise reduction equipment. This seems more of a good idea now that interchange is possible between well-known makes, and would also make remote wiring less of a problem.

Interfacing between the console and the rest of the studio equipment is carried out in various ways. This might comprise single connectors of the *XLR* type or larger multiway connectors. It could also be terminal blocks with or without cables connected to form an 'umbilical cord'. This cord would probably terminate in an external rack with all other equipment also feeding into the same rack. Signal connections are either made or changed in either an internal or external jackfield, which again might also be part of the interface. Jackfields still tend to be the Post Office type but for reasons of space bantams and even miniature types are now sometimes used.

Automation must now be considered when decisions are being made concerning new equipment. Some will say that it is arriving and others that it has already done so—but whatever one's views it is going to be a fact of life in most of the larger studios within the next year or so. Even if it is decided not to automate immediately, then it would seem very wise to make provisions for the future. Unfortunately, as seems always the case in the audio field, a certain amount of confusion exists and this is mainly because different companies are developing their own systems. Therefore compatibility between one studio and another may well create problems—manufacturers are offering their own or proprietary systems and at least two more major London studios will be automation operational by early 1977. Automation connected with tape auto location may perhaps be a warning to tape operators to watch out, but tea-making ability of the robots has not been demonstrated as yet.

Most manufacturers are constantly experimenting and improving techniques but at the same time tending to progress with a certain caution. They won't discard a well-proven technique until convinced that a worthwhile plus is going to be obtained. Most use mechanical switching and relays (reed type) for example and are still considering the desirability of fet switching and logic. However, some are farther into this thinking than others, and possibly America more so than Britain. Automation will of course push these new techniques more quickly along with the use of vca's and similar devices. The console builders are not dragging their feet, but on the other hand want to make certain that their clients are getting the best. Because cost tends to influence decisions, they must also be certain that new innovations are going to last the normally expected life of the equipment, and hence justify high initial capital expenditure.

Before starting the individual reviews one other technique should be mentioned and that is regarding the desirability of using unbalanced or balanced circuitry incorporating the use of transformers. Neve, for example, sticks rigidly to a balanced system with liberal use of transformers. They design their own and say that they are constantly improving them. The console operates on a 24V rail and still gives a very respectable amount of headroom, and they claim that it is by far the best way of doing things. The purists will go along with this. The other school still insists that when transformers are used there are problems with low end response in particular and also to an extent the high end. However, lab results don't seem to bear this out and transformers offer a positive method of impedance matching.

Some designers push up the voltage to obtain the headroom without too many transformers, others compromise. The differences in a well engineered console are very small and it is up to the client to decide on his past experience or particular problems which he prefers.

All manufacturers tend to use the same construction techniques, and that is basically modular units fitted into a console framework. The naked framework left after the functional units are fitted is then clad in either metal, wood or synthetic material panels, and there is very little deviation from that format. However, despite the opening comments on similarity, they will all endeavour to make their product immediately identifiable, unless specifically requested otherwise.

API

Interviewed: Derek Stoddard, 3M Company; Derek Varnals, Wally Fisher, Threshold/Decca

Of the three American consoles reviewed, API are the ones most resembling the more traditional British format: this means that there are separate input channels, group faders and monitor input channels. The appearance, despite the format, is fairly compact; possibly more so than a comparable British one. The construction is modular with the modules being connected into a pc mother board. They are not individually cased and are not, as with MCI and Harrison, in long channel strips, but in individual units. One standard range console has no less than six modules per channel (including fader and automation control). No true customisation is available but there is a wide variety to choose from. There are three or four large consoles with a very complete range of modules and, additionally, a complete catalogue of other console components. Faders, amplifiers, limiter/compressors, all manufactured by API. They are probably one of the only large manufacturers either in the UK or the States who actually do this. In fact it is worth mentioning that Strawberry South studios in Dorking decided on an API but, because of their particular requirements, they are building their own console framework and filling it with API modules and components sent over to England. It will be interesting to see (and hear) how this works out.

The standard factory-produced consoles are housed in a Spanish Oak Formica veneered material completely covering the exterior. There is a soft vinyl front edge. The panels are finished in either a light beige colour or black, with coloured coded knobs and internally luminated fader scales. These are activated as soon as the fader is moved from the off position. The normal faders, rather curiously, have knobs instead of the more usual scalloped thumb (or finger) profile type, although the latter are available as an alternative. A small detail perhaps but worth mentioning.

Typical facilities offered on a console might be as follows: input modules in two units; one containing mic and line inputs, limiters,

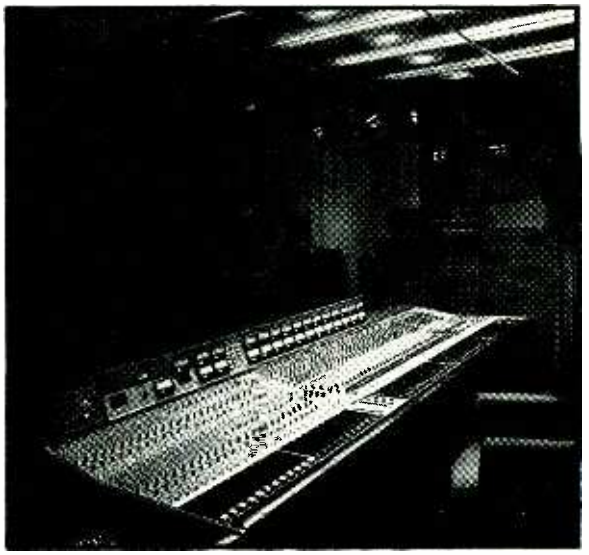
noise gate, overload indicator, grouping feature, phasing button etc, the other containing the echo and foldback send controls, separate L-R and F-B panning, solo and cut button. Equaliser modules can be normal type or parametric. Routing is direct or via track assign buttons which are internally illuminated. Monitor modules. Echo control and return with full equalisation. Studio playback and foldback assign, limiter/compressors, tape remotes and a number of blank panels for special custom purposes complete the wide range available. Meters supplied are normally conventional vu type.

