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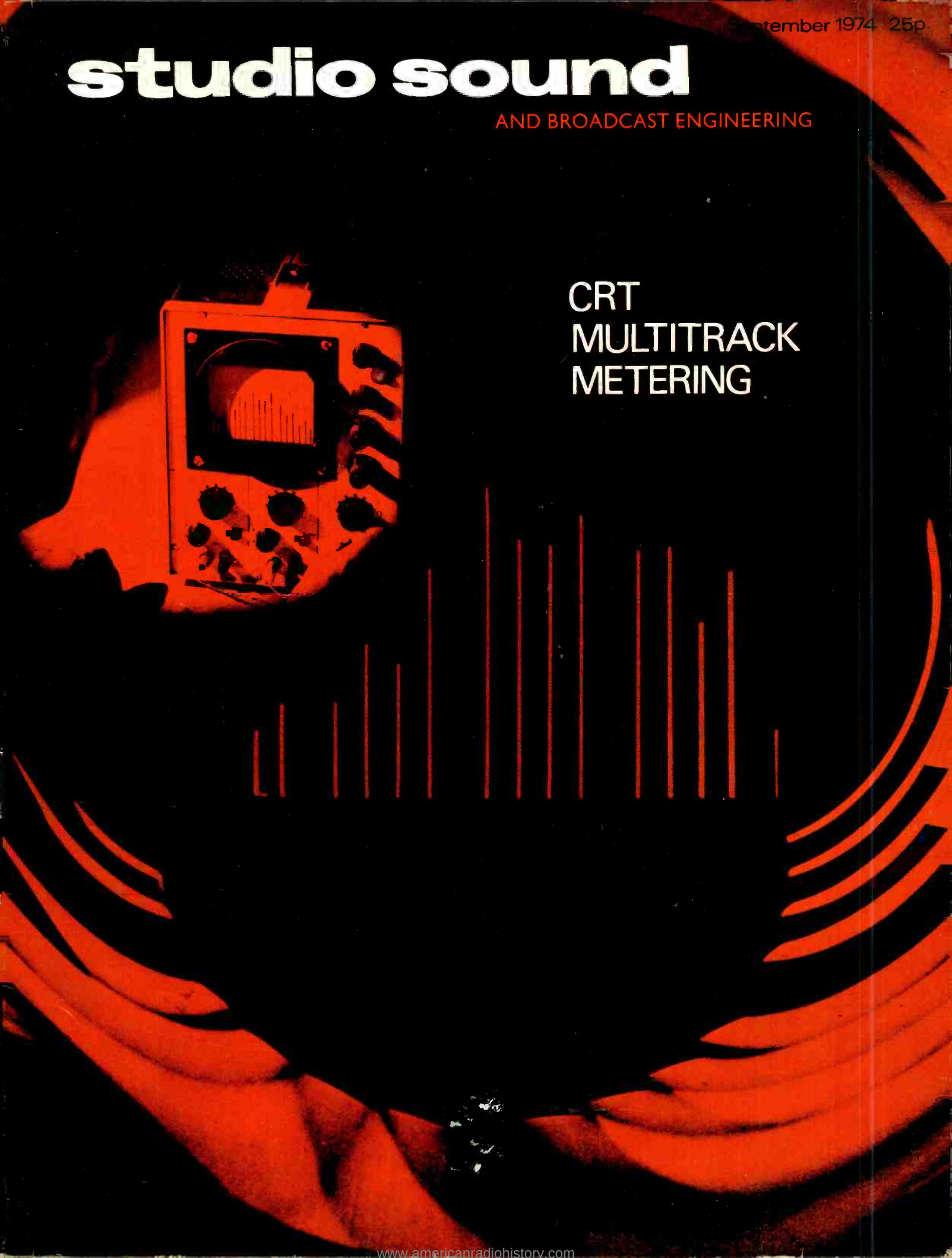

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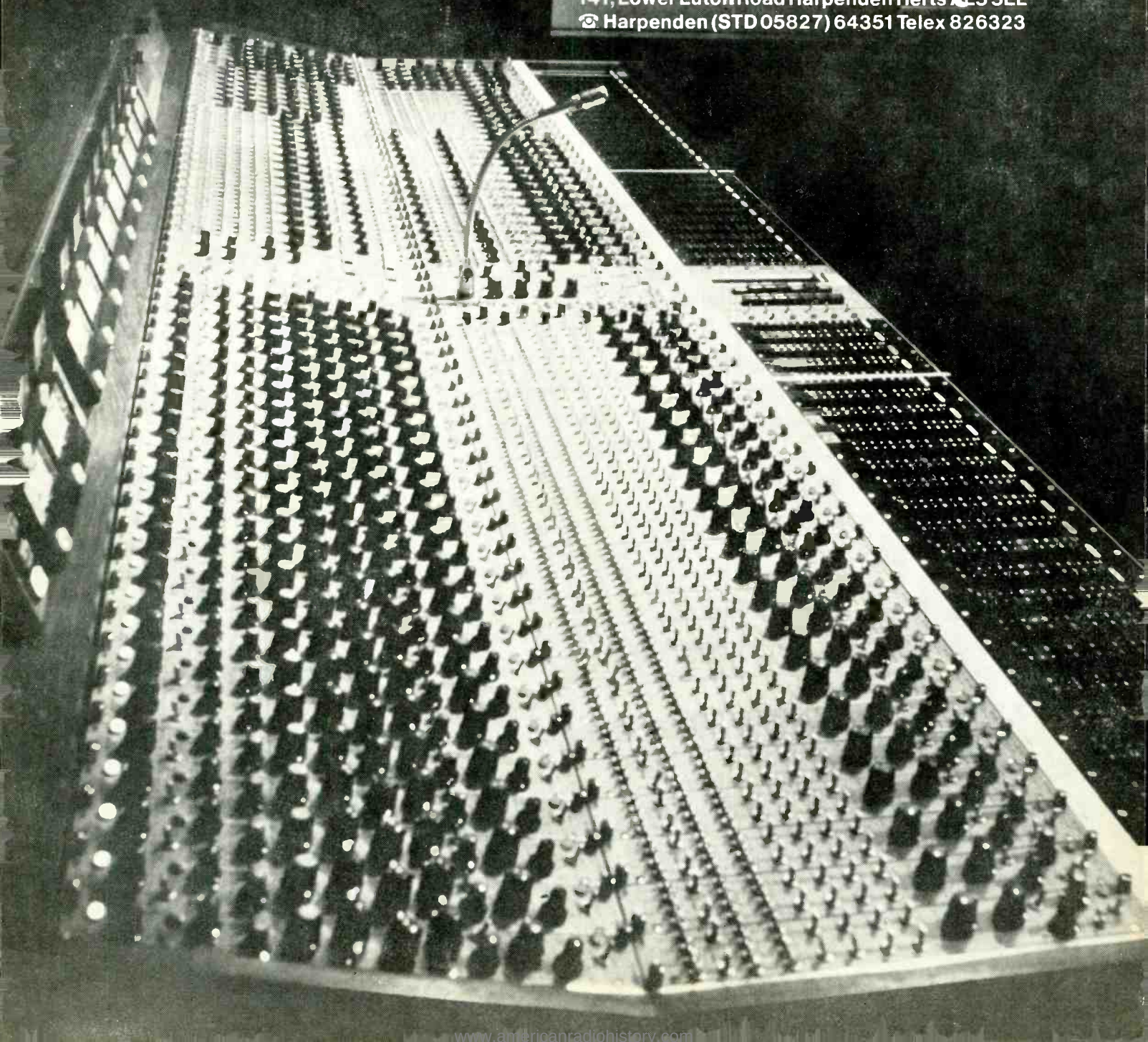

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STUDIO SOUND, *published monthly, enables engineers and studio management to keep abreast of new technical and commercial developments in electronic communication. The journal is available without charge to all persons actively engaged in the sound recording, broadcasting and cinematographic industries. It is also circulated by paid subscription to manufacturing companies and individuals interested in these industries. Annual subscription rates are £3 (UK) or £3.30 overseas.*

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

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All STUDIO SOUND *correspondence should be sent to the address printed on this page. Technical queries should be concise and must include a stamped addressed envelope. Matters relating to more than one department should occupy separate sheets of paper or delay will occur in replying.*

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Loose-leaf binders for annual volumes of STUDIO SOUND *are available from Modern Bookbinders, Chadwick Street, Blackburn, Lancashire. Price is £1.25 (UK and overseas). Please quote the volume number or date when ordering.*

SEPTEMBER 1974 VOLUME 16 NUMBER 9

PEAK PROGRAMME meters or Volume Unit indicators? That particular Great Debate came to a satisfactory conclusion, so far as this journal is concerned, when it was finally realised that both instruments have a worthwhile role in the sound recording studio. If you wish to avoid overmodulation, you need a ppm. And if you need to compare average signal levels, mindful of the subjective sound levels, you need either a very good monitoring system or a VU.

As audio control desks grow increasingly complex, yesterday 16 channel, today 24, tomorrow 36, so the difficulties of watching large numbers of separate meter movements become more taxing. We are not aware that any methodical study has been made of man's capacity to concentrate on a multiplicity of simultaneous events. It is nevertheless abundantly clear that a major change in the colour of one or more light sources, in a row of say a dozen, is much more easily sensed than the sudden wide deflection of a conventional meter needle among a row of such meters.

Several months ago, James Crabbe outlined the design philosophy behind a multichannel audio level display effectively converting an oscilloscope into four peak-reading indicators (December 1973 STUDIO SOUND). In this issue, Trevor Attewell describes a more advanced form of the same principle, again using a monochromatic cathode ray tube. Although technically intriguing, these two systems lack the colour-change overload indication available from a suitably designed multi-element light emitting diode indicator. The NTP colour crt display demonstrated at this year's Association of Professional Recording Studios Exhibition combines the colour facility of a led display with the versatility of a television display, in this case using 625-line scanning instead of more conventional oscilloscope tracing.

The one obvious disadvantage of highly compacted multichannel programme level indicators is that mixing consoles cannot themselves easily be compacted to similar proportions. The area occupied by a mixing control panel is dictated by ergonomic considerations rather than by subsidiary component sizes. Compacted too closely, the controls of an elaborate desk can become a jungle of unreadable labels and worthless calibrations. This is not, however, true of channel faders. In many consoles, these are spaced apart uncomfortably widely to an extent dictated by the width of each channel module. In radio and television broadcasting, it is not uncommon for channel faders to be grouped much closer to each other than are the corresponding control strips—despite the increased concentration then needed to relate each fader to the appropriate channel module.

All of which raises the prospect of future mixing consoles departing from the rectangular tabletop format that has so long been popular. It is quite conceivable that the next generation of consoles will be nearer triangular than rectangular, one point of the triangle facing the operator. A tightly compacted group of channel faders would fall, as at present, beneath the sound balancer's hands. Behind the faders, where they are most easily seen and acted upon, would be a similarly narrow group of line in/out switchable channel level indicators: either multicolour leds or a single crt display. And behind these, fanning out to form the rear section of the triangle, could then be arranged as complex a group of controls as has yet been demanded by a multitrack studio. Could this be the shape of consoles to come?

Cover: photographed by Tim Bishopp.

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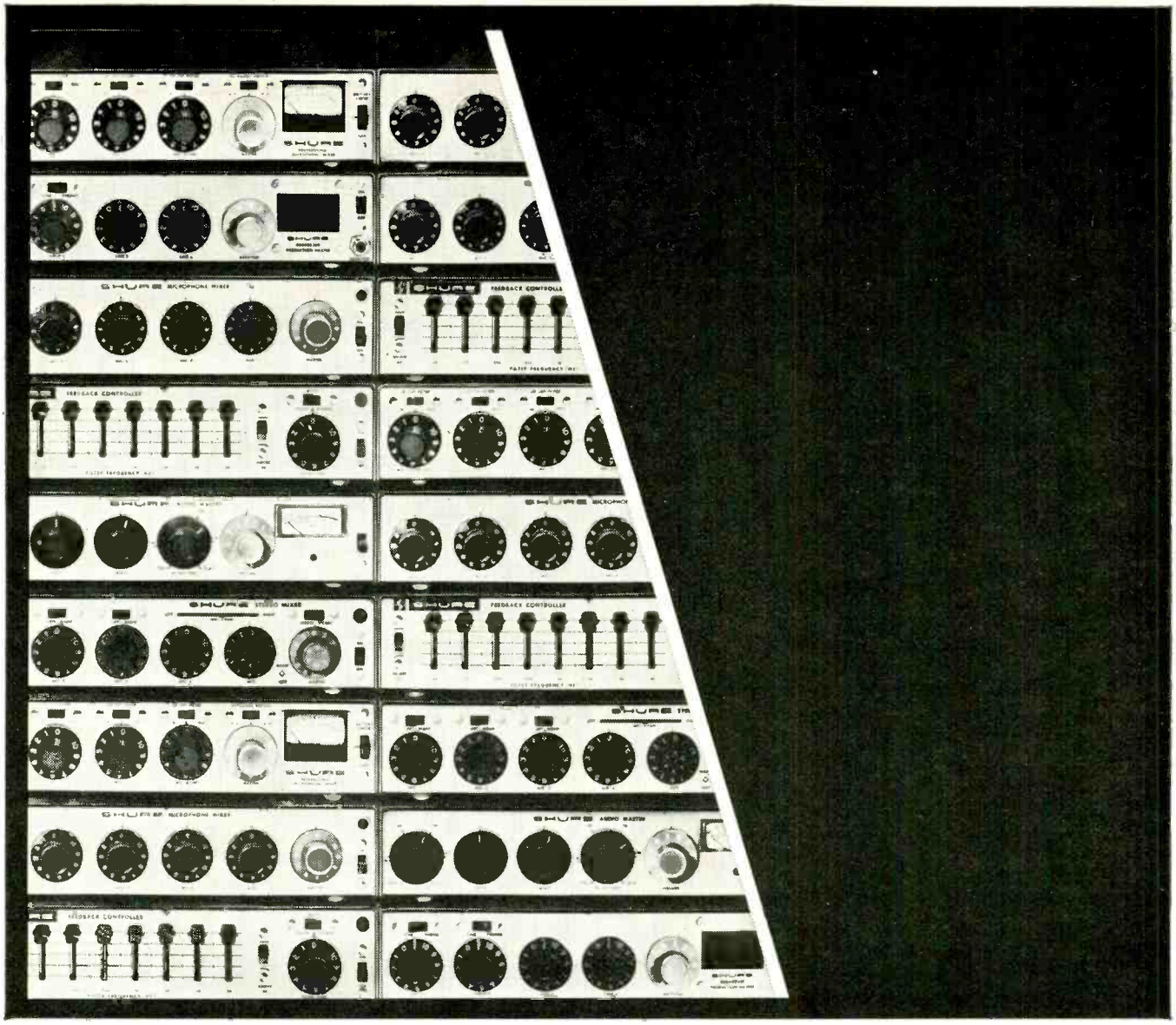

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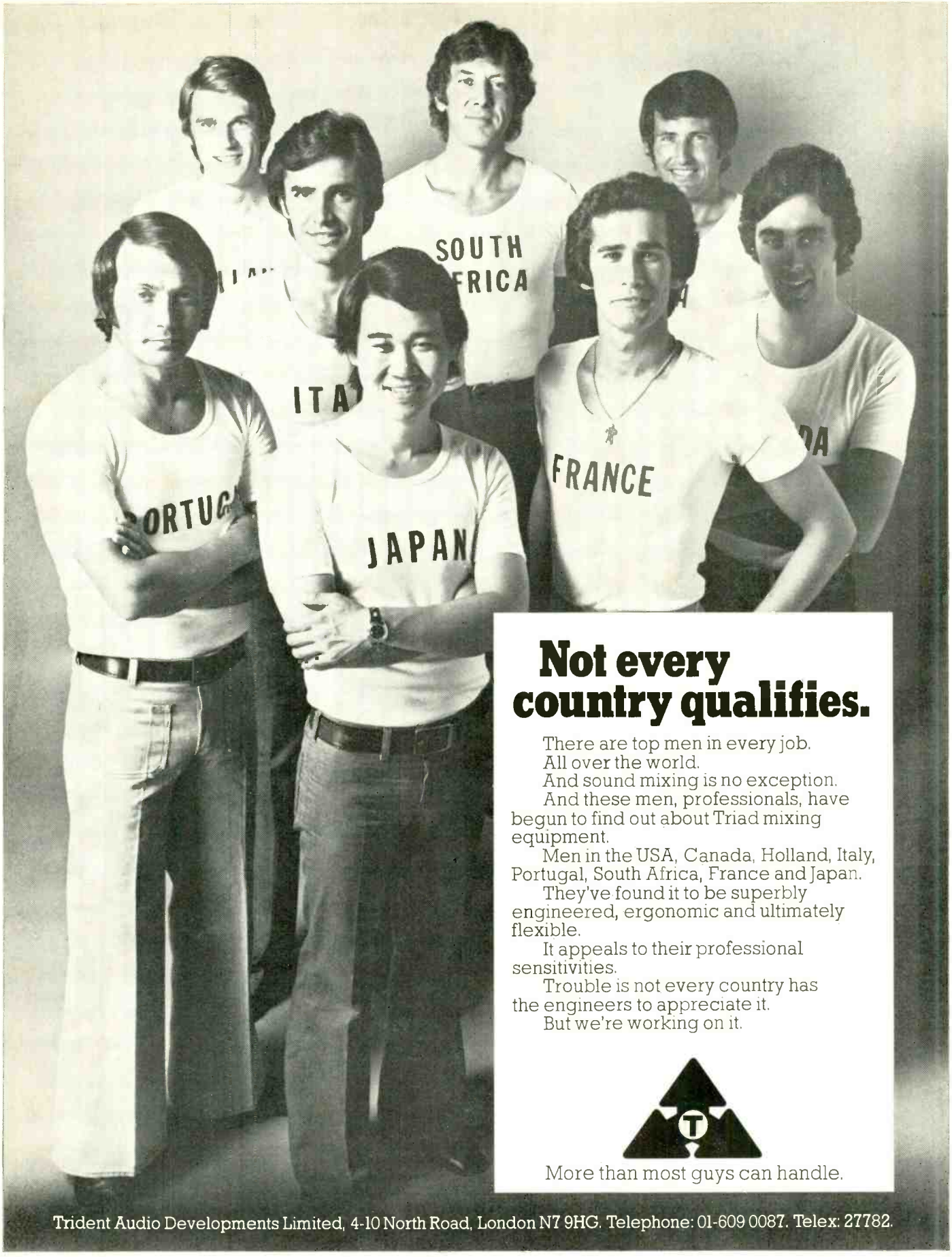

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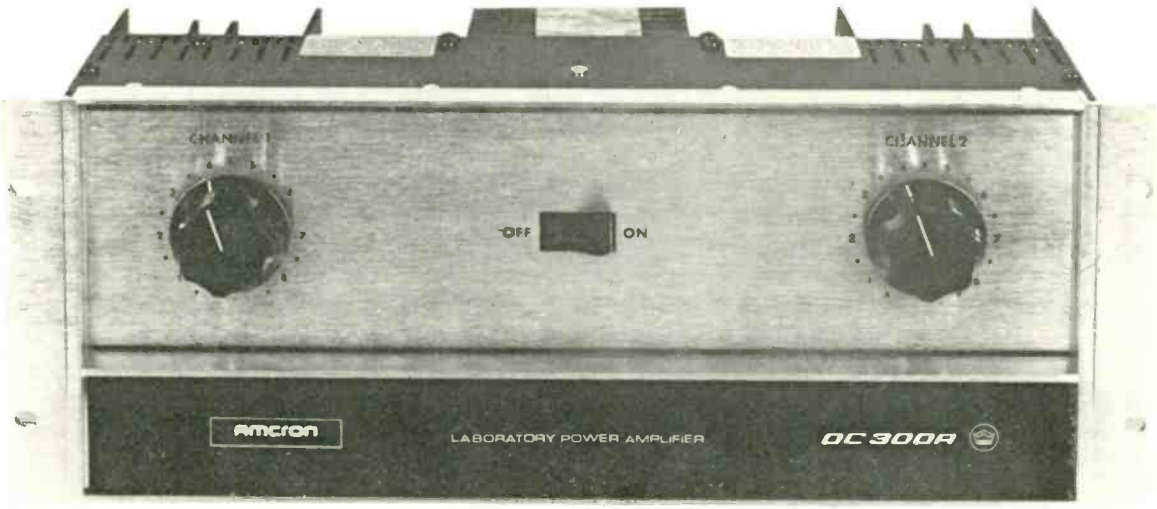

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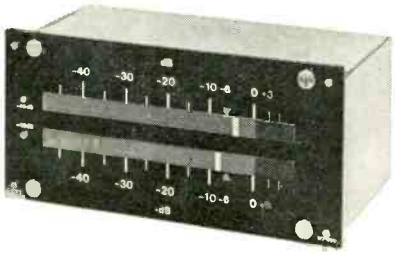

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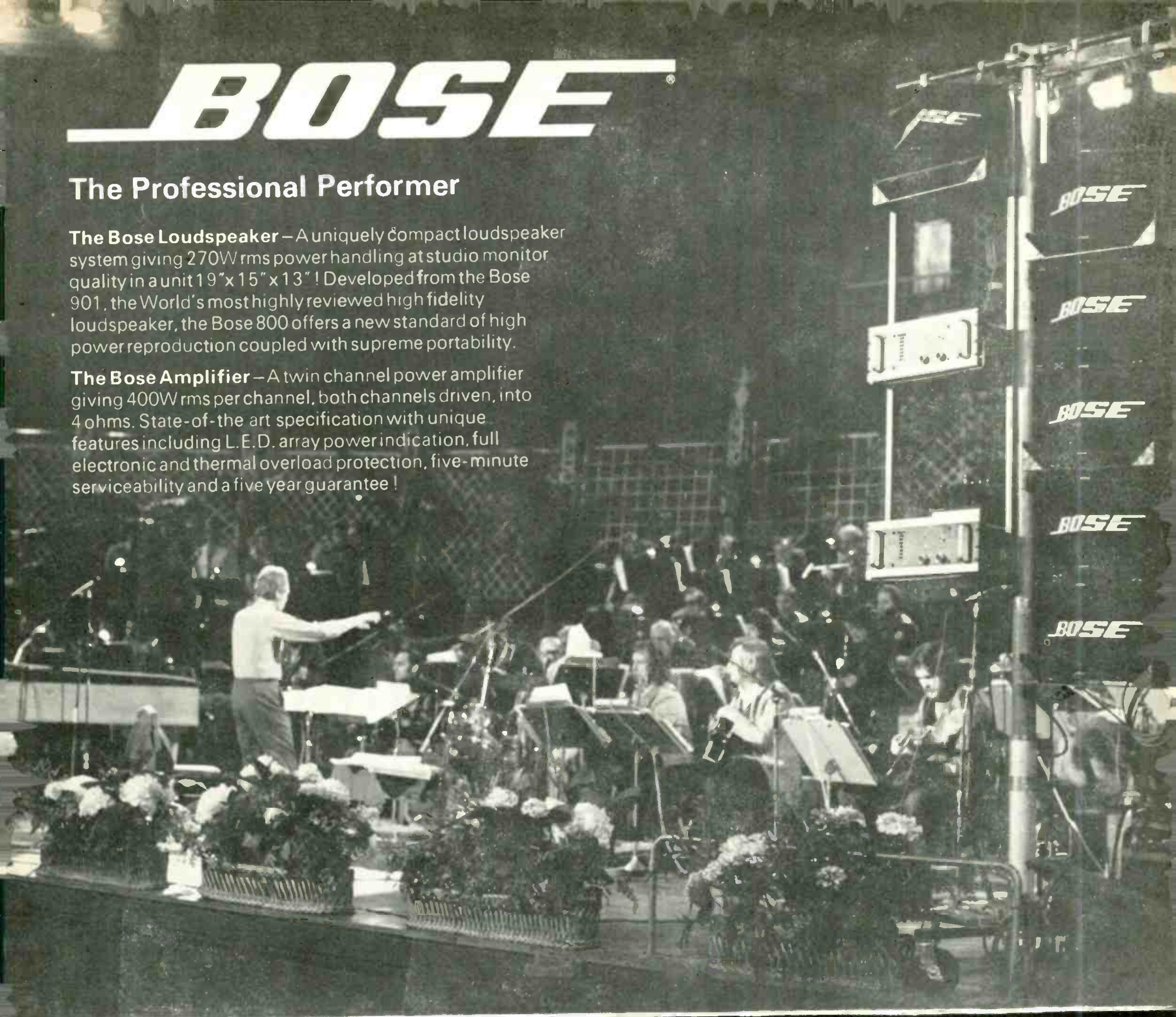

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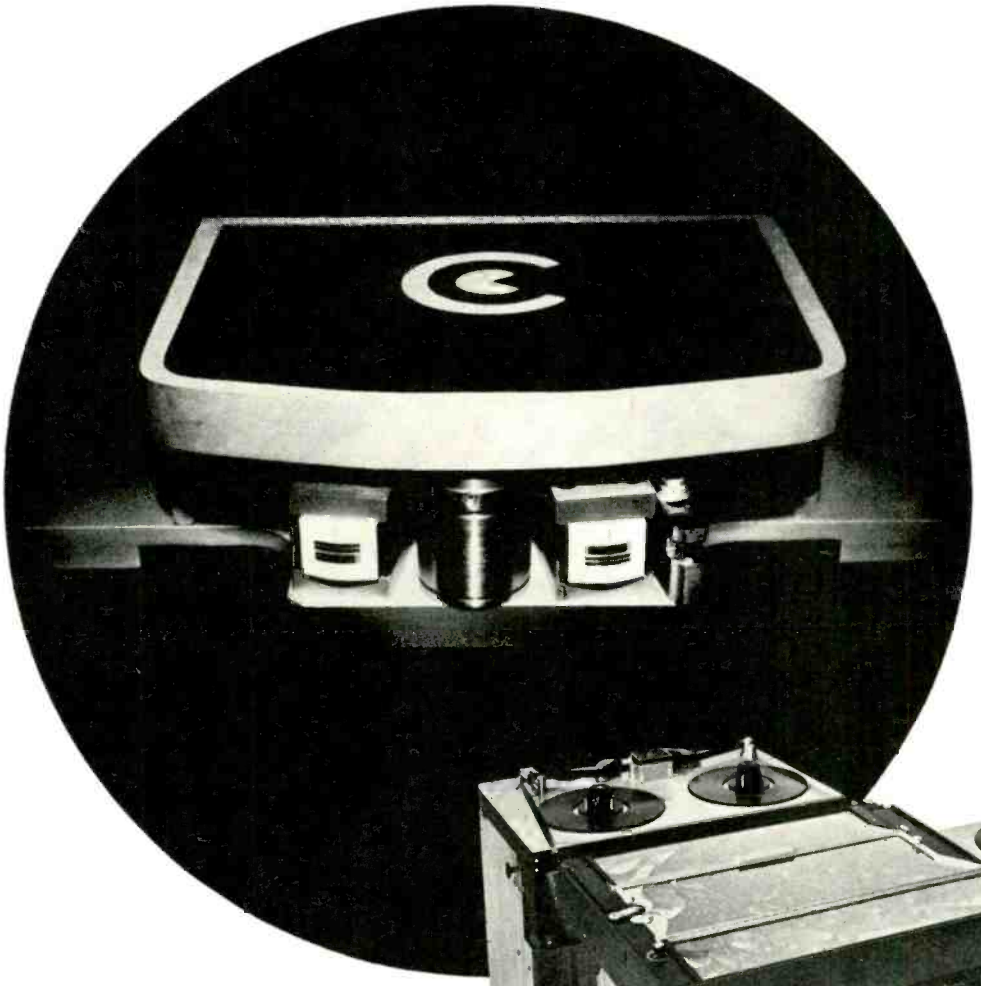

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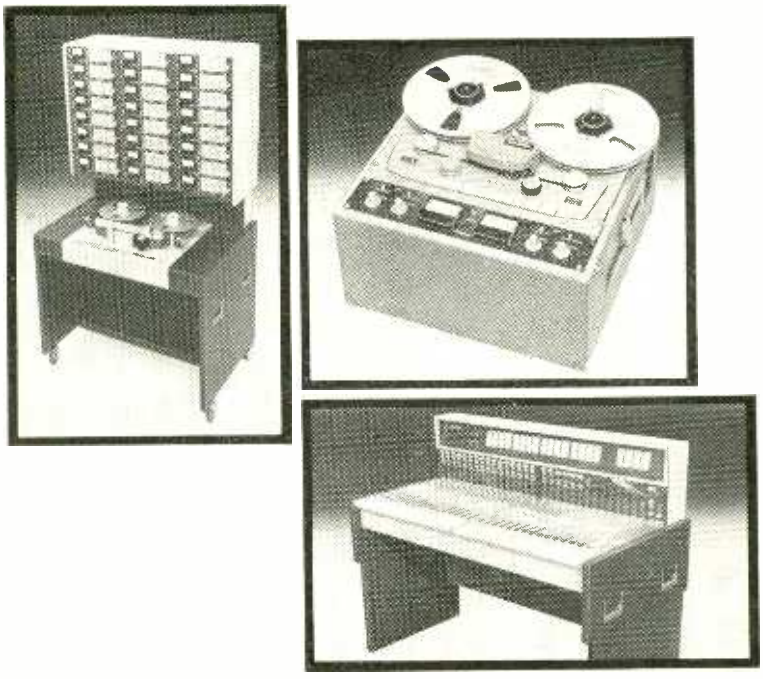

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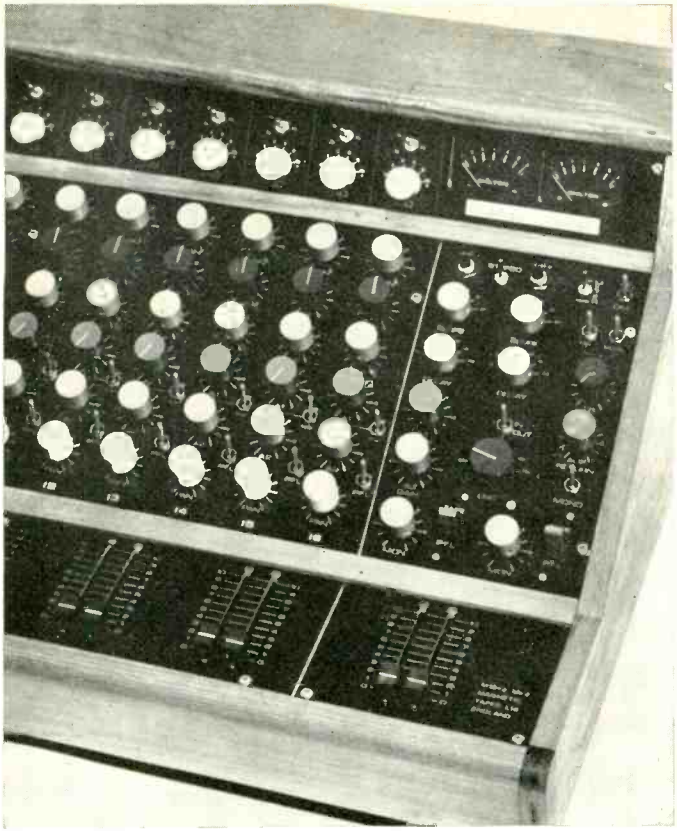

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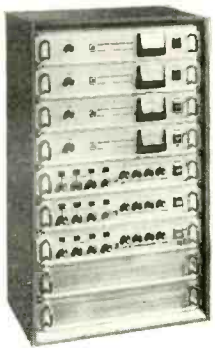

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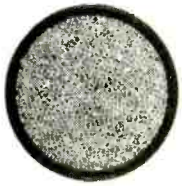

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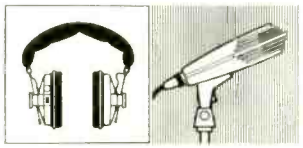

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Power fet

YAMAHA ANNOUNCE the successful manufacture and incorporation into a prototype amplifier of a power transistor utilising the field effect. Research had been proceeding for some time after an original invention by Jun'ichi Nishizawa of the Tohoku University Electronics and Communications Research Centre. As opposed to the quasi-pentode characteristics of the conventional fet, the 'vertical type construction' is claimed to yield a quasi-triode characteristic. Fifteen patents are pending.

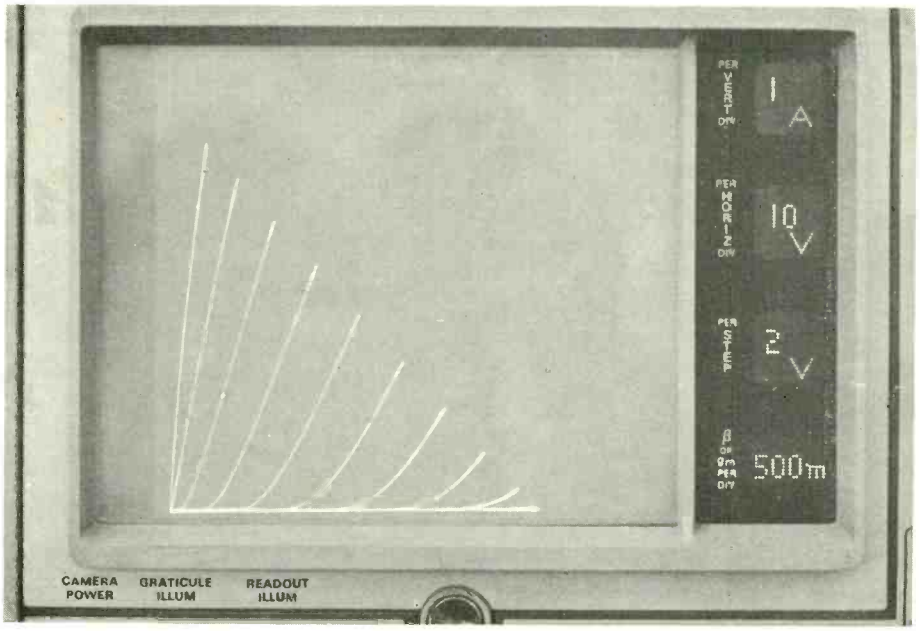
Current performance of the conventional fet is limited by a relatively low saturation point, the so-called pinch effect by which above a certain voltage V_{ds} the depletion layer achieves a steady maximum independent of V_{ds}. With increasing V_{gs} the saturation current I_d falls below that for which $V_{gs}=O$. Although power amplifiers using such devices had been constructed, their output had been limited to around five watts.

The diagram shows a schematic cross-section through the 'vertical type fet', and the photograph shows its transfer characteristics, where $\mu \simeq 10$, $g_m = 2000$ mMHO and internal resistance 5Ω. Because of the absence of carrier storage of conventional devices, it is claimed that frequency response is extended and notch distortion reduced.

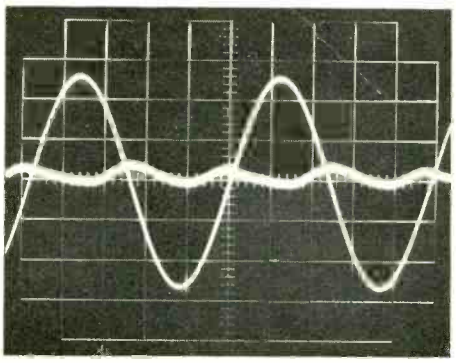
The crt traces show responses of the Yamaha *CA-1000* in Class-A mode and the output of the power fet prototype to a 20k Hz sine wave as specified. Due to the square law power fet transfer characteristic, distortion is primarily of even harmonics; a distinct, smooth second harmonic can be seen, as compared with the distortion from the *CA-1000* which contains a visible third harmonic. It is claimed that the even-order distortion can be 'almost completely eliminated' by push-pull working if the transistor pair is 'completely matched'.

With the inherently superior linearity, it is asserted that practical designs may utilise less negative feedback, resulting in improvement in stability and transient performance. The high input impedance reduces the power drive requirements of the preceding stage, low impedance voltage drive being sufficient.

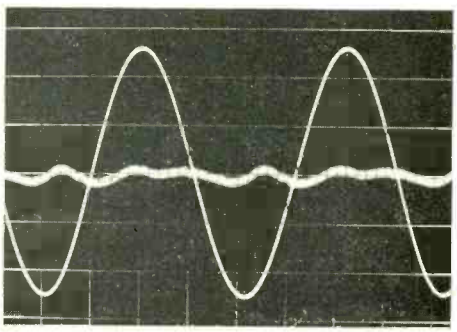
The monolithic power fet effectively utilises a parallel array of fet



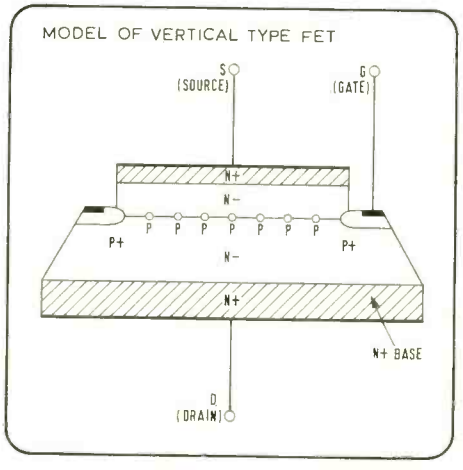
V_d — I_d characteristic of composite vertical type fet

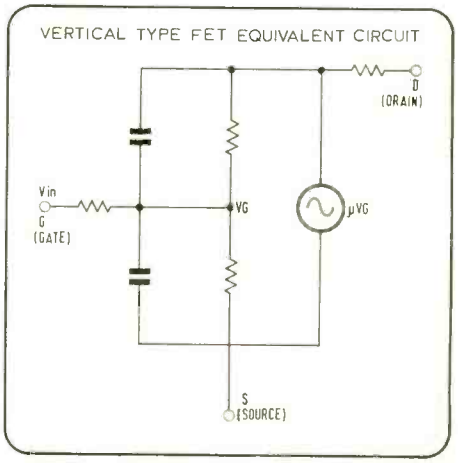


Prototype fet amplifier
10W into 8Ω at 20k Hz. THD=0.028%



CA-1000 (class A mode)
10W into 8Ω at 20k Hz. THD=0.012%





junctions as shown. The $n+$ base is a silicon wafer on which is deposited epitaxially a high-resistance $n-$ silicon layer. After selective diffusion of the highly doped gate $p+$, a further $n-$ layer is deposited. The temperature characteristics are stable: the saturation current decreases slightly with increasing temperature. Thus, thermal runaway is not possible, and temperature compensation is unnecessary even at high operating powers.

In addition to Yamaha, several other Japanese firms are presently able or will shortly be able to offer fet power amplifiers. Known manufacturers include Pioneer, Toshiba, JVC and Sony, although it is not known (July) whether distribution is fixed.

The prototype shown by Yamaha was convincing in parallel demonstration against other high quality, high power amplifiers. Claimed output is 150W into 8Ω, both channels driven, with a power bandwidth of five to 50k Hz. Total harmonic distortion at full power is given as 0.1 per cent, at one watt as 0.04 per cent; intermodulation distortion (70:7k Hz, 4:1 SMPTE method) as 0.1 and 0.01 per cent respectively.

Distributors of the production power amplifiers, which are expected to arrive in the UK at the beginning of 1975, are Fallowfields, Strathcona Road, North Wembley, Middlesex. Price is expected to be above £500 per two-channel unit. It is not yet known whether the fet power transistors are to be available separately.

ORTF: news and comment

Jusqu'à D'Estaing

THE FRENCH radio and television monopoly, ORTF, has been split into three. Each of the three tv sections will be in competition with the other two, and will be responsible for one of the existing television channels of which two are in colour. The third cannot be converted for technical reasons.

ORTF has been beset by financial problems. It faces a deficit this year of 90 million francs (£8M) to add to last year's deficit of 80 million francs (£7.1M). At the beginning of June 2,000 ORTF technicians struck for higher pay and ORTF, director general M Marceau Long, was obliged to approach the Prime Minister, M Chirac, to ask for an increase in licence fees to £20. The cost of a colour television licence is already £19, and that for a radio £3. At the beginning of the decade ORTF was the second most prosperous broadcasting organisation in Europe, with a third of its income coming from scarce and hardly fought - over advertising time. 200,000 new licences were being taken out every month and total income was about £126M, about that of the BBC for the year ending March last year.

Even with an audience of 45 million watching ORTF programmes on 15 million sets, the organisation cannot make ends meet, even though licence-dodging in France is practically unknown. The decline has been attributed to bad staff relations, wasteful programming and inefficient planning. On one programme alone, a colour version of 'The Sleeping Beauty', they overspent their budget by £85,000 only to show the programme on the black and white-only channel to compete with a detective serial on the other side.

A recent survey showed that 68 per cent of the French public wanted to watch an independent commercial channel but, in keeping with the rest of ORTF's troublesome history, public feeling hardly entered into it. The wish to preserve a state monopoly is fostered, though for very differing reasons, by most of the influential groups in French public life: most of the Gaullist party, all the left wing parties, who wish to have nothing to do with commercialisation, the trade unions, and the press, who don't want to relinquish their advertising. President Giscard d'Estaing won his recent election by too small a majority to ignore them.

ORTF was set up in 1964 by an act passed in the Assemblée on June 27 of that year—almost ten years to the day before ORTF was dismembered. Its predecessor, RTF, was the accepted tool of government, but hardly anybody minded for opposition politicians treated broadcasting with derision; L'Office, as ORTF came to be known, was supposed to have been given financial and directional freedom.

A continuing irony of ORTF's plight ever since has been that French broadcasting was more free in the years before the war than it has ever been since. At that time private stations had been licensed by the government to operate alongside the state-run stations, just as in this country at the present time. Then, during the war, the Germans closed all the radio stations and confiscated all the radio sets they could lay their hands on, particularly in northern France, with the result that radio in France was practically extinguished, and when the war ended the service had to be started from the bottom.

The only broadcasts which had reached France had been made by one Charles de Gaulle, who had spoken to the French population from BBC studios in London. When he returned triumphantly to France he realised that his broadcasts had created an image of himself in the minds of the French people that existed almost outside his own personality, and later admitted that he often considered, when making a decision, whether 'de Gaulle' would approve of this or that. De Gaulle was the first politician to use 'public image' as a political instrument.

The French radio service was not restarted until 1948. De Gaulle was not in power for long and the new socialist prime minister, M Ramadier, declared in 1947 that de Gaulle would not be allowed to broadcast. In 1956, when the number of tv sets reached a quarter of a million, the socialist prime minister, Guy Mollet, put news programmes in a special category subject of the Ministry of Information. In 1956 and the subsequent year, the news and current affairs were separated into a special news division divided from the rest of television. De Gaulle was kept off the air for 11 years and, when he returned to power in 1958 to form the Fifth Republic, he operated precisely the same form of censorship that had been initiated by Ramadier.

The reasons for this are complex. Firstly de Gaulle realised long before anyone else just how powerful the medium, whether radio or television, could be. Secondly, there was a French tradition that the government had control of the telegraphs, a tradition which went back to the last century and arose from fear that it might be used by enemies. Thirdly de Gaulle considered that the press was hostile to him, but the press was protected by an Act of 1881 allowing anyone to start a newspaper without the need for official sanction and free from official interference. Therefore de Gaulle considered it only fair that he should be able to use broadcasting to gain his right of reply, another feature of the Act of 1881 being just such a right.

De Gaulle played radio, then television, like a musician would play an instrument. RTF was a department of government responsible directly to the ministry of posts and telegraphs, and the bureaucracy that ran the one ran the other, with the result that it took weeks for a decision to be made as to whether to cover some big world event or natural disaster.

De Gaulle's interference in broadcasting matters extended beyond ORTF. He once refused to allow CBS to use a relay station on French soil to broadcast a programme in which Jean Monnet, who built the Common Market, was to appear. The programme had to be relayed from a Belgian studio via Goonhilly. In 1960 the link between Radio Luxembourg's Paris studio and the transmitter was cut because the government did not like the station's coverage of the Algerian war, and two years later it nearly happened again when an opposition member in the assemblée became Radio Luxembourg's president.

The government always found stations outside France broadcasting into the country troublesome. There are four, known as the 'peripheriques': Europe No 1, Sud Radio, Radio Tele - Luxembourg and Radio Monte Carlo. There was a scandal in 1965 when the international edition of the *New York Herald Tribune* revealed on May 21 that, through its government - owned advertising agency, Havas, it owned 100 per cent of Europe No 1, 83 per cent of Radio Monte Carlo and 35 per cent of the television station. and 97 per cent of Radio Sud. Not only that, but that it had tried to increase its holding in Radio Luxembourg by buying stock in the Compagnie Sans Fil. Radio Luxembourg protested and the French government stopped trying to buy the station.

During this period, then, and particularly during the Algerian war, RTF was subjected to even more interference, and there were sporadic strikes by technicians protesting at the interference in programmes. The programmes were scrutinised by a body called the SLII, a committee for co-ordinating government press relations which met every morning and decided how to handle the day's news.

Once they had decided they would exercise unseen but considerable pressure on ORTF to pursue the policy they had outlined. Stories are told of how members of the committee used to go as far as phoning to the control room to dictate last-minute programme changes, and an ex-assistant head of the SLII revealed that censorship was exercised on a direct personal level and not through the committee at all. In 1959 an administrative decree had been made that in future RTF would be allowed to operate under a new charter as an independent commercial organisation with a certain amount of budgetary autonomy. The enactment of this edict did not

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come until 1964, when ORTF was formed, but the organisation did have a little more freedom. The organisation was then responsible for its affairs to the ministries of Information and Finance. The Ministry of Finance controlled the day to day running of its financial affairs even down to programme budgets. The Ministry of Information saw to it that RTF upheld the ideal of an uplifting cultural medium and it is true that, outside home news, RTF provided some magnificent programmes around this time. When covering world news, they displayed a tenacity and objectivity they could not exercise at home.

Unfortunately, though, the new charter amounted to little. The only advantage was an administrative council which comprised eight civil servants, one representative of the viewers' organisation, one press man, two members of the ORTF staff and four government nominees. The greatest problem, a crucial one, was that the then Minister of Finance refused to allow control of the budget to pass outside his ministry, so that neither the director-general of ORTF nor the administrative council had control over their own finances.

For the next four years the mixture was as before, and ORTF was bound to the government line. The crisis came during the troubles of May 1968, when students and police were fighting in the streets and the ORTF news bulletins were showing the presidential progress on a state visit to Roumania. The journalists put up with this for five days. Then three discussion programmes about the riots were cancelled in the same week, and the journalists went on strike. They did not do so necessarily because they were sympathetic with the students, but because they insisted that the general strike needed fuller coverage.

They stayed out for 11 weeks from May 24 until July 11. They were promised reforms, and that there would be no reprisals. In the 'reorganisation' that followed, 60 journalists were sacked and another 40 were moved to obscurity in the provinces, though the director-general of that time insisted that the moves were in no way reprisals. One of the dismissed journalists sued for wrongful dismissal and was awarded £12,000.

After that it could be noticed that the head of news and the head of tv were Gaullists, that the small number of permanent staff of ORTF, a privileged minority, were Gaullists, and that the underprivileged much larger number of contract workers were the non-Gaullists. Few if any communist journalists were ever employed although there was a small number of communist technicians.

At around that time yet another broadcasting commission, the André Diligent Commission, criticised ORTF for its biased news reporting. In September 1969 the two television stations were told to compete, producing the sometimes comic, always expensive spectacle of French journalists chasing one another halfway round the world, trying their hardest not to photograph from the same angles, and each desperate to prove that their channel produced better news than the other.

Accusations of political bias continued. M Olivier Todd was installed as link man on the French 'Panorama' but walked out in June 1970 when a film of French troops in Algiers was cut. But from then until 1972 there was relative calm, and the accent moved from news reporting to entertainment. It was during this period that French television became known for its venality and violence. But all the while the politicians, who now realised the value of broadcasting, were watching carefully and, as one observer put it, 'the prevailing ideology of the régime of Pompidou invaded every moment of the screen'.

The Paye commission, set up to examine reorganisation of ORTF and the introduction of a third channel, reported in June 1970 and recommended a third state-run channel. The report was not met with too much criticism and the director-general of ORTF set up his own commission to examine ways of implementing the findings of the Paye commission.

By 1971, nothing had changed. ORTF was suffering from continual strikes and split into warring factions among its top-heavy administration. Then, towards the end of that year, two incidents opened up the old sores. M Maurice Clavel, a journalist, was due to appear in a discussion programme called Armés Egales. In this long-running series (36 editions) two guests were each invited to assemble a filmed essay on the chosen subject from opposing points of view and to discuss the subject after the film had been shown. The programme lasted about two hours. Clavel noticed that his filmed essay on the permissive society had had an unflattering reference to M Pompidou deleted and so he walked right off the programme, leaving the link man with an hour to kill.

A more serious incident occurred when André Diligent, author of the Diligent report, got up in the Assemblée to deliver his annual report as chairman of the finance commission on information. At the end of his speech he revealed that there was methodical and scientific corruption within the ORTF. He said that a particular advertising agency (which turned out to be none other than the government-owned Havas) was paying large sums to employees of the ORTF to sneak in mentions of cars, entertainers, aviation companies and others. It was also said that much of the payola was going to those involved in sports programmes, where there were lots of display signs to be put into shot.

Later, a burglary was reported at the Havas offices. Some property was stolen, together with a large file which turned up on the desk of the director-general of ORTF, Jacques de Bresson. Two men were arrested and their names withheld. A senate inquiry was instigated and ORTF were put under the guidance of the Control Commission. The inquiry alleged that the chief culprit was the boss of Havas, M Roland Pozzo di Borgo. He denied everything.

In June 1972 ORTF was given another and equally meaningless statute. De Bresson was sacked and replaced by Arthur Conte, an ex-socialist Gaullist. The heads of the two competing channels since the clean sweep of 1969 were promoted sideways. Thirty journalists were sacked and eventually replaced by parties favourable to the Gaullist persuasion, and a new appointment was made, that of Head of Programme Harmonisation, whose function was never satisfactorily explained, except to say that he was to maintain the monopoly in broadcasting at the expense of those opposing the monopoly. Conte, needless to say, was an ardent supporter of Pompidou.

The new arrivals had just warmed their seats when a M Aranda went into hiding after revealing that he had a huge pile of documents incriminating prominent citizens in French public life, not excluding ORTF. The trade unions followed by saying that they too had papers which would show that ORTF had been pressured heavily to distort the news and manipulate public opinion.

In April the following year (1973) Conte had to abandon an experiment in which he had tried to allow programme chiefs a freer hand in programme planning. He had abandoned the system whereby all programmes on all three channels were co-ordinated to start at 8.30 pm. Howls of public protest made him desist. By October he had been sacked after an embarrassing row between himself and the Ministry of Information 'over the government's use of the broadcasting service to further its own political ends'. The Minister of Information joined the dole queue with Conte. There had been allegations of financial blackmail on the part of the government as well as political interference. A month later Conte published a rather spiteful book on the subject in which he called Pompidou rude names but didn't say anything about the inner workings of ORTF. Conte was due to appear on an interview programme to discuss the book when the programme was cancelled and replaced by music—on a television station.

In June this year ORTF was beset by strikes so frequently that there were only three news bulletins a day, linked by music. ORTF had regained a great deal of prestige in the presidential election, when it had shown great skill in presenting the issues fairly. The only times when ORTF has been able to show its mettle is at a time when no one would dare to risk being accused of manipulating the broadcasters. Pompidou had even campaigned on independence for ORTF before he was elected.

The reforms proposed by the new president will go a little way to easing the situation, but not very far. All it will answer is the criticism that ORTF is badly managed. The French still think of ORTF as the mouthpiece of government. One other thing reduces the credibility of the President's attempts to reform ORTF. The Minister of Finance who, in 1964, refused to allow ORTF to control its own finances was M Valéry Giscard D'Estaing.

BBCQ

ON JULY 6 the BBC broadcast a programme of drama, music and birdsong as a first test transmission in four-channel sound. Four channels were transmitted by broadcasting two on Radio Two and two on Radio Three. The BBC announced the experiment on May 28. On March 18 the BBC had held a press conference at which they more or less discounted the possibility of such an experiment. That is to say that when asked by one of the attending pressmen

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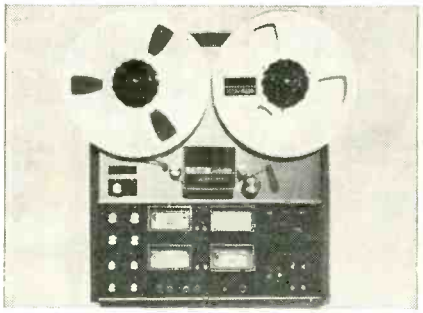

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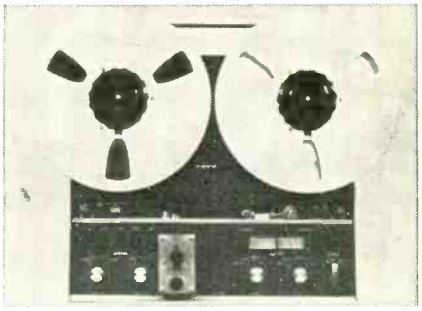

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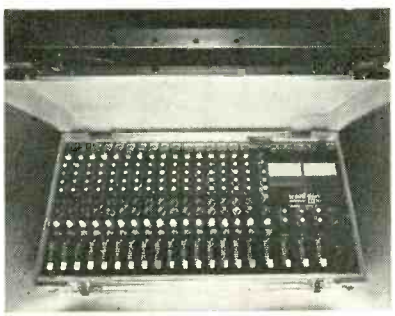

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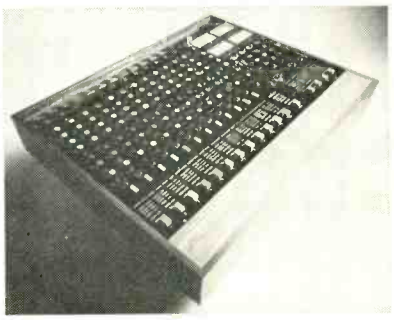

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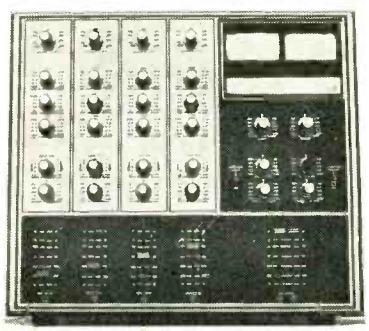

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whether there would be experiments using two stereo channels they reiterated a previous statement about not wanting to encourage the public to buy equipment they might later have to discard.

As long ago as January of last year Mr Stephen Hearst, controller of Radio Three, announced some new plans for the station which included just such experiments in quadraphony as have just taken place. He said that Radio Two and Three would be used simultaneously and he was even specific about the time of the putative experiments — between midnight and 1 am. 'The number of people who hear it will be infinitely small,' he said; but these experiments would be well into the future and meanwhile he was concerned to develop conventional stereo, which he felt as important to radio as colour was to television.

Thus journalists at Head of Engineering Information Mr C. B. B. Wood's press conference in March were puzzled by his reluctance to say whether the BBC would do any more in quad than make tapes, though the BBC say they were only discounting, for the moment, any regular service. In addition, the May issue of the journal *BBC Engineering* had published two articles and an editorial about quadraphony and the BBC were giving great publicity to the fact that, although no one would hear it as such unless invited to Broadcasting House, 'The Tempest' had been made in quad.

The BBC research department is working on what it regards as the many shortcomings of the various 4-2-4 systems in an attempt to identify and clarify these shortcomings. The transcription department, who were responsible with Radio Three for the Tempest production, began experiments towards the end of 1971 to study 'the operational implications of quadraphony and the various systems of information storage which have been proposed'. They conducted a survey among 100 of the world's broadcasting stations to get an idea of present and future trends in the medium. They received fewer replies than hoped for but those they did get demonstrated an interest in quad. 'Quadraphony is for many stations now more than just an experiment and the BBC expects to service their overseas customers' requirements in the not too distant future. The matrix versus discrete arguments will continue, but as each week passed (sic) by so some measure of agreement comes nearer.' The nearest approach to their expressing an official attitude was expressed in the editorial mentioned above: 'The BBC, in view of the capital investment involved and the necessity to provide a continuing and satisfactory service to stereophonic and monophonic listeners, will need carefully to assess the possibilities in both technical and economic terms. Thus while experiments in these new fields are actively pursued no immediate introduction of a new service should be expected.'

For the July experiment Radio Two was used to broadcast the front left and right channels and Radio Three was used for the rear, with the rear left being broadcast on what would normally be Radio Three's right-hand channel. The BBC also broadcast a rear channel on medium wave for those who didn't have a second vhf receiver but who wanted to do some experiments nevertheless.

As far as future experiments go the BBC is cautious about making any statement. They will probably make more broadcasts using the above arrangement, but they say that before they used any matrix system for experiments they would have to be satisfied that such a system did not degrade the signal-to-noise ratio and was perfectly compatible with mono and stereo. Nevertheless we may confidently expect some form of matrix to be broadcast as an experiment in the not-too-distant future.

Cassette cleaning by 3M and EMI

NEWLY-INTRODUCED Scotch head cleaner 'features a special thin-base cleaning material which requires just one 15-second pass at 40-hour operating intervals'. The cleaning tape is supplied in cassette case for dust exclusion. It is claimed that each cleaner is good for about 24 operations 'under normal conditions'; thus the life is for 960 hours of tape motion at 40-hour applications. Price is 99p including VAT. 3M (UK) Ltd, 3M House, Wigmore Street, London W1A 1ET. Tel 01-486 5522.

EMI offer a similar cassette package, again to be applied once every 40 hours. In addition there is a version suitable for cartridge head maintenance, in similar packaging. Prices are 55p (cassette) and 63p. EMI Ltd, 135 Blyth Road, Hayes, Middlesex UB3 1BP. Tel 01-573 3888.

Creative electronics and sound

'WE ARE mainly looking for a student who is a potential entrepreneur, who is able to co-ordinate a project and carry it through to a successful conclusion; 75 per cent of our students have to be competent musicians and pass an audition, the remaining 25 per cent should be able to prove innovation. The musician should have or be able to compose his own music or at least play from ear.' The course offered by Fanshawe College, 1460 Oxford Street East, London, Ontario N5W 5H1, Canada, in 'Creative electronics and music' claims to provide a three-year course for the record producer. Subject headings covered include recording production, electronic music, music language, electronic language, language and communication, music industry and perception. Details from the Registrar.

Ceefax

CEEFAX, WHICH the BBC have been developing since 1968, may be about to be used on a regular basis. The BBC are asking the government if they can start an experimental service. The BBC's director of engineering, Mr James Redmond, said at the end of June that the technical problems had now been overcome and the corporation was ready to start a regular experimental service. The service would establish whether there was enough public interest to maintain the service and to indicate to the television makers whether it would be worthwhile investing in capital to make cheap Ceefax decoders.

The system displays written information on television screens. It was developed at Kingswood Warren. The system could be fitted to a normal television set and several buttons would enable viewers to select from 30 pages of information. The adaptation would cost less than £100, though that price was announced in October 1972. Transmission is accomplished by using the gaps between picture scans, 50 every second. Among uses mentioned by Mr Wood, the head of engineering information, when the system was announced in 1972, were for farmers wanting instant weather forecasts, football fans wanting results, and the investor who could choose a page of stock market prices and see whether 'he could go to bed with a peaceful mind'.

The BBC say there have already been some broadcasts: when they announced their readiness to start the service they said they had just completed 5,000 hours-worth of tests conducted out of broadcasting hours and that 'we know of a few gifted amateurs who have already made their own Ceefax receivers . . .' The experiments would probably provide a news service 'and other genuine programme material'.

PAG footage counter

TWO VERSIONS of the counter shown are available, displaying either minutes and seconds or feet. The latter is switchable between 16 mm and 35 mm formats, and displays one to 9999 ft; the other displays from 1s to 99 min 59s. The encoder unit supplies a pulse drive for the counter, and may be fitted to projector, recorder or other equipment in the normal way. Alternative displays are available: 95 mm high back-projected numerals or 51 mm high seven-segment numerals as shown. Auto stop and cueing are provided for, the latter provided by green dots moving across the screen in place of traditional film-marking, and autolooping is achieved by automatic stop/start and rollback. PAG Films Ltd, 492 Kingston Road, London SW20 8DX. Tel. 01-542 1171.

Ampex vso

THE VS-10 variable speed oscillator has been introduced by Ampex, available as a separate item. Specifically designed for use with their own series of machines, the *AG-440* and *MM-1100* types, it is available with four-digit electronic speed readout, with a range of ±1 whole tone in quarter-tone steps and a coarse/fine adjustment. Up to three recorders can be driven simultaneously; weight is 1.36 kg. Ampex (GB) Ltd, 72 Berkeley Avenue, Reading, Berks. Tel. Reading (0734) 55341.

Calrec business

THE BBC have placed a further contract with Calrec for stereo broadcasting equipment, similar in function to that previously delivered. The *Mark 2* versions are lighter and smaller, with wider facilities. It is in three portable units: unit one contains eight mono channels with usual equalisation and routing to four main and one independent stereo groups, together with eight auxiliary mono groups and pa output groups; unit two has small-signal amps, faders, routing and further channel facilities; unit three contains metering and monitoring.

Tyne Tees Television has recently received from Calrec a 20-channel, four-group mono desk. Custom-built, it was designed after on-site study of operational requirements by the two concerns.

Sennheiser for Beeb

SENNHEISER ANNOUNCE that an order for 300 pairs of *HD 414* open-ear headphones has been placed with them by the BBC. Wimbledon coverage by foreign commentators accredited to BBC tv for the duration was with the *HMD 414* microphone/headset combination.

New Scottish vhf

BBC VHF RELAY stations at Ayr and Millburn Muir began transmission on June 13. On the site of existing 405-line tv relay stations, they extend coverage of Radio 1/2, Radio 3 and Radio Scotland in vhf by around 80,000 people; stereo broadcasting will commence with the Scottish stereo service.

Consumer shows

THE FIRATO radio and tv exhibition is to be held from Friday August 30 to Sunday September 8 at the RAI Exhibition Centre in Amsterdam. The last such show was in 1971, with 276,370 visitors; this year around 100 manufacturers and importers are expected to participate. Trade day is Thursday 29. Details from Amsterdam RAI, Europaplein 8, Amsterdam, Holland. Tel. 020-5 411 411, Telex 16017. The Harrogate UK exhibition is between August 30 and September 1, at the Majestic Hotel, Harrogate. Further details from Exhibition and Conference Services Ltd, Claremont House, Victoria Avenue, Harrogate. Tel. Harrogate (0423) 62677.

The Salone Internationale della Musica and Hi-Fidelity is to be held as usual in Milan, between September 8 and 10. 82 hi-fi exhibitors cover 12,000 m²; 63 music stands cover 10,000 m². Segreteria Generale, 20124 Milano, Via Vitruvio 38, Italy. Tel. (02) 20.21.13.

Cadac and quadraphonic radio

AN ORDER has been placed with Cadac by the Swedish Broadcasting Corporation for a studio desk incorporating quadraphonic facilities. The configuration is based on 36 in, 16 out, with provision for 24-channel monitoring. Modules include the standard Cadac quad and the new equalisation using their ic gyrator. The order was confirmed after 'many months of negotiation', and delivery is expected early next year. Although no encoding is incorporated at present, provision is made for later insertion of a desired system.

USA FCC and Dolby B

THE US Federal Communications Commission has approved the use of the Dolby B system with reduced pre-emphasis in FM broadcasting. American FM stations are now free to use a combination of B type noise reduction and reduced pre-emphasis at 25 μs as compared with the US standard of 75 μs and the European equivalent of 50 μs. Although several FM stations, in New York, Boston and Chicago, have been broadcasting Dolby B encoded signals, these have been with the traditional 75 μs pre-emphasis, under existing regulations.

The arguments for Dolby B encoding and subsequent alteration of the pre-emphasis are discussed in two papers presented to the AES: David Robinson, 'Dolby B Type Noise Reduction For FM Broadcasts,' Vol 21 pp 351-356 (June 1973); and Ray Dolby, 'Optimum Use of Noise Reduction in FM Broadcasting,' Vol 21 pp 357-362 (June 1973).

Historical reasons for the pre-emphasis have been long outmoded, due to the improved hf handling of contemporary equipment. Standardisation still requires a long time constant for compatibility, corresponding to +3 dB points of 2k Hz (75 μs) and 3k Hz (50 μs) approximately. Significant energy content at high frequencies means that, for a given transmitting level, either overall transmitter input programme level reduction or hf compression is necessary, with subsequent degradation of signal-to-noise ratio and/or quality.

It has been argued (Bauer, 1970) that the distribution of frequencies in a typical music programme has a hf attenuation corresponding to a time constant of 25 μs; this, rather than the equipment limitations, suggests a more natural standard for pre-emphasis.

If no decoder is available, a Dolby B encoded broadcast can be reasonably adjusted by means of hf roll-off to achieve an acceptable result. By chance, it is found that combination of B encoding and 25 μs pre-emphasis passed through a conventional receiver of 75 μs de-emphasis produces an end result subjectively very close to the original; with 50 μs de-emphasis it is claimed that the difference is noticeable but not objectionable, the reception being slightly 'brighter'. Thus, compatibility with existing formats is obtained: a listener equipped with decoding and de-emphasis will achieve the appropriate noise reduction; the present listener will benefit from higher effective signal strength, since the reduced pre-emphasis will not normally require reduced program level.

Since the effective programme strength is increased, improvements in interference rejection and coverage are possible using existing transmitter powers. A typical figure given for signal-to-noise improvement is 9 dB; this is equivalent to an increase in broadcasting coverage based on a square law calculation of 2.8x, which is expected to be reduced in practice.

The SCA system, by which further programme information is carried on a second subcarrier at 67k Hz, is a possible further source of interference in the characteristic form of hf 'monkey chatter'. It is likely that further types of control signal may be broadcast in a similar manner. A typical noise reduction of 9 dB is claimed using Dolby B processing.

Quad/Eight ppms

ALL SOLID-STATE ppms have been introduced by Quad/Eight Electronics, the *PK14* and *PK16*, the digits reflecting the number of leds per meter. VU characteristic is available as alternative; the vertical segmented readout is divided into the usual red and green areas. Integration times are claimed within DIN *45406* (ppm) and USA C16.5/1954 (VU). Adjustments provided include led brightness control and integration and decay time adjustment. The anachronistic *PK14* arc-scale led meter is to refit to present 90 mm meter installations; the *PK16* is vertically scaled. Full details from UK distributors Feldon Audio, 126 Great Portland Street, W1, or from manufacturers at 11929 Vose Street, North Hollywood, California 91605, USA. UK price approx £90, with delivery time estimated at one month. USA delivery from stock.

Advance PO approved

THE OS *3000* oscilloscope from Advance has been approved by the British Post Office for internal use. An initial order is for 300 units, to be designated Post Office Type 16A.

Altec distributor in UK

THEATRE PROJECTS of London have been appointed exclusive distributors of Altec equipment in the UK. The professional range of sound products is to be available. Theatre Projects, 10 Long Acre, London WC2E 9LN. Tel. 01-836 7877.

Marantz Headphones

A NEW HEADSET with electrostatic transducers is introduced by Marantz, the model *SE-1S*. Claimed frequency response is 20-20k Hz ±3 dB, with distortion at 100 dB SPL remaining below 0.5 per cent at all frequencies from 40 Hz to 20k Hz, with 1.5 per cent at 20 Hz. Impedance is 30Ω nominal, weight is 440g and power requirement is three watts per channel with overload protection. Price is £59.50. Pyser Britex Ltd, Fircroft Way, Edenbridge, Kent. Tel. 0732-71 2434/5.

CLEANFEED

by Cross Patch

Unlucky for some: Looks like the IBA will not be developing the commercial radio network beyond the 11 contracts already awarded plus two still up for bids, at least for some time to come. Little leaks from Knightsbridge suggest that the brakes have been put on until the Government reaches a decision on how many stations will be permitted. The original plan approved by the Heath Government was for a total of 60 stations, but the present Government is said, by those with an ear to Westminster keyholes, to want to reduce this number to below 20.

The factor likely to govern the final choice of numbers is the commitment to outstanding orders for transmitter equipment and the penalty payments that might be called for on cancellation, but it would also relieve the IBA of the very difficult problem of finding suitable transmitter sites and then getting planning consent. The suppliers of transmitter equipment could well take a sympathetic attitude to cancellation payments as they all have vital export orders awaiting urgent delivery and some lucrative defence contracts. In the present economic climate such a cut-back is viewed almost with relief by some would-be applicants who have been recasting the costings with gradually evaporating enthusiasm.

Right from the very start the whole grand idea of commercial radio seems to have been dogged by troubles which need never have occurred if only much more careful preplanning had gone into it. The impression remains that too much was made of the profit potential making a false comparison with the success of independent tv and so brightly did the future prospects glow in the eyes of the hopefuls that they were blinded to the commercial realities. In the beginning every aspirant, both big and small, declared that he was ruthlessly determined to get a franchise, and no harm whatever in declaring a ruthless determination, but ask any of them how they were going to run their stations if they did get a franchise and the answers made it obvious that very little thought had been given to such uninteresting matters as staffing and programmes. As for profitability forecasts, cash flow projections and the like, the less said the better.

A significant event which passed with little notice at the time was the early withdrawal of interest by Hughie Green who knows as much about commercial radio as any man living and whose colleague, Derek Faraday, spent many months of detailed study into the problems of propagation. Commercial radio must be made to be, and eventually will be, a modest success, although in its present form it can never be as profitable as some had hoped and it is going to be an uphill battle for most. It could have been otherwise.

Curse you, Moriarty!: With mounting excitement we hurried to Stand 73 at the APRS 74 Exhibition where, said the catalogue, we were to see something to do with exploding tape music. To be played, according to the knowledgeable, on Neddy Seegoon's own 12-octave racing piano, folks! Alas, 'twas not so. Just a mistake in emphasis. But we enjoyed the Blue film.

Crystal balls: It doesn't take the Hudson Institute to tell us that consumer marketing patterns are changing in the leisure field. A lingering look at the trade statistics is enough to give rise to interesting, if slightly chilling, prognostications. Accepting that the DTI's computer is in a permanent state of semi-glitch, current figures show an alarming downward slope in tv sales and projections continue the trend. Whether this is a reflection of domestic economic strictures or audience indigestion, perhaps a combination of both in arguable proportion, surely it presents an opportunity to the record industry further to increase its share of the home entertainment market. There can be no doubt the marketing departments are working on it. However, disposable income is shrinking, there can be no question of that, but the gramophone record still remains an attractive buy. It is up to all of us, particularly at the studio end of the chain, to keep it that way by sitting on the costs and pushing up the quality.

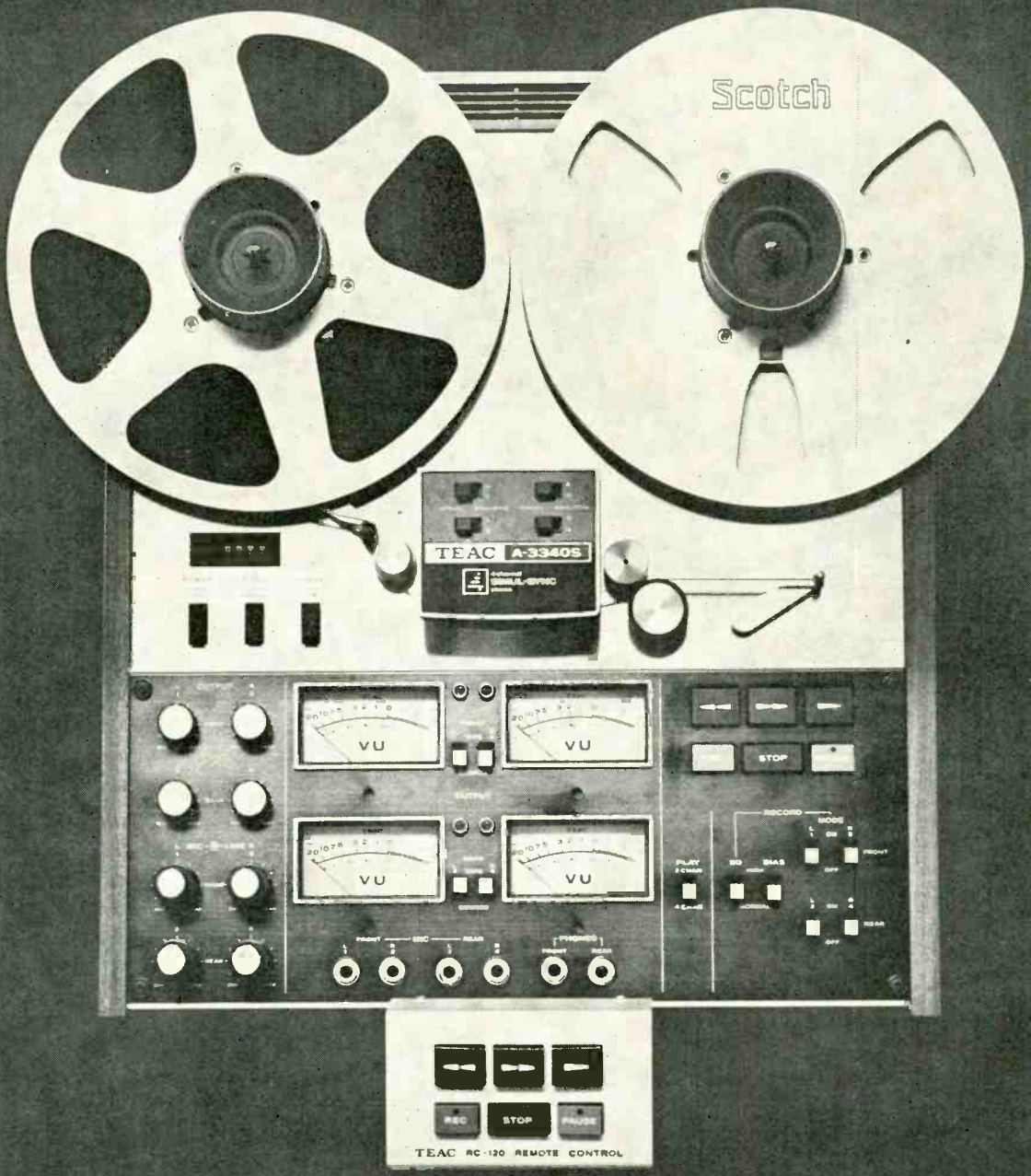
'allo, 'allo, what's all this then?: There is a story being told in our favourite all-night boozerie about a fairly well-known group who broke with their manager, then trotted along to a record company to sign a recording contract. In due course an album was released and the manager is now threatening to sue on the grounds that the group are still signed to him, whatever they may think, and the record company has egg on its face for not verifying the facts before signing a contract. 'Oh no, not that old chestnut again?' you will be asking yourself. Well, yes it just might be, but chit-chat over drinkies is a notoriously unreliable source of hard news.

No matter what the real story is, if anything, the rumour does ring round an ever-present peril in the recording business. The peril implicit in accepting a situation at face value and in good faith from someone who has absolutely no intention to deceive while in truth the whole thing is bristling with legal snags. At the studio end of the business the danger is unlikely to add up to more than a passing embarrassment with red faces all round. There is the villain who will ask you to master a bootleg tape swearing that it is by four of his cousins who happen to sound exactly like *Slade*, but he need be no problem. The producer who does his own fixing with scant regard for Musicians' Union rules can be a bit of a nuisance, but little more than that. The customer who brings you an armful of commercial discs to be dubbed on to tape as part of a programme without getting prior permission from the copyright holders is a real menace. That can involve a studio in a conspiracy charge and that ain't funny. Getting the customer to sign a piece of paper purporting to absolve the studio from blame can do just the opposite.

In the not-too-distant past, learned judges have ruled that such a piece of paper admits recognition of malpractice and therefore constitutes an admission of liability. So all a poor studio manager can do is proceed with caution, respecting the law, and making sure that at all times it can be shown that every reasonable precaution has been taken against inadvertently doing something naughty. When it comes to buying secondhand equipment there are one or two dealers of impeccable reputation, otherwise there is a little Latin tag used by lawyers—*caveat emptor;* let the buyer beware—it might have fallen off a lorry and if by chance it has neither ignorance nor time is any defence against a nasty charge of being in possession of stolen property, or even having once been when it is traced back to you. Yes, *caveat emptor* indeed, because there is an awful lot of 'hot' stuff around including some which would seem to be entirely genuine and yet has been disposed of without the owner's consent. Better have another look at the serial number on that Nagra.

Quadratic halt: Well-supported rumour going the rounds that a major hardware manufacturer is pulling out of the quad scene . . . at least until some standardisation can be agreed. If true this is a very sensible move which should have been made months ago. Not that the system in question is any worse or any better than any of the other systems, depending on how you listen and what you listen for, and whether it is discrete or matrix, or this and that and whatever, and how many knobs there are on the front panel. You know, the record industry really is quite unique in giving priority to creation often at the expense of marketing. No other industry could have survived the incredible cock-ups that have occurred when goods have been produced like rabbits out of hats to the astonishment of retail trade and public alike without the slightest detectable sign of market research and salesman-training having gone before. Remember stereo? We shall probably never know the name of the enthusiast who caused the premature release of stereo records long before either the retail trade or the public were ready, before even stereo recording techniques were perfected. But the problems quietly sorted themselves out without undue loss of blood and the sales figures continued to soar with hardly a hiccup in the graph. On the other hand the introduction of the cassette was a lovely bit of expert marketing, but the only example to come readily to mind. However, when all is said and done the record industry has provided so much pleasure to so many, and earns us our bread and butter with a little jam tomorrow. The curves continue to point ever upwards showing an astonishing growth rate both in volume and profits . . . so far.

THE NEW TEAC A3340S



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105 HIGH STEET ETON BUCKS SL4 6AF PHONE WINDSOR 51403/53014

PATENTS

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

June 5

1360736 Standard Telephones & Cables Ltd.
Scanned displayed device.
1360760 Commissariat A L'Energie Atomique.
Rectangular pulse generator.
1360828 Klemt KG, Arthur.
Optical apparatus.
1360840 Matsushita Electric Industrial Co Ltd.
Automatic tape loading type magnetic recording and reproducing apparatus.
1360858 Philips Electronic & Associated Industries Ltd.
Signal processing arrangement for a colour television camera.
1360875 Philips Electronic & Associated Industries Ltd.
Generating amplitude - modulated sawtooth signals.
1360918 Matsushita Electric Industrial Co Ltd.
Magnetic tape duplicating system.
1361032 Wurlitzer Co.
Musical instruments.
1361048 International Computer Products Inc.
Apparatus for driving tape or other elongate material.
1361123 General Electric Co.
Radio receiver selecting arrangement.
1361124 General Electric Co.
Audio signal quality indicating circuit.
1361145 Hughes Aircraft Co.
Optical raster scan generator.
1361156 Bendix Corporation.
Digital sweep generator in video storage device for a radar data display system.
1361202 Eastman Kodak Co.
Intermittent strip feeding device.
1361203 Eastman Kodak Co.
Device for advancing imperforate photographic film.
1361248 Fuji Photo Film Co Ltd.
Thermal recording cathode ray tube.
1361252 Borusutzki, H. G., and Nordgren, M. O.
Electric sound generating assembly.
1361274 RCA Corporation.
Selective tint correction circuits.
1361295 Nihon Denshi KK.
Electron beam recorder.
1361297 Minnesota Mining & Mfg Co.
Noise exposure computer and method.
1361371 Kureha Kagaku Kogyo KK.
Piezoelectric electroacoustic transducer.
1361431 Philips Electronic & Associated Industries Ltd.
Electronic musical instrument provided with variable inter-coupling of the keyboards.
1361457 Eastman Kodak Co.
Telecine apparatus.
1361480 Krupp GmbH, Fried.
Method and circuits for attenuating a wideband background noise level and interference signals superimposed on it.
1361495 Rackett, G. F., and Sacks, R.
Apparatus for handling endless loops.
1361500 Matsushita Electric Industrial Co Ltd.
Intermittent tape drive type data recorder.
1361539 Burwen, R. S.
Wide dynamic range noise masking compandor.

June 12

1361578 Sharp KK.
Colour television.
1361610 Plessey Co Ltd.
Apparatus for playing disc records.
1361675 Hermann, H.
Film splicing assembly and film splicer.
1361732 Multicore Solders Ltd.
Cleaning of gramophone records.
1361746 Nippon Gakki Seizo KK.
Tone-generator for electronic musical instruments.
1361756 Litton Industries Inc.
Linearity correction circuit suitable for cathode ray tubes.
1361774 Oda Gosen Kogyo KK.
Electro-conductive ceramic guide and its manufacturing method.
1361778 Matsushita Electric Industrial Co Ltd.
Colour still picture display apparatus.
1361808 Optasound Corporation.
Synchronising system for recording visual images and sound.
1361809 Optasound Corporation.
Brake system for a battery-operated tape recorder.
1361891 American Telecommunications Corporation.
Telephone actuating mechanism.
1361995 Agfa-Gevaert AG.
Cine camera.
1362061 Marconi Co Ltd.
Display arrangements.
1362065 Agfa-Gevaert AG.
Apparatus for effecting line-by-line scanning of a series of images in motion.
1362105 International Business Machines Corporation.
Apparatus for sensing magnetic data.
1362131 Post Office.
Reducing unwanted modulation in a communication system.
1362154 Hughes Aircraft Co.
Automatic tuner.
1362191 Independent Broadcasting Authority.
Television systems.
1362192 Cabachin Ltd.
Inductive remote control system.
1362225 Somers, S. B. L.
Magnetic tape cassette.
1362233 Hewlett-Packard Co.
Method of filtering light and apparatus therefor.
1362234 Hewlett-Packard Co.
Acousto-optical filter apparatus.

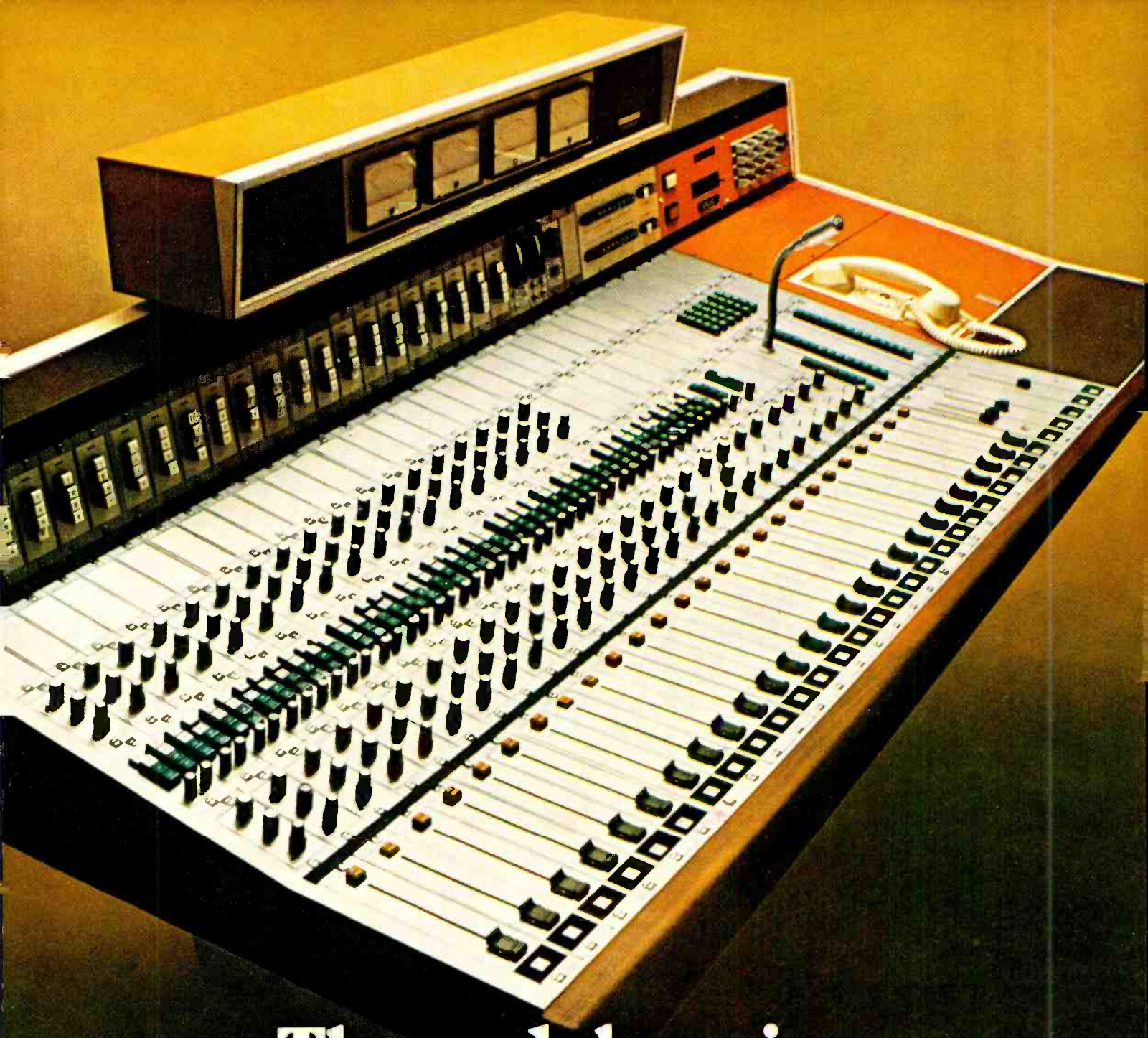
June 19

This issue did not appear due to printing difficulties.

June 28

1362282 RCA Corporation.
Variable gain amplifier.
1362322 Wurlitzer Co.
Piano soundboard assemblies.
1362413 Industrial Patent Development Corporation.
Decoding method and apparatus.
1362477 Singer Co.
Display raster computer.
1362487 Westinghouse Electric Corporation.
Means for generating a flat-topped pulse with sine-squared rise and fall characteristics.
1362524 Plessey Co Ltd.
Energy receiving arrangements.
1362588 Matsushita Electric Industrial Co Ltd.
Electric signal apparatus.
1362640 Chicago Musical Instrument Co.
Musical instruments.
1362709 Tischer, F. J.
Waveguides and components and circuit arrangements using waveguides.
1362728 International Business Machines Corporation.
Magnetic tape cassette players.
1362741 General Electric Co Ltd, and Morgan, T. R.
End-fire periodic dipole aerial arrays.
1362763 Bosch Fernsehanlagen GmbH, Robert.
Television apparatus.
1362836 Matsushita Electrical Industrial Co Ltd.
Radio mobile station detecting system.
1362926 United Aircraft Corporation.
Mode interferometer squinting radar antenna.
1362946 Thomson—CSF.
Multiplexer - demultiplexer for microwave antennas.

36 ▶



The modular mixer

Take a good look at this mixer. Under that eye-catching console is a system that reflects the technical expertise gained from years of experience in the studio sound business.

Here, at last, is a mixer tailor-made to your requirements, but costing no more than a standard production model.

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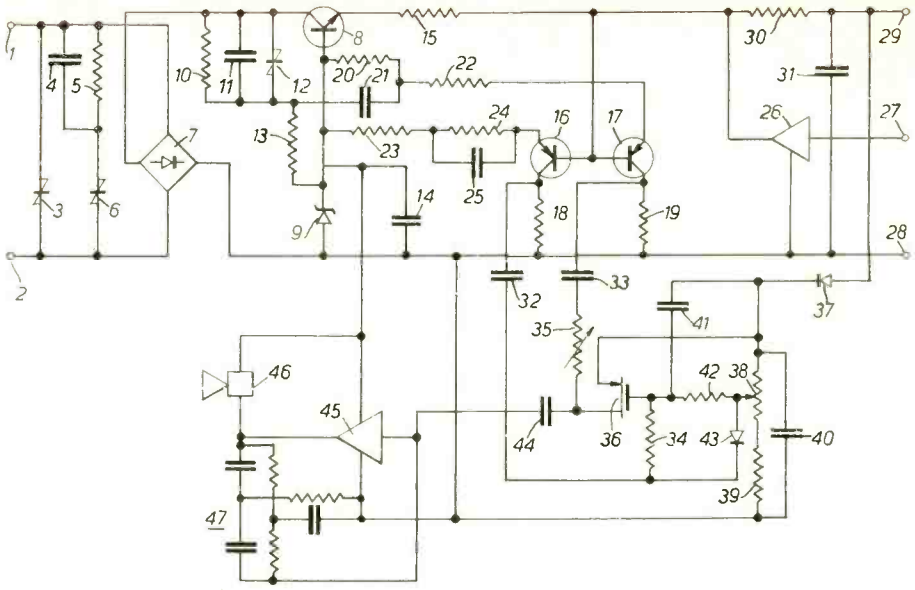
Schlumberger

Schlumberger Instruments and Systems, 296, Avenue Napoleon Bonaparte,
92500 Rueil-Malmaison, France. Tel: 977 02 23. Telex: Mahonby 26640

PATENTS



Amplifiers with built-in feedback suppression

THE POST OFFICE, in BP1,349,734, describe an amplifier for use in a public address system or loudspeaking telephone which should be free from the risk of feedback howls. The system could therefore be of considerable use in studio foldback systems to safeguard musicians wearing cans and in radio stations where incoming phone calls to studio guests are broadcast in conference fashion.

The telephone line is applied at terminals one and two along with 50V dc. A microphone such as an electret is connected between terminals 27 and 28 to an amplifier 26. Loudspeaker 46 reproduces the output of amplifier 45. Selective negative feedback over the amplifier 45 is provided by twin-T filter 47 connected from the output of the amplifier to its input. The filter 47 is so designed that there is a substantial amount of negative feedback at all frequencies except a narrow band (e.g. of between 18 to 20k Hz). Thus the gain of the amplifier within this narrow band of frequencies is very much greater than at other frequencies, particularly within the audible frequency bands.

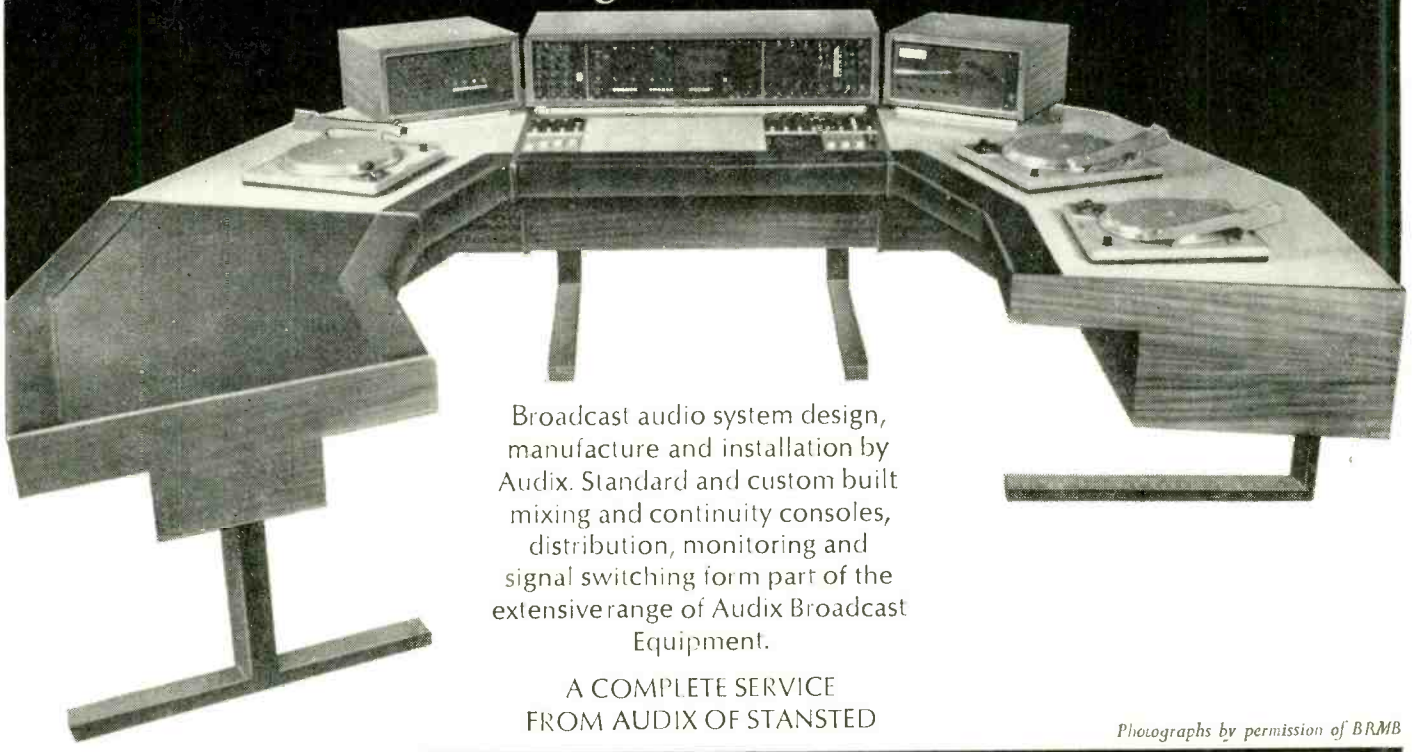
If the loudspeaker 46 and the microphone connected to terminals 27 and 28 are placed too close, a feedback path will be created which under normal circumstances would lead to oscillation and feedback howl. But because the amplifier 45 has greater gain at around 18 to 20k Hz, the circuit is much more likely to oscillate at about 20k Hz than in the audible frequency band. When this happens the high-pitched oