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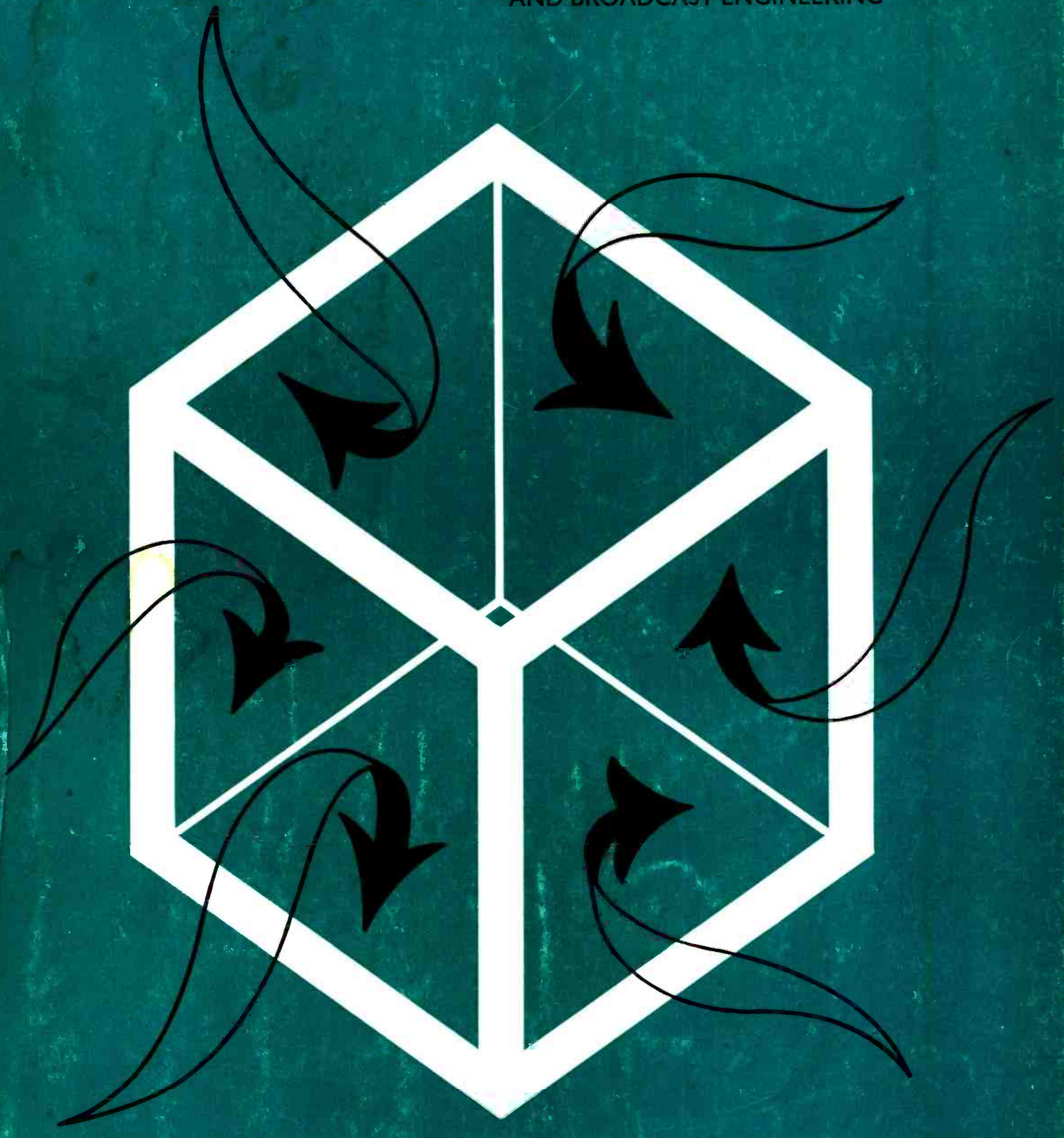

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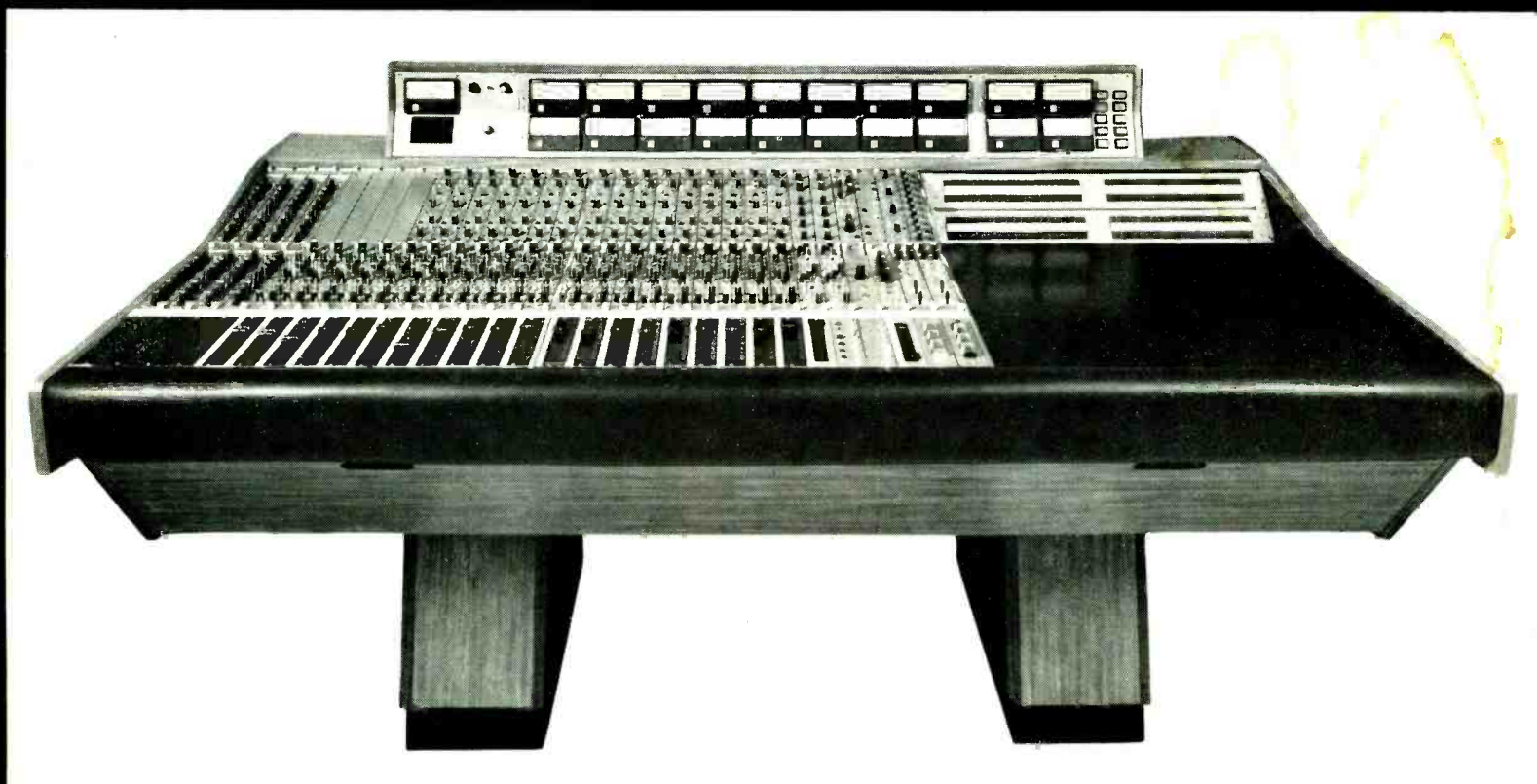

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The techniques of microphone placement will remain esoteric. If you do it, then you will continue to approach it intuitively and not bother about generalising and rationalising; why bother, if it isn't actually necessary to the job? If you're on the outside, then no amount of discussion or reading will be able to replace the need to wave the microphone around in front of an instrument and to listen to the results. That is the basic requirement of learning about this practical art. There are, however, some fundamentals—these, though, tend to come through intuitively after a wide experience of situations and never arrive in convenient, gift-wrapped rules.

The justification, therefore, for presenting three articles around the subject is that of showing three particular approaches to a problem. Within the three areas covered, varying from a commercial orchestral session on one hand to a purist but emphatically practical mic array on the other, it is possible to make further broad principles clear; but again these tend to arrive from familiarity with the subject. Thus, the three discussions each relate to a single situation and the way in which that recording was engineered. It is possible to digress meanwhile, but this again is anchored to the main theme.

Probably the most useful outcome is to indicate roughly the areas of non-verbal technique. To show these at least shows the pure practical requirements. This distinction is one constructive step, in a curiously negative sort of way. The message, basically, is to take these articles as case studies. They aren't intended as any more by us or by the authors. Other engineers, given the same job, might opt for different styles, but that doesn't matter. The essence of the subject is its individuality, and it's from that that recording keeps its life.

contents

FEATURES

COLUMNS

APRIL 1976 VOLUME 18 NUMBER 4

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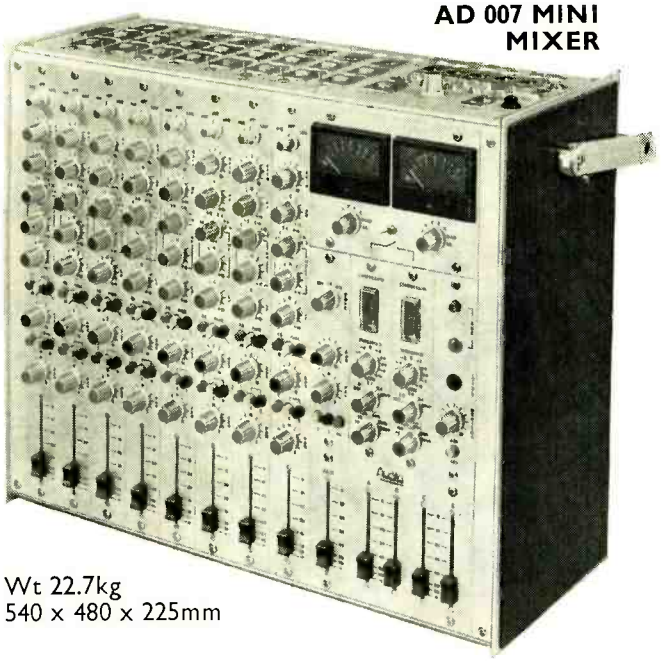

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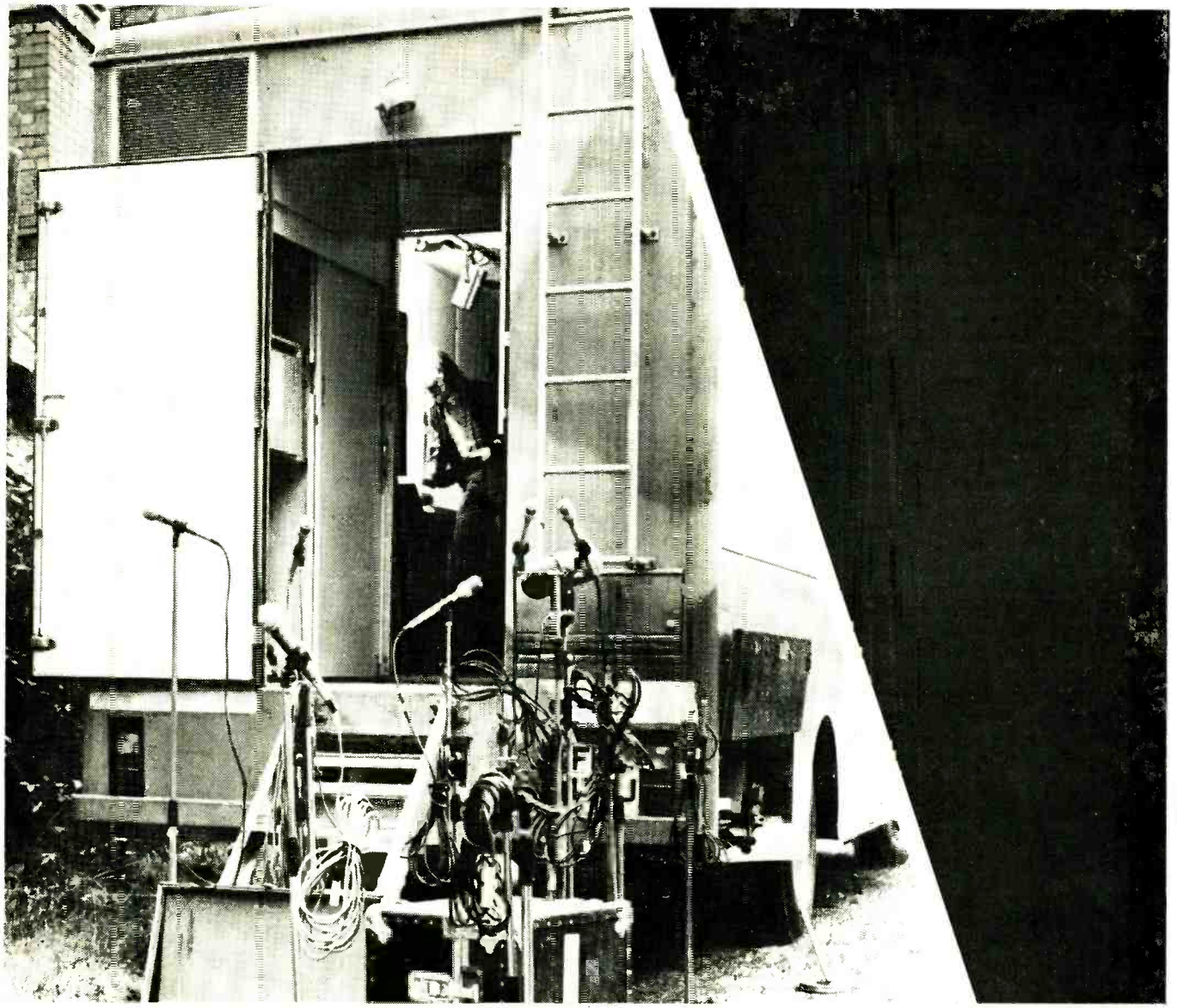

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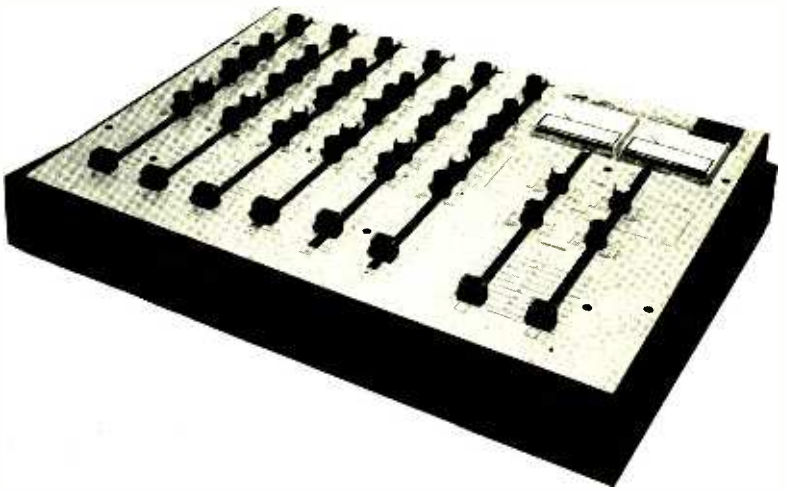

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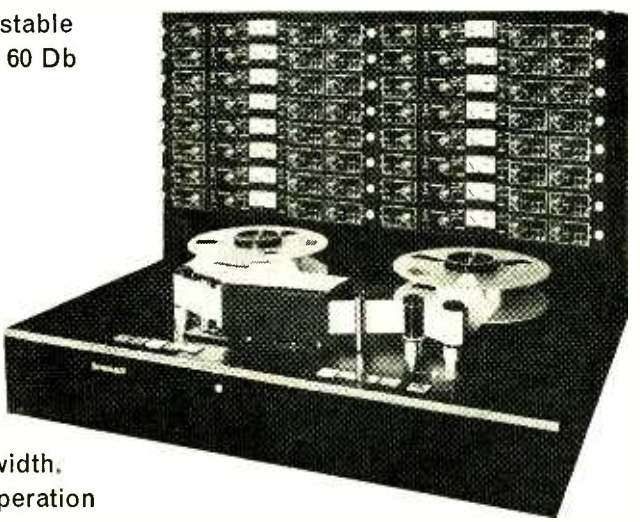

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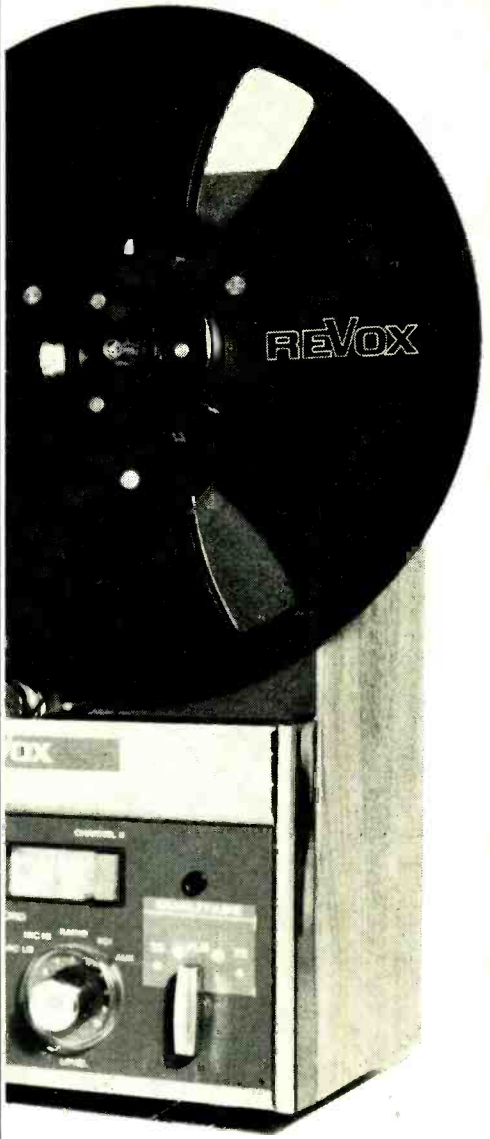

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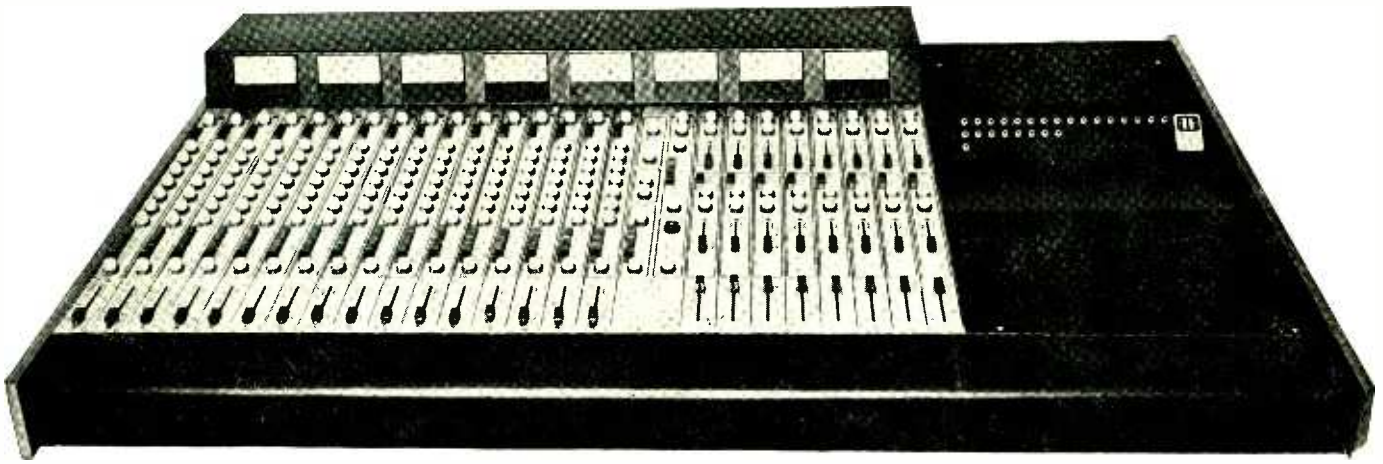

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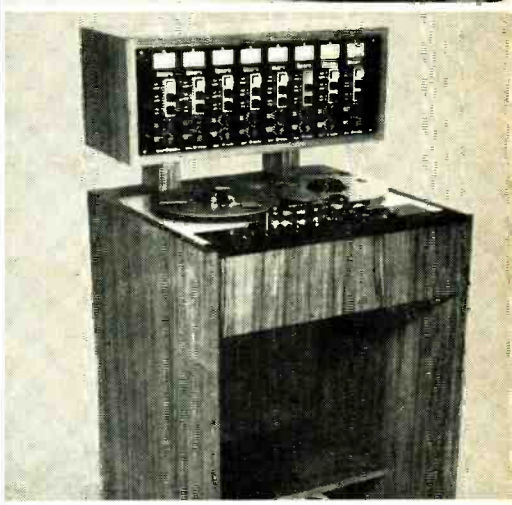

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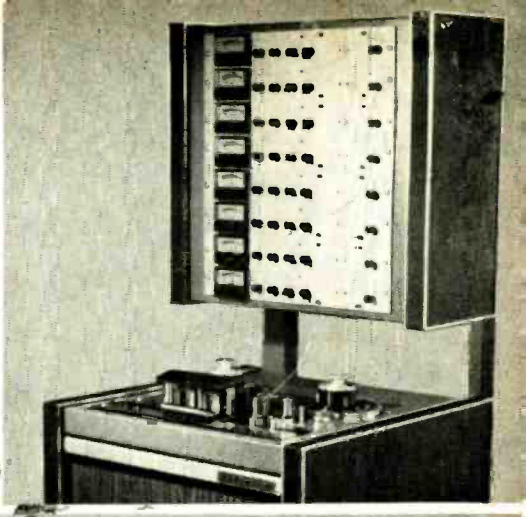

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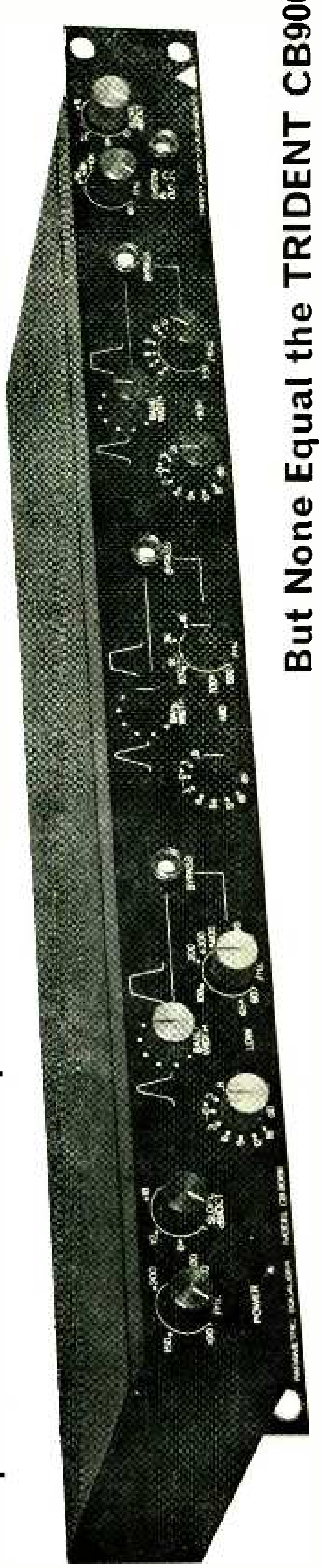

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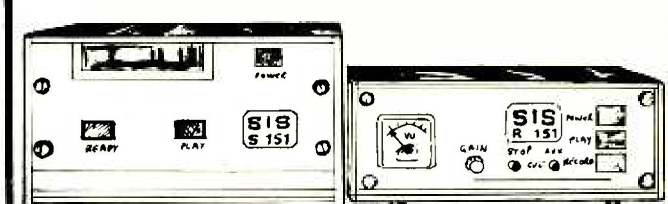

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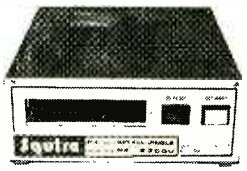

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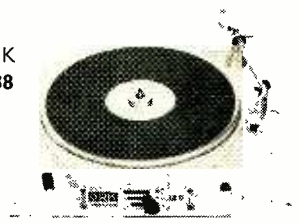

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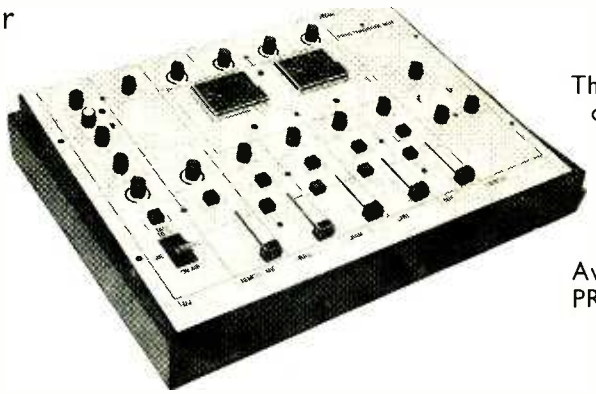

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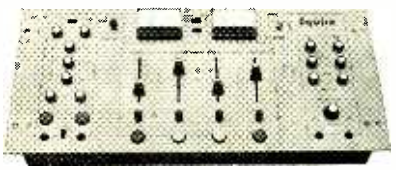

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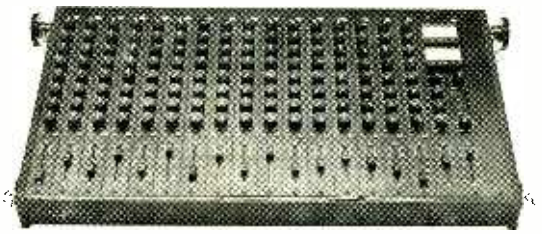

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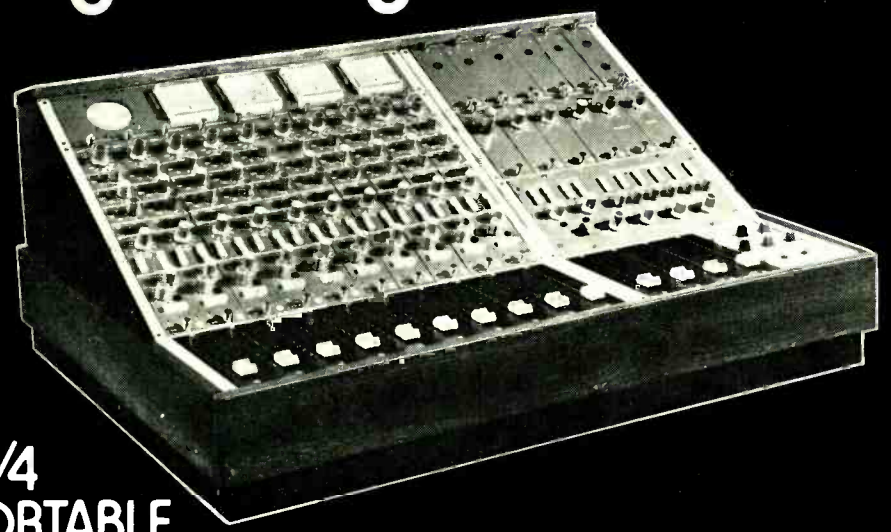

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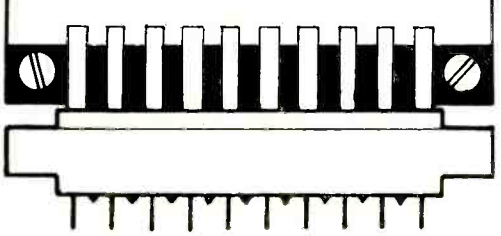

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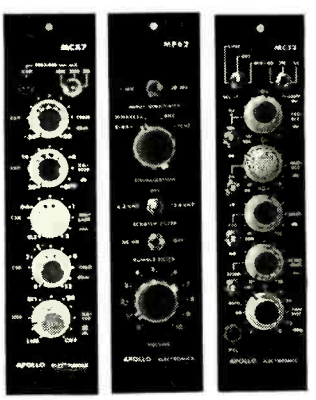

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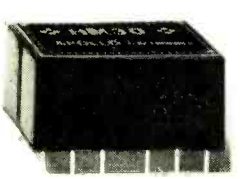

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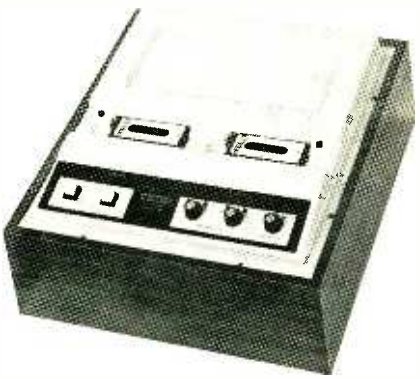

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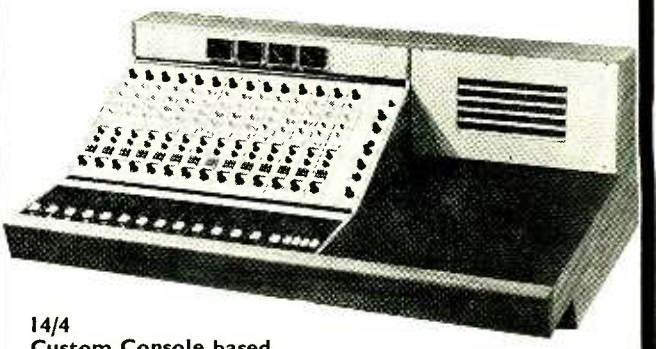

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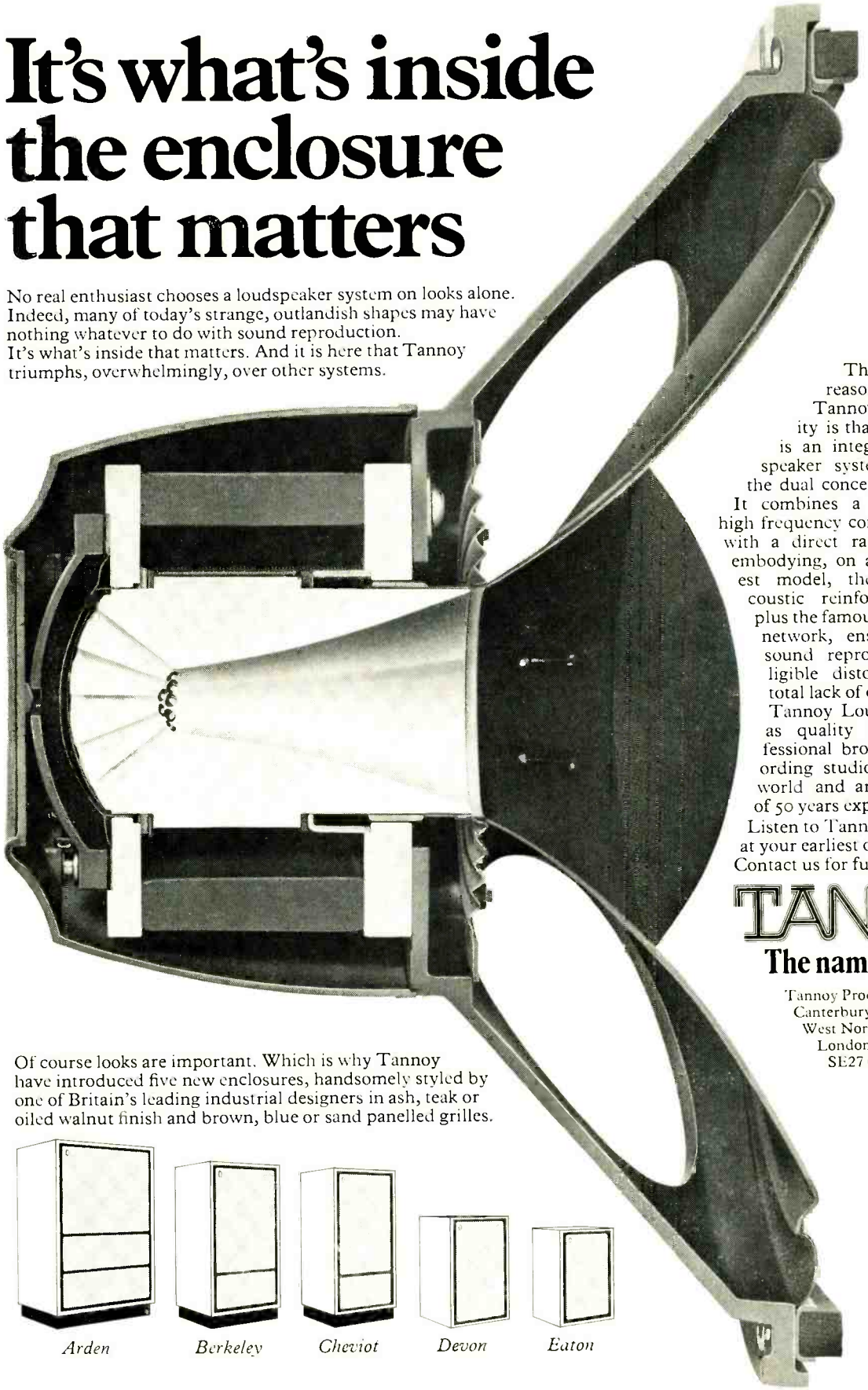

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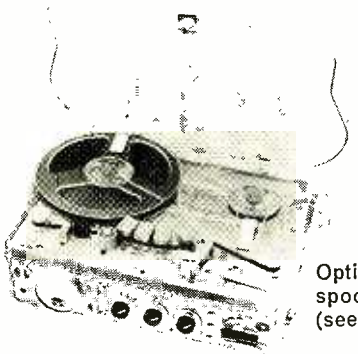

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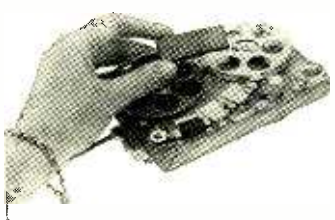

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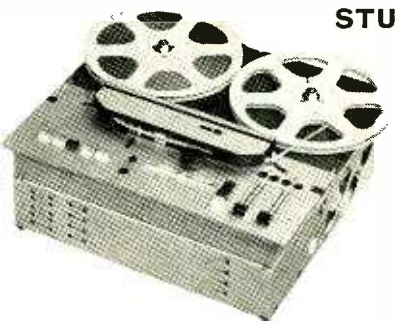

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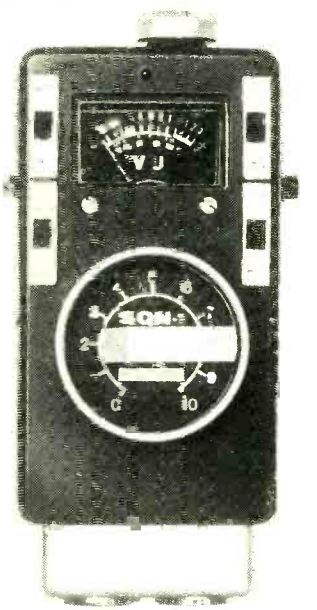

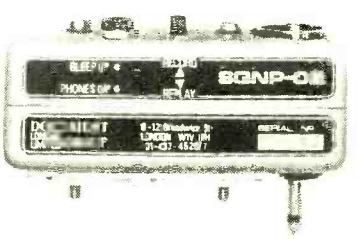

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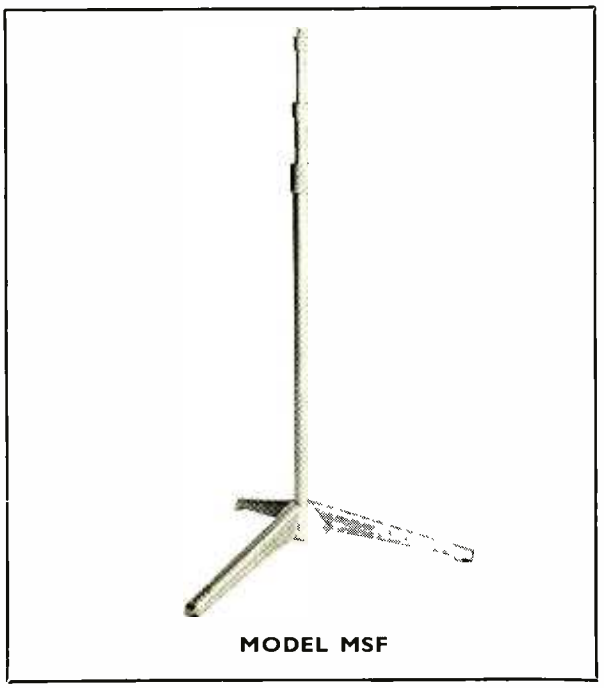

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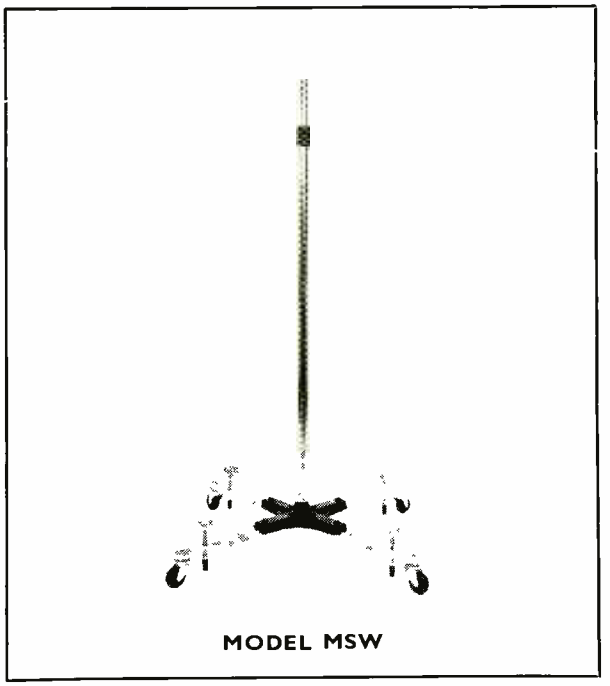

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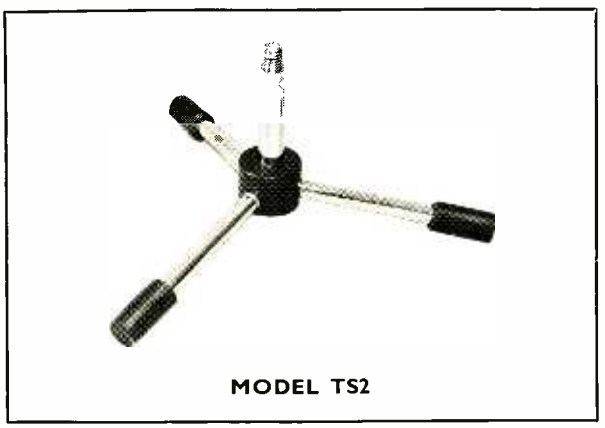

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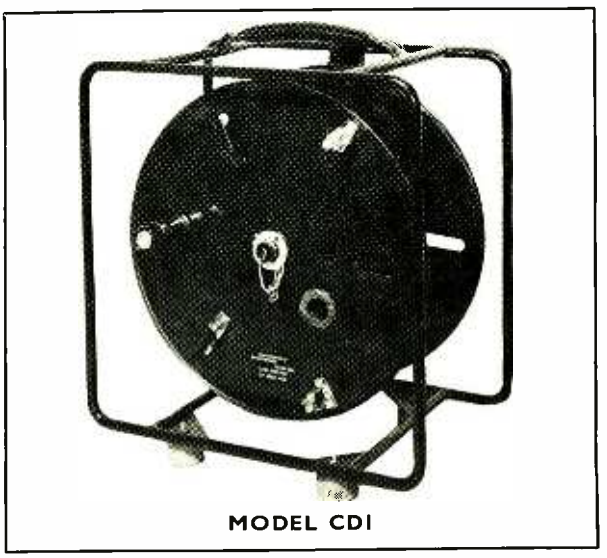

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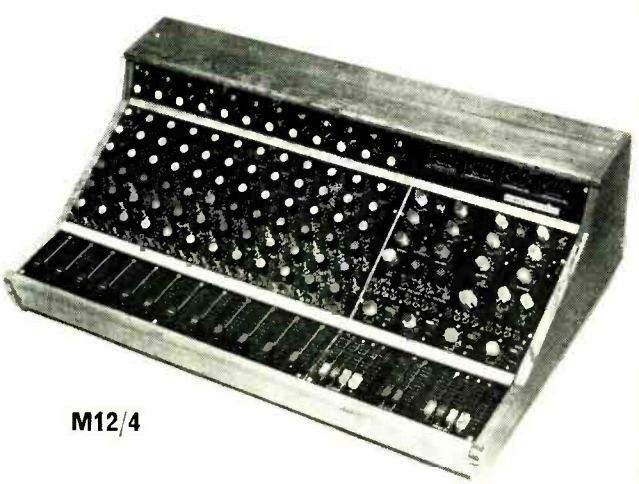

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letters

Dear Sir, The literally fabulous piece about Ambisonics in your most recent issue is in places as accurate as its spelling of my name, and has given us a quiet chuckle or two, especially the bit about NRDC having 'handed over £30 000'. In fact by hard thought and hard laboratory work, Ambisonics has been created much more cheaply than many people might suppose. In fairness, the note must have been written before Adrian Hope (whose work we generally respect) spent a total of some dozen member-hours with the Ambisonics team. Moreover its general intention seems to be entirely helpful, and it provides a good opportunity to correct some false presumptions about what Ambisonics and its developers are, and equally what they are not.

With NRDC the inventors of Ambisonics are a research and development team, not a manufacturing organisation with an Advertising Manager and a PR Department, nor a recording or broadcasting organisation with studio and production facilities, and it is misdirected to look to us for the kind of publicity that might be appropriate to such organisations. Moreover Ambisonics is not some rigid and arbitrary 'system' that can be disgorged to be swallowed whole like a lump of undigested dinosaur. Ambisonics is a technology of surround-sound which provides the means of designing systems for surround reproduction on engineering principles, and of specifying such systems on a basis of rational choice [1, 2].

Two consequences follow from this. The first is that the problems of design are no longer those of wondering how to achieve a given result, as in less developed technologies, but those of deciding the weight to be given to those desirable features that, in any system, it is physically impossible to have in full measure all at once. Thus, apart from essentially routine work, the design problem is solved once a consensus has been established on criteria of performance. This is evidently not something that the developers can do on their own, and it is unreasonable to ask for 'a final package, with which everyone is satisfied' to be produced by fiat. Nor is the required consensus something that can be materially helped by public demonstrations and the like. Rather, it is established by quiet technical discussions conducted in private, and needless to say such discussions are in progress with a number of highly relevant parties.

The second consequence is that the obvious need to handle the signals correctly at every stage in a properly developed surround-reproduction chain, if correct results are to be obtained at the end, means that it is necessary to design and validate equipment and methods all the way from studio techniques, through encoding for recording or broadcasting, to user-equipment providing correct feeds to the listeners' loudspeakers[3]. *The basic principles can be stated quite simply, and have been so stated in several publications for those who have eyes to see, but complete technology and its underlying theory*[4] *clearly involves quite a lot of 'nuts and bolts', the full description of which will necessarily require a series of articles in professional and learned publications at various levels of exposition; some of these are indeed already in press or have appeared, while others are yet to be written. In the meanwhile a set of six Ambisonic Technology Reports are planned to be issued in the new year, to which the pair of articles in* STUDIO SOUND *will in effect be the Introduction.*

Adrian Hope has of course our full concurrence in emphasising the need for it to be widely known that a second-generation surround-sound technology exists which, in one form or another, is likely to be widely adopted by those organisations that have not committed themselves irretrievably to the so-called 'quadraphonic' approach. Clearly this will involve properly linked availability of both software (records and broadcast

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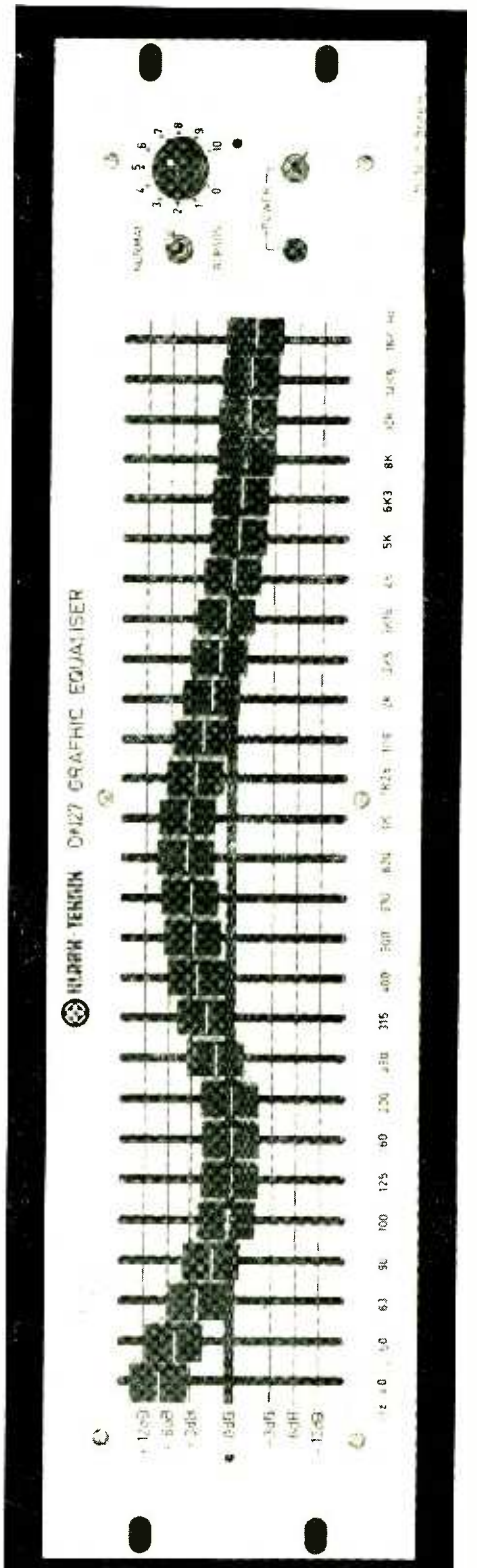

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460

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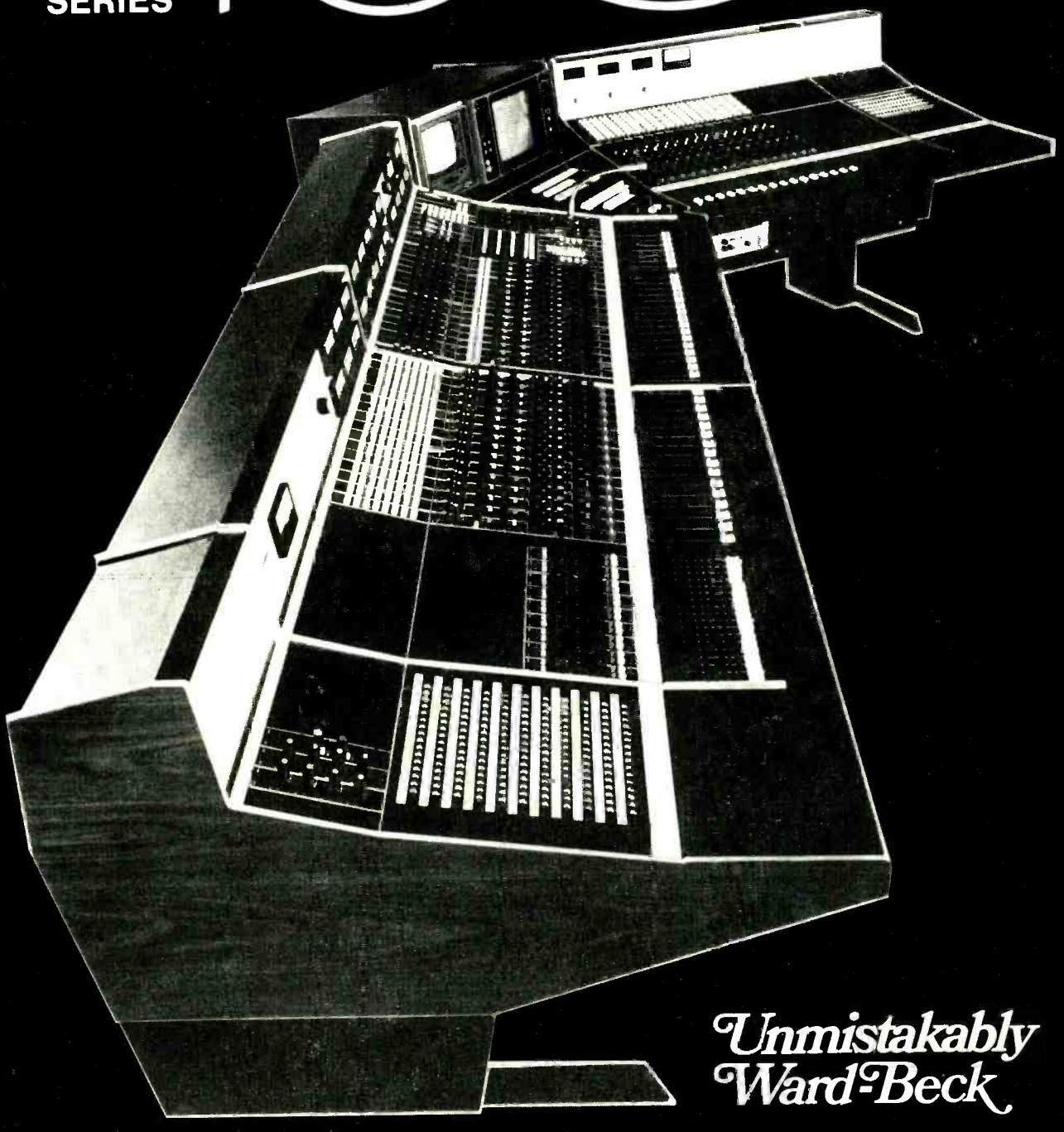

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LETTERS

signals) and hardware (especially consumer decoders), and it would be irresponsible to encourage premature interest in the one without the close support of the other. The history of audio should surely teach us that restraint, even in the face of some pressure, can be in the best interests of the whole industry. However, thanks to Adrian Hope's tip-off I wrote some months ago to BASF; I am also writing to the Fukien Real Bamboo Gramophone Needle Co

References

1. Fellgett, P. B. and Gerzon, M. A.: *Encoding Standards for 2-channel surround-sound.* Electron. Lett. *11*, 518-519, 1975.
2. Gerzon, M. A.: *Compatible 2-channel encoding of surround-sound.* Electron. Lett. *11*, 615-617, 1975.
3. Fellgett, P. B. and Gerzon, M. A.: *Ambisonics.* 'Studio Sound', 20-30. August 1975.
4. Gerzon, M. A.: *A geometric model for 2-channel 4-speaker matrix Stereo systems.* J.Audio Eng. Soc., *23*, 98-106, March 1975.

Yours faithfully, Peter Fellgett, University of Reading, Dept of Engineering and Cybernetics, 3 Earley Gate, Whiteknights, Reading RG4 2AL.

Don't automatically shoot the journalist. That £30 000 figure was given to me by an NRDC spokesman, at an NRDC press conference. There can also be no excuse that the NRDC was caught unprepared, because (as the Corporation records will doubtless show) I dutifully observed protocol and gave written warning well in advance that I would be asking questions on Ambisonics. It was only during my subsequent lengthy (and, incidentally, very rewarding) discussions with the Ambisonics team that I learned how much of the money had been spent on patents, rather than handed over to the team in crisp once-ers. How odd that the NRDC never made this clear. But either way it is still £30 000.

My other main point was, and still is, that whatever Ambisonics is (be it system, magic black box or rationalised approach to recording) it is still saleable. If not, why is the NRDC wasting money on it? Thus, it needs to be sold to the only people that can buy it (be they broadcaster, record companies, studio engineers or hardware manufacturers). But few of these people know or care about clever things like what a *Poincare* sphere is. Neither can they be bothered to plough through lengthy articles of the type so far written on Ambisonics (myself included). But they *will* read through a catchy press release, and turn up to a demonstration, provided of course there was free booze. It may be prostituting the system to sell it this way—but that's life. For this reason I am glad Professor Fellgett has written to the Fukien Co as I understand they are now mass-producing the Shibata stylus, it is probably more important to interest them than it is to gain the blessing of the BBC.

Adrian Hop

Dear Sir, I was very interested in the article entitled Consumer Compromise *published in the February 1976 issue of Studio Sound. It is most encouraging to know that the importance of high sound quality in television is appreciated by the author. He appears, however, to have mis-*

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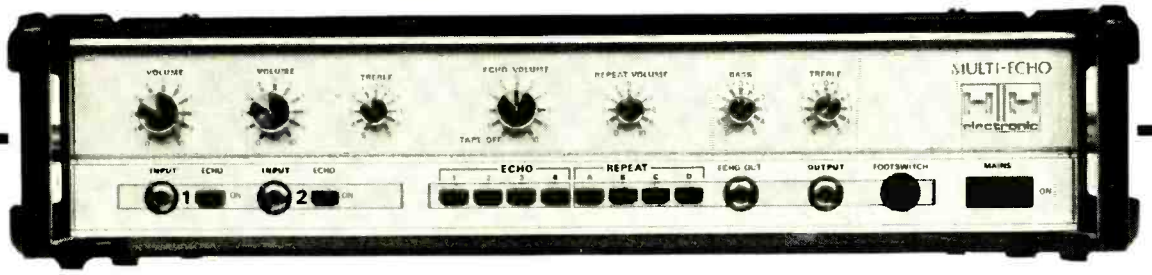
The H||H Multi Echo



At last an echo unit with studio applications at a price that will catch the attention of most professional users.
Probably the most versatile system ever produced, the Multi Echo is capable of an amazing 240 echo-repeated selections.
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news

Poland

Given the good reception of the First Programme that is now possible on long wave following the introduction of the 2 MW transmitter at Konstantinow, Polish Radio is reallocating former First Programme frequencies on vhf to reinforce those scheduled for use by the new Fourth Programme. The Fourth Programme is now broadcast from Warsaw, Losice, Surpe, Bialystok, Bydgoszcz, Gdansk, Katowice, Czestochowa, Kielce, Koszalin (two frequencies), Cracow, Lublin, Lodz, Olsztyn, Opole, Poznan, Rzeszow, Szczecin, Wroclaw (two frequencies), and Zielona Gora on frequencies between 68.24 and 70.82 MHz. The programme is broadcast 17 hours a day Monday to Saturday and for 16 hours on Sunday. The content is mainly cultural or educational, with news bulletins; music and drama are in stereo. The First Programme is relayed for three hours every morning (except Sundays).

UK Film

The report of the Prime Minister's working party on the future of the British Film Industry was published in January. It makes 39 recommendations, including: a £5 million injection of new funds derived from the present levy on the excess profits of the independent television companies; £1 million annually from the Eady levy—the charge on cinema admission prices normally redistributed by the British Film Fund according to gross box office takings on each film; and the setting up of a British Film Authority to take over the functions now fulfilled by the Department of Trade and the Department of Education and Science.

The working party, whose members included Richard Attenborough, Bernard Delfont, Lady Falkender, a largely absent Carl Foreman, Alasdair Milne and Alan Sapper, was appointed on August 1 last year.

The report says that the levy on the ITV companies' excess profits last year was nearly £21 million, and is expected to be nearly £14 million in the current year. The proposal is that the companies would be exempt from a levy on any of their profits that they devoted to film production. The IBA and Independent Television Companies Association have welcomed the proposal.

The BBC has offered to provide a fund of £250 000 a year 'for use as "seed-money" or pre-production finance in order to promote feature films designed primarily for showing in cinemas but which would in due course be suitable for television transmission by the BBC.' Each project would receive £25 000. 'The BBC will leave the full £25 000 in the film but will be entitled to recovery and a suitable profit share like any other investor. Once the investment has been recovered, the BBC will be prepared in due course to provide a minimum of a further £25 000 for the United Kingdom television rights in the film'. The BBC would administer the scheme, but no permanent BBC staff would be employed on any of the projects. Any profits the BBC made would have to be ploughed back into film making. Unlike the IBA and the ITV companies, the BBC has said nothing.

'Greater efforts', the report says, 'should be made by producers and distributors of British films to obtain better prices for films offered to United Kingdom television.' Alasdair Milne of BBC Television and Brian Tesler of London Weekend Television dissociated themselves from this recommendation, which is hardly surprising, but no-one, not even Alan Sapper, dissociated themselves from the recommendation that the period after which a film can be shown on television should be reduced from five years to three.

Also puzzling is the lack of any incisive comment on one of the abiding evils in the film industry, the monopoly of film distribution by the two large exhibitors. Two, perhaps three of the report's 127 paragraphs refer vaguely to restrictive practices and distribution, but hardly connecting the two, a reticence perhaps inspired by the presence on the working party of Sir Bernard Delfont, boss of the EMI cinema chain.

Reaction to the report has been predictable. Of the £5 million cash injection Kenneth More said he would believe the money would benefit movies when he saw new films being made because of it; most of the government money given to films seemed to disappear without ever reaching the shooting stages. Films were often still abandoned half way through because one backer dropped out, he said.

Director Michael Winner thought the new money would be lost just as the NFFC's money had been. Films ought to be put on the same footing as the other arts, and particular productions financed as they were in the theatre, with stars working at less than their normal fee 'in projects of particular merit which might not normally be made in a medium catering to mass taste.' He also said that personal taxation should be reduced to allow film talent in front of and behind the screen to return to this country.

John Dwyer

Sine generator

The latest B & K sine generator provides automatic sine sweeps between 10 and 20k Hz in a continuous linear or logarithmic sweep. The sweep can be controlled manually or from a ramp generator such as those incorporated in the B & K recorders when used for automatic frequency response plots. A five digit frequency display provides 0.1 Hz resolution.

Other features include a low distortion 7W amplifier, a compressor for automatic regulation of output over a 60 dB range, a precision output pad covering 100 dB, built in metering, and provision for frequency modulation of the output. The *1023* generator also provides marking pulses for frequency calibration of recorder paper and tuning signals for an external heterodyne slave filter.

B & K Laboratories Ltd, Cross Lances Road, Hounslow, Middlesex TW3 2AE. Phone: 01-570 7774.

Emergency power

The NEA Lindberg units in the *520* range feature a no break power transfer from mains to a bank of storage batteries which power a thyristor inverter. The potential output of the inverter is always kept in phase with the incoming mains so that in the event of line failure, power transfer is effected with as little transient generation as possible. These heavyweights provide a stabilised output in the range 2 to 40 kW in both 2 and 3ϕ format. NEA Lindberg A/S, Industriparken 39-43, DK-2750 Ballerup, Denmark. Phone: (02) 97 22 00. UK: Avel-Lindberg Ltd, Arisdale Avenue, South Ockendon, Essex RM15 5TD. Phone: South Ockendon 2444. Telex: 897106.

Rogers service facilities

In spite of the liquidation of Rogers Developments (Electronics) Ltd, owners of that firm's audio gear will still be able to obtain after sales service from a new enterprise that has arisen, phoenix like, from the ashes of the old company.

The new concern, Swisstone Electronics Ltd, is staffed by members of the old Rogers company and operates from the latter's factory. Initially, Swisstone will provide maintenance, but plans are in progress to restart the manufacture of some product lines.

Swisstone Electronics Ltd, 4/14 Barmeston Road, London SE6 3BN. Phone: 01-697 8511/8627.

Vatican City

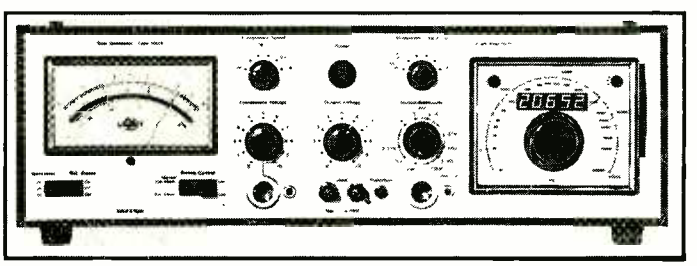
The world's largest rotatable aerial is to be installed for Vatican Radio. It will be mounted on two 79m steel towers and fed by a new 500 kW Telefunken transmitter.

Mixers and amplifiers

The versatile range from Malcom Hill Associates offers a choice of two types of mixers and several types of power amplifiers ranging from 100 to 800W.

The simplest mixers manufactured by the company are offered in 10 or 16 input format using a hardwired, non modular construction. They feature high and low Z

B & K 1023 Sine generator



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inputs and standard line level outputs. At channel level, there are the usual facilities associated with pa work including echo and foldback sends, a-b panning and simple eq. Power comes from four internal 9V batteries.

The modular mixer range offers four stage eq on fixed frequency centres/channel as well as an extra foldback circuit over and above that incorporated in the non modular series. Pfl facilities are standard. These mixers can also be upgraded towards recording applications through custom routing and line level input switching arrangements.

The power amplifiers offer the sort of specification expected from high quality transistor circuits. The following figures are quoted for the 200W version; the manufacturers claim that these are typical for the whole range:

Rated output power: 200W into 8 ohms.
Total harmonic distortion: at 1 kHz better than 0.02%, 10W, .05% at 200W.
Sensitivity: 0 dBm for 150W into 8 ohms.
Noise: below —100 dB re 200W into 8 ohms, bandwidth unspecified.
Frequency/power response: within 1 dB 20 to 20k Hz.
Damping factor: 300 at 40 Hz/8 ohms.
Rise time: 15 μS.

Malcom Hill Associates, 3 Maidstone Road, Tonbridge, Kent. Phone: 062 785 545.

Dreadnaught

These power amplifiers are big and meaty and much in keeping with the style of large power amplifiers for which America is well known.

The Dreadnaught *1000* offers 250W/channel into 8 ohms (FTC rating) while the smaller *500* version delivers 150W into 8 ohms. Both amplifiers feature full electronic circuit protection for both output transistors and loudspeakers connected to them.

Extracts from the manufacturer's specification. Apart from power output, electrical specifications are identical for both models:

Total harmonic distortion: 0.25% max .025% typical.
Frequency response: 20 to 20k Hz at 250W/channel, ±.5 dB.
Intermodulation: by SMPTE 0.1% max, .025% typ.
Slew rate: 25V/μS.
Signal to noise: 100 dB.
Cooling: varispeed electric fan.
Metering: calibrated front panel meters for each channel.

Dunlap Clarke Electronics, 230 Calvary Street, Waltham, Mass 02154, USA.

New address

The C E Hammond Group, whose agencies include Revox and JBL, has moved to new premises at Byfleet, Surrey.

The move, which took effect from February 1, divides the group into two sections. The address for all matters concerning Revox is 105/109 Oyster Lane, Byfleet, Surrey KT14 7LA. Phone: 41131.

The remainder of the Group, including Cambridge Audio, JBL, Lamb Laboratories, Leader, Meteor Light and Sound, Phase Linear, Sonus and Sound Technology, resides at 111 Chertsey Road. The rest of address and phone number is same as Oyster Lane.

Eye catch

This is the Spectra Sonics *1032-32* console. It provides 32 inputs, 32 outputs, 32 monitor lines and 32 meters for engineers with 32 eyeballs. Without patching, it also offers seven line level cleanfeeds direct to the monitors.

Certainly the console isn't short of majors; neither does it lack for peripherals. There are four echo sends and returns, four quad outputs, two stereo, one mono, four control room monitors, two studio and three cue outputs. Individual attenuator pads are available at channel level and on all subgroup outputs. The covered patch bay at the right hand side of the desk will accept up to 96 inputs with 52 output lines in addition to all the usual system breakpoints in the desk organisation.

Extract from the manufacturer's tech spec:

Frequency response: ±.25 dB 20 to 20k Hz.
Signal to noise: (mic) greater than 82.5 dB below +4 dBm line out ref—50 dB source from 50 ohms. Corresponding line figure 87 dB at unity gain.
Total harmonic distortion: less than 0.01% at +18 dBm out (1 kHz).
Intermod: less than 0.02% at +4 dBm.
Crosstalk: greater than 60 dB.

The console, first introduced at the New York AES, costs $56 576.06 and can be supplied ex stock.
Spectra Sonics, 770 Wall Avenue, Ogden, Utah 84404, USA. Phone: (801) 392 7531.

Belt pack intercom

In its standard configuration, up to 50 stations can be connected on line to two independent channels. Each station features a mic limiter, carbon or dynamic input, flashing call light, two watt headphone amplifier and auxiliary audio input. Using a two wire transmission system, the manufacturer, RTS Systems of California, claims a wide frequency response and low distortion.

With 22 gauge cable, the *TW* system operates over 700m. Remote power supplies (either *PS10* or *PS50*) will operate up to 10 or 50 remote stations respectively. Both the main and remote stations can be supplied in rack mounting form. Belt packs costs $150 each. *PS10* $350, *PS50* $500.
RTS Systems Inc, 4167 Fair Avenue, North Hollywood, Ca 91602, USA. Phone: (213) 980 0511.

The control room, Strawberry Studios, Stockport, England. This is the latest facility to undergo the Westlake treatment. It has resulted, claims Strawberry manager Pete Tattersall, in 'a very tight, punchy sound' that everybody is 'absolutely delighted with'.

FRAP

That stands for Flat Response Audio Pickup which is the trade name of the transducer and the foremost of the claims by the manufacturer. Several models are available; the pickup for woodwinds fits into a 10/32 screw thread tapped into the body of the instrument. The manufacturers recommend using an extra mouthpiece suitably modified. For the flute, the transducer is mounted in a specially manufactured silver nickel back plate which replaces the conventional plug. Because both pickups couple directly with the instrument air column, the arrangement is said to eliminate all key, valve and handling noises.

Another version of the device has been designed specifically for use with acoustic instruments: violin, guitar, bass, harmonica, piano, gongs and congas although it is claimed to work with virtually all acoustic instruments. *FRAP* mounts directly to the instrument by adhesive wax thus avoiding mutilation of the instrument.

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NEWS

All models of the pickup are used with a complementary pre-amp/line driver powered from internal batteries. The manufacturers say that the system offers a level response from 20 to 20k Hz for the woodwind model and an even wider response for the acoustic pickup. The studio models are fitted with Cannon connectors for driving a balanced line.

FRAP, Division of Strobotronix Inc, Box 40097, San Francisco, Ca 94140, USA. Phone: (415) 543 5458.

Slim faders

These faders use a conductive plastic track as the resistive element thus gaining the associated low noise performance, but they measure only 13 mm between fixing centres. Made by Waters, the *MM4* and *MM6* (short travel) are available in either 600 or 10k ohms track resistance. Operational noise is –70 dB below 0.25V.

Waters Manufacturing Inc, Longfellow Centre, Wayland, Mass 01778, USA. Phone: (617) 358 2777.

UK: Soundcraft Electronics Ltd, 5/8 Great Sutton Street, London EC1V 0BX. Phone: 01-253 3631.

Equaliser

Klark-Teknik has added a new 27 band graphic equaliser to the 27 range. Based on $\frac{1}{3}$ octave centres, the *DN27* features improved circuitry and layout packaged in a custom designed case. The makers claim a very high standard of electrical performance with a noise level of –90 dB (20 to 20k Hz re 0 dBm). Quoted distortion measures less than 0.01% at +4 dBm output into 600 ohms. The unit costs about £400.

Klark-Teknik Ltd, MOS Industrial Site, Summerfield, Kidderminster DY11 7RE, Worcs. Phone: 0562-64027.

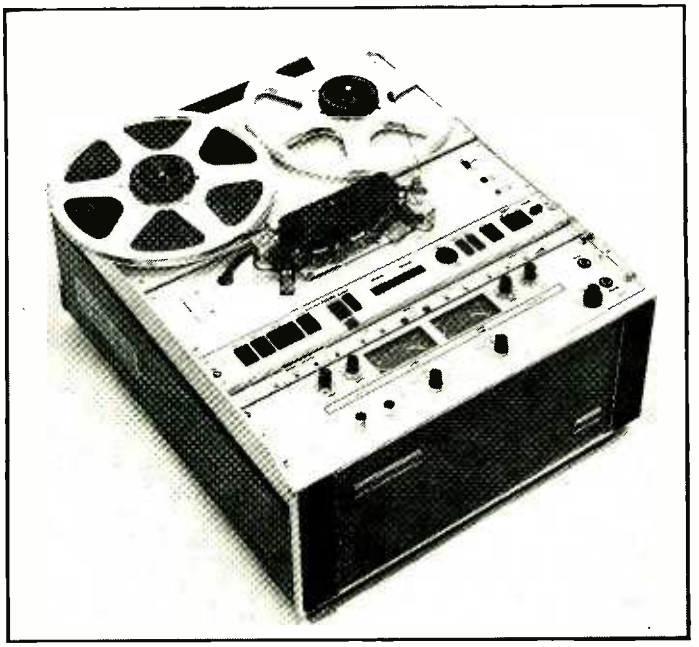
New power amp

It comes in chassis form but is supplied with a grey bonded aluminium and plastic dust cover. The front panel incorporates indicator and on/off switch. The six versions available include balanced/unbalanced inputs and low impedance/100V line outputs.

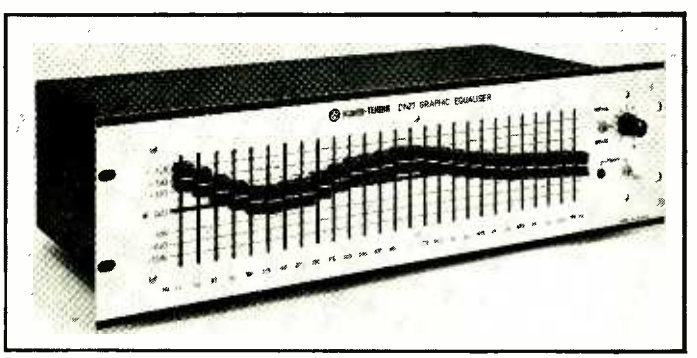
Extract from the manufacturer's specification:

Power output: 120W rms into 8 ohms.
Frequency response: ±1 dB 30 to 30k Hz.
Noise: sourced from 600 ohms input 82 dB, bandwidth unspecified.
Input level: —10 dBm for 100W.
Distortion: less than 0.2% thd.
Protection: there, but unspecified.
Power requirements: 240V ac.
Size: whd 205 x 180 x 362 mm.
Price: £107.

Cryslon Electronics Ltd, Berrington Road, Sydenham Industrial Estate, Leamington Spa, Warwickshire. Phone: 0926 37628.



Above: *The Studio 8 transportable or console machines from Ferrograph are now available with a straight line in/out option. Other models include preamp and mixing facilities for operation at mic level, line level only machines retain the headphone monitoring facility.*



Above: *Klark-Teknik DN27 graphic equaliser*

Well biased

For those who own and operate Electro-sound high speed duplicators, the advent of a new design of bias generator will come as welcome news. According to the manufacturer, the model offers more output power, higher electrical efficiency, simpler maintenance and the possibility of better matching of bias buss to varying loads caused by switching duping slaves in and out of circuit. Further, it incorporates a *Biastune* circuit which is said to provide a purer output waveform thus minimising recorded bias noise.

When ordering *Biastune*, which is available as a separate facility with existing equipment, it is necessary to quote the latter's bias frequency.

Electro-sound Inc, 725 Kifer Road, Sunnyvale, Ca 94086, USA. Phone: (408) 245 6600.

Addenda-sound reinforcement survey

The following were inadvertently omitted from the last month's survey:

Acoustic Transducer Company Ltd, Pier House Laundry, Strand on the Green, Chiswick, London W4. Phone: 01-995 3654. The company manufactures their well-established range of 25 cm 75W drivers using 7.5 cm flat wound voice coils. There are three models available: a full range, musical bass and studio bass. While motor parts are the same for all models, differences include varying cone weights and presence/absence of parasitic radiators. One off price £65, £67 and £70 respectively.

Midas Amplification and **Martin Audio Ltd.** Both reside at 54/56 Stanhope Street, Euston, London NW1 3EX. Phone: (Midas) 01-387 7679 and (Martin Audio) 01-388 7162. Both companies work closely together to produce complete sound systems for live gigs and studios.

Midas produces portable consoles for high quality sound reinforcement for use by touring bands; there are also desks for permanent installation within theatre sound systems. Facilities available on the input channels include parametric eq and routing networks of varying complexity. There are specialised modules which incorporate precision crossover networks, limiters and other modules with characteristics corrected for stage foldback purposes.

Martin Audio designs and builds horn loaded and direct radiator loudspeaker systems for live sound applications from theatres and clubs to open-air festivals. Systems incorporate electronic crossovers and power amplifiers manufactured by Midas. The company also offers a laboratory service for evaluation of electronic and electro-acoustic hardware using B & K test gear.

Shure Electronics — *SR range.* The new *SR range* of sound reinforcement gear comprises the *SR101* eight channel mixer with slider fader inputs and foldback outputs, reverb, eq and cross patching for interface with other consoles or control units such as limiters or graphic equalisers. The *SR105* 200W power amplifier for use direct coupled into a four ohm load or with an optional 100V line transformer. The *SR108* features a bi-amplified speaker system in the horn loaded top end/tuned port low end column loudspeaker. The *SR102* and *103* are standard two-way multi-driver systems which offer dispersal over 140° horizontal and 65° vertical. For permanent (*103*) and temporary (*102*) installations. *SR106* is an electronic crossover for use with the *SR108* and the *SR105* units.

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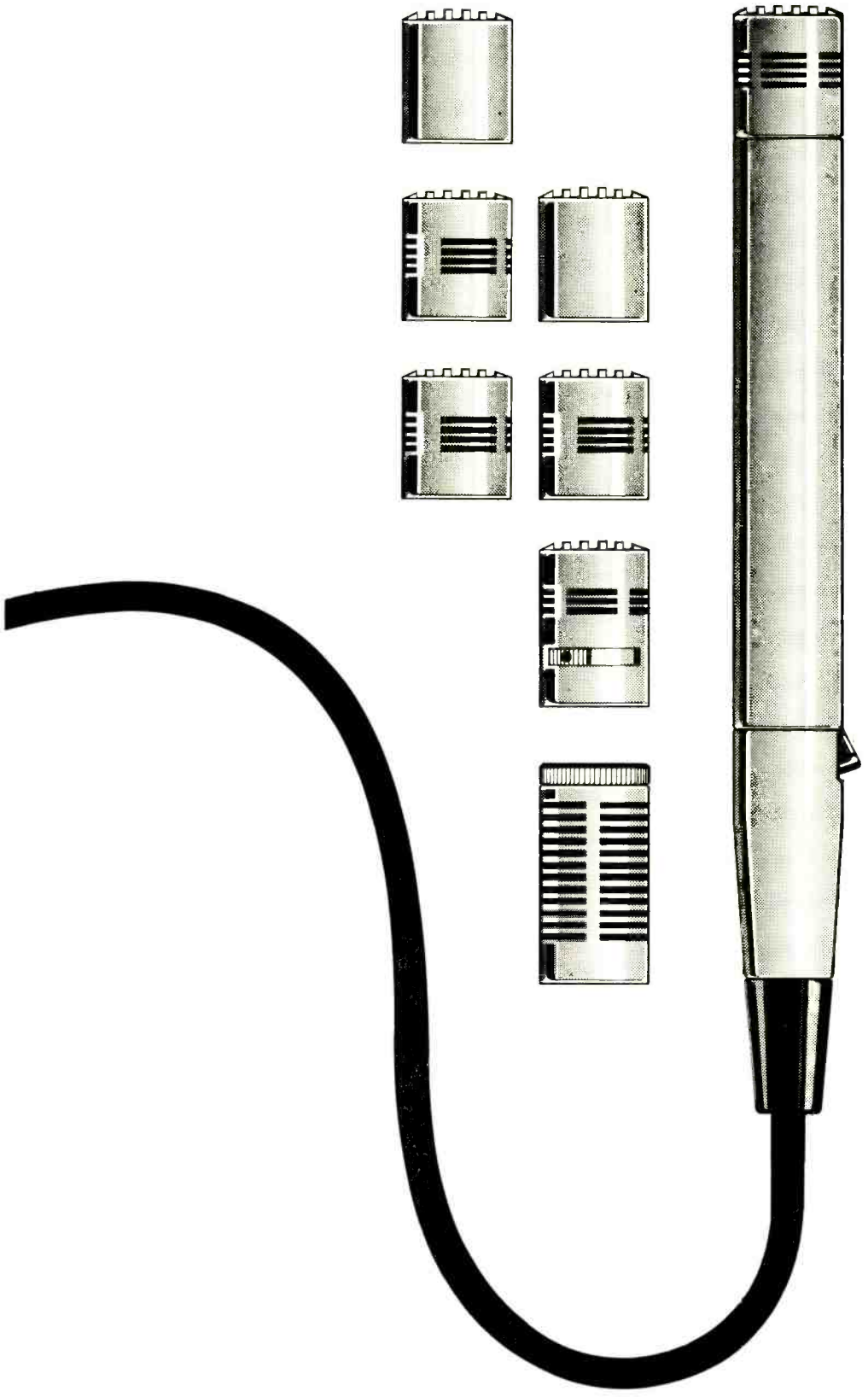

Write for full information on the Schoeps range to the sole U.K. distributor:
Scenic Sounds Equipment
27–31 Bryanston St.
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Phone 01-935 0141

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Recording Chagall Windows

STUART ELTHAM*

The recording of John McCabe's Chagall Windows *was one of the outstanding orchestral recordings of 1975. Procedure for this short-notice session is described by the engineer, this specific example giving an idea of general practice of mic balance and session organisation.*

* EMI RECORDS LTD, LONDON

WHILE in the middle of a take with Paavo Berglund and the Bournemouth Symphony Orchestra on location at the Guildhall, Southampton, I received a message that Ken Townsend, the studio manager at Abbey Road, wanted me to ring the studio operations room urgently and speak to Classical Producer John Mordler. So, during the next playback I got through to John, who wanted myself and the rest of the recording team to go on immediately to the Free Trade Hall, Manchester for a recording with the Hallé Orchestra conducted by John Loughran. The recording was to be a new composition by John McCabe called the *Chagall Windows*. I was naturally delighted, for having previously recorded two other works by the same composer, *Symphony 2* and *Notturni Ed Alba*, I realised it would be an exciting experience. John McCabe had composed the music inspired by the twelve tribes of Israel that the stained glass windows depicted; John Mordler then explained the difficult part. The recordings would have to start on the day after completion at Southampton: Tuesday, January 7, 1975, from 7-10 pm, with two more sessions on Wednesday, January 8, from 1.30-4.30 pm and 6-9 pm.

This obviously posed problems, as we had an evening session in Southampton finishing at 9 pm, and we had then to clear the hall and repack the equipment onto the van. Ken explained that the other mobile equipment was in use on the continent, but felt sure that despite the very tight time schedule it would be possible if we pulled out all the stops. I then conferred with the other members of the mobile recording team, electrical engineer Richard Hale and my assistant Peter James, both of whom readily accepted the challenge. We hastily worked out what additional microphones and booms would be required and Richard then phoned back to Abbey Road with the facts so that they could be left out, for collection; this he duly did in the early hours of Tuesday morning.

As the acoustics of the Free Trade Hall are rather dull and lacking in reverberation, for this classical recording I decided to use three omni-directional microphones for the main orchestral microphones; these would be Neumann *M50c*. Also, as the orchestra occupy all of the stage, we would require some heavy booms that could be put on the floor in the front aisle, and would go up to a height of 5m so that the *M50*s would be 3m over the orchestra plus 1.5m for the stage. This was the equipment that Richard and Peter were going to collect from Abbey Road.

It was raining when I arrived in Manchester and as usual there was a long queue for taxis so I tramped to the Midland Hotel with my case, booked in and went next door to the Free Trade Hall. The EMI van was at the stage door and there were Richard and Peter talking to the stage manager. Two problems: firstly, the orchestra was rehearsing in the afternoon and we would have to run cables and put microphones on stage with the orchestra in place. Secondly, due to the extra size of the orchestra, additional seating had been provided for them by building an extension apron from the stage over the front aisle. This meant that to get our booms in place some of the front seats would have to be removed. The organisation backstage at the Free Trade Hall under the direction of Ron O'Neal runs like oiled clockwork, so we loaded all our equipment onto the lift in the centre of the stage and it was carefully unloaded in the basement by the backstage staff and put in; and so off for a quick lunch.

For classical mobile recordings, we prefer to remove our equipment from the van and install the mixer and loudspeakers in a suitable room. The mobile unit at Abbey Road has four portable eight-track Studer *A80* machines and Graham Kirkby and Richard, who are responsible for this equipment, have completely re-designed and had built outer cases for these tape machines. It is thus relatively easy to remove them from the vehicle. We have had trouble in the past with classical music recording on the van, caused by extraneous traffic noise and even rain on the roof. Personally, I find the acoustics of a mobile van make it very difficult to judge the quality of sound perspective and ambience so I would prefer to work in a room lined with bricks and mortar; the dressing room we were going to use was ideal being about 6.5m x 6m x 3m.

I had previously worked out from the orchestral line up the microphone layout and to which section would be put onto the eight tracks. The three *M50*s would be placed left, centre and right over the strings, which consisted of 16 first violins, 14 second violins, 12 violas, 10 cellos, the eight basses covered by a Neumann *U87* on a small boom. Two Neumann *KM 86* would be placed left and right on to the twelve woodwind, piano *fet U47*, harp *KM 84*, celeste *KM 84*, horns *U87*, timpany *KM 84*, three percussion three *KM 84*s. No mics would be required on the trumpets, trombones and tuba as they would come through loud and clear on the orchestral *M50* mics. Two *U87*s had to be placed left and right at the rear of the hall for the extra ambience required.

By our return, all the equipment had been brought in and the front seating removed for our booms. We then moved the equipment to the correct working positions for mixer and monitor speakers, with the tape machines in the corner. It's useful to have the door of a room opening behind me, so that anybody coming into the room doesn't get in front of the loudspeakers tripping on cables and mains plugs. Richard Hale soon had it plugged up and after switching on was able quickly to check that all was working correctly by means of the oscillator in the EMI mixing console. So, leaving everything switched on, Richard started to run the multi-core cables from the hall under the stage and down to the control room.

Meanwhile Peter and I were setting up microphones on stage. Soon, the orchestra arrived and we were crawling through the various sections of the orchestra plugging cables from the microphones to the junction boxes that Richard had left under the stage for us. Musicians' wit can be very scathing. Moreover, fiddle players can use a violin bow as good as any fencing master and Peter suffered a few well aimed stabs at parts of his anatomy as he crawled between first and seconds. Luckily they had a tea break and we were then able to work in peace and quiet, so we took the opportunity to set up the booms and rig the orchestra *M50*s. They need very careful setting as these microphones will pick up more extreme top frequencies at the front of the diaphragm;

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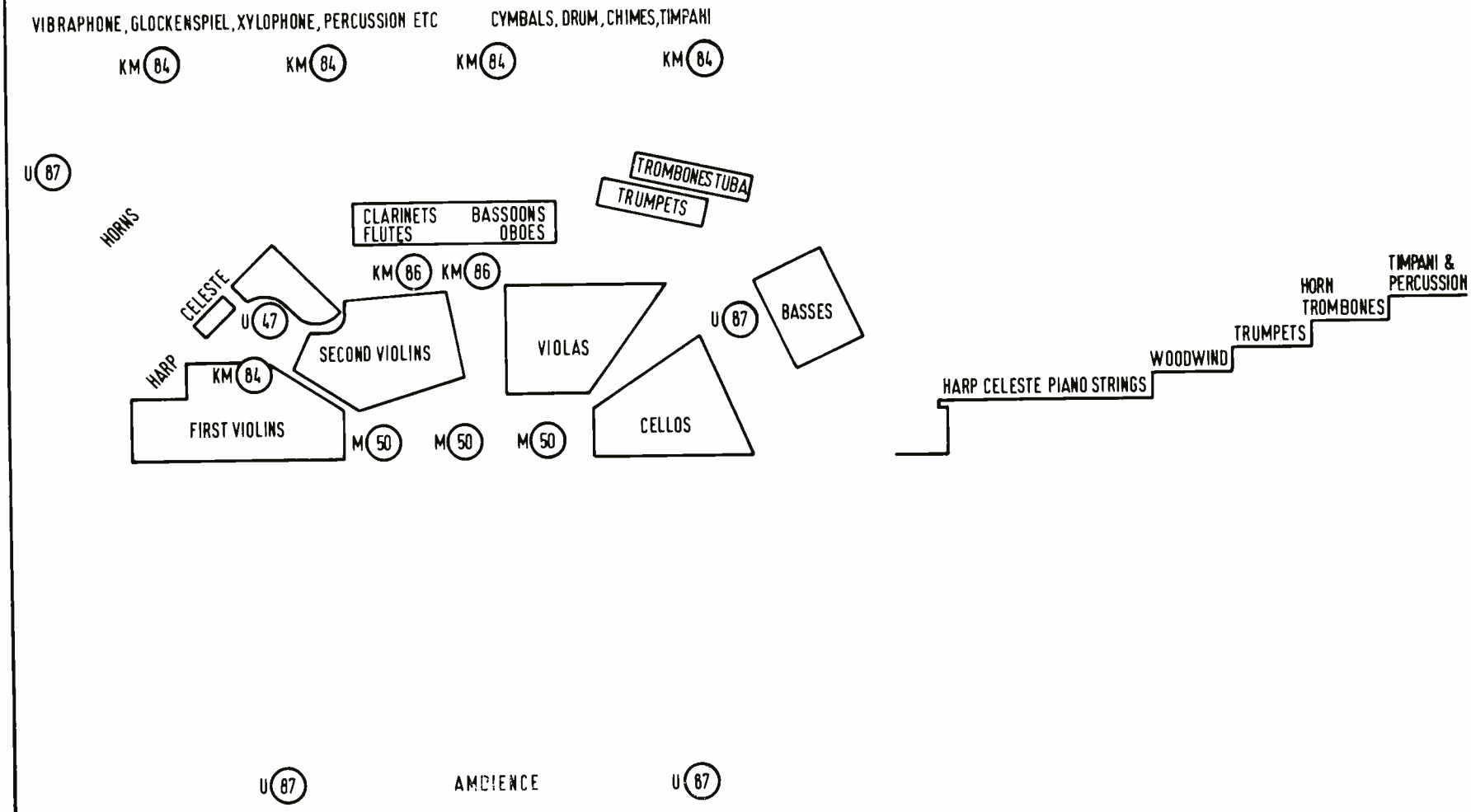
FIG.1 ORCHESTRA AND MICROPHONE LAYOUT FOR RECORDING CHAGALL WINDOWS, FREE TRADE HALL MANCHESTER - PLAN AND SIDE ELEVATION



each of the three *M50*s has to be adjusted to suit the violins on the left and centre, violas and celli on the right. While I was doing this Peter James had gone up in the balcony to rig the two ambience *U87*s. From my position on the floor of the hall I was able to direct him to the exact position required.

Richard, having finished his cable running, appeared with talk back loudspeaker, red light and telephone; these were placed on our aspidistra stand near the conductor. One useful piece of equipment developed by EMI Research division is a portable white noise generator. So I went below to the control room and after testing the red light and telephone, Richard with the wn generator was ready to test each microphone for me, and I was able to check them for level and quality and to see that each one was plugged through to its correct fader.

Peter had reappeared in the hall and was setting up the closed circuit television camera in the balcony, focused on the conductor; this is for the usual reason of seeing in the control room when the conductor is ready to record without bothering him with needless telephone calls or enquiries on the talk back.

Richard then lined up the Studer *A80* machines to the batch of 40 reels of 25 mm EMI tape that we had brought with us. Little adjustment was needed, so next came the Dolby record and replay and finally Dolby tones and line up frequencies were recorded at the start of the first reels of tape. For outside work EMI always use two tape machines and record on both tapes in parallel so that we are covered in case of loss or breakdowns. We then played my test tape of various musical and vocal items so that John Mordler and I were able to judge the tonal effect in the control room from these known pieces of music—and we noted that the very low bass frequencies tended to boom slightly.

Next, I turned my attention to the mixer. Monitor level was set from my music tape and I switched the microphones to the appropriate tracks as follows:

Orchestra left, centre and right	tracks 1 and 2
Woodwind	track 3
Basses	track 4
Percussion	track 5
Timpani	track 6
Ambience	tracks 7 and 8

Harp, piano, celeste and horns were panned 15° between 1 and 2. The complete recording channel appeared to be working well with no crackles or high background noise. We have an ingenious piece of equipment in the form of a digital counter. This is connected across the tape announce button, so that as each take is announced it is displayed on an led unit which can be seen by the producer, tape machine operator and myself. This is most useful for classical recording, as we can reach 100 takes for one symphony.

It was getting near to 7 pm and the orchestra were taking their places on stage. I was able to make the last minute adjustment to the microphones and stands. The left hand woodwind microphone facing the flutes and clarinets was set to focus on the clarinets as the flutes in front would require less presence. The same applies to the right hand woodwind mic—the oboes' sound is very cutting so it's the bassoons' that needs boosting; however you have to be careful not to get too much clatter from the mechanism of these instruments. A quick check on the percussion mics and we are ready to have a run through for a balance test.

John Mordler asked James Loughran to give us part of the first piece that would include a loud *forte* passage. This would allow us to check the dynamics from soft to loud and see whether the balance would need changing as loud brass and timps ring out.

As the orchestra played I realised that we had not enough volume and clarity from the strings and that the trombones were being picked up by the bass microphone in fact louder than the basses. The front three *M50*s were lowered to 2.5m, closer to the strings. Now the problem became the brass, trumpets and trombones plus tuba, who were sitting in a long line. So if we moved the brass to the left away from the bass microphone we would bring the trumpets behind the woodwind and pick them up on their microphones. Therefore, trumpets stay put. We then moved the trombones up one riser and to the left. I could do with more definition from the basses so their microphone was lowered by 25 cm; the back desks of the basses are under the side balcony which is not a good thing, but this cannot be helped.

Down to the control room for a further test; this time, the percussion need help as the cymbal and drum are balanced too close, so the microphones are moved away and closer to the vibraphone etc. At the same time we require more clarity from the cellos, so their *M50* is lowered a further 15 cm. Peter does this for me, and John Mordler and I listen to the orchestral sound on our distant *U87*s. We find that the lower frequencies tend to boom slightly; a quick visit to the balcony shows this appears to be reflected from the side walls, so the *U87*s are moved closer together and away from the side walls. By cutting 2 dB of bass at 100 Hz, quality considerably improved.

We both agree that the balance is good. John phones John Loughran to say that we are ready. Peter starts the tape machine; I announce Take 1, switch on the red light and the recording has now commenced. This first take lasts for about seven minutes and at a prearranged spot in the score the orchestra stops, Peter spools back the tapes, John phones the stage and invites the conductor and principal members of the orchestra to come for a playback. Everybody is pleased with the balance but the third drum of the timpani tends to sound a little boomy. The musician who was playing timpani has also listened to the playback; he agrees with us, and we both go up to the stage. As he adjusts the drum head, I move the microphone directly over the top and before the next take we request for the passage containing the timps to be played again. I equalise the *KM 84* microphone with +2 dB at 100 Hz and −4 dB at 10 kHz; all is well, and we continue with Take 2. During the break we have a visit from ITV television who are coming in to televise the first live performance of this work on Wednesday; we will meet their chief engineer at 11 am next day.

The session finishes at 10 pm and we are well up to time; we are all a bit too tired for playbacks, so we arrange to have them next day at 1 pm, our session starting at 1.30 pm. The chief engineer from ITV tells us that it would help them considerably if after the last session at 9 pm we could remove all of our mics and cables from the hall, as they would have to remove the apron and put back the front rows of seats ready for their concert next day. Of course we readily agreed to this and in return they would see that none of their heavy lighting cables would be run on top of ours, so it would be easy for us to withdraw our multiway cables from the hall to control room without difficulty; 30m of heavy duty lighting cable can easily weigh 100 Kg.

At 1 pm the playback commenced and we were all pleased with the sound. John McCabe had a couple of musical points to raise with John Loughran and at 1.30 pm the afternoon session started. This piece of music contained the piano, which played a figure with the basses. There was plenty of piano on the front *M50*s but it needed more presence, so a touch of the *fet U47* was added. I find this mic gives a very smooth bottom end to the piano. This balance had to be correct, since the piano mic was on the same track as the strings and coule not be altered on remix. Next came a passage with woodwind, celeste, harp and percussion. John McCabe said that it should be just one sound and you should not be able to hear each instrument so at this point, with a cue from John, I lowered the level of the woodwind mics, harp and celeste, just leaving the vibraphone. This could have been done on remix, but I prefer to make sure that the sound is correct during recording and make the necessary adjustments then.

No mention has been made of the microphone on the horns—this is because I wasn't using it, as the horns were coming through quite loud and clear on the orchestra mics. The bells of their instruments were facing towards the wooden panelling at the side of the stage and it was reflecting from here, towards the *M50*s.

And so the sessions progressed by the evening we were well up to time, and were able to record the *Hartmann Variations* as scheduled. At nine o'clock all was completed. John Mordler thanked the orchestra, I moved from the mixer to tape machines to do the playbacks and Peter and Richard went upstairs to the hall to start breaking down microphones and booms and coil up the mic head leads. I joined them a half-hour later, and we were clear of the hall by 10.45 pm.

We were all pretty well tired out and we hurried to the steak bar opposite the Free Trade Hall for a pint and a meal. And we were pleased with the work we had done. Only one electrical fault, and that was a noisy card in a Dolby replay. It had been a rush job but well worth it.

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C.E. 4038 Bi-Directional Ribbon Microphone

A pressure-gradient transducer microphone designed after years of research sets a very high standard of fidelity for ribbon microphones. It is manufactured by agreement with the British Broadcasting Corporation, patent 738,864 and 742,006. It is ideal for orchestral and musical work, and is essentially a studio microphone. It has a smooth wide range frequency response, an absence of transient distortion, and relative high sensitivity comparable with that of superior moving coil microphones. The frequency response is exceptionally flat from 30 to 15,000 c/s and throughout this range the shape of the bi-directional polar response is maintained substantially constant both in the horizontal and vertical planes. The ribbon is of extremely low mass and is correctly damped so that the transient response is exceptionally good.

Non-linear distortion is practically non-existent at all levels which will be encountered in practice. The case is made of heavy gauge perforated brass, backed by finely woven monel wire mesh screen to exclude dust. The microphone can be either mounted on a stand or suspended from lugs to enable it to swivel and tilt.

The standard finish is a satin ripple stove enamel. The outlet is a 3-pin connector inside the stem of the microphone. A 4069A jack is required for connection. The stem is fitted with a ring safety clip to retain the jack.

Technical Specification

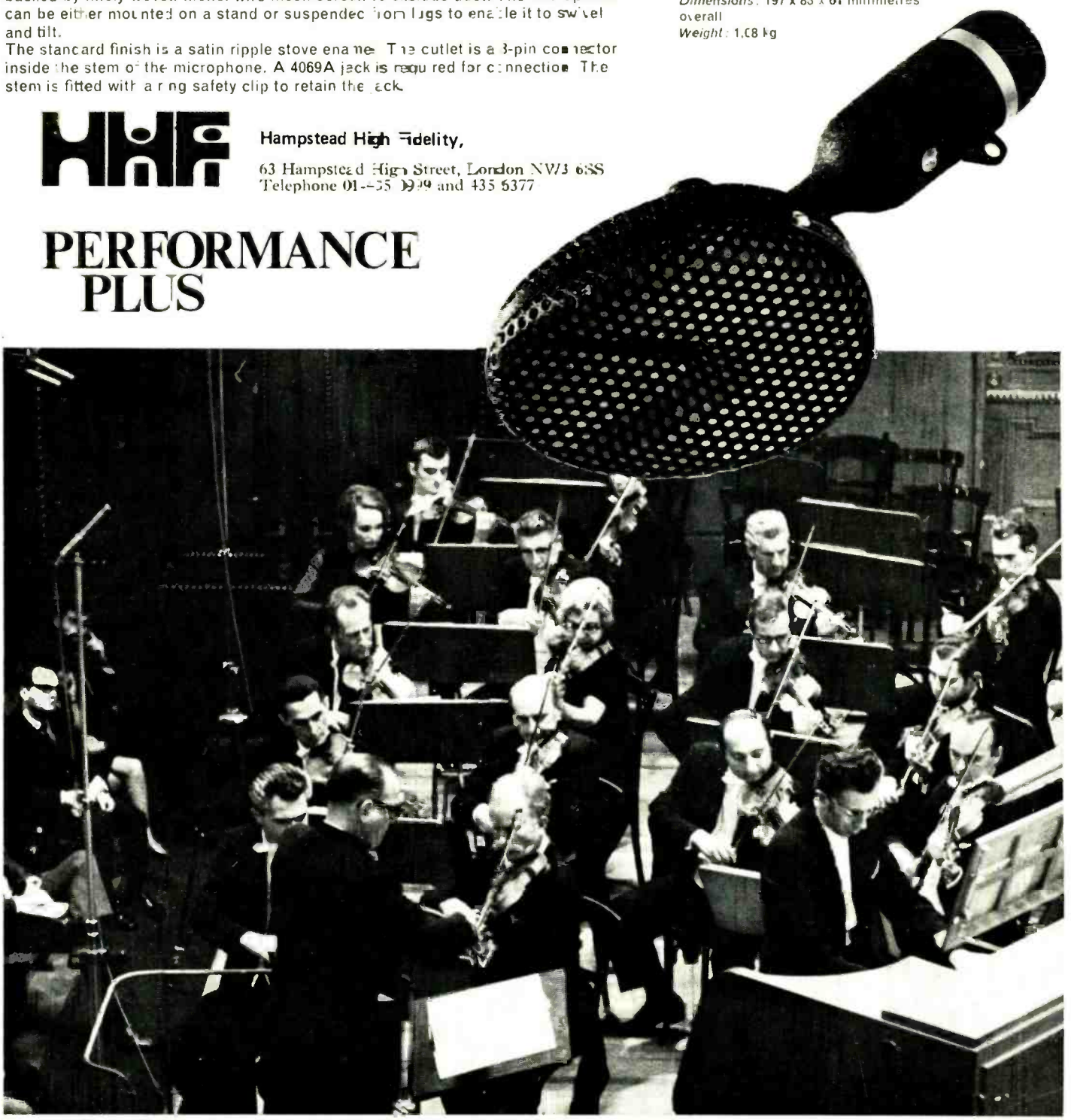
Mean Sensitivity: Open circuit voltage per dyne/cm² (micro-bar) 0.06 mV
Open circuit voltage level per micro-bar ref. 1 volt —85 dB
Power delivered into 30 ohms for 1 micro-bar ref. 1 mW —76 dB
American ASA rating, ref. 1 mW —151 dB
Electrical Impedance: nominal value 30 ohms
Equivalent Electro-Magnetic Hum Pick-up:
Less than ± 5 dB on 0.0002 dynes/cm² for 1 milligauss at 50 c/s
Distortion (Non-Linear):
Less than 1% for a sound intensity of 125 dB above 0.0002 dynes/cm² (20 micro-Newtons per square metre) at 110 c/s and less than 0.1% for +125 dB at 250 c/s
Dimensions: 197 x 83 x 61 millimetres overall
Weight: 1.08 kg

HHF

Hampstead High Fidelity,

63 Hampstead High Street, London NW3 6SS
Telephone 01-435 9949 and 435 5377

PERFORMANCE PLUS



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Survey: microphones

Not all the models on offer from a particular manufacturer are necessarily represented in the listings; generally, the survey includes only those which might find applications in up market sound reinforcement or recording studios. Selection criteria include capsule performance, output impedance and suitability of connectors for interface with professional sound equipment.

KEY
TRANSDUCER TYPE. MC—Moving coil. R—Ribbon. DR—Double ribbon. C—Capacitor. RC—Varactor (tuned circuit fm system). El—Electret.
POLAR RESPONSE. O—Omnidirectional. C—Cardioid. HC—Hypercardioid. SC—Supercardioid. B—Figure of eight. S—Special. V—Various. VS—Various switchable.

ADASTRA

Adastra Electronics Limited, Unit N.22, Cricklewood Trading Estate, Claremont Road, London NW2 1TU. Phone: 01-452 6288/9.

Model No.	Transducer type	Polar res.	Impedance	Output	Price	Remarks
M.12/EX.220	C	C	600	—70 dB	£23.50	Windshield
M.14/B.7107	C	C	600	—70 dB	£18.25	Windshield
M.21	El	C	600	—68 dB	£14.00	ON/OFF Switch
M.53/MDF.623C	MC	C	50K/600	—82 dB	£17.75	
M.58/MDF.619BC	MC	C	50K/600	—58 dB	£20.50	

AKG

AKG Akustiche Und Kino-Gerate GmbH, A-1150 Vienna, Brunhildengasse 1, Austria.
UK: AKG Equipment Ltd, 182/184 Campden Hill Road, Kensington, London W8. Phone 01-229 3695/6.

Model No.	Transducer type	Polar res.	Impedance	Output	Price	Remarks
D202	MC	C	300	.16 mV/μB	—	Two way system
D200	MC	C	250	.14 mV/μB	—	Two way system
D224	MC	C	250	.13 mV/μB	—	Two way system
CK1	C	C	N/A	.95 mV/μB	—	Condenser capsule
CK2	C	O	N/A	.8 mV/μB	—	Condenser capsule
CK5	C	C	N/A	.95 mV/μB	—	Internally suspended
CK8	C	HC	N/A	1.5 mV/μB	—	Interference tube
CK9	C	HC	N/A	1.1 mV/μB	—	Interference tube
C451/2	FET preamps for use with above condenser mic capsules					
C414E	C	V	—	.6 mV/μB	—	Polar response switchable—inc. fig. of 8
D58	MC	HC	—	.072 mV/μB	—	Head only
D190	MC	C	—	.23 mV/μB	—	General purpose
D590	MC	C	—	.13 mV/μB	—	Head only
D21	MC	C	—	.22 mV/μB	—	Extended bass
D160	MC	O	—	.13 mV/μB	—	Windshield
D1200	MC	C	—	—	—	Variable bass
D2000	MC	C	—	.23 mV/μB	—	Designed for PA
C510E	El	C	—	—	—	Interchangeable cartridge
C510E	El	O	—	—	—	Studio Lavalier-tie pin
D140	MC	C	—	—	—	Hum back coil gives 23 dB improvement over earlier models

Prices on application for all models

ASTATIC

The Astatic Corporation, Conneaut, Ohio 44030, USA.
UK: Allotrope Ltd. See *Pearl*
Export to rest of world: Morhan Exporting Corporation, 270 Newton Road, Plainview, New York 11803, USA.

Model No.	Transducer type	Polar res.	Impedance	Output	Price	Remarks
810	MC	HC	150	-54 dB re 1 mW/μBar	$90	Hi/Lo Z switch

BEYER

Eugen Beyer, Electrotechnische Fabrik, D71 Heilbron, Thereseinstrasse 8, PO Box 170, Germany. Phone 07131, 82348.
UK: Beyer Dynamic (GB) Ltd, 1 Clair Road, Haywards Heath, Sussex. Phone: 0444 51003.

Model No.	Transducer type	Polar res.	Impedance	Output	Price	Remarks
M160N	DR	HC	200	—152 dBm	£96.07	
M260NC	R	HC	200	—153 dBm	£55.73	—
M500NC	R	HC	200	—153 dBm	£64.30	High front/back ratio
M101NC	MC	O	200	—150 dBm	£48.24	Clamp and windshield
M111N	MC	O	200	—153 dBm	£53.89	Studio Lavalier
M67NC	MC	C	200	—148 dBm	£54.16	Speech/music switch
M69NC	MC	C	200	—144 dBm	£45.08	—
N201NC	MC	HC	200	—149 dBm	£54.87	Clamp/ windshield
X1NC	MC	C	200	—146 dBm	£31.84	General purpose Hum back
M88NC	MC	HC	200	—144 dB	£81.05	30 to 20k Hz

All the above sensitivity figures refer to the EIA rating.
The company also manufactures a range of radio mics and receivers. They can be supplied to conform with European and FCC specifications. Hand held units are generally based on the *M201*; transmitter belt packs will operate with most low impedance mics.

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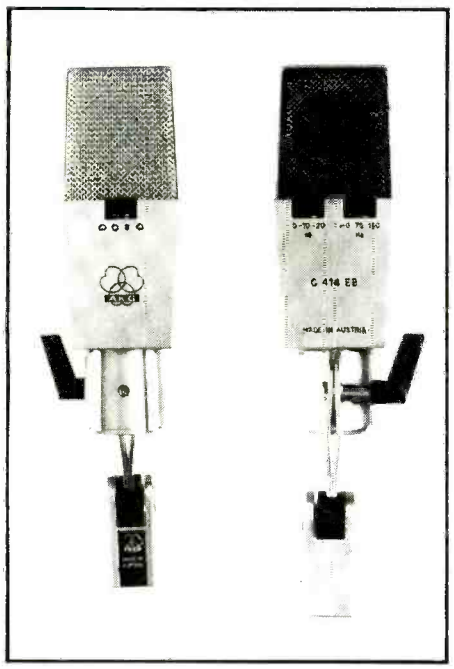
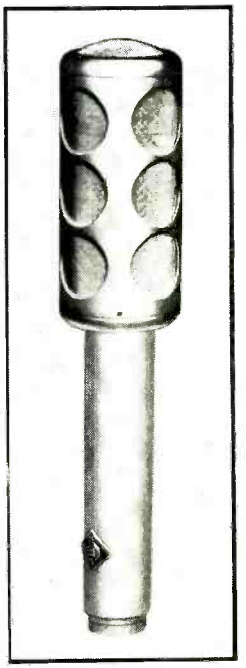
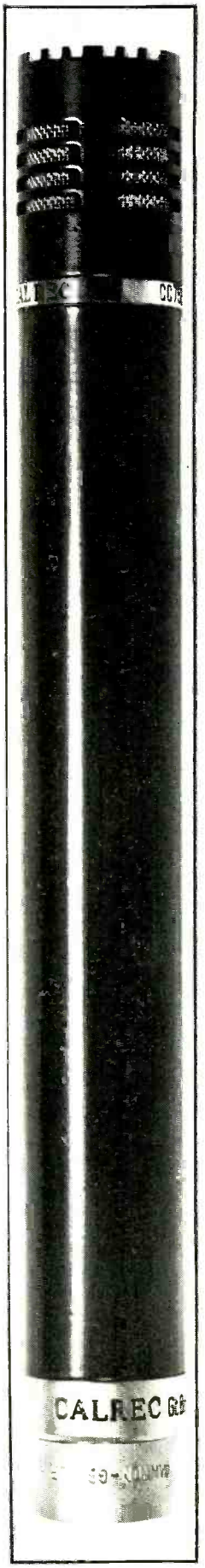
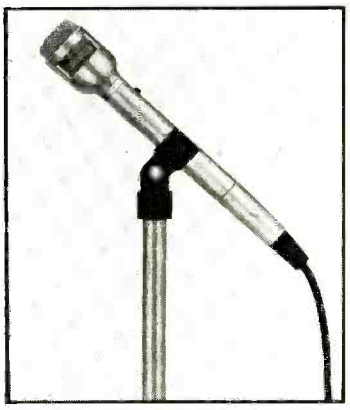
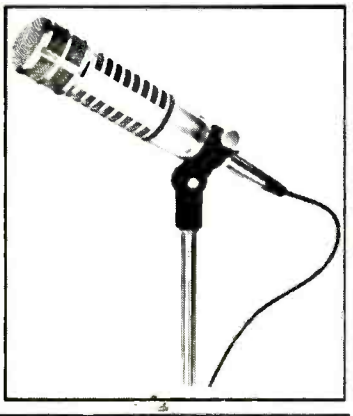


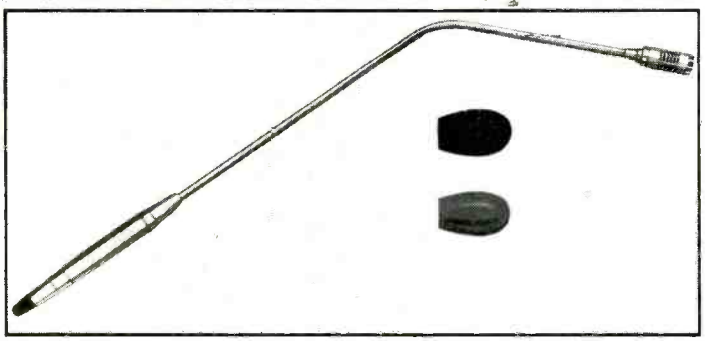


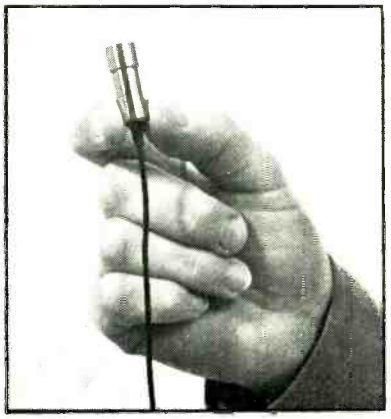






Top row l to r: *AKG C414 EB switchable response capacitor mic. Beyer M69C. Neumann KMS 85. Calrec CM 950C (CB9c with CC50 capsule amp).* **Second row l to r:** *Turner 220S. Electrovoice RE20. Pearl DC63.* **Third row:** *Eagle PRO M25.* **Bottom row l to r:** *Lawtronics LM25 lavalier. Shure PE5 EQ mic with four way equalisation. STC CE 1037.*





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CALREC

Calrec Audio Ltd, Hangingroyd Lane, Hebden Bridge, Yorks HX7 7DD. Phone: 0422-2159.
Distributors: Beyer Dynamic (GB) Ltd, 1 Clair Road, Haywards Heath, Sussex. Phone: 0444-51003.

Model No.	Transducer type	Polar res.	Impedance	Output	Price	Remarks
CM1001C	C	O	1k	0.8 mV/μB	£36	Hand held
CM1003C As above for general purposes						
CM1050C As *1003C* except cardioid						
CM1051C As 1050C but with bass roll off filter						
Detachable capsules:						
CCO1	C	O			£16.35	Hand held
CCO3 As above for general purposes						
CC50	C	C	Full range cardioid			
CC51	C	C	Bass roll off, cardioid			
CC56	C	C	Spherical ball mesh for close vocal work		£12.50	—
Pre-amplifiers for use with the above:						
CB7C	—	—	1k	1.5 mV/μB	£24.46	—
The above is internally powered from a 1.5V cell giving a life varying between 400 and 1200 hours.						
CB20C	—	—	1k	0.8 mV/μB	£24.38	—
This is a standard 48V phantom powered pre-amp. 0.5 mA drain.						
CB21C: As above but for use with phantom power lies of any voltage between 7.5V and 50V.						

CAMBRIDGE

Cambridge Records, 125 Irving Street, Framingham, Mass 01701, USA. Phone: (617) 879 2282.

	R	B	250	—55 dB	—	—

The above mic can be supplied with a variety of line matching transformers. *C5a* pre-amp, phantom powered, delivers a high level signal at low output impedance. Overall noise figure claimed to be better than 21 dB re 0.0002 dynes cm^{-2}.

DUKANE *Medallion*

Dukane Corporation, Communications Systems Division, St Charles, Ill 60174, USA. Phone: (312) 584 2300.

7A845	MC	C	200	—55 dB	—	Sw 7/12 dB roll at 50 Hz
7A890	MC	SC	150	—56 dB	—	anti-boom

The company also manufactures a range of radio microphones working at FCC alloted frequencies. These would not be licensable in the UK.

EAGLE

Eagle International, Precision Centre, Heather Park Drive, Wembley HAO 1SU. Phone: 01-902 8832.

Pro M10	EL	0	600	—70 dB	£35	Uses *HP7* cell.
Pro M20	EL	C	600	—60 dB	£32	—
Pro M25	EL	C	600	—70 dB	£37	Mounted on 60 cm boom
Pro M5	EL	S	600	—65 dB	£16	Lavalier

ELECTROVOICE

Electrovoice Inc, 600 Cecil Street, Buchanan, Mich 49107, USA. Phone: (616) 695 6831.

Model No.	Transducer type	Polar res.	Impedance	Output	Price	Remarks
UK: Special Products Division, Gulton Europe Ltd, Brighton BN2 4JU. Phone: 0273-66271.						
635A	MC	O	150	—55 dB	£47	—
DL42	MC	Gun	150	—50 dB	£249.50	Rifle mic
DS35	MC	C	150	—61 dB	£66	Anti close bass
667A	MC	C	150	—51 dB	£186.50	Response curve tilt
CS15	El	C	150	—45 dB	£176.50	Phantom powered
CO85	C	S	Lo Z	—56 dB	£89	Tie tac, v small
RE15	MC	SC	Lo Z	—56 dB	£139	Bass rolloff
RE16	MC	SC	Lo Z	—56 dB	£146	—
RE55	MC	O	Lo Z	—55 dB	£123.50	20 to 20k Hz, flat

CE

Hampstead High Fidelity, 91 Heath Street, Hampstead, London NW3. Phone: 01-435 6377.

4038	R	B	300	—85 dB	—	For levels to 125 dB spl
4021	MC	O	300	—80 dB	—	Studio and acoustic ref
4104	R	C	300	—80 dB	—	Noise cancel, lip guard
4115	R	C	300	—85 dB	—	Broadcast

LAWTRONICS

Lawtronics Ltd, 139 High Street, Edenbridge, Kent TN8 5AX. Phone: 073271-5191/2. Telex: 957186.

LM23	El	S	600	—72 dB	£23.95	Lavalier

NEUMANN

Georg Neumann GmbH, Charlottenstrasse 3, 1000 Berlin 61, West Germany. Phone: 251 4091. Telex: 184595.
UK: F W O Bauch Ltd, 49 Theobald Street, Borehamwood, Herts. Phone: 01-953 0091.

KM83	C	O	200	1 mV/μB	£77	—10 dB atten
KM84	C	C	200	1 mV/μB	£77	—10 dB atten
KM85	C	C	200	1 mV/μB	£77	—10 dB atten
KM86	C	VS	200	.8 mV/μB	£192.07	—10 dB atten
KM88	C	VS	200	.8 mV/μB	£192.07	—10 dB atten
KMS85	C	C	150	.6 mV/μB	£173.51	for high spls
U87	C	VS	200	.8 mV/μB	£192.87	10 dB sw roll 200/30 Hz
U47fet	C	C	150	.8 mV/μB	£181.58	—10/6 dB pad sw. 50 Hz rolloff switch
SM69fet	C	VS	150	1.8 mV/μB	£426	Two caps for coincident stereo
KMA	C	S	800	—	£111.37	Studio Lavalier
All the above are for use with phantom powering from 48V dc.						

PEARL

AB Pearl Mikrofonlaboratorium, Knutsgatan 6, S265 00 Astorp, Sweden. Phone: 042-515 20.
UK: Allotrope Ltd, 90 Wardour Street, London W1V 3LE. Phone: 01-437 1892/3. Telex: 21624.

D441LS	MC	HC	200	—51 dB	POA	Windshield, anti-pop

40 ▶

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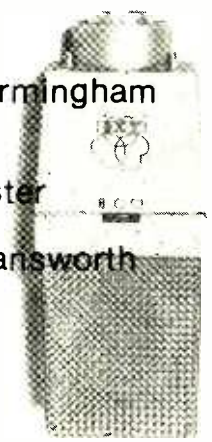

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AKG Equipment Ltd 182/4 Campden Hill Road
London W8 7AS. Telephone 01-229 3695.

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SURVEY: MICROPHONES

Model No.	Transducer type	Polar res.	Impedance	Output	Price	Remarks
LD18	MC	O	200	—74 dB	POA	—
RD16	MC	C	200	—70 dB	POA	Small size
RD34	MC	C	200	—74 dB	POA	—
F69	MC	C	200	—70 dB	POA	High output
HM47	MC	O	200	—76 dB	POA	Studio Lavalier
HM49	MC	O	200	—74 dB	POA	High performance
CL3	EI	O	200	—	POA	Tie clip studio mic
DC20	C	O	200	—46 dB/Pa	POA	—
DC21	C	C	200	—44 dB/Pa	POA	—
DC63	C	V	200	—60 dB	POA	Variable polar pattern, incl. figure of 8
DC73/12	C	C	200	—40 dB/Pa	POA	10-50V powering
DC73	C	C	200	—46 dB/Pa	POA	—
DC96	C	C	200	—61 dB	POA	Low noise, 130 dB dynamic range
EC71	C	C	200	—58 dB	POA	Miniature high performance
EK71	C	O	200	—58 dB	POA	Miniature high performance
FP92C	EI	C	200	—66 dB	POA	Self contained battery
FP92CO	C	C	200	—38 dB/Pa	POA	Internal 15V battery
FP92KO	C	O	200	—42 dB/Pa	POA	Internal 15V battery
SP84	C	O	200	—42 dB/Pa	POA	Variable rolloff. 15V
SP85	C	C	200	—42 dB/Pa	POA	Variable rolloff. 15V
ST8	C	V	200	—46 dB/Pa	POA	120V. Dual unit for coincidental stereo
TC4	C	C	200	—52 dB	POA	120V. Very high performance
VM40	C	O	200	—48 dB/Pa	POA	Speech/music/ —10 dB switch
VM41	C	C	200	—48 dB/Pa	POA	Speech/music/ —10 dB switch

Interference tubes supplied for *SP 85*, *VM41* only as complete unit.
Unless otherwise stated, mic power supplies are 48+6—8V phantom.

PEERLESS

Peerless-MB Gmbh, D6950 Mosbach-Ne, Industriestrasse, Postfach 1608, West Germany. Phone: 062 61/2953-55. Telex: 0466 132.
UK: Peerless Fabrikkerne (UK) Ltd, 40 Nicholas Way, Northwood, Middlesex. Phone: Northwood 27941. Telex: 923844.

MB301	R	C	200	01. mV/μB	—	40 to 18k
MB119	MC	O	200	0.2 mV/μB	—	General purpose
MB119SM	As above with speech/music response switch					
MB219	MC	C	200	0.13 mV/μB	—	Anti handling noise
MB219SM	As above with speech/music response switch					
MBC540	Condenser mic with integral pre-amp and 500 ohms single ended output. Following capsules available:					
/1	C	O	—	0.6 mV/μB	—	20 to 20k Hz
/2	C	C	—	0.5 mV/μB	—	—
/3	C	C	—	1.3 mV/μB	—	High sensitivity
/4	C	C	—	0.6 mV/μB	—	Bass roll off

The above can be used with pre-amp type *MBC 548* offering balanced output at 200 ohms impedance. Output voltage reduced in proportion.

PYE

Pye Business Communications Ltd, Cromwell Road, Cambridge CB1 3HE. Phone: 0223-45191.

Model No.	Transducer type	Polar res.	Impedance	Output	Price	Remarks
LBB9003/05	MC	S	200	—	—	Studio Lavalier
LBB9100/05	MC	C	200	—	—	F/B ratio 18 dB
LBB9101/05	MC	O	200	—	—	35 to 18k Hz

SCHOEPS

Schalltechnik Dr.-Ing, K. Schoeps, 75 Karlsruhe 41, Spitalstrasse 20, Postfach 410970, West Germany. Phone: (0721) 42016/42011.
UK: Scenic Sounds Equipment, 27/31 Bryanston Steeet, London W1H 7AB. Phone: 01-935 0141.

CMH52CU	C	O	Low	1 mV/μB	—	Unit construction gp
CMH54CU	C	C	Low	1.2 mV/μB	—	Unit construction 60-20k.

The above can be supplied with a variety of connectors. Specific models operate from either 12V phantom or parallel, 48V phantom. Max spl 132 dB at 0.5% thd.
Detachable capsule series *Colette*

Capsules						
MK2	C	O	—	1.2 mV/μB	£65.50	—
MK3	C	O	—	1 mV/μB	£65.50	—
MK4	C	C	—	1.2 mV/μB	£65.50	—
MK40	C	C	—	1.6 mV/μB	£75.50	Speech cardioid
MK41	C	HC	—	1.3 mV/μB	£75.50	—
MK5	C	S	—	1.2 mV/μB	£92	Omni/cardioid switch
MK6	C	S	—	0.8 mV/PB	£123.50	Omni/fig of 8/ cardioid switchable

CMC5 U Pre-amp body accepting any of the above capsules. Fitted with *XLR* connectors (only style distributed in UK) and powered from 48V dc phantom. Other powering voltages available to special order.

SENNHEISER

Sennheiser Electronic, 3002 Bissendorf/Hann, Germany. Phone: 05130 8011.
UK: Hayden Laboratories Ltd, Hayden House, 17 Chesham Road, Amersham, Bucks HP6 5AG. Phone: 02403-5511.

MD441U	MC	HC	200	—52 dBm	£85.60	Treble/bass switch
MD421U4	MC	C	200	—52 dBm	£59.95	Bass atten switch
MD413U	MC	C	200	—56 dBm	£39	Anti-boom
MD21N	MC	O	200	—52 dBm	£37.85	Robust
MD214U3	MC	O	200	—58 dBm	£63.10	Lavalier studio mic
MD211U	MC	O	200	—56 dBm	£53.80	40-20 kHz ±2.5 dB
MKE201	EI	O	1.5k	—32 dBm	£40.55	5.6V internal battery
MKE401	EI	SC	1.5k	—27 dBm	£47.35	5.6V internal battery
MKH415T	RC	SC	200	—32 dBm	£149	12V phantom interference
MKH815T	RC	L	200	—26 dBm	£198	12V phantom, interference
MKH125T	RC	O	150	—32 dBm	POA	Lavalier 12V
MKH105T	RC	O	200	—32 dBm	£121.55	20-20 kHz ±2.5 dB, 12V
MKH110	RC	O	2k	—32 dBm	£160.45	8V phantom power

The *MKH110* is intended for instrumentation in the range from 0.1 Hz to 20 kHz. As such, a three volt dc offset exists on the output.

SESCOM

Sescom Inc, PO Box 590, Gardena, Ca 90247, USA. Phone: (213) 770

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Model No.	Transducer type	Polar res.	Impedance	Output	Price	Remarks
3510. Telex: 910-346-7023.						
UK: Allotrope Ltd. See *Pearl*.						
MC325	El	O	200	—65 dB	POA	Studio Lavalier

SHURE

Shure Bros Inc, 222 Hartrey Ave, Evanston, Ill 60204, USA. Phone: (312) 679 5830.
UK: Shure Electronics Ltd, Ecclestone Road, Maidstone ME15 6AU. Phone: 0622-59881.

SM5B	MC	C	150	—79.5 dB	£168.60	Boom mounting
SM5C	MC	C	50	—84 dB	£176.40	Boom 100 Hz hi pass
SM7	MC	C	150	—79.5 dB	£151.80	Boom mounting
SM33	R	SC	150	—81 dB	£99	Anti vibration
SM50	MC	O	150	—78 dB	£51.60	Robust
SM51	MC	O	150	—82 dB	£47.40	Studio Lavalier
SM53	MC	C	150	—81 dB	£100.80	Hum buck
SM54 As *SM53* but with additional pop filter. Hand or stand held.						
SM56	MC	C	150	—76 dB	£63.60	Anti vibration
SM57 Hand held *SM56*					£49.80	
SM58	MC	C	150	—76 dB	£63.60	Robust. Anti pop
SM60	MC	O	150	—81.4 dB	£32.40	—
SM61	MC	O	150	—82 dB	£43.80	Anti handling noise
SM62	MC	C	150	—82 dB	£49.80	Small size
SM76	MC	O	150	—87.5 dB	£79.80	Slim style
Some of the above are dual impedance 50 and 150 ohms switchable.						
Unisphere B series						
315S	R	B	Lo	—58.5 dB	£41.40	Pressure gradient
300	R	B	Lo	—59 dB	£68.40	Pressure gradient
579SB	MC	O	Lo	—59 dB	£30	—
New models						
PE5EQ	MC	C	H/L	—	£54	4 stage adjustable eq
PE52	MC	—	H/L	—	£39.60	Close talk mic

SNS

SNS Communications Ltd, PO Box 448, Hove, Sussex BN3 6JA. Phone: 0273-724444.

The company manufactures a radio microphone system based on the AKG *CE5* electret capsule. The transmitter is incorporated into the hand held mic body and operates on fixed frequency in the band 174 to 175 MHz. The unit is powered by rechargeable batteries. The receiver is intended for battery/mains operation. It incorporates an output socket for recharging the transmitter batteries. Connector is *XLR*.

TECHNICS

Matsushita Electric Company, Japan.
UK: National Panasonic (UK) Ltd, Technics Hi Fi Division, 107-109 Whitby Road, Slough, Berks SL1 3DR. Phone: 0753-34522.

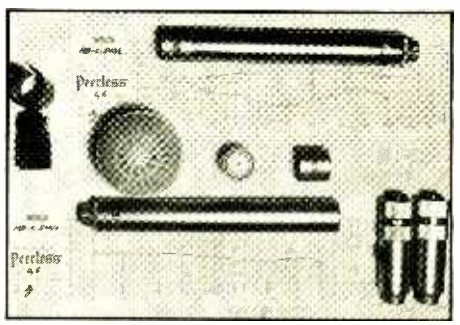
RP-385OE	El	SC	600	—72 dB	£41.56	Low cut filter

The *RP-385OE* incorporates a 10 dB pad network enabling use with spls up to 128 dB. Self noise equivalent to 28 dB spl.

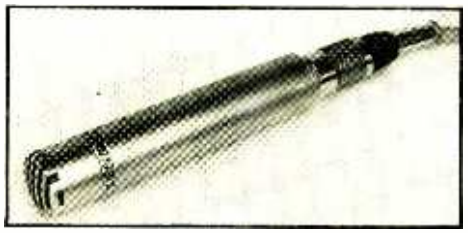
TURNER

Turner Division, Conrac Corporation, 909 17th Street, N E Cedar Rapids, Iowa 52402, USA. Phone: (319) 365 0421. Telex: 464437.
UK: Marketing Division, Canadian Instruments and Electronics Ltd, 35 Waverley Street, Nottingham. Phone. 0602-71157/8.

603L	MC	C	150	—57 dB	—	blast filter
703	MC	C	150	—55 dB	—	Mesh ball screen
2203	MC	C	150	—55 dB	—	Anti handling noise
2302	MC	O	150	—56 dB	—	—
35A	MC	S	150	—60 dB	—	Lavalier



Above: *Top: MBC 540/2*
Bottom: MBC 540/1 Peerless
Right: *Resla Superstar 80*
Below: *Sennheiser MD211*



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LETTERS

understood what I wrote in my article Better sound in Television, *mentioned in his footnote No. 8, regarding the distribution and transmission arrangements for television sound in the United Kingdom, as he states that 'what gets to the microphone isn't transmitted with little degradation'. As I tried to explain, the fact that television sound is conveyed from the microphone to the receiving aerial by substantially the same equipment and techniques as that of vhf/fm radio ensures that neither is significantly degraded on the way. I should be grateful if you would publish this letter in order to set the record straight.*

Yours faithfully, A. F. Reekie, Senior Engineer, European Broadcasting Union (EBU), Union Europeene de Radiodiffusion (UER), Technical Centre, Avenue Albert, Lancaster 32, B-1180, Bruxelles.

Dear Sir, It occurs to me that commercial concern with bandwidth and output power into a resistive load is possibly degrading the true performance of audio amplifiers, and hampering better developments.

The usual form of voltage dependent current limiting of the output will give a large power output but does not cover possible output conditions with a complex load. This could lead to a negative output resistance on parts of the cycle when working, which could excite all sorts of loudspeaker/crossover resonances. If plain current limiting of some form is used the choice of safe output transistors falls between a few homogeneous base types (as BGW) which are slow due to base storage effects, or a large number of epitaxial types which are slow due to the large base/collector capacitance of the combination.

The answer is surely to provide sufficient (and fast) driver current both on and off. At high frequencies the turn-on current should be equal to the turn-off current, ideally and the gain of the output devices will probably be only a tenth of the worst dc value which is usually used for driver current calculations.

It seems in fact that we are arriving at an amplifier with a powerful fast driver system which is buffered and protected from the load by the output devices. For example the new Quad design (where the driver amplifier is effectively separated from the output and fills in the crossover errors) seems to be arriving at this system.

The basic bandwidth of the amplifier seems to have a magic sales attraction just as power output does must surely not compromise the stability margin into any load. The usable bandwidth must also be limited at the input so that the input slew rate cannot beat the output slew rate and so cause transient overload, ie the feedback must always be in control.

I cannot see why transient troubles should exist in a good amplifier which meets these conditions but they do. Could it be that due either to saturation of the output devices (causing a hangover effect) or to latch up in earlier parts of the circuit possibly caused by a reactive load overshooting at the output. Both these effects can and should be eliminated at the design stage but very rarely are.

I think BGW are to be praised for breaking away from convention in the protection field at least.

Yours faithfully, Dr J. Emmett, EMO Systems Ltd, Clyde House, Neville's Cross, Durham City DH1 4JF.

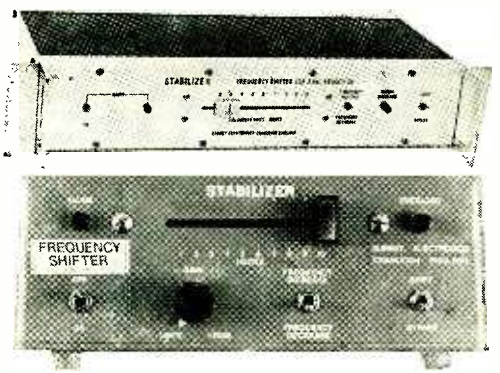
	Fundamental	2nd	3rd	4th	total	
1:1	0	—64	—65	—78	·085	
10 dB reduction	0	—64	—70	—78	·071	1.7 compression ratio, +10 gain
10 dB reduction	0	—64	—70	—72	·075	infinite compression ratio
10 dB reduction	0	—53	—60	—59	·27	—0·5
10 dB reduction	0	—44	—54	—53	·7	—0·1
1:1	0	—57	—68	—73	·14	
10 dB reduction	0	—50	—61	—66	·33	1.7 compression ratio, +10 gain
10 dB reduction	0	—49	—53	—60	·43	infinite compression ratio
10 dB reduction	0	—38	—40	—49	1·60	—0.5
10 dB reduction	0	—28	—31	—39	4·87	—0·1

Dear Sir, The Omnipressor review seems to be fair. There are, however, a few points on which I would like to comment, detailed below.

1. *On page 3 it is stated that the mains leads are routed on the pc board, which is true. However, we cover these leads with plastic tape designed to withstand the voltage, so that these leads cannot be contacted accidentally. Of course, the tape can come off or be removed and if it is not replaced will do little good. Another precaution is to route all the hv wiring on the bottom of the board, which need not be exposed except for component replacement? in this case the unit will of course be unplugged.*
2. *The criticism of the calibration is well taken. We felt that calibrating closer than 5 dB would be poor practice as we do not use precision pots and would not be entitled to greater accuracy. However, it would probably be a good idea to add tick marks between the calibrated points to allow resetting, and we'll probably do so when another run of panels is printed.*
3. *The meter ballistics are typical of the meter used, and are admittedly not as fast as a standard vu or peak meter. However, they may appear to be much slower if a slow release time is set, as the meter works off the level detector circuit. If one is interested in level measurement of program material, it would be best to set the release time control in the faster range. Of course, if the meter is used for setup, a continuous signal will be used and the criticism doesn't apply.*
4. *The distortion comments are potentially the most damaging if not explained. I think that it is inappropriate to measure distortion at such a low frequency as practical circumstances in which one is concerned with distortion at 20 Hz are few, and virtually every other component of the audio chain except pure amplifiers suffers the same 'defect'. Incidentally, it might be noted that the distortion is a theoretical consequence of the release time, and not a failing of the Omnipressor. Since the half-wavelength of the input signal is 2.5% of the longest release time available, a distortion of 1% at this frequency should not be unexpected. If by some chance someone were concerned by distortion at 20 Hz, it would be a simple matter to parallel the time constant capacitor with a larger one, suffering of course loss of calibration of the time constant controls.*

   I think it would be more fair, and certainly more representative, to quote the distortion at 40 or 50 Hz, and then let people examine the graph if they are interested in the 20 Hz distortion. If this is impossible, at least it should be pointed out that the cause is theoretical in nature and can be obviated.
5. *In the first full paragraph on page 7 it is stated that 'an attack time of only 100 µs for instance is quite unusable for anything but making new sounds'. I believe this should read 'a release time of only 1 ms . . . ', as a fast attack time is obviously useful in limiting application, and in fact many limiter manufacturers advertise even faster attack times.*

STABILIZER



The Stabilizer is a versatile frequency shifter for howl reduction on both speech and music. It offers variable shifts either up or down between 1 and 10 Hertz so allowing choice of the optimum shift for the particular acoustics and sound sources involved in each installation. The standard practice which is emerging for music is to split the mixed audio feeds, with those instruments which produce sustained notes, such as guitar and organ, fed direct to the amplification systems and the feedback—troublesome vocals going through the shifter first. A shifter not only allows more usable gain (4-8 dB) but also gives a greater stability margin between the onset of 'warbling' and actual howling. With a shifter this is something between 3 and 5 dB whereas a conventional system will go from 'ringing' to howling with a gain increase of 1 or 2 dB.
Available as a boxed unit with either balanced or unbalanced signal lines or rack mounting version offering studio quality 'SHIFT' control, duplicated jack and XLR connectors and a smart anodised finish with engraved front panel. Stabilizers include a signal overload LED, a 24 Hz high pass filter to remove VLF signals before connection to power amplifiers and a mumetal shrouded mains transformer to achieve low noise levels.

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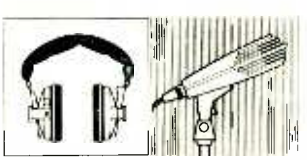
Dimensions: length 6", shaft Ø 0,95". Weight: 8,60 oz.

BEYER DYNAMIC



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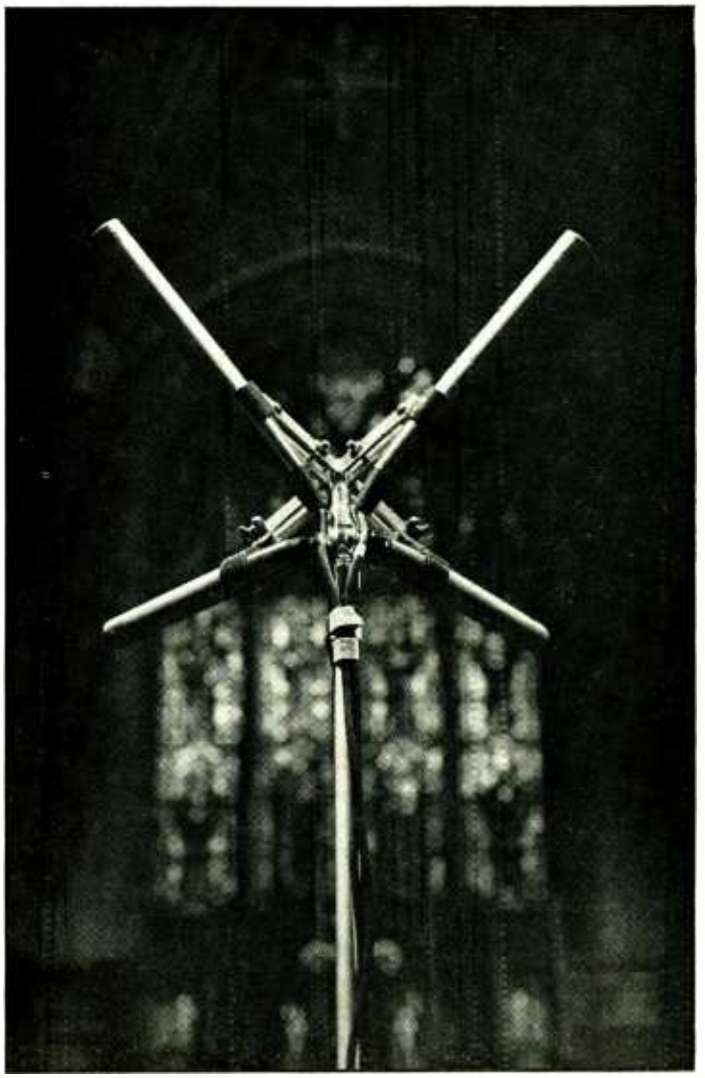
Practical aspects of purist techniques

JERRY BRUCK *

With increasing concern for multi mic orchestral balancing, purist techniques are almost forgotten. But they work.

*POSTHORN RECORDINGS, NEW YORK



'THE problem with Christianity', someone once remarked, 'is that it has never been tried.' Audio purists, and quad buffs in particular, might well say the same of quadraphonic recording today. A little looking, listening, and the occasional *Whither Quad*? type of article is sufficient to convince one that the effort is to wither quad. A certain well-known record producer once caused me to recoil with his enthusiastic offer to 'wrap a Brahms Symphony' around me. I begged off, stating a preference for brandy and bedmate to ward off winter's chill; a solution which, I believe, Brahms himself would have savoured.

What is this urge to tamper with a reality which is the common coin of concert-goers the world over? At the outset, let it be stated that no argument is intended with the handful of composers, such as Berlioz or even Gabrieli, who were unquestionably several channels ahead of their time. Nor would I trifle with pop, which long ago embraced its electronic amanuensis to spawn soundscapes and space-age spinets owing less to their progenitors than to the producers who know, better than any, for whom the decibel tolls.*

It is in fact the serious concert-goer, when he or she listens at home, who has the most to gain or lose according to the quad pro quo. If we admit that the musical involvement is greater, then the stakes are higher, and the outcome of more consequence. If we may risk a philosophical sally, it is the very nature of reality that is up for grabs. It is the perpetual human fascination with the nature of reality that prompts the purist to attempt its re-creation, hoping that a measure of success will permit re-examination of a musical event, and make possible a deeper, more intense, involvement and understanding. To recapture, in the original meaning of the term 'high fidelity', a valued musical event, is to mark out the firmament of the purist's world.

The alternative, of undeniable appeal to many, is the transmutation of reality through manipulation of its elements into a structure which appears more colourful, more exciting, than the original—a new reality, replacing the old; a construction, not a reconstruction. No moral judgment need be made here, as we return to terra firma except to point out that many who are unhappy with commercial quadraphonic sound may, by mistake or misdirection, have wandered into the wrong camp.

What might a purist find amiss in the course of a saunter through today's splendidly-equipped studio? *Realistically speaking*, what is being sought? If we find a means of employing four audio channels in recording so that, in playback, the position and perspective of a musical group is recreated in our listening room, and further, that information relevant to the acoustical character of the original hall *and our position within it* is provided, we might just be coerced into believing ourselves transported back to a familiar and beloved locale. It is possible that we might grope our way to that fabled favourite seat in the house if we are provided a four-channel interplay of level differences, arrival times, spectral distributions, and varying reverberant content. All well and good, but as our Purist Pilgrim begins the journey, not even John Bunyan could have imagined the tortuous road to be traversed.

The classic slough of despair, to which we are all more or less inured, is of course the multi-miked, multi-channelled, multi-splendored approach to stereo recording in which 'directionality' is a function of pan-pot setting, 'presence' is found

Fortunate are we that the respective trade unions oversee such bachanalia, insisting that decorum be observed until the proper contracts are signed and fees arranged. Were it not but for their upholding the strictures of a moral society, who knows what unlicensed excesses would be visited upon the unwary? So long as Fletcher and Munson live, there remains hope for decent people.

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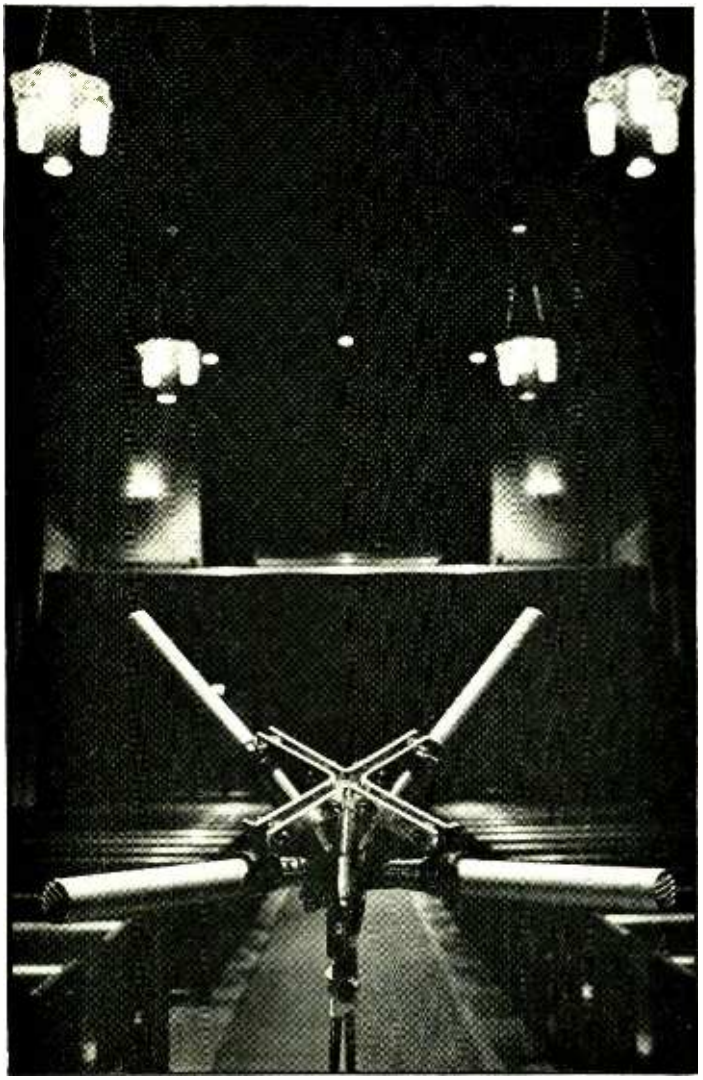
two notches up on the mid-range equalizer, 'reverberation' is the death-rattle of a metal plate, and 'phase differences' something the producer knows can be resolved if Everyone Just Sits Down and Tries To Be Reasonable. This, so far, is only the *front two* channels.

For the rear channels we can pan-pot around, or even assign, some of the material elbowing for position out front. That's 'surround sound' with a vengeance, and at least one major company has declared itself to be only interested in material recorded this way. One of this company's chief engineers, who described himself



to me as a 'recording purist', obligingly drew me a map of an orchestra, indicating where each and every one of the fifteen microphones he used was placed. I didn't realise just how deep his purist streak ran until the other day when an acquaintance of mine, who plays clarinet in a wind quintet, brought to me the group's latest recording for comment, made by this same engineer. After a moment's audition, in which I failed to pick out any very definable locus for the group, I asked hesitantly how many microphones had been used. 'Fifteen!' was the proud reply.

So let us look now for a purist's Purist, one who actually employs ambience microphones for the rear channels. Usually these will be placed well to the rear; sometimes at the very back of the hall, or at the very least well back from the main group. The most fundamental error here is one which I myself made in my first quad recording, which boasts a sixty-foot separation between front and rear pickups. The effect on playback, if I move at all, is that of striding through the hall in seven-league boots. A heady sensation, but hardly realistic. The obvious cause of the problem is the confusion between rear sound as apparent *in the rear of the hall*, and rear sound *as heard from the listener's actual position*. The latter is what we are after. Compounding this miscalculation, it is commonly the case that an omni-directional microphone has been used for the ambient pickup, since no directional information is deemed necessary. Clearly, even at the full length of the hall, some direct sound will be picked up, and the rear information will then include some sound which in respect both to arrival time and spectral distribution, is incorrect.

In sum, it is probably a welcome trend in the record industry that the liner notes on quad records so often include diagrams showing the actual disposition of the musical forces involved in the session. Otherwise we might never be able to guess.

Short of accepting this sorry state of affairs as 'state of the art' what is to be done? Total cynics are being serviced by a prominent New York studio, who offer lapel buttons reading: *Back to Mono*. Those merely sceptical may read on.

A surprising number of professional recording engineers, once you get to know them, admit to some knowledge and even use of simple microphone techniques, such as the stereo pair in coincident or slightly spaced array. I prefer the latter, especially in the form worked out by the French Radio ('ORTF technique'), which uses spaced cardioid microphones angled 110° to each other. The relatively small amount of phase difference information obtainable with this system, (interestingly, about what the human ears receive) seems to contribute an airiness to stereo recordings absent in coincident techniques, and which does not detract from the sharp resolution of the system's pickup. For quad, then, it is not surprising that some primal instinct suggests 2+2=4, and indeed a symmetrical grouping of four directional microphones results in four stereo pairings which can be made to look at either a uniform 360° area in which the array is centred, or even a sphere. Note that any and all stereo imaging is referred to a single point, central to the rig, which seems to fulfil the requirement for a common perspective, ideally that of the listener. Furthermore, since directional microphones are required, considerable control of what does and does not appear in a given channel is available. Lastly, the entire system is a composite of stereo pairs, rather than an assemblage of elements which it is hoped may be convincing in a quad presentation. Only one thing remains: what does it sound like?

Two years ago I had worked out a refinement of an earlier quad mic rig, and chose to test it in a nearby church on what seemed rather unpromising material, solo harp. The resultant recording was played back, first in stereo then in quad. Listeners were struck with the remarkable difference between the two. The stereo, itself spacious yet well-defined gained in quad the full warmth and richness typical of the sound of the instrument. The lower register in particular acquired a fullness and solidity quite unlike anything experienced in two-track reproduction. Enveloping all, almost palpably, was the vibrant interior of the church. The actual impression of the physical placement of the harp was, if anything more firmly fixed in the quad presentation.

This, it seems to me, largely summarises the importance of quadraphonic sound for the serious music listener. Forgetting the sonic spectaculars, the thousand-voice choirs with organ, offstage thundersheets and live sheep in the balcony, the real potential of quadraphonic sound is in its ability to restore timbral nuances, intensify perspectives, and provide, at last, the element no other system has ever been able to more than suggest—the sense of the total environment, which finally includes both musician and listener. We acknowledge the importance of this every time we select a seat in a favourite concert hall, relying on that acoustically catalysing environment to help draw us into the shared experience of musical performance.

My original intention was not that of composing a paean to quadraphony but since its promise is so largely unfulfilled, and so few realise this, it seems worthwhile to suggest that the candle may be worth the game.

In an early interview published in these pages (Dec 1970, p530), I described an experimental quadraphonic array which, through the kindness of John Goldsmith of Unicorn Records, and his engineer, Bob Auger, I was permitted to try out during a recording session for Mahler's *Third Symphony*, conducted by the late Jascha Hornestein, with the London Symphony Orchestra. The array used attempted to reproduce a spherical segment of the Fairfield Hall, with both rear and height ambient information presented as closely as possible to their original relationships. Nicknamed *Bruck's*

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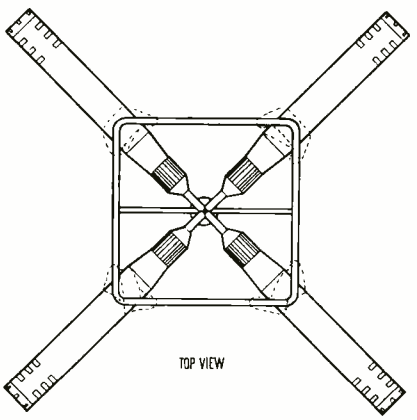
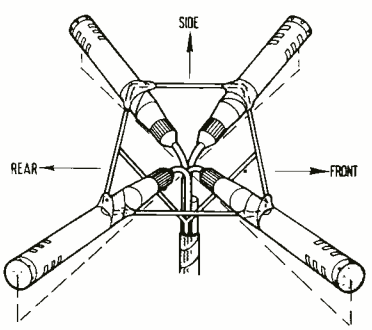
PRACTICAL ASPECTS OF PURIST TECHNIQUES

Sputnik, this and similar microphone arrangements then being experimented with in England acquired the more genteel sobriquet *Tetrahedral Ambiophony*, a term which made up in conceptual purity what it lacked in later popularity. The difficulty came not from the sound, which was startlingly lifelike, but from the rather peculiar loudspeaker placement necessary for idealised playback. I had hoped, personally, that Buckminster Fuller's Geodesic Dome would sweep the world's housing developments, for it alone seemed designed to house the Ideal System. Fortunately, I have been spared a lifetime of disappointment and frustration by the realisation that, since from the conventional seated position in a concert hall, the floor and audience prevent any useful sonic information from reaching the listener at any angle much below the horizontal, it is really only necessary to record and reproduce a rough hemisphere in order to represent the actual listening environment. The system I then devised to record this spherical section has some interesting features.

FIG.1 FOUR-MICROPHONE ARRAY





Four hypercardioid microphones are laid out at right angles to each other (see **fig. 1**) and then tipped upwards a short distance, and held by a simple mount. The angle between any pair is then about 85°. The Schoeps *CMC-441* microphone was selected for this application, as its extremely uniform polar pattern and smooth overall response make it ideal for such a rig. This arrangement results in four quite uniform stereo images encircling a common position, presumed to be that occupied by a listener. What may not be immediately apparent about this configuration is the additional pair of stereo images formed by the opposing microphones—ie, left front and right rear, and right front and left rear. These pairs are too widely angled to offer an even spread of stereo image individually, but the combined pairs can be seen to cross at their centres, reinforcing the centre image common to both. A phantom fifth channel is created, in effect, conveying height information.

In practice, the rig is tipped forward slightly, the front pair (any so designated) facing the musical ensemble, and somewhat above them. The bulk of the ambient information is conveyed by the remaining complementary stereo pairs, with the crossed pairs on top completing the sonic canopy.

No doubt those with better-lubricated slide rules than mine can find fault with some or all of the statements just made. I can only hope that while my downfall is being calculated, someone with an experimental bent and some basic equipment will try this idea for themselves. The harp recording mentioned earlier was made with this setup, as have several others since, with very satisfactory results. The speaker setup for playback uses the two front speakers in their usual placement, near the room corners and near the floor, while the rear speakers are elevated as much as practicable, with placement otherwise as in front.

One further, and I think final, permutation of this design is currently being tested. In order truly to isolate each microphone to its own quadrant, it is necessary to block as much as possible of the small rear lobe of each hypercardioid, which otherwise introduces a small amount of material from the opposite side. Circular baffles, made of foam sandwiched with a thin core of sheet lead, have been fitted into the array, blocking out mid and high-frequency direct sound from the rear microphones, and affording the front pickup a detail and dryness unusual even with directional microphones.

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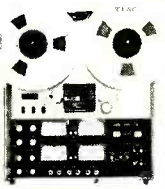

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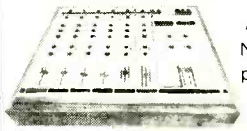

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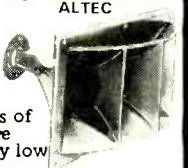

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PRACTICAL ASPECTS OF PURIST TECHNIQUES

Further refinements have taken place at the other end of the microphone cables. An exceptionally high quality input device with several special features was developed in conjunction with Mark Levinson (**fig. 2**). The microphone inputs provide dc power to the Schoeps microphones, and by utilising differential amplifiers, eliminate the usual input transformer. Adjustable feedback governs the gain of each of the four channels, optimising noise and distortion characteristics for any setting. A special low-frequency boost circuit effective only below 100 Hz allows the inherent low-frequency rolloff characteristic of gradient microphones to be precisely compensated, and similarly a high-frequency rise (3 dB at 22 kHz) flattens the top end. Switchable hipass filters (18 Hz and 35 Hz, 18 dB/octave) allows bothersome low-end problems to be dealt with, such as flutter caused by movements of air currents across the microphone diaphragms. This, in particular, had been serious problem in some earlier recordings, made with flat-to-dc input amplifiers. A four-channel fader with prefade position, peak read-and-hold metering switchable from front to ambience channels, with optional high-frequency boost to simulate NAB record characteristics, and comprehensive output and monitor switching facilities rounds off the unit. There is no provision for mixing channels.

The entire system has been designed to take the fullest possible advantage of the potential of simple microphone techniques in quadraphonic recording, rather than to overcome its difficulties. In one respect defenders of multichannel recording have a point, and that is the vulnerability of any simple microphone technique to the recording room. Precisely for the same reason that a stereo pair can work so well in a good location presenting what is there without blemish or enhancement, so in a poor location results can be predictably unacceptable. This is even more true of quad recording, for it is specifically the recording environment that is now being revealed to us by this technique. For those who might find the requisite of a suitable recording locale too great a challenge, this excerpt from a recent letter to *Hi-Fi News* may show where our priorities have gone astray: ' . . . multimiking may be the lesser of evils if the acoustic is thoroughly bad; but with, for example, an orchestral recording session costing thousands of pounds is it not false economy not to go to whatever lengths are necessary to secure a hall with a good acoustic?'**

Recording engineers are oftimes strange folk. Ensconced amid the twinkling leds and flicking meters of our Star-Trek consoles, we sometimes forget to listen. I recall a conversation with the Swiss engineer, Freddie Wettler, in which he dismissed simple microphone techniques as 'something I tried back in the Fifties'. In the intervening decades, many improvements and refinements have taken

**Prof P. B. Fellgett, Dept. of Engineering & Cybernetics, Univ. of Reading

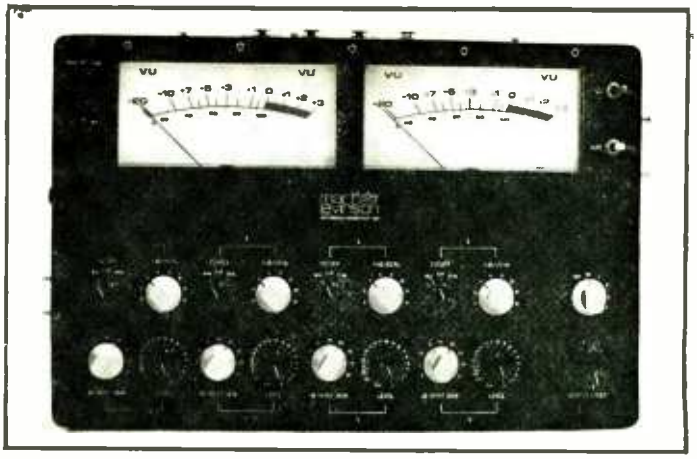

FIG. 2. Quad mixer for use with Bruck's Sputnik.

place in every link in the recording chain, from microphones to tape recorders. We might all consider, from time to time, going back and rechecking some of our more encrusted assumptions in the light of more advanced equipment or techniques. Above all, complexity for its own sake has been frowned upon since the days of William of Occam, and complexity for the sake of churning up additional income seems a little more than dishonest when a fine performance may suffer from an excess of technical expertise. Perhaps we need a gentle reminder that, at heart, we share an abiding respect for, and love of, music. For many of us its preservation is our greatest joy.

By now, the reader has had more than a taste of the formidable array of prejudices I have built up in some twenty years of music recording. Happily, English Common Law does not permit me to be hung for my views, which in any case may find some resonance in the engineering underground. So, while waiting for that sound of one hand clapping, I offer this modest proposal: On your next serious music session, when you find a spare couple of channels on that 16-tracker, or maybe its a solo flute and you only need twelve, take a moment to rig up a few mikes on a stand in some vaguely symmetrical arrangement, run the pots three-quarters up, and then forget about them until just before the editing session when you've got the tape all racked up and you're shuttling it back and forth waiting for the producer to show up. Open the channels and give a brief listen. Just in case . . .

OK, you haven't got the time for useless games. How about that kid who's always hanging around? The one who goes for the tea and biscuits during the breaks, and sits over there in the corner reading those old back numbers of recording mags you've always meant to get around to, but never . . . yeah, him. He always wants to play around like the Big Boys. Tell him he can have a go. You never know.

He just might be another Alan Blumlein.

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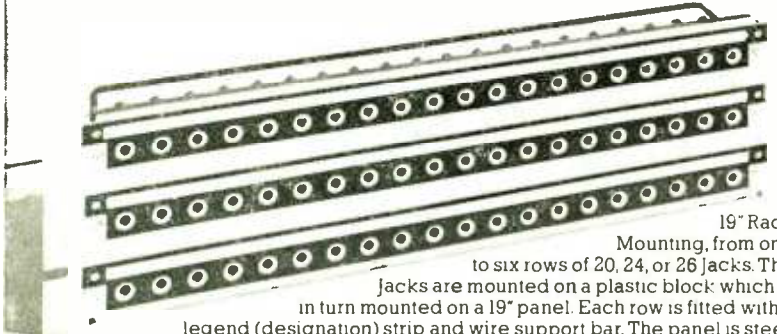

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'Oh.'

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Actually, the village of Golant is nearer 200 miles away: close to Fowey on the south coast of Cornwall and approached by convoluted B roads lined with weathered white cottages and cream teas. 'Just keep going until you can't go any farther.' The car headlights pick out some small fishing boats moored in the river. The man who gave the instructions meant exactly what he said. Damn. That must have been the pub, back on the left up the hill. Reverse up, park and go in.

'Evening.'

'Evening.'

'You be wanting the recording studios?'

'Well, er yes.'

'Ah, you better go through there and phone you know. It's a long walk along the railway line unless they bring the boat . . . Would you like a drink while you're waiting?'

The boat never did start and yes it was a long walk down the track that in the daytime is used to carry china clay wagons to the port of Fowey. Quarter of an hour later, after stumbling along in the rapidly fading light of engineer Jerry Boys' torch, the lights of the converted saw mills came into sight towards the rear of a little backwater off the main river. No other buildings around; just a fully equipped 16 track studio about ½ mile from anywhere with an overdub session going on late into the Saturday night . . .

Sawmills is a studio, basically much like any other bar the rural setting. The relatively spacious control room hits you with a 20 input Sound Techniques desk (much raved about by owner/producer/engineer/tea op Tony Cox, and Jerry Boys) *M79* 16 track, assorted Studers, racks of Dolbies, enormous custom Tannoys and the inevitable unwashed coffee cups and NAB spools fighting for a position on top of the console meter housing. Similarly, the studio area is equipped with all the hardware instantly recognised for track laying the world over. Even so, there's got to be something special to make people take the four hour car journey followed by boat trip (or walk if the tide's out etc) from London. Tony says the main driving force is the attractive rates. These work out at £1250 a week/£200 a day although nobody would think of going that far for a simple overdub. There exists the possibility for a pound of flesh. If a client worked round the clock, he could buy time for an equivalent of £8.50/hour—16 track. But to do that would be to miss the point of the studio.

It's country and relaxed. The self catering accommodation in the heated chalets is basic but comfortable. There's a friendly pub in the village and the studio rates aren't so high that clients can't afford to take the odd day off during a long term project to go polling about in the boat if that's what they like. Jerry gives an insight into the *raison d'être* for the studio and its location: 'Setting up's a bit different from the London studios. Here, because of the way the studio operates, people tend to come down for a couple of weeks and it's a very relaxed way of working. People aren't paying by the hour. If they start a day late, they start a day late and don't get charged for it . . . within reason, we don't care. One tends to set up when they're here having sat down and talked about it . . . In London, you set up to start at an exact time—after all, that's what the clients are paying for. I didn't like that way of working which was why I moved down here to get away from all that.' Tony: 'If someone books 12 hours in a London studio, they want 12 times 60 minutes. Here, long sessions at low rates mean that the pressure is off a bit.'

Three engineers handle the sessions: Tony, Jerry and Peter Martelli although the latter wasn't around at the time. They give the impression of adaptability in what they do, and how to make the best use of the facilities on offer. Tony Cox is almost as happy talking about main drainage or goathusbandry (unfortunately, he had to get rid of his two animals which he purchased to do a bit of site clearance because he was away too often to look after them properly) as he is about production and recording techniques. For instance, there are many stories of ingenuity in the design of echo chambers. Sawmills has a unique approach by virtue of its geographical location on one side of an uninhabited valley. They open the studio door to the outside and point a stack out across the valley. At the other end of the building, a mic is placed outside of the control room door. When the power is wound up, the pickup is said to sound rather like a loop echo but with more diffusion of sound. Try that one in Oxford Street.

Cox seems to have been right through the music business—he started as an artist with EMI in a 'Peter and Gordon type duo' (polite laughter from the back of the control room). As is often the case, he gravitated towards production and arrangement (Renaissance et al) and somewhere along the line picked up the inclination and know how to design and build his own studio. Operationally, the results are interesting. From a glance at the rough stone walls of the studio area, one imagines that the acoustics would be impossibly live; no one wants to record a string or brass section 100 per cent of the time. But there isn't even a drum booth. Things requiring heavy isolation are placed in a recess built into one side wall of the studio. Jerry Boys says he recently did a session laying down a rhythm section. It just happened that the pianist wanted to play the Bechstein opposite the drummer. No problems. Miked up with a

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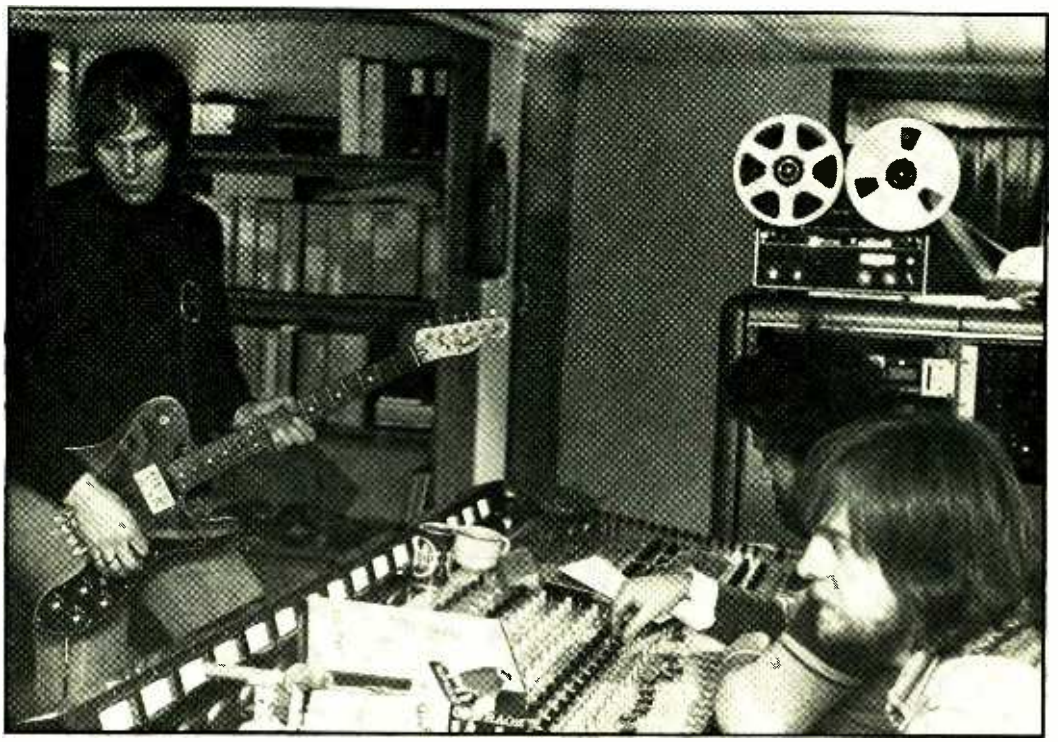
Obie Clayton—a late night overdub



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couple of Neumann *87*s inside and the lid just open; the only isolation required was a four foot screen and an old coat thrown over the top of the piano.

The answer lies in the ceiling. Although it's low for the application—from eight to 15 feet in the middle—Tony says it is absolutely dead, eliminating the vertical dimension in the acoustic sense. The ceiling has been constructed in three layers. The lowest consists of absorbing tiles enclosing a 'trap' some 20 centimetres deep filled with rockwool enclosed between the false and real ceiling. This method of construction has been used over the entire area and apparently works efficiently, even at the low bass end. The overall resulting sound feels bright but not echoey. 'Because the walls are old stone and very rough, the tops bounce off and rapidly diffuse as opposed to going backwards and forwards as with smooth walls. The sound comes back as a general "live" feeling to the studio.'

Jerry Boys, who came from Sound Techniques and, before that, EMI, has favourite mics for particular jobs although 'they change from month to month.' Generally, he likes moving coils on drums because condensers seem to suffer far more from capsule distortion resulting in intermod when used with loud noises. 'Not only that, moving coils are cheaper—you tend to destroy capsules when you're in front of Keith Moon... Also, dynamics give a nice, hard edge to drums but condensers are good for over the top.' The studio has the usual collection of Neumann *U47*, *87* and *88* mics. There is also a selection of AKG *C12A* valve condensers, *224*, *202*, and Beyer *D12* and *D190* plus 'a Sennheiser that we've acquired for a few days from a client—although we're going to give it back to him.' There are many diverse opinions as to the best way of miking a piano. Jerry uses one technique to mimic the sound of an electric piano from the studio Bechstein. Very simple really. He sticks a condenser inside brought up to one channel on the mixer. Yet another takes the output from a conventional piano pickup having been put through a waa-waa pedal. Both channels are routed to the same output group. Apparently, the arrangement sounds rather like a Fender.

Back in the control room, the organisation of the Sound Techniques desk is still rather unusual but becoming popularised. The outputs from the individual mic channels are brought directly out onto the console mounted patch panel which also carries the tape machine line in/out connections. On multitrack, the usual set up is to patch directly from channel out to line in without going through an output group. This situation eliminates at least a couple of line amps thus minimising the total number of electronic blocks in the signal path. However, the 20 input desk still provides conventional facilities. There are four output groups which comprise little more than a simple fader. Routing to these is by the usual pushbuttons. Requiring only four of these per channel, it makes the desk look very basic, especially when seen with hardly more than four single faders representing the outputs. The simplicity belies the usefulness. There are two echo sends and two monitor lines per channel matching two echo returns on each output group.

Although the channel eq is uncomplicated, it fulfils most requirements. Where it can't, the desk mounted patch offers rapid connection with any of four Audio and Design parametric equalisers which offer rather more scope than the best channel eq modules. Other sound bending devices include the ubiquitous high speed Revox used for adt, *BX20* spring line, a couple of A and D stereo limiters with built-in noise gates, a Fairchild 660 and a nameless object 'that we don't know what it's called which we never use because it goes bump in the night . . . Oh yes, er, and several pairs of wellington boots—Biba purple and gold . . .'

A session with a brass band was observed or, at any rate, some of it until this part of STUDIO SOUND was duly thrown out of the control room when things got rather hectic. Mostly, it was smooth considering the odds. Between 25 and 28 amateur musicians ('What's a couple of euphonium players between friends?') who had never seen a recording studio in their life. Only problems were flying elbows and a rather dead sound resulting from the absorptive properties of human flesh. The first was corrected by re-arrangement of the seating, the second by feeding some reverb from the spring line into the monitor circuit.

But the sight of the tuba player and friends, laden with instruments, strung out over half a mile of river bank in the pouring rain . . .

Like the man said, don't do a session at low water or when the boat won't start . . .

Frank Ogden

Left: *Jerry Boys setting up for a 26-piece (approx) brass band.* **Below:** *Sawmills Studio—the valley is occasionally used as an alfresco echo chamber.*

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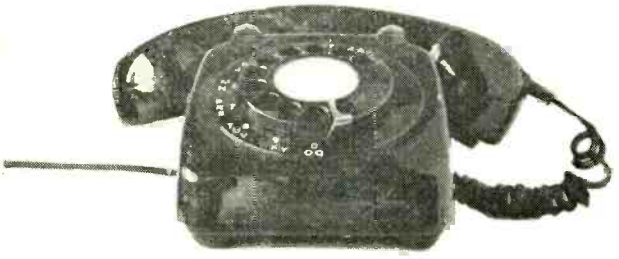

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Pop orchestra: a case study

ADRIAN KERRIDGE *

Making proper generalisation about microphone placement is clearly impossible, since it remains the most personal area of recording technique. This discussion, based loosely around a large pop orchestra studio session, indicates areas of doubt as well as the relatively few clear principles. Any session, even one as closely organised as this, is always crucially dependent on the music involved.

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WHEN discussing microphone techniques, one can normally only generalise, for it is perhaps the most personalised area of the whole of the state of the recording art that we're involved with today. So there are several precautions that should be taken in writing an article about such techniques. During this article I will make reference to families of instruments, sections of the orchestra, while not necessarily tying down any specific microphone type, other than dynamic or a capacitor. In sound engineering most engineers have their pet type of microphones for their particular type of recording work. We must also bear in mind that I will be discussing what is normally labelled the 'pop' approach to recording, rather than the classical approach, which takes place under fairly dry acoustic conditions such as a studio having a reverberation time of around 0.3s at 500 Hz and reasonably flat in reverberation time over the range 20 Hz to 20kHz.

When dealing with musical instruments (and it is proposed to deal with a fair sized orchestra) we should really consider the instruments section by section but treat them overall as a whole. Obviously, they are related by section and by ensemble to the musical score. Although you can discuss certain microphone techniques for specified instruments, you must remember that any applied technique always relates to the type of music and the particular type of sound that you are aiming at. So while we can give examples of how to mic up specific (what I would call 'top') sections of the orchestra, that is any section of the orchestra that is going on top of the rhythm section, variations on this theme will naturally occur. Over a number of years specific techniques for dealing with the rhythm section have evolved and there are reasonable generalisations of how to record a rhythm section 'correctly' and 'properly'. Engineers never usually mention these value judgements because they are normally working in conjunction with a producer, who may not have a clear knowledge himself of what he wants. It has always been my belief (and I think of many other engineers) that having recorded a good rhythm section sound, got a good gutsy, punchy sound in context with the given type of music, you can usually sit any other family of instruments on top and make the thing happen. During my experience I found this to be so, whether dealing with large pop orchestral work, with strings and brass, or just coming down to the middle of the road pop record—or, indeed, the heavy rock record with strings, brass, woodwind, Moogs and all the other electronics that go on top. Usually, it does work.

It may look as if many outs have been taken during the course of this introduction, in avoidance of definitions, but as the experienced engineer knows it is extremely personalised. Being asked to describe a microphone technique is really rather like a painter being asked how he painted a particular picture and the reasons why. It's very much the same thing to ask an engineer, who indeed is acting as an artist in this sense. He is not painting pictures but painting sound pictures. How does he begin to paint them and where does he begin? The question 'why?' without qualification is impossible to answer by painter or engineer. So I reiterate that what ensues should be a fairly generalised although often specific example of how to treat a fairly large orchestra. Later on we will deal with vocal overs, for completeness' sake—but this is, as you can appreciate, a whole subject in itself.

It is absolutely essential, when dealing with either studio setup or studio recording acoustics, that the precise nature of the music be known, and the purpose for which it is being recorded. I've always found it obligatory practice to discuss with arranger and producer the type of sound that we're going for on the date. Do the desk work first; it makes life a lot easier on the actual session.

We must also consider, alongside, the question of separation, which some engineers ignore or don't sympathetically understand: some use too much, and some get it right. This right degree of separation for the particular type of music is very important to the overall feel of the final result. Even in a dead studio, good use of non-separation can be made to suggest a feeling of depth, width and perspective. Very often, it can be overdone—then the instruments of the orchestra sound like they've been completely separated out, even as if they've been overdubbed, to a clinical degree, so that when the whole thing is mixed, it doesn't come together as a whole. When people say 'Well it's a great sound, but it doesn't *feel* right', usually it's because of bad technique in any of miking, use of studio acoustics, separation or writing. It can also be said that the final sounds on any recording only come together with the extremely careful placement of the microphones. Even the movements within a section of one microphone by a few centimetres, left, right, up, down, back or forward to the instrument, can make a complete overall difference to the sound of that section. A very good specific example is that of a large trumpet section, given later.

This article takes the layout of an idealised medium-to-large pop orchestral setup. We also have an accompanying string section recorded simultaneously. For points of discussion, it will be easier to refer to **fig. 1** which shows a typical medium sized layout in a large studio. Apart from all balance engineering thoughts, the prime need is that the musicians can see each other, have good communication and, above all, the md can see the whole of the orchestra and vice versa. There's nothing worse when an engineer does not consider the comfort of musician or md. The line up in fig. 1 includes: drums, percussion (for this example I've put in vibes, the toys—the Latin-American family of instruments, conga drums or tumbas, wood block, tubaphone, marimba and timpani); electric bass; electric guitar; acoustic guitar; piano doubling electric piano doubling clavinet.

Woodwind is four players doubling, cost being a very important consideration in commercial recording. The woodwinds would be flute 1, flute 2, probably doubling clarinets and saxophones, flute 3, and flute 4. They might also double oboe, cor anglais etc. The brass section consists of four trumpets, four trombones, four horns. Strings are 12 violins, four violas, four celli and harp. Incidentally, for sheer weight my personal preference here would be for 16 violins, six violas, four celli and arco basses. The accompanying score, **fig. 2**, shows two flutes, 1 and 2, four horns, bass

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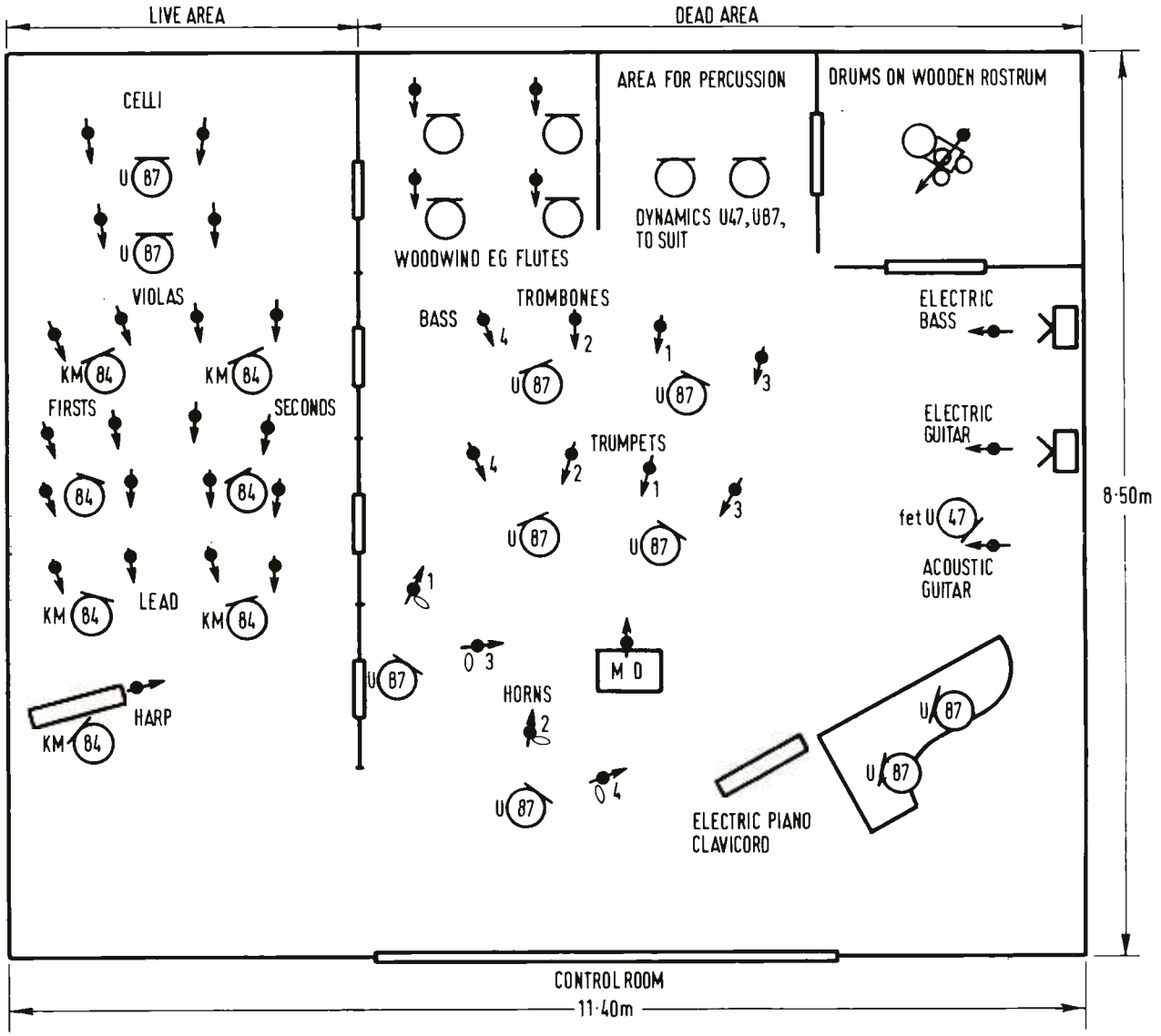
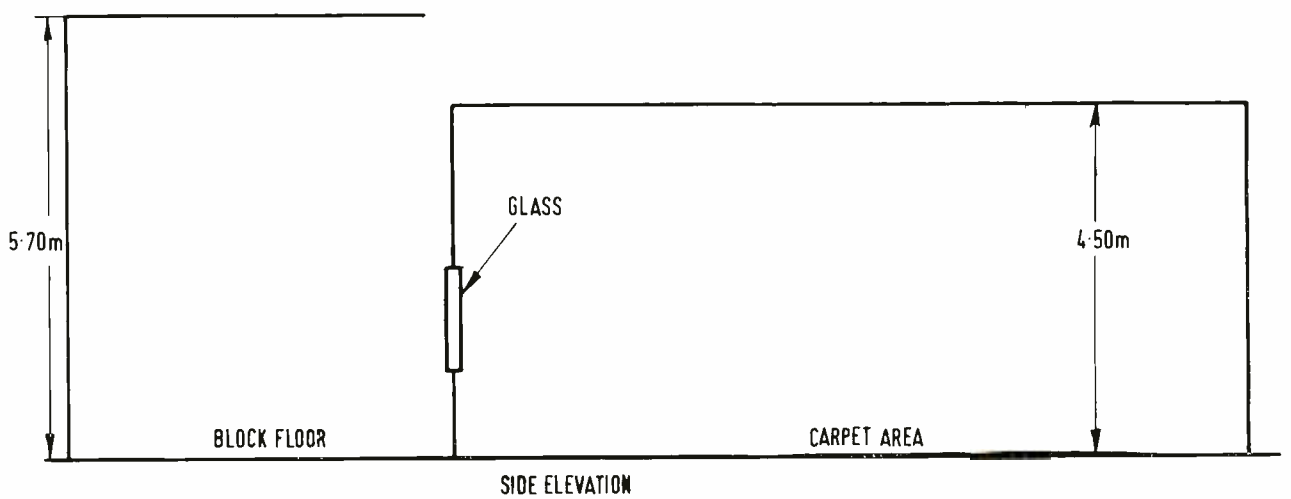
FIG.1 STUDIO LAYOUT (MORGAN BRUSSELLS)





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POP ORCHESTRA: A CASE STUDY

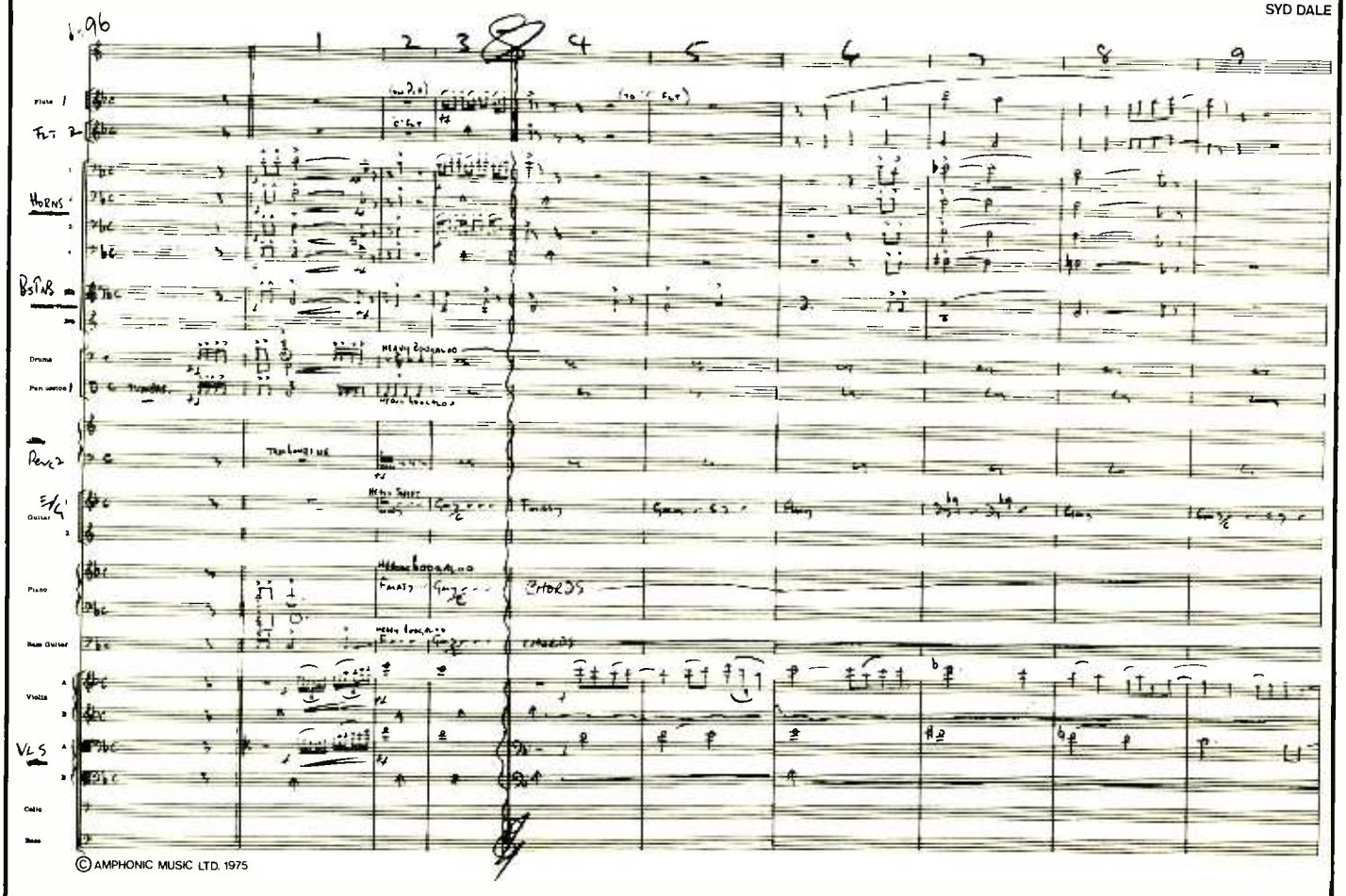
trombone, drums, percussion, electric guitar and the string section, and is shown purely as an example of the writing; although the orchestra is not the same, it is useful for examples later. The orchestra in fig. 1 represents a version of the session about which we talk. The type of writing typical here is heavy boogaloo rhythm section, really punchy brass on top, with string backing punctuated by flutes. Flutes are written either with the brass section or as an independent section between the strings and brass; the woodwind work with brass in bars 3 and 4 in fig. 2, with the horns—note the voicing. In this particular example we're using only two woodwind and not the four, as of course it very often happens in writing that we do not utilise all the instruments all the time, otherwise we'd live in a very boring world.

In fig. 1 we have a fairly good situation: the md can see everybody, they can see the end of the stick. From the engineering aspect, it's comfortably laid out to give good separation—instruments that give the least amount of output, woodwind and string sections, are both well away from the brass and well separated, the strings particularly by the division of the screens. As indicated, in this studio these screens have small windows in them set at an angle, usually downwards to reduce audible reflections. Woodwind are close against the wall and are screened either side. The screen between the percussion and the woodwind is fairly heavy and reaches from floor to almost ceiling height. The drummer is enclosed by two screens, with a gap between, and once again he has small glass panels to be able to see what's going on.

Bass, electric guitar, acoustic guitar and keyboard sections are fairly well spread out and this can present a problem in an orchestra of this size with regard to feeling and interaction, but at least the piano player can see the acoustic guitar, the electric guitar, the bass player and the drummer; they can see him and the three electric instruments are sitting next to each other, divided by two screens approx 1.5m high. It's quite normal in this type of setup to give percussion, drums, bass, in fact all the rhythm section headphones with foldback, various mixes for the individual players or the total orchestra. Also, the md will be in direct communication with the box via cans. In many studios he will be able to speak directly to the individual player foldbacks, which makes for an ideal situation where he can talk in confidence to any player over some delicate point without public embarrassment. He might also have pa talk to the studio, as well as talk to the control room, thus avoiding having to shout over the whole of the orchestra.

For smooth session running it is important that all these factors, and others relating to space and the comfort of the players, are

FIG. 2 POP OVERTURE to bar 9



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right, particularly when they have to sit on a studio floor for three hours, krutzing away. Everybody must be absolutely happy and comfortable and this way we get good results. It can be argued, of course, that this is an unusually large session and with modern multitrack recording techniques we would not record all the strings and all the brass together; fair enough. We would usually, in fact, record just the rhythm section, overlaying brass, woodwind and strings individually. But it must also be remembered, and this is my experience time and time again, that results are so much better when the whole orchestra plays together. In **fig. 3** the drummer might for example, have in bar 9, first beat, a written bass drum beat, a bass drum which gives the brass a kick to get them going. If the brass are not there, the drummer has nothing to latch on to—no feel. Similarly, brass players love to get a large rhythm section behind them to get them working.

The next problem that arises, of course, is the enormous number of channels that we're going to use to record the orchestra. Maybe the console is limited in its number of input channels; compromise can be difficult but technically not insurmountable. Then we hit the headaches of the actual mic techniques, to achieve the separation: to get the close sounds, to use the room acoustics to their best ability and to use distance between player and the microphone in conjunction with whatever limited room acoustic is available. The string area here is wood block floor relatively liver than the adjacent carpeted area. The ceiling height also differs between the two. I would expect a reverberation time in the carpeted area to be about 0.3s at 500 Hz, with the bright area to be getting into 0.8 or 0.9s.

Now, after the necessary preliminaries, we turn to the mic technique itself, section by section. The orchestra divides naturally into the following: 1) rhythm, 2) brass, 3) woodwind, 4) strings, including harp.

Rhythm

Most studios have their own preference for their rhythm setup: with the rest of the orchestra set around this. Hard and fast rules, sometimes, however, don't apply, from my experience working in many European studios. Modern studio acoustic thinking tends to be towards fixed areas for the rhythm section anyway. The basis of the whole of the recording is the rhythm section, and with the drums it seems appropriate to give specific favourite mics. These imply personal preference, no more—other engineers use different types with good results. As we said, it is not possible to generalise. My own particular preference for this type of drum recording, remembering that we're given a rock rhythm section, would be as follows. Bass drum: dynamic, eg AKG *D12*. Snare drum: two microphones, one on top and one on the underside. At this stage it must be mentioned that we would always use equalisation carefully to achieve appropriate results for the type of music that we are recording. The top side of the snare has a Sennheiser *MD441U*, with Neumann *KM 84* on the underside. The *KM 84* capacitor mic is used very close to the underside of the drum, so the 10 dB head cut should be employed. Hi hat: *KM 84*. Small tomtom: AKG *D202*. Floor tomtom: AKG *D202*. On the overall kit: Neumann *fet U47*s.

To discuss in detail the exact positioning of these microphones is somewhat difficult, as it very much depends on the player and the type of kit employed. We can, however, lay a few basics. Most pop musicians in studios now employ the bass drum with the head removed, and therefore preference would be for the mic to be close to the outer head rim of the drum, on the perimeter. The closer you get to the centre the more you get of the actual impact; the farther you come out from the drum, the more you get the 'overtone', and more of the harmonic structure of the note rather than the basic fundamental. I can only stress once again that final mic placement can only be made by listening and by knowing drummer and kit.

The snare microphone is normally placed on the edge of the drum itself, pointing in towards the skin. This is more for convenience than anything else because if it's too obtrusive, it gets in the way for riding on to cymbals and on to tomtoms, particularly the small tomtom. No problem at all with the underside mic, placed right underneath the drum, slightly outside of the snares themselves. The question arises once again: what sort of sound are we going to get? And again, this is where the ears come in. When mixing a snare sound equalisation is all important. You must be careful and have the right sort of feel when putting the two sounds together. Without actually playing an example of a tape and the different sounds that can be obtained by this technique, it's necessary to leave it to the intelligent imagination of engineers reading the article, who I'm sure are familiar with this principle. The tracking and eventual mixing of the orchestra, insofar as it affects mic placement, will be referred to later.

Hi hat presents no problem, with normally a capacitor microphone, or indeed a dynamic if one is available, placed over the hi hat towards the perimeter. Small tomtom microphone is placed downwards and towards the edge of the drum, again to get the harmonic structure of the note. The same applies to the floor tomtom. Overall kit sound comes from the two microphones, two *fet U47* on top of the kit. These must be used with the greatest discretion; once again the artistry of the engineer comes in and it is difficult to define just how much of the overall sound one would use without listening to the drums with the rest of the orchestra. So many producers and engineers fall into the trap of listening to individual instruments, equalising them, then throwing the total sound together later. Often, it doesn't sound right. Final equalisation, final mixing, whether it be monitor mix or final reductions, must be anticipated by listening to the overall orchestra —even a millimetre movement on the fader, two or three dB difference in hi hat equalisation, or minimal variation of the overall kit sound contribution makes an enormous difference to the overall sound obtained. Finally should be mentioned the double kits and the variations. Obviously, use extra microphones as necessary or perhaps just one between two tomtoms together if dealing with two small and two large tomtoms. Ideally it would be better to mic them separately, but this of course depends on the number of channels available. With one mic on two tomtoms it is better to mic above and directly in between the two, adjusting to the sound that one hears.

For me, there are three methods of 'miking' on the bass guitar. One is direct from the pickup of the instrument—not always successful because it depends on the player. The second is conventional microphone pickup from the speaker output and the third from the direct output of the loudspeaker coil. I have known many engineers to use a combination of all three and this sometimes works. However, my own personal preference has been to take a direct output from the speaker itself and inject this directly into the desk—of course with eq and the other etceteras that go with it. This can usually result in a hard, dry, tight, forward sound. When using combinations of mic, direct pickup and direct from the speaker, very careful balancing and equalisation of the three channels is needed. In many cases, it results in over miking and the simpler method of one of the three usually works better. For best results you have to know the player, the amplifier and the instrument concerned. My particular instrument preference in recording comes down to Fender Jazz or Precision and/or the Rickenbacker. This, once again, depends very much on the type of music. All three, though, get a good, bass sound with individual variations for that type of material which requires it. The question that arises then is: what type of material requires a Rickenbacker sound? This is a difficult one to answer because once again it is by judgement of the player, producer and engineer whether this type of sound produced on the session is appropriate. I should also mention phasing; if using direct from pickup, microphone and direct from output it is extremely important to be sure that all signals are in phase. Most consoles can cope with phase reversal should one feed be out of phase with another.

It's always best to put the bass player together with the whole session rhythm section, as tightly and as closely together as possible, consistent with requirements of separation. Even though they might be wearing headphones and can hear each other, they must have this intimate communication and the feeling of tightness within the section, which can only be achieved by close-knit work. Many engineers, because of separation problems and for other fads best known to themselves, tend to separate these players into little boxes; in my experience, it's always been a musical disaster when this happens. The players feel the same way.

Separation between bass and drum depends on music and bass volume. It is usual to get 20 dB of separation, even when they're close, between bass and drums, and with careful use of high pass filtering there is usually no problem in separating bass and drums or any of the other rhythm instruments. In fact, drums to bass is

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generally better than 30 dB with miking and bass to drum better than 25 dB. Normally this is achieved without any problems at all. On recording the bass, I prefer compression, to smooth out the unevenness of the instrument or the playing of the notes, usually employing a ratio between 4:1 and 8:1 and a compression factor of not more than 6 to 8 dB on the overall spectrum of the instrument, thus working towards a hard, tight, forward sound. I do not believe in limiting or compressing any of the other instruments as I record, preferring rather to get them down as they are with their dynamics—unless production reasons dictate otherwise.

Electric guitar is usually not much of a problem. A good dynamic or condenser mic will suffice, placed against the amplifier. Most of the effects are being created by the player himself, with others done later on by mixing. Acoustic guitar can present a bit of a problem in this layout, from a separation point of view. If the brass were playing loud, a lot would get into the acoustic mic together with a lot of electric guitar, due to their closeness. However, with something like an *fet U47* type, placed closely on the instrument, separation can be achieved. In the light of this setup I'd suggest just one mic and not two as many people do use. When two are used, one is on the sound or f hole and one on the wood of the instrument itself, for recording guitar in stereo.

With this sort of line up, the acoustic guitar probably isn't too prominent, just chunking away, so we use a single-mic approach. If the acoustic guitar were used here as a front instrument then the recording objective would change, suggesting stereo treatment. If we were overdubbing then approach would be entirely different once again. With acoustic guitar in particular, the acoustics in the studio and the microphone distance from the instrument would be governed very much by the type of sound and the type of equalisation employed. It is very difficult to be more specific than that, as the reader will appreciate. In this particular instance with a Jumbo guitar, the miking would be on the sound hole of the instrument itself, and placed sympathetically to achieve the required sound.

In this particular setup, it is quite likely that the piano will be recorded in stereo, not perhaps on every number. I would use two capacitor microphones of the *fet U87* type. One would be placed fairly high up on the strings, the other placed where the strings cross. I suppose I should really define the piano as a Steinway or a grand piano of similar nature. It is once again, and it seems like another getout, very difficult to define the exact position of the miking on the instrument itself. One can generalise, as previously, but in practice the movement of both microphones even by a few centimetres can make an enormous difference to the sound.

Pianos in heavy rhythm section setups have always tended to be difficult to record with the amount of bass that will enter the mics, coming from bass and bass drum. In many studios this leakage can run down the walls, and if the piano is close to the walls into the piano. Hence, in modern acoustical techniques, piano traps are employed to prevent this and to give good separation. One can to a certain extent alleviate such bass problems by careful use of highpass filters, but this defeats recording a clean piano with its full frequency spectrum (if production demands this approach). The piano can be classed as a percussion instrument and has an enormous range. If we're going to use it to its fullest extent in any orchestra, whether it's pop, classical or middle of the road, it is my feeling that we must record the widest range possible consistent with separation. We'd use the right amount of equalisation to get the right amount of poke out of the sound.

Although not shown, jangle or tack piano must be mentioned, the upright piano with the tubby sound, the piano that either has the drawing pins in the heads or that has the tabs and foot pedal arrangement to give us the jangly sound. There's no mystery about recording it, being simply a question of poking an ear in the back, listening to the type of pattern that's being played and placing a microphone on it.

Electric piano is very much easier to record than its acoustic forbears. My studio preference is for the Fender *Stereo 88*, either using two microphones for stereo effect and spreading it across two tracks, or direct injecting still in stereo via two transformers into the desk. Direct injection does alleviate any possible separation problem and gets a very tight, forward piano sound. This is probably many other engineers' favourite way of recording it as well.

Clavinet is, again, direct injected, giving a very forward, tight sound. There is plenty of control with the eq and no worries over separation. Although not shown, I would mention in passing the organ. It may be *C3* or whatever, but the Leslie is of course the key to the whole sound. Preference here is for a double miking technique on the Leslie, one mic on the top and one mic on the bottom of the instrument close to the cabinet. It's better miked at the back of the cabinet, where one can get directly into the cabinet itself. On remix or indeed on sessions, other instruments pass through it, such as a guitar, electric piano, clavinet. Useful sounds; and of course the Leslie is miked in exactly the same way.

Percussion

Percussion is a difficult section in many ways to cover because of the vast number of instruments that the engineer has to handle. It's really a subject in itself to cover in depth. But I would like to give one or two examples. Congas have three ways of miking. possibly four ways if we look at it in stereo format. Two mics go on top, one over each of the drums at about 0.5m distance, or at least a sufficient distance to give the player room to raise his hands on top of the instrument. This gives us a stereo picture. The second possibility is to mic from underneath and inside with dynamic microphones; I have tackled it with dynamic microphones and had excellent results. A third method would be to use one microphone over the instrument itself, of course using equalisation together with careful listening. Lastly, one bi-directional capacitor may be placed edge-wise on, between the drums. Separation this way is excellent (**fig. 4**). Bongos could be treated in the same way although very much more difficult and restricting for the player. My own preference is to mic the bongos either with two mics (if the music calls for it) from the top side pointing directly on to the skins, or with one microphone in between the two drums themselves.

Tambourine is an interesting instrument to mention here, not only for the type of sound that can be achieved by equalisation but also by the differences of sound the player can get either using a tambourine with the skin removed or with skin on. Once again you have to listen to the sound and determine the exact placement. One of those instruments treated lightly by many—but its rise time is extremely fast.

Timpani are the frightener for many engineers. They are not really that difficult to record, though. Depending on how many timps are being used, I would use one mic between two, or two mics between four, spaced at 1m above the instrument. Usually a capacitor microphone is used, adjusted in height and position according to type of sound required. They're very versatile instruments. A particular incident was on a film where we had to recreate the sound of very high flying turbo-prop aircraft with associated low rumble; this was achieved by using the large orchestral bass drum beaten very softly; mic at 3 cm and equalised. That example also gives some indication of the tremendous sensitivity demanded: the placement of microphones on an instrument to achieve a given sound is often only arrived at after much trial and error.

Brass

There are 12 brass instruments in this setup, a large complement. Preference for miking would be to divide as follows, bearing in mind the type of music and the acoustics of the studio. The four trumpets would be handled with two mics, one between each pair. Trombones would also be miked one between each pair. Ideally the horns, if there are enough channels available, should be miked individually, but in practice you might use one mic in between each pair of players. It sounds easy, but in practice is not quite so. It is of paramount importance that the mics on all these instruments (and I've no actual need to say this to the hardened professionals among us) have to be placed absolutely correctly to achieve the correct *section* balance. In bars 9 to 14 on the example shown in **fig. 3**, you will see how the sections are working together, the relationship between the woodwind, trumpets, trombones and horns. Musical readers will see how important it is that the balance be absolutely right. The critics among us, and I include myself in this, will say 'well yes it's very easy to describe mic positions but what happens with distance, what about overload at

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close proximity to the brass?' The answer is very simple. Preference on this particular setup, and indeed in general, would be to use the *fet U87*, with 10 dB head cuts. It is again difficult to say at what distance to work from the instrument; it's a question of logical thinking combined with a good feeling for what you're recording. But one could put an average distance between, for example, trombones of 1m or 1.5m from the instruments. Room acoustics play an important part here. The same with trumpets, but then of course we have further problems with open and closed brass—my own particular preference is to ensure that when the instruments are opened and closed I ask the players to cooperate by moving in and out accordingly. The section is probably divided into two and two; if the exact spacing between the players and the mics is not spot on, so that the perceived strength of one player is greater than that of the other, then the result in the box can be disastrous. In fig. 1 the trumpets are set 1 and 3 and 2 and 4, their normal positions in the orchestra. Frequently the leads change, though, depending on the musical requirements. Now, some engineers would prefer to get it as in **fig. 5** which obviously make life very much easier. With these two microphones brought up on two channels there is quite a lot of leeway for error, but it's quite important to listen very carefully to get a good four-part harmony, especially should they be playing *divisi*. Other complications can arise, since trumpets in the section can be further divided into flugelhorns and trumpets. This may vary to the extent that the trumpets may for musical reasons have mutes in. Then, it's a question yet again of listening and adjusting the balance to ear.

Out of all the brass family, the horns, because of the awkwardness of the instrument, are the most difficult to mic.

FIG. 4 CONGAS

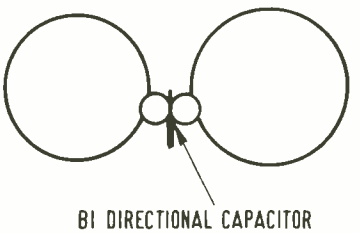

FIG. 3 LONDON LIFE bars 8-15

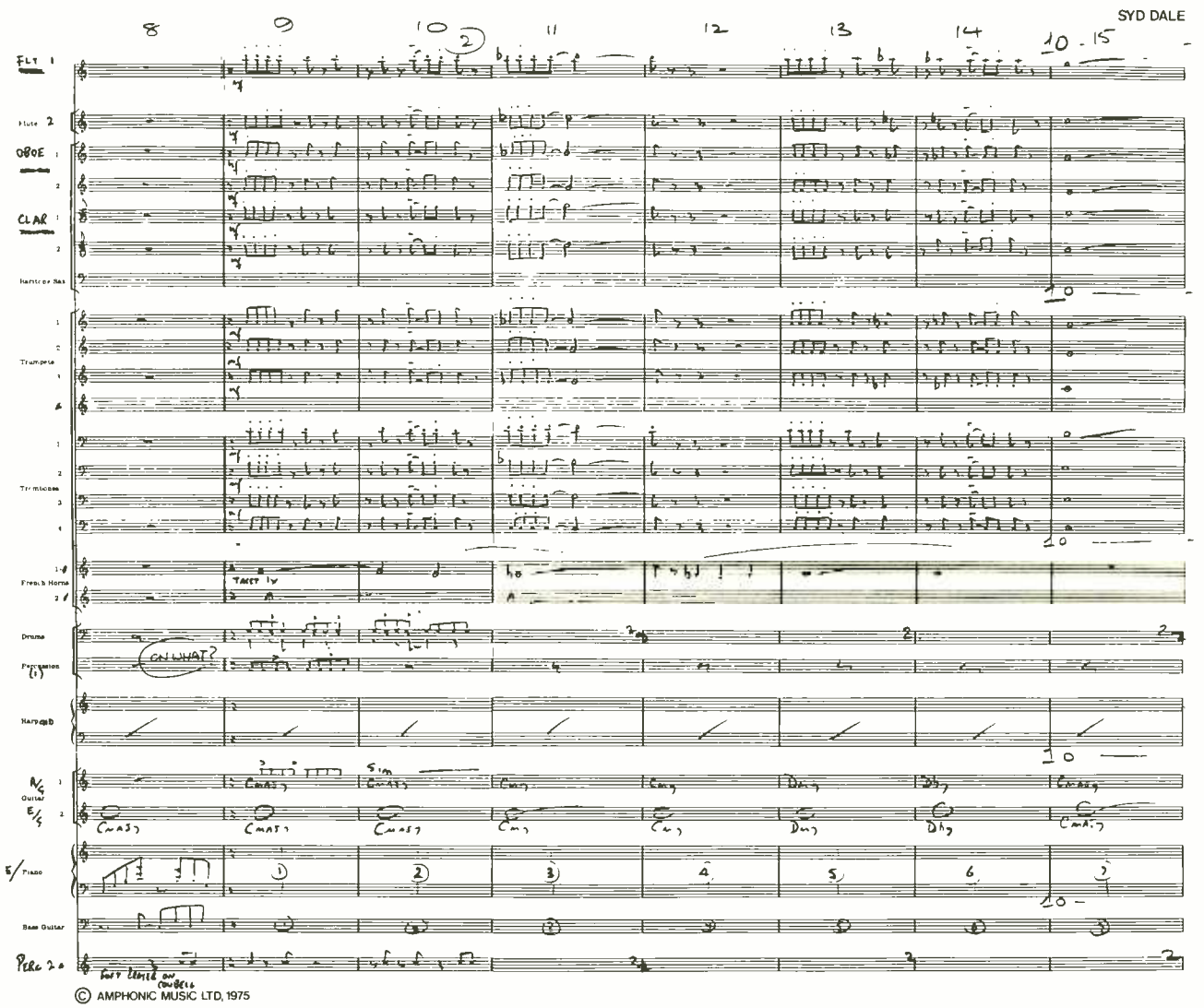

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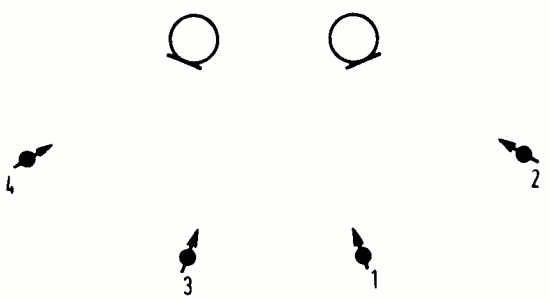
FIG.5 TRUMPET SECTION-2



Current thinking is to mic the instruments directly from the back, but a few years ago (and for some engineers today) preference was to use a reflective screen behind the instruments and to mic the sound on its reflection. I don't disagree with the old ideas, but don't think it makes a particularly good sound for a modern type of recording. My own preference is to mic the instrument directly on the bell, once again 0.5m to 1.5m, depending on the acoustics and playing. There is one snag here, however. Horn players spend many years losing all the watery, raspy sounds that you hear when you put your ear very close to the instrument. With careful placing of the mic this can be avoided and we can get an extremely good tight, close horn sound without a raspiness which I've heard on too many recordings. In the example that's shown in fig. 3, since horns are playing long notes, this is not a problem.

Separation between trumpets, trombones and the horns in the example given is not a problem, because of the proximity of the instrument mic itself. One question that immediately arises is that of separation between the brass section and the acoustic guitar. You may run into problems if a reasonably omnidirectional mic such as the *KM 84* type is employed, but if a mic is used such as the one we discussed, the *fet U47*, *fet U87* or a similar cardioid type, then really with close miking, this should not be a problem.

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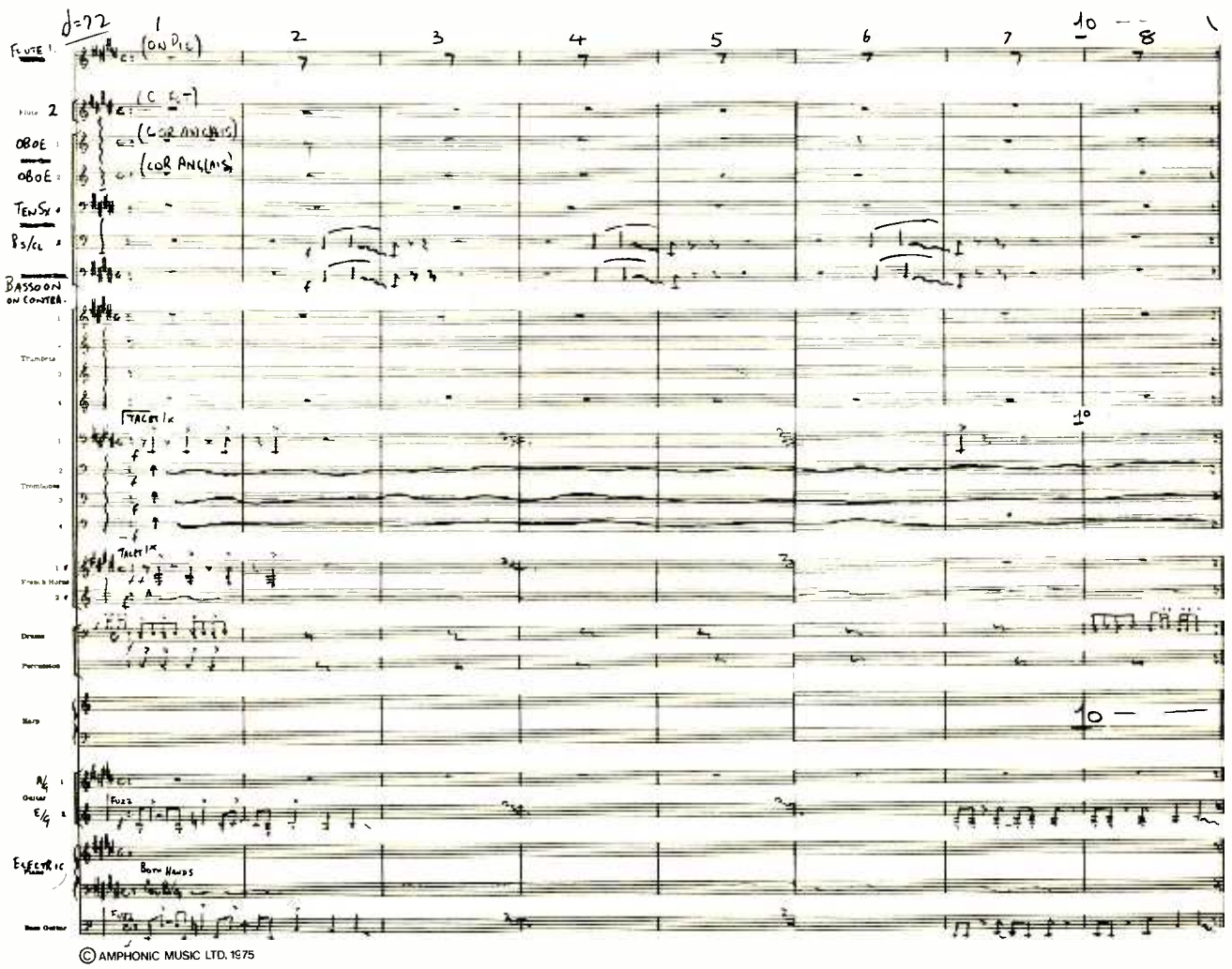
FIG. 6 JUGGERNAUT to bar 8

SYD DALE



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Woodwind

It will be seen in the example given in **fig. 6** that woodwind are with the brass section. My own miking preference for woodwind in this case of two C flutes is to place the microphone fairly close to the lip plate but away from the direct breath of the player. Distance would be approximately 10 cm from the lip plate itself and slightly to the right as one looks at the player. Many of the purists will say oooh far too close to mic for a 'natural' sound. I agree. But for the given example, this would be the right thing to do, for it would give us good separation, a very tight sound once again. If we now talk about more orchestral sound where a more fluent, transparent sound is expected, then of course, mic technique and approach would be completely different. The microphone might be placed 2m from the player, possibly at a 45° angle and back from him. On overdubbing this would not be amiss.

Thus, when you talk about miking the woodwind family, it is even more essential to have a very intimate knowledge of where the sound comes from and type of music providing the context. Another good example here is of the bass flute, an instrument which I personally love and I feel is not used enough. Beautiful when well recorded, but gives small output indeed. So the best results for me have always been by miking very close on the lip plate, again slightly to the right of the player. As with the C flute, we do not get the breath of the player but emphasise the beautiful, sonorous timbre that the instrument possesses. The alto flute is a similar example, although its relatively low output is not as low as the bass. Piccolo speaks for itself.

The oboe is a very resonant instrument and gives a good output. I would normally mic it at about 0.5m in front, with the mic face looking down on the instrument itself, ie the cardioid side of the mic looking down. It's necessary to avoid the break in the instrument and tend to mic towards the top end because any difference in output will tend to be at the break itself which is always difficult for the player to smooth over. Cor anglais is an extension of the oboe, miked in a similar position as shown in **fig. 7.** Certainly my own recommendation for miking this is not closer than maybe 0.75m, although it's hard to tie down precisely.

Clarinets yield to similar miking technique to cor anglais and oboe, once again depending on type of music, type of material, type of sound. For pop close work maybe 0.75m is about right; for larger orchestral work, it's a question of taking the mic away and listening within the orchestral context. Bass clarinet is another favourite instrument. This can be tackled with two mics, if it's in the pop context, because the instrument gives out part of its range up the instrument and the remainder from the bell. One microphone about 0.5m from the instrument, spaced equally between the bell and the main body, will also suffice. The contrabass clarinet produces, when used in the lower register, sound from the bell; very closely miked and well equalised it can make some fantastic sounds that are completely unrecognisable as the instrument yet add tremendously to the overall sound of the mix.

The bassoon should, in the pop context, be miked fairly closely. From the engineering point of view it is as usual a question of sticking your ear around it. Although it sounds crude and simple, it is also very effective in determining exactly the position of the sound and hence to place the microphones to that sound. It has been my experience that, when used in pop writing, arrangers tend to stick to one register. Such sound will come out at a particular point of the instrument so put the mic in close proximity to the area of the instrument that is giving the best sound. Once again a very hard one to define, a question of using your head.

The contrabassoon sounds an octave below the bassoon. It is a difficult member of the woodwind family to attack, because it much depends on the writing; it is also very large. A specific example is shown in fig. 6 bars 2-3, 4-5 and 6-7, where it is treated as an interesting sound on its own. It would therefore be very tightly miked on the bell of the instrument. It is also interesting to note that it is in unison with the bass clarinet, sounding an octave below, but the relation of the two sounds would depend on musical intention.

Saxophones cover the whole range: soprano, tenor, alto, baritone and bass. Most commonly used are soprano, tenor, alto and baritone; bass saxophone is used occasionally but a typical section in a band, a large band, would be two altos, two tenors and a baritone. Once again it's very difficult to tie down actual mic distance but it would be pretty close and in the region of 0.5m to 1m from the instruments. Normally, you would head for in between the bell and the body of the instrument. The sound, as we're all aware, comes out from mostly down the whole length, except with a soprano saxophone where we get the sound largely from the body. However, I have had instances of recording

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FIG.7 COR ANGLAIS

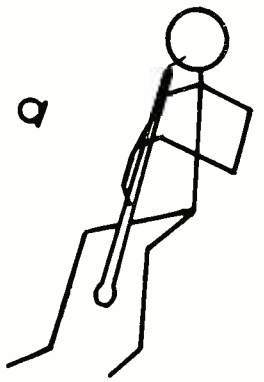

FIG.8 VIOLINS IN PAIRS

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with the soprano saxophone where I've decided to use two mics, one on the body and one placed at the mouth of the bell. There should be a qualification that saxophones play many different roles in the orchestra, playing a particularly wide range of different types of music and therefore it is very difficult to be absolutely precise on the miking technique. It is a question once again of the sensitivity and the feeling of the engineer, and his musical ability to interpret what has been written. In many rock sessions for example, particularly where we're concerned with the baritone saxophone, it's quite in order to stick a mic down the bell of the instrument itself and equalise hell out of it. Some remarkably 'good' sounds can result. The same thoughts could apply to a lesser degree to the brass section. Here, especially, the engineer must be aware of the total spl that the mic will accept; many of the mics that we use today of the capacitor types do have attenuation on the head to prevent overloading close to high output instruments.

Strings

In this particular instance we're talking about 12 violins, four violas four celli. The context is pop writing. Violins are divided into six first and six seconds, violas are written in four parts and the celli are also in four. Preference for technique here is to mic the firsts with two microphones of capacitor types such as *KM 84* and the seconds likewise, so we have four microphones covering the whole violin section. The front mic on the first is placed at approximately 1.25m above and slightly to the front of the player, looking directly towards the pair of intruments. This can be seen in **fig. 8** and the mic position relating to the overall studio also by looking at fig. 1. As there are four players to each mic on the back set of violins these were miked at a distance of some 1.50m and at a slightly different angle to pick up the four players. It will be appreciated, however, that the mic placement is extremely critical and it is down to the experience of the engineer to place and to listen. The violas are given one mic between two, placed similar to that of the front row of the first section. Celli sometimes present a problem in the studio, but for purposes of this type of recording I decided to split them down into two and two using two mics, two *U87*s and positioned as shown in **fig. 9**. This whole technique employed on the string section is open to very much discussion by engineers for it is very much tied up with the room acoustics, the type of music that's being recorded and the other caveats that go with it, but we have to remember that in this type of layout we are also fighting a separation problem, to which I will refer later.

The harp probably gives most trouble from a separation point of view, discounting any equalisation or highpass filtering. My personal preference (and I now talk about total live recording, where one needs good harp separation) is to take a small dimensional capacitor microphone such as a *KM 84*, bound round with some form of anti-shock mounting such as sponge rubber. This then goes in the second hole down on the back of the instrument facing the sound board **fig. 10** (1). The purists amongst us will shudder but in actual practice with the right type of eq the sound can be phenomenal, very close and truthful. The other placement is just off, the soundboard. This, though, has problems because the player pulls the harp back into the body while playing. Many harpists get a very easy time on sessions, because they play six bars for the intro, rest for another 84 bars and then play another two bars. So you can have a problem if you are placing the mic on the soundboard, for the player cannot rest the instrument without moving the mic.

A third system is to place the microphone just off the strings, fairly well towards the top end and to the right of the instrument as indicated in fig. 10, position 3. The only problem is that, although you will get a very good sound, the mic has to be placed diagonally and fairly close, and can become an obstacle for over-enthusiastic harp players, particularly on runs. The problem that also arises here is picking up another instrument playing nearby. With close miking, the output of the harp being fairly heavy, this doesn't normally interfere. The dictates of studio setups as fig. 1 don't always give ideal conditions with many instruments. A point that immediately comes to mind is the proximity of the harp to the front desk of string players. Not a good situation from a separation point of view.

Vocals

A typical vocal group might be four boys, three girls. My preference for miking these might be as indicated in **fig. 11,** the vocal group in separation room or booths of sufficient proportions to accommodate them comfortably with the right degree of air conditioning. There must be good visual contact with the studio, and good foldback facilities. Some vocal groups prefer to work on cans, some prefer to work to speakers; whatever, it's important to realise that vocalists like to be very comfortable and feel that the room they are in is working environmentally with them and not against them. In fig. 11 they are all facing towards the studio,

FIG. 9 CELLO

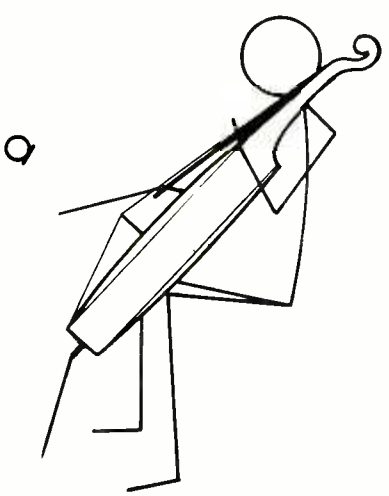
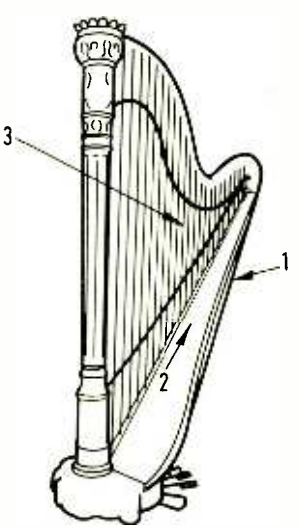


FIG. 10 HARP



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looking through the glass and quite separated. This sort of setup would suffice only for certain types of writing. If the writing is close harmony, where the group need to have a strong musical feel with each other and get working together, then the setup in **fig. 12** would be better. It could be argued that as they're isolated it doesn't matter where they are. This point of view is short-sighted, though, as they need to have communication with the md particularly if dealing with *colla voce* passages. In fig. 12 you've got the boys and girls facing each other; still the same number of microphones but they are now looking at each other. They do still have some form of communication with the studio: a bit of a compromise, but remember they have foldback into the box. You have a much better chance of a very good internal balance with the group. You will see in the diagram that two small loudspeakers are placed, both facing the dead side of the mic, one for each of the vocal sections. I normally never record the vocal group using pop shields, preferring groups to have good microphone technique themselves with the ps, bs and ds well under control. The same applies to solo vocalist. Many circumstances force us to use pop shields, although I know of many solo artists with extremely good mic technique who can and do work very close to the microphone.

Separation and Scoring

We should discuss the requirements of separation. These depend on: the heaviness of the rhythm section compared with that of the strings; the heaviness of the brass section compared with that of the strings; and the heaviness of the brass section and the rhythm section compared with the woodwind. Now, as we can see from the setup, the strings are reasonably well screened, because in this studio the screens go from floor to ceiling for almost the length of the studio. The flutes are screened. Separation difficulties are going to occur between the brass and the strings; on this particular session it was not untypical to get separations from *ff* brass to strings of 10 dB. Brass to flutes came out in excess of 15 dB. Rhythm section to strings was no problem whatsoever, certainly in excess of 15 dB. Percussion to brass or rhythm to brass was no problem, because of the close miking on the brass section and the screening of the heavy output instruments such as the drums; separation was probably around 18 to 20 dB.

Thus, it can be seen that there is enough flexibility of separation for mixdown. The major problem with really heavy rhythm and brass will be as against the strings. For this very reason it is common practice to overdub a string section to maintain a good degree of separation and to provide for good control later on in the mix down. Brass can also get into the piano. The piano lid is generally raised on the short stick and covered with some material—the musicians' pet hate, because the piano sounds like a dead lump of wood and doesn't sound for them. From the engineering point of view, this will give good separation, with no problem between brass and piano. But watch that bass drum rolling down the studio wall.

One other far-reaching problem we should talk about here is the leakage between drums and strings. Even with the drums and the strings well screened, we spend a lot of time using a lot of microphones, very carefully getting tight, crisp snare sounds, forward tomtom sounds, and good cymbal sounds. But 10m away you've got a large string section with six mics whose gain on the mic channels is somewhere in the region of 40 dB per channel. Open up the string tracks on remix and what have you got—instant destruction of the drum sound. Another reason for overdubbing strings. But such leakage can be useful on certain types of session where one needs the space and the depth in the recording, such as large, internally balanced orchestra where if the drums do sound back, it doesn't detract from the overall sound. The live drum sound, as many of you realise, is currently fashionable, particularly on many American pop records, and so doesn't really present itself a problem with a live recording of this nature.

One other relevant comment about the sound of the drums on this particular session, and my general personal preference, is to avoid placing the drums within too dead an area. Many acoustic gentlemen might agree with me; and my preference particularly on this session was to place the drums on a wooden rostrum, which helps the sound enormously. It gives good control but gets a real forward, living sound. Deadening him is the easiest way to destroy one of the hardest working men in the orchestra to 66 ▶

FIG. 11 VOCAL LAYOUT-1

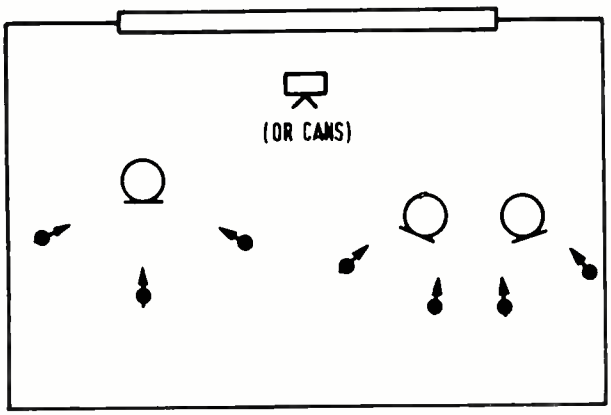


FIG. 12 VOCAL LAYOUT-2

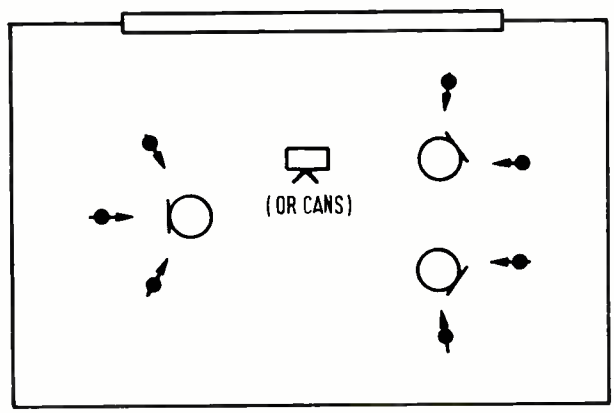
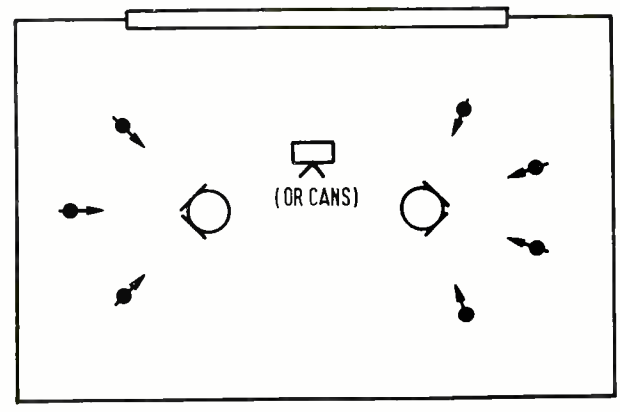


FIG. 13 VOCAL LAYOUT-3



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make him sound as if he's playing on cardboard boxes.

Another point that I would wish to make is that a good room with good acoustic transient response, flexibility in its live and dead areas, right sort of trapping and the right sort of bass absorption can be made to work very effectively for you, with very little problem hanging over at the console end.

Another point of note is the scored positions of the various instruments. These are notated in fig. 1. You'll notice that trumpets 1 and 3 are sitting together, miked separately, with 2 and 4 miked together. There is, though, no hard and fast rule about this. For example, bass trombone always sits on the outside of the trombone section. Now, to get a well balanced section, particularly when they're playing *divisi*, I prefer to place them as shown. Some engineers may have other preferences and once again no hard and fast rule holds good, so you could have a situation where 1 and 2 would sit together and 3 and 4 would sit together. We could have another situation where trombones 1, 2 and 3 play on one mic and the bass trombone is miked separately or 1 and 2 together with 3 and 4 miked separately. Each of the trombones could be miked separately, but this is getting into an enormous number of channels, particularly with this type of large setup.

It's also interesting to note the preference that the horns have for sitting. 1 and 3 usually sit together, as do 2 and 4. Also, note the position of the bells in fig. 1, which shows I would prefer to rotate the players to get the bells pretty close together, so that we can get good pickup and good relation between the written parts. It doesn't normally upset the players when they perform as they might expect to be put in this state unless you have four mics on the horns. And most horn players are very sympathetic to the recording engineer's needs, provided they are not cramped, the recording engineer doesn't get heavy and he understands the musical problems involved.

Stereo

It will be appreciated that the discussion so far has been concerned with multi-track techniques; we have not discussed track layouts and do not propose to. Any stereo information on remix would be injected stereo information and stereo miking techniques would only be of theoretical mathematical interest on a session of this nature. We could, on this one, handle a stereo string section, but in order to do the job properly it would be my preference to overdub the strings as a pure stereo section. With the type of writing employed, it would be very doubtful whether the right results would be achieved. Further, it would be my recommendation for injection stereo. The four mics on the strings would be injected and panned into a stereo position; likewise the mics on the violas and on the celli.

We could use stereo techniques on the vocal group, as shown in **fig. 13.** We could use four microphones, cardioids placed in pairs one above the other, each microphone at an angle of 90° to the other—this would give us a stereo picture. Figure-of-eight is avoided because of likelihood of phase cancellation on the back end of the mic. Also, we don't want any extra room ambience from the other side of the mic, although it's sometimes used to good advantage when situations demand. We don't put a single crossed figure-of-eight in the middle because probably for this type of session it would not produce the desired results and the amount of control of balance between the girls and boys.

Conclusion

The really first class engineer must have the ability, with good basic microphone techniques, to translate the dots from the players and their instruments into a recognisable, fundamental sound that has sympathy and sensitivity for the score, the composer, the musicians, the producer and all concerned with the production, whatever it is. Hence the concern in this article only to deal with microphone techniques acoustically, and not to attempt to deal with equalisation treatments or sound perspectives electronically created through the console. It is appreciated, however, that the two work closely together and one is used to enhance the other more often than not. It is also extremely necessary for the engineer should understand the generated wave patterns of the sounds they make together with the unwanted odd sounds that they make (with all that plumbing, nobody is perfect). The engineer should understand the generated wave patterns of the instruments and the registers of the instruments that sound naturally good or bad. When considering microphone techniques, the comfort of the player must also be maintained—remember, a comfortable player is a happy one and will always give a better result.

In conclusion, I must emphasise once again that mic placement is a very personalised technique. There are so many factors to consider. To have the sympathy, to have the sensitivity and above all to interpret what the composer has written, be it group or solo artist; to work in harmony with the players and to create a genial atmosphere on the session makes life a lot easier for the engineer on the console. And the mic placements really should come intuitively rather than from a hard and fast written-down rule. Much of the article has been concerned with areas of doubt—these have to be mentioned in order to emphasise this personalised and non-verbal quality. The technique of mic placement remains something *felt*.

LETTERS

As a general comment on measuring distortion in compression type amplifiers, I would point out the following: the distortion at a certain amount of gain reduction, say 10 dB, can vary widely between units of the same or different manufacture because of lack of standardization. Obtaining 10 dB gain reduction can be accomplished in many fashions. For instance, one can apply a signal 20 dB above threshold with a compression ratio of 2:1, or apply a signal 10 dB above threshold with a compression ratio of 8. In the case of the Omnipressor, one could apply a signal 1 dB above threshold with a ratio of −10. Although the same gain reduction would occur, the distortion figures would vary widely, and properly so. In the first case, the agc detector is putting out a large signal caused by 20 dB of drive, and this signal is being attenuated, so that it has a large dc component, and any ripple or imperfections caused by the agc detector are being smoothed out by a resistive attenuator. In the second case the agc drive is halved, and gain following the agc is doubled, giving the same average dc value, but twice the ripple. In the Omnipressor, where negative compression is obtainable, the requirements on the agc circuit are quite stringent, and we are quite happy with our circuit, which gives better than 1% distortion at 1 kHz even when the compression ratio is set so that increasing the input 1 dB decrease the output 10 dB !

We are as guilty as Mr Ford in this regard, as our specifications don't state the conditions under which distortion was measured. In point of fact our data was taken in the infinite compression mode, which is fairly stringent, although not so much so as in wide expansio.. or negative compressio . Just to give you a comparison, let me take some data, at 1 kHz and 50 Hz respectively.

As high as those last two figures seem, you are entitled to that much distortion, based on the release time constant.

Possibly I am being overprotective, but I feel that these considerations should be pointed out in an article which discusses comparative merits of compression amplifiers. We feel that the Omnipressor is a very good general purpose compressor, as well as being a unique special effects box.

Yours faithfully, Richard Factor, Eventide Clockworks Inc, 245 W64 Street, New York, NY 10019.

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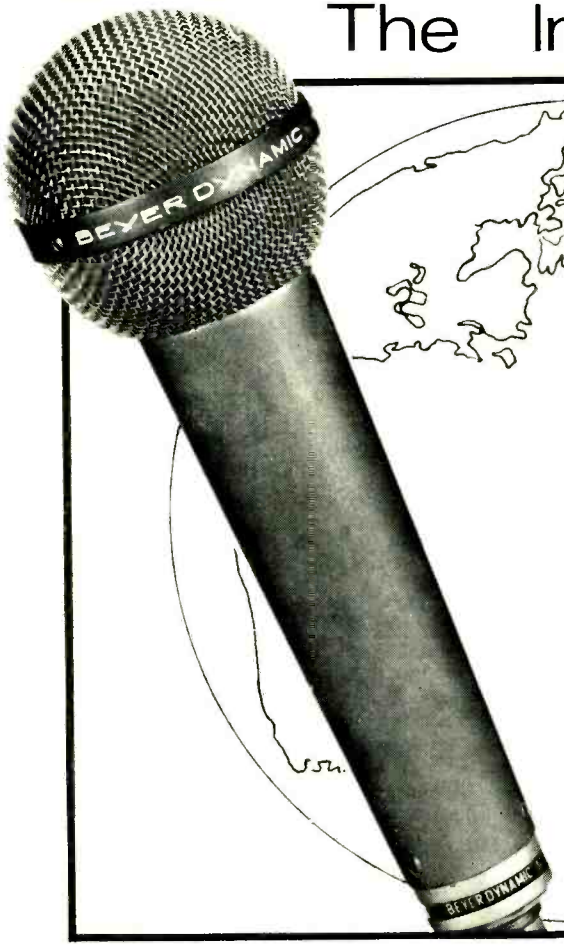

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