API are completely involved in automation, being one of the pioneer companies. Many console functions can be automated; all levels, panning, echo and parametric equalisation. In fact API have a completely automated purpose-built mix-down console available. The system works in conjunction with their own programmer although others, eg Allison, could be used. Data is stored on a tape cartridge because it is claimed that a floppy disc has inadequate capacity for all console control functions. One track of the audio recorder is normally required for the timing code, but this may alternatively be obtained from appropriate tape timing devices.

Cadac

Interviewed: Bill Price, Paul Nunn of Wessex Studios

Cadac consoles are built on a massive, mainly aluminium alloy framework using the ISEP modular system. This framework is then clad almost totally in very attractive wood veneer panels which also cover the main frame support of square section steel. The first impression is of a very elegant piece of furniture. Cadac pride themselves on their woodwork and justifiably so. It is all carried out on the premises in an extremely well equipped workshop. The 68 ▶



veneers, which differ from one console to another, may be natural or synthetic and are chosen by the client early in the proceedings. Rather unusually, the metal work for modular construction etc is produced by outside specialist contractors. The colour of these functional panels has tended to be standardised by Cadac but they will spray any other colour although advising adherence to light shades because they feel that they are more practical. However exception to every rule in the form of a pa type console; the property of a well-known pop group, which was at the factory presumably for servicing. It looked very impressive finished in dark blue (Cadac's normal silk screening colour) with orange fluoro luminescent silk screening.

Cadac consoles are almost totally modular with little or no use of fixed panels except for metering and some function controls in the meter housing. The modules are not totally enclosed in metal casing but only have front panel and a side plate to which is attached a single pc board. The ISEP connectors, the male half of which is of course connected to the board (as opposed to printed edge connectors), make for very positive contact. The open module construction probably makes for slightly easier servicing but they obviously have to be handled with greater care when taken out and away to the workshop.

Cadac consoles are often 'L' shaped and they are obviously happy to construct to this arrangement. It makes them very good ergonomically by bringing controls to within easy reach of the engineer; important on large facility consoles in restricted space control rooms. Cadac total modular construction with all facility channels in line would tend to make the console fairly spread out if they were not angled around in some form. However they have and will build straight and in fact are flexible in meeting the clients particular wishes. The layout of the modules can also be designed in any way.

The standard range of modules offered includes: input channel amplifier and comprehensive equaliser; separate line gain control, phasing and eq insert switch. Routing module, to foldback, echo, quad module, L-R and F-B panning, jackfield insert, on/off check switch and routing to groups by toggle switches. These switches are laid out and marked in quad notation and are three-position with centre off. Of course, this arrangement limits the number which can be selected from each channel. Group module with re-routing by toggle switches again, input gain control from other groups, L-R and F-B panning, routing to Q. Monitor modules with full panning and routing to foldback, echo and quad. Echo module and quad with joystick panning. Cadac also manufacture their own limiter/compressor with noise gate and also a special Dolby module. This is a useful device particularly for use with Studer machines with separate sync and playback outputs. Meters are normally vu but others can be supplied including their own newly-developed gas column type.

Cadac are willing to make modifications to any of their standard range of modules, and build any devices to meet customers' special requirements. An additional new range of modules is being developed and will be in the form of a single strip containing all facilities except faders and main metering. All switching will be electronic using cmos logic, except equalisers and other minor functions. Track assign will be controlled from a central control module allowing each channel to be assigned to up to four tracks. All of the information can then be recorded so that all routing and other functions can then be instantly recalled at a later time. This should then solve the old problem of how to completely re-set the console after your series of sessions has been interrupted by somebody else. These modules will form the basis of a new compact range of modules—quite a departure for Cadac.

Cadac have developed their own system of automation which is being called CARE (Cadac automated remix equipment) and is based on their *V-cat* system. This is a voltage controlled attenuator. The CARE system can also accommodate various other functions, eg echo send/return levels, panning, foldback, eq and signal routing. Synchronisation requires one track of the audio recorder and storage is on a floppy disc. A large automated console is under construction at the present time, for Pye Studios, London.

Harrison

Interviewed: Eric Stewart of Strawberry South Studios, Dorking.

Harrison are one of the more recent entrants into the recording console market and, like MCI, use advanced, state-of-the-art electronic techniques. Appearance (in fact there is quite a resemblance to MCI) of all the consoles is identical and only the length varies depending on the number of channels, the maximum being 40 input-output and 32-track busses. The overall effect is one of extreme compactness in a console which is mainly clad in a rich dark-coloured wood. There is a wide, soft padded front edge and the whole is supported on a square section metal stand. An almost horizontal jackfield is fitted at one end and an optional producer's desk section can be supplied. Six standard modules are produced and each are in the form of full-length strips and therefore the slope of the console is constant from the channel faders right up to the track assign buttons. The meters are in a continuous housing along the top edge of the modules and arranged so that each meter is in line with each module. An option here is an additional vu meter overbridge.

The six standard modules are finished in a dark grey, almost black colour with various coloured controls and with blue silk screening. They are designated as follows: main input-output module, communication, group master, quad master, control room monitor and studio monitor modules. The number of input-output modules corresponds to the number of input channels of course, and there are normally only one each of the others. The concept of operation of the input-output channels and hence the whole console is decided by preselecting the status of each module. A single push-button on each module assigns status control to one of two groups on the module status selector on the group master module. Each of these groups, A or B, have four selections: source monitor, return monitor, return mix, source mix.

Source monitor mode is selected for normal recording and monitoring the output of the console 32-track busses (line in to tape machine). Return monitor is selected when it is desired to monitor the output of the multitrack recorder. Return mix is used for mixdown to mono, stereo, or quad. Source mix reverses the functions of the monitor pot and the vca fader. This last is a useful facility enabling, while live recording, the monitor mix to be written into the data storage of the automation system and thus providing a start for subsequent automated mixdown.

The main input-output module contains the usual facilities which include separate mic and line input attenuators, a four-section parametric equaliser and filters, 32-track assign buttons with led indication, four echo sends, stereo foldback and of course the vca fader. The monitor pot is rotary and there is L-R and F-B panning. Other modules contain echo returns but with no eq, oscillator, talkback etc. No limiter/compressors are installed in the console. Normal meters fitted to the console are electronic light bar display type with vu characteristic. The lower eight bars are yellow and indicate −20 to 0, and the upper four are red for the 0 to +3 section. This upper red section also acts as a peak detector by flashing at double intensity. The peak threshold is adjustable between +4 dBm and +24 dBm. Optional ppm meters can be supplied but without the peak flashing facility. Normal vu meters can also be fitted in various ways including the overbridge mentioned.

Automation interface and control is included and designed primarily for the Allison Research programmer.

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MULTITRACK REVIEW

Helios

Interviewed: Dick Swettenham, Neil Adams, Helios; Fred Meijer, Release Records, Dublin.

Helios console frameworks are constructed mainly in aluminium alloy which carries the ISEP modular system. Cladding tends mainly to be light metal panels with wood trim at waist line only. The base is constructed of square section alloy tubing. This all makes for a very rigid framework but with a great saving in weight. Helios have a reputation for building very compact consoles and reasonably light in weight, many having been installed in mobile units. Most of the metal work is carried out by Helios in their own well-equipped factory; only wood trims are from outside sources. Helios have no standard colours and will finish panels in any bs shade, but there is a tendency for certain colours to have short runs. Currently it is dark brown and it certainly looks very pleasing. Possibly this happens, not only with Helios, when a new client sees an existing desk in a particular colour, decides it looks OK, and opts for it rather than risking an unknown.

Quite a lot of Helios desks have been constructed on the wrap-around format, each side wing being at about 45 degrees. They are very happy about doing this and along with the basic overall compactness it makes a very easy to operate and ergonomically correct console. But the Helios people have no hang-ups about building to any size, shape, colour or material. You pays your money and takes your choice! They are in fact true custom builders. The functional units are either modular, mainly input channels, equalisers etc, or easily-removed panels. These panels are used for routing switches, monitor facilities, monitor control, echo units etc. The modules are totally enclosed.

Helios have a large range of standard module and panel designs prepared and will either construct a console using a selection of them or, in keeping with their policy of custom building, will modify or design afresh.

Typical Helios facilities are as follows: input channel amplifiers with comprehensive three or four-section parametric equalisers and filters, mic and line inputs, jackfield insert, phasing button etc. Routing module which would encompass solo, pfl, foldback, and echo send, panning either stereo or quad. A panel containing track assign switching which could either be press-button or rotary. One Helios rotary design includes a digital indication of tracks selected but of course has the limitations of non push-button selection. Echo send and return modules. Echo return and monitor linear faders. Track monitor panels and monitor control unit. Patchable quad joysticks. Limiter/compressors are built by Helios using Audio and Design main components. Also available are phasing devices and Dolby or dbx noise reduction as well as many other ancillary devices. Helios also specialise in remote control facilities for controlling tape machine and other devices such as Dolbys. Other features of a typical Helios desk could include: automatic line select for mixdown from one button, overload indicators with variable threshold and a very useful programmable cut matrix.

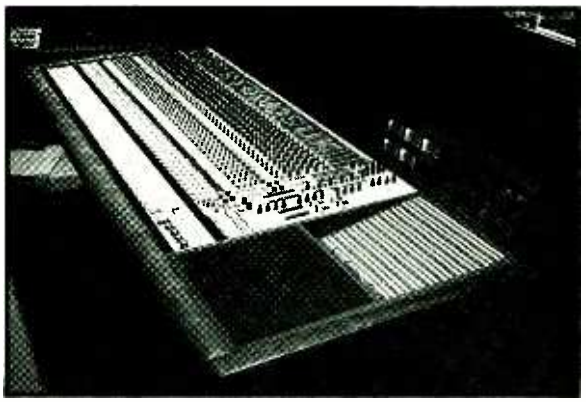
Any meter types can be fitted such as vu, ppm, led, light beam, gas column or even a colour video display system.

Helios are not directly involved in developing their own automation system at the moment, but they are offering vca's in channels operated by standard faders with grouping and master dc busses. Along with the programmable cut device this can all be interfaced with any proprietary memory system. Helios engineers are looking at ways to improve existing methods and may yet come up with their own system.

MCI

Interviewed: George Bala, CBS Studios; Dave Dearden, MCI.

The latest MCI console has recently been installed in a large London studio and certain design aspects were contributed by the studio's chief engineer. Therefore in some ways the desk was custom-built for them but the format will now be a standard for future MCI clients. However they will be getting a very comprehensive console utilising very advanced electronic techniques. The console construction is quite different to the usual British method and consists basically of a large shaped metal box into which the functional modules are fitted. The modules are complete full length strips from faders to track assign buttons in one constant slope up to the meters. The modules consist of one large pc board attached to the steel top panel with no further casing, and are plugged into a mother board running along the bottom of the console. Compared with the UK way of doing things, this may seem a method which might invite trouble at a later stage with electrical contact and general strength. In fact the reverse seems to be the case. The console is very strong and quite rigid and to date has given no problems. The panels are finished in a sandy yellow colour with black silk screening, the front edge is softly padded and the end trims are in solid oiled oak. The base support is in square section metal, but with only two uprights gives the whole console a very slim and elegant appearance.



The principal module in the console is the input-output one of which up to approximately 44 can be fitted. It contains the normal facilities which include an extremely comprehensive equaliser, 32-track assign buttons each with led indication, vca channel fader and linear fader for monitor level and of course L-R and F-B panning. The functions of the channel fader and monitor fader can be reversed on individual modules or a programmed group. No joystick panning is provided but on the console seen in London a very ingenious quad panpot was fitted. This is a single rotary control giving full 360 degree control either circular or figure of eight! It was again developed by the studio chief engineer and hopefully will become available on all future desks.

The meters installed on the console can either be conventional vu or bar graph gas column type. These latter are housed in a continuous fitting so that each meter lines up with a module. They have special filters and variable intensity so as to reduce any possible eye strain. They are also instantly switchable between vu and ppm characteristic, but the most interesting feature is the Spectra-Vue facility available as an option. This uses 42 of the meters to produce an audio spectrum display in real time as the programme is being monitored. It separates a mix or solo into ½-octave bands. For example a stereo mix using 21 on each side.

MCI desks are delivered automation prepared using vca faders etc. However a special feature of the system is automatic nulling of all automated controls. The outboard hardware for the system, 72 ▶

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computer, storage etc is to be released in the near future and the London studio mentioned are eagerly awaiting it.

Neve

Interviewed: Les Lewis, Peter Moody, Neve; Dave Harries, Mike Blackburn of AIR Studios, London

Neve consoles are very strong and massive utilising aluminium alloy and steel for the main framework housing the ISEP modular system. Wood or wood laminate trim is confined to waist line and along the top of the meter housing, with soft padded front edge of vinyl, or hide to special order. The console sits on a base frame of square section steel tube. All metal-work is made to a very high standard in their own elaborately equipped metal working shop. The panel colours have been standardised in a dark blue/grey for a long time and this is continuing, along with the lighter shade of the new compact range. Other non-functional panels, mainly at rear and below, are finished in a fine black crackle. The base is in the blue/grey. They possibly could be persuaded to deviate from these colours but from the size of Neve's operation it probably makes more economic sense to stick with them. Perhaps this could be termed a conservative attitude, but their consoles always look extremely good and very professional. Conservative, perhaps after all not; they are at the present time building an automated console with uv luminescent silk screening. Neve have developed their own automation system and at the present time the only other British company (Cadac being the other) to have done so, but are unique in having departed from the usual voltage control devices. The NECAM system as it is known is based on a mini computer, floppy disc store, code reader, display and control panels etc and of course servo-driven faders, the unique part of Neve's system. Tape machine control (auto locate etc) is possible as well as console functions. A NECAM equipped console is due for delivery to AIR Studios before the end of 1976. An earlier demonstration was very convincing (see STUDIO SOUND, May 76, p 14) and the completed desk is now eagerly awaited.

Perhaps a thought about this here, it certainly makes a lot of sense when one is familiar with the usual stygian gloom of the average control room on a late, late session. Neve's large console shape has been traditionally straight in line, usually impressively long, but with possibly a right-angle section providing a producer's desk and/or jackfield housing. However if a wrap-around is desired then it can most certainly be done.

As has been stated the overall appearance of Neve consoles is very good and the new compact range carries this on. The overall shape has been slightly altered by gently curving the dividing and end cheek sections. The modules and panels are a slightly lighter colour which is enhanced by the use of blue coloured controls.

A combination of modules and panels is used and the modules are totally enclosed offering complete screening and protection when removed from the console. A very comprehensive range of modules is available, both for the established and the new range, and typically are as follows: input channel amplifiers with extensive semi-parametric equalisers, high and low pass filters, combined mic/line input attenuator, phase, eq and solo buttons. Routing modules with flexible push-button assign to all busses, foldback and echo, L-R and F-B panning, solo and cut buttons. Group faders and group switching modules to enable re-grouping also with panning. Monitor matrix panels, linear monitor faders and monitor facilities panels, and also quad panpots. Neve limiter/compressors can be supplied along with a range of other devices. Metering can either be vu and/or peak type and provide complete monitoring of all console functions.

The new compact range modules differ in that although not housed in a long single channel module they are arranged on the desk in strip form. The input channels have mic and line inputs with separate sensitivity trims. Routing may be direct to track or via stereo panning to output busses selected again on push-buttons. Monitor tracks are arranged in line and provide up to 32 inputs. A single button provides change over of all channels from mic to tape with individual override switches to hold single channels in either state. The standard console frames for housing these new modules can provide up to 32-track output and still leave space for fitting additional facility modules and special custom requirements.

Raindirk

Interviewed: Ron Pender, Raindirk; Terry Yeadon, Kingsway Recorders

To date, Raindirk have only produced one multitrack console; that installed in Kingsway Recorders, London. However, they have manufactured many smaller units and a lot more are planned.

The console at Kingsway is extremely well engineered and built on the now familiar ISEP modular system. It is totally housed in a very strong framework of steel and alloy, trimmed around with wood. All panels are finished in a rich burgundy colour with white silk screening, although any colour may in fact be used to choice. The modules are totally enclosed in steel cases, a system much favoured by the majority of British manufacturers as has been noted in other reviews. Although it adds considerably to the overall weight of the console, it does seem a very good system; providing complete protection and screening.

With a new company, the question of customisation is a little different to a more established one. The first large console was designed as a result of complete co-operation between Raindirk and Kingsway and therefore a total custom design. Modules designed for this console are now available as standard items but they are 74 ▶

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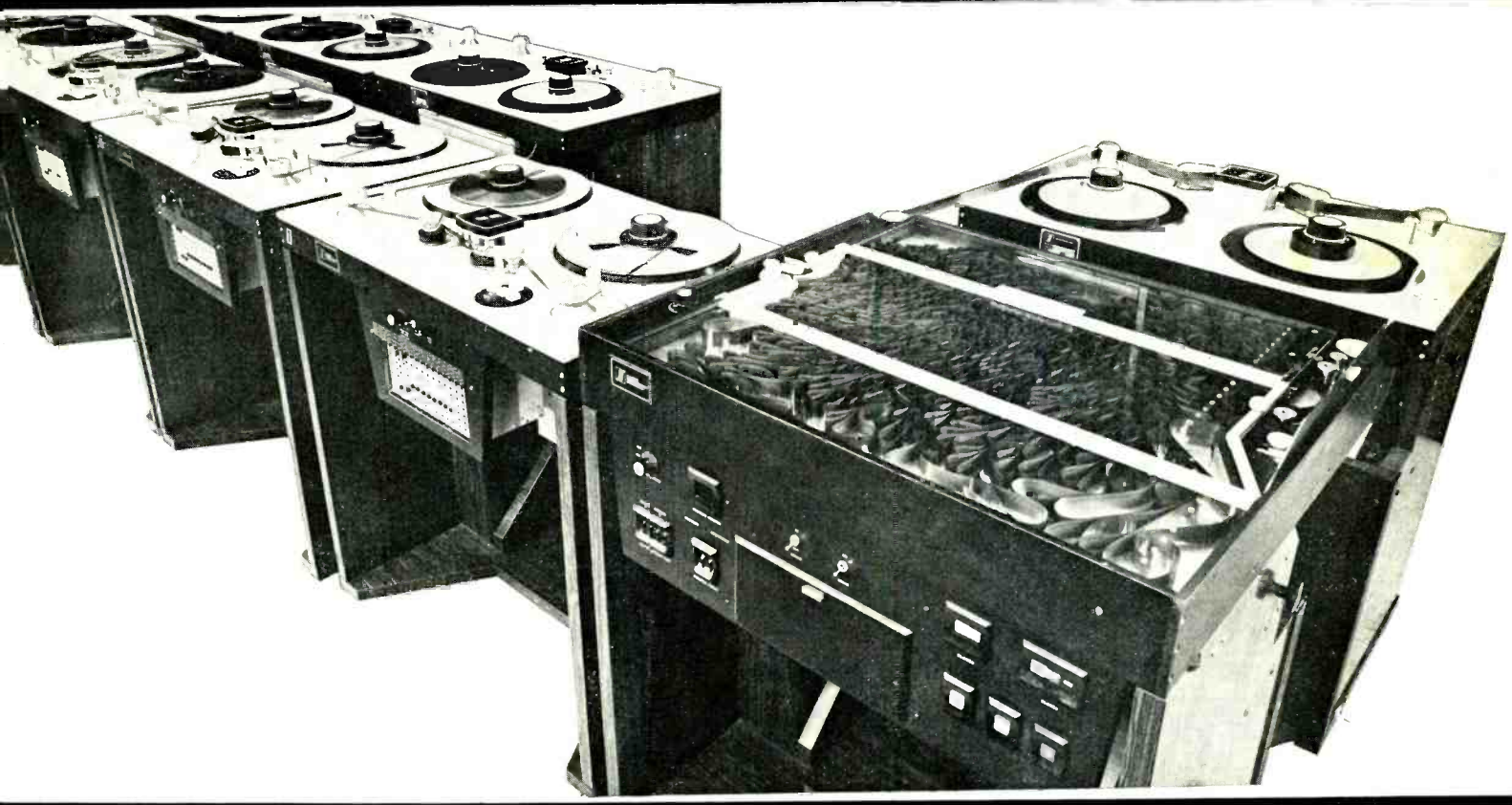

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reviews

White 140 sound analyser

Hugh Ford

MANUFACTURER'S SPECIFICATION

Display: 11 x 28 array of red light emitting diodes. 27 channels on ISO ⅓-octave centres from 40 Hz to 16 kHz plus one broad band channel. Either 1 dB or 2 dB steps for display range of 10 dB or 20 dB, plus over-range indication on each channel. 40 dB dynamic range via adjustment of attenuators.

Filters: Two pole-pair bandpass response (see below) meets ANSI S1.11-1971 Class II. Each channel individually converted and smoothed. Smoothing time constants selected to accommodate statistics of pink noise. Each channel trimmed for overall response of ±1 dB with pink noise in from 40 Hz to 16 kHz.

Front end: Microphone input—2000 ohms to accommodate standard 200 ohm dynamic microphone, transformer coupled, standard XLR connector. Input range for dynamic microphone: 40 dB spl to 110 dB spl (2.6 μV rms to 2.6 mV rms). Calibrated for microphone with sensitivity of —56 dBm or 0.13 mV/microbar (1 microbar=74 dB spl). Internal gain adjustment for other sensitivities. Line level input: 20 kilohms input impedance; input range of 2.6 mV rms to 2.6V rms; standard phone jack. Input attenuator: 10 dB steps from 40 dB to 90 dB.

Display vernier: 2 dB steps. Allows centring of ⅓-octave channels to accommodate approximately 16 dB difference in energy between ⅓-octave channel and broad band channel.

Noise generator: Provides pink noise flat from 40 Hz to 16 kHz. Output level may be selected from 20 mV rms or 0.5V rms with front panel switch. Level varied by front panel vernier. Low level suitable for driving microphone input. High level suitable for driving impedances of 5000 ohms or greater. Transformer coupled. XLR connector. Noise generated by digital shift register technique with word length of approximately 32 megabits at a 50 kHz clock rate.

Miscellaneous: Rear panel terminal strip. Line input connection. Scan output for remote oscilloscope display. Noise output.

Power requirements: 120V ac nominal at 0.2A.

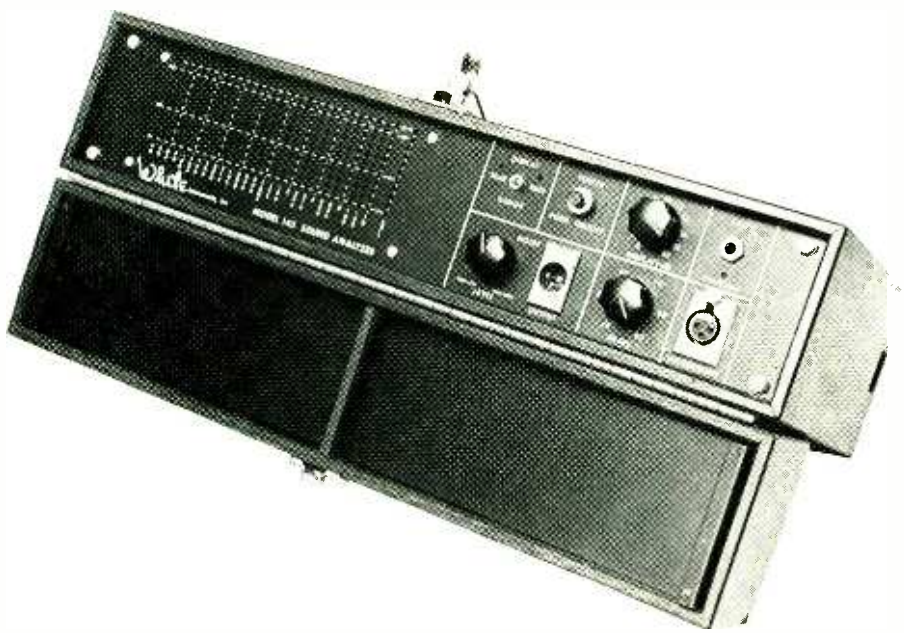
Mechanical: 89 mm by 483 mm standard rack mount. 178 mm required behind panel. Supplied in wood grained formica. Covered carrying case with space in lid for accessories. Can be supplied without case and with dust shrouds for rack mountings.

Optional microphone multiplexer: Accepts inputs from three dynamic microphones. Gain for each input independently adjustable. Low impedance, high level output for driving line level input of model **140** via an unshielded pair. Self contained; uses 9V transistor batteries. Scan rate carefully selected to minimise 'aliasing' effects. Carried in lid of model **140** carrying case.

Price: £2219; $3620.

Manufacturer: White Instruments Incorporated, PO Box 698, Austin, Texas, USA.

UK: Scenic Sounds Equipment, 27-31 Bryanston Street, London W1.



THE White type *140* is a real time spectrum analyser which uses a matrix of led indicators for its display of 27 ⅓-octave bands each of 11 level steps. In addition there is a sound pressure level display and an overload indicator for each band.

A limited dynamic range is displayed, which can be switch selected to be either 20 dB or 10 dB, thus providing either 2 dB or 1 dB increments in the display matrix. However, as a result of the overload capabilities of the instrument, the effective dynamic range is 40 dB because an attenuator is incorporated which increases the ⅓-octave display sensitivity by up to 20 dB in 2 dB steps.

In addition to this attenuator there is a master attenuator which has six 10 decibel steps which are calibrated in sound pressure level (spl). This calibration is based on the use of a dynamic microphone with a sensitivity of 130 mV/microbar connected to the microphone input of the instrument. This input is a fully floating high sensitivity input feeding a pre-amplifier, the output of which feeds the main instrument via a tip ring and sleeve switched jack socket. If a standard 6.35 mm jack plug is inserted into this socket the microphone input is disconnected and a high level input provided by the jack plug as an unbalanced input.

The microphone input is a standard *XLR* connector like the output of an inbuilt pink noise generator which is also fully floating and transformer coupled. The noise generator has a variable output level control in the form of a potentiometer which also has a push-pull action for switching between a high and a low level output.

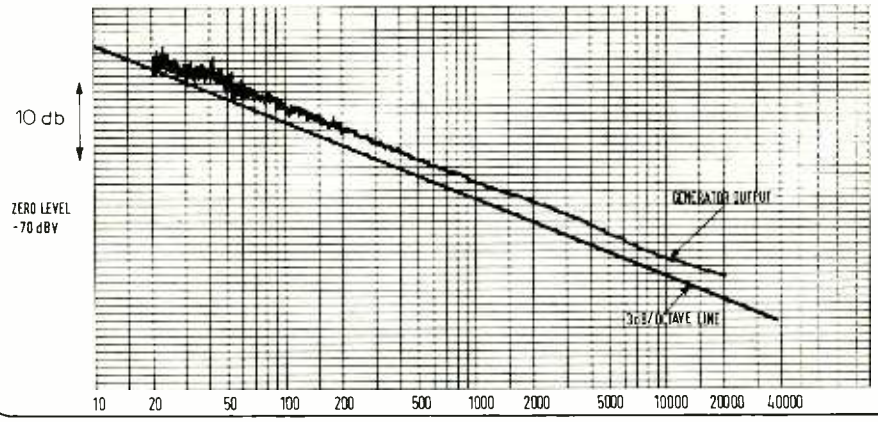
All these facilities are front panel functions which are supplemented by a barrier strip connector on the rear panel which duplicates the noise output, the pre-amplifier output and main input and also provides a sync output and level output so that the inbuilt display may be duplicated in the form of a ramp display on an oscilloscope.

The complete instrument is normally housed in a convenient carrying case which has compartments for various accessories, but the design is such that the unit is also easily mounted in a standard 483 mm rack.

The type *140* instrument as reviewed is intended for frequency response determination, room equalisation and other such 'steady state' applications but may be used for spectral analysis of programme material if averaging time errors are acceptable. However, more suitable for dynamic analysis is the White type *142* analyser which is similar in concept but includes instantaneous peak detection, together with a memory for comparing two stored spectral analyses.

Clearly the latter instrument is a very valuable tool for indicating peak levels when using recording systems such as tape or disc (particularly cassette tape duplicating) where the system is limited by high frequency saturation, but the type *140* instrument as reviewed is an ideal tool for checking frequency response of any equipment and such applications as room equalisation. Furthermore for the latter application a microphone multiplexer is available for averaging the output from three microphones.

FIG.1 White 140 pink noise output at maximum high level



The noise generator

A spectrum analysis of the output of the noise generator as shown in **fig. 1** demonstrates that the noise spectrum is genuinely 'pink' within close limits over the frequency range 20 Hz to 20 kHz. Repeating the spectrum analysis at a number of output levels confirmed that the noise spectrum remained constant with output level.

The available output voltage in terms of rms voltage was in two ranges which were effectively 0-480 mV and 0-19 mV. Maybe these ranges are not very well chosen, as the lower output range provides rather too high an output for use with high sensitivity inputs, such as microphone inputs, and the high output voltage range provides insufficient drive for some high level inputs.

The output impedance of the noise generator was found to be about 200 ohms in either the high or the low output voltage range, with a minimum recommended load of 5000 ohms, which is rather on the high side.

While the front panel noise output is fully floating, the rear panel output is peculiar in that it is unbalanced and is not properly functional unless one side of the front panel output is grounded.

The microphone pre-amplifier

The microphone pre-amplifier is virtually an independent piece of circuit from the main unit, and the pre-amplifier output is linked to the high level input by a link on the rear panel barrier strip. Overall pre-amplifier gain was found to be 57.3 dB with an input clipping level of 13 mV (equivalent to 114 dB spl with the nominal microphone) and a red overload indicator being illuminated on the front panel at 12 mV input. Provided that a suitable mic is used this margin is more than adequate.

Likewise, the input impedance was measured as 1660 ohms at 1592 Hz which is ideal for 200 ohm microphones, but could prove troublesome with the more unusual higher impedance microphones.

The overall frequency response of the pre-amplifier when fed from a 600 ohm source is shown in **fig. 2,** from which it is to be seen that while the response is generally flat above 100 Hz (–1 dB) the bass roll off is at –2 dB at 40 Hz, which is the lower limit of the analyser's display.

The display and controls

Bearing in mind that the display has a maximum sensitivity of 1 dB increments, checking the performance of the attenuators is not an easy matter if good accuracy is to be attained; in spite of this the two step attenuators were found to be within ±0.5 dB in overall or incremental error—quite satisfactory for their purpose.

By its nature the display frequency response is likewise difficult to check to great accuracy, but using either a separate pink noise source or using sinewaves it was found that the accuracy was within the readability of the display. The overall display is in fact formed by sequentially switching between filters, but in practice no objectional flicker is present and readability is good. The rear panel oscilloscope output is of course just a duplicate of the switched level output and a trigger output is provided to synchronise the oscilloscope display which takes the form of **fig. 3** and is a useful way of recording frequency response data.

The microphone input was found to have a sensitivity of 155 μV for an indication of 74 dB spl on the sound pressure level indicators at 1 kHz: this is 1.5 dB too low in sensitivity, but when using ordinary moving coil microphones this is probably of little consequence. The frequency response of the spl indication is reasonably flat, as was found with the overall frequency response of this input as shown in fig. 2, there being no weighting curve in the instrument.

Checking the centre frequencies of the displays showed that they were accurate, but the display had a slow integration time such that its output was only usable on steady state signals. The instrument is therefore only useful for frequency response checking and room equalisation, as opposed to the model *142* which has a fast peak sensing display.

The filter curves were not of course to the standards used for noise analysis, but quite realistic. The 1 kHz filter was found to have 3 dB points approximately 90 Hz off the centre frequency, with 20 dB points 260 Hz off the centre frequency, which makes good sense for a 20 dB display range on the ISO centre frequencies.

Summary

The White model *140* analyser is an extremely useful instrument for checking system frequency response or room equalisation with a real time display. The inbuilt pink noise generator was found to be an accurate source of pink noise and the display and attenuator accuracy was quite adequate for the intended uses of the instrument.

If the White *142* is to the same standards it will be an invaluable instrument for 'doctoring' recordings for disc cutting or domestic duplication.

Unfortunately, while good servicing information is provided, the construction of the review sample makes servicing somewhat tiresome, but it is understood that the manufacturer is modifying the instrument to a modular type construction. ■

FIG.2 White 140 frequency response of pre-amplifier

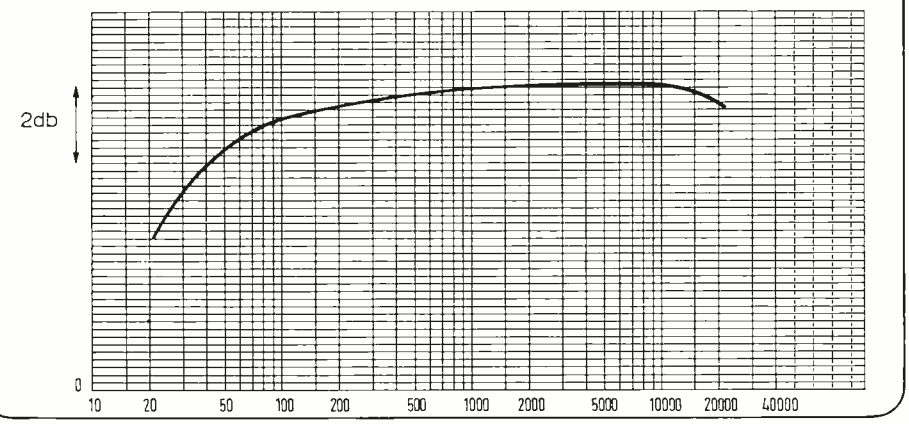
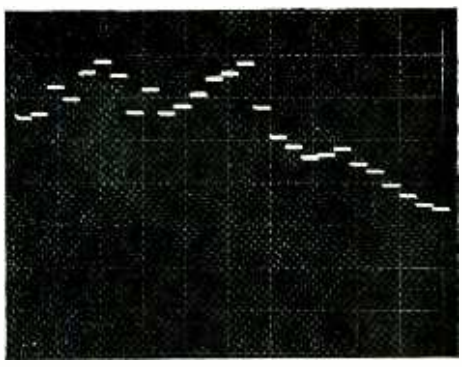


Fig. 3. *White 140 external display output*



(e) Track assign switching: there seemed to be a definite preference here for press buttons in order to give complete flexibility in routing. Some sort of indication is desirable. The type with the little mechanical iris seems very acceptable and there is no lamp replacement problem. Led's are also a good idea and if switching is electronic, with no mechanical visual indication that the button is pressed, then they are essential. Push buttons with filament lamps inside may create certain difficulties let alone the additional power requirements which can be more than the desk electronics require.

However with current limiting the system does work and obviously gives a pretty clear indication.

One point which was raised was the plotting of the desk set-up so that it can be repeated at a later stage. This, of course, frequently happens when a one-off session is put in the middle of a block of sessions maybe booked for an album recording with a very complicated set-up. Possibly a digital recording on any machine (cassette or one track of the multitrack could be used, no necessity for synchronisation). The information could then be played back and displayed on a video screen. Meanwhile it is believed that some studios have installed Polaroid cameras above the consoles to record the position of every control. ■

AES 55th CONVENTION, A REPORT

Hammond with *DN 27* and *DN 22* receiving their first US showing.

The noise reduction front was relatively quiet with the two main protagonists showing one new item each, neither directly related to the recording studio.

The dbx offering was a domestic 3-band dynamic expander, the *3BX*, which will be in production as of January 1.

Dolby's new item is the *CP50*, an offshoot of the *CP100* containing the optical processing only, with cost as the obvious saving for those theatres that do not require the magnetic facilities of the *CP100*.

The demonstration rooms were on the fifth floor and a particularly interesting loudspeaker was being shown in one by Richard Sequerra. Unfortunately the room was a bit 'rough', making critical assessment very difficult. The small pyramid-shaped enclosures, which are understood to be capable of 120 dBA in a large control room, certainly made some nice sounds and although the prime market will probably be top hi-fi ($2000 per pair) interest has apparently been shown by some studios.

A further interesting shape was being shown by the JVC Cutting Centre in the form of an 'engineering prototype' set of headphones. The tweeters are fitted out front, offering much greater potential for full field image location (see photo). The headset was being used to demonstrate *B-Phonic* and *Q-B-Phonic* sound which 'represent elaborations on stereo and quadraphonic technology respectively'. The demonstration was certainly impressive, though the programme material got a bit much at times. The *Q-B-Phonic* method of recording is to use two dummy heads both facing forward, about a third of a metre apart with a fibreglass baffle between them. Each head produces a pair of binaural signals which are processed with eq and time delay to produce the required playback.

Also shown by JVC were two new *CD-4* demodulators, one using a double pll technique and the other using ptl (phase tracking loop). And, of course, Sansui were demonstrating the QS system in another of the fifth floor rooms . . . but in general there didn't appear to be a lot of quadraphonic discussion around the show.

So where to put it all? On the studio design side Jeff Cooper was available for discussion, and Tom Hidley was represented by Sierra Audio. The latter was showing slides of the way that the large studio at Kendun went together. Perhaps the phrase that's going around 'Eastlake time is clean-up time' should be referred to the Monopolies Commission.

Overall the 55th Convention was one of the good ones, but surely something better can be done in terms of refreshment facilities . . . two dollars for half a pint of beer! ■

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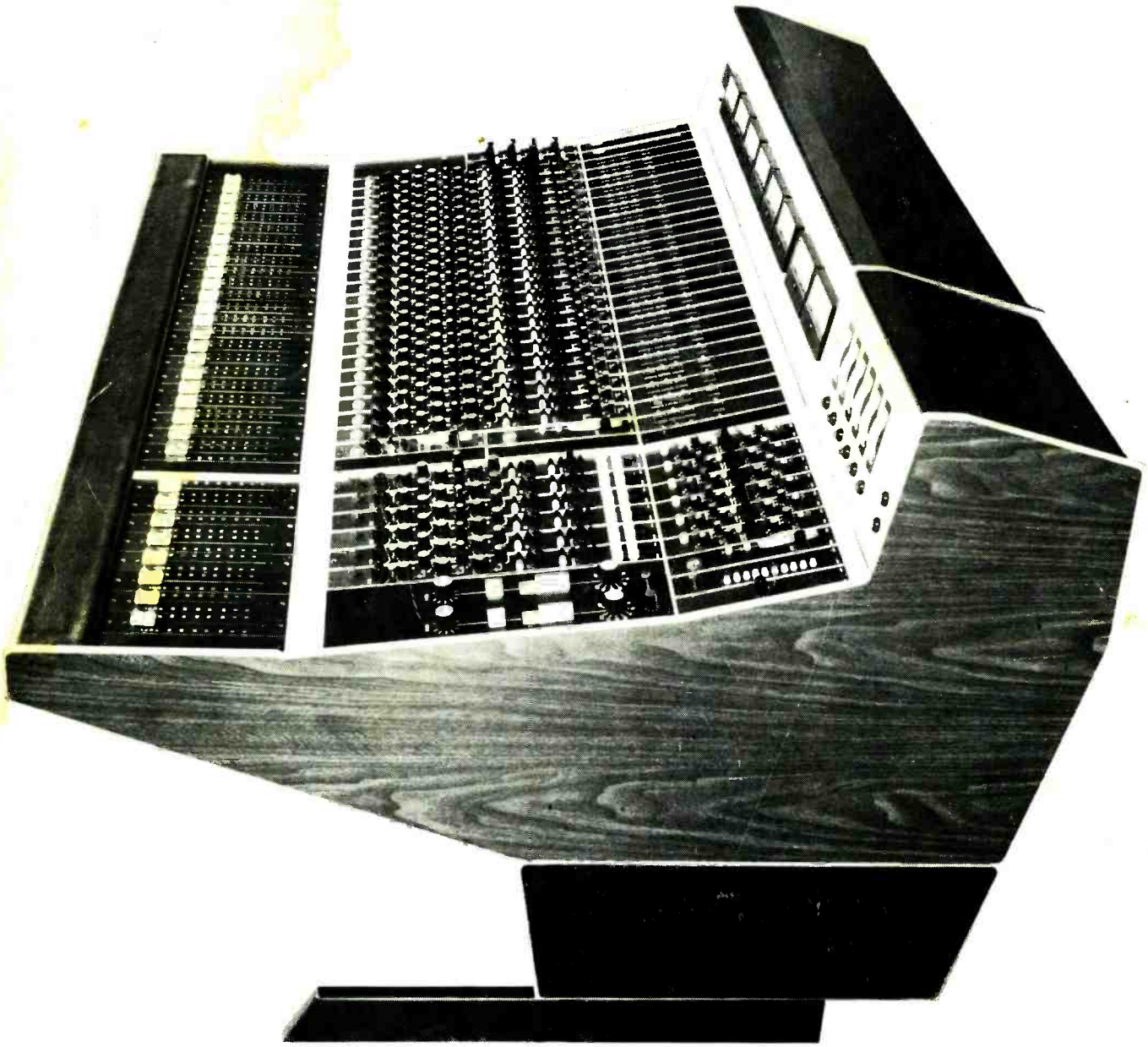

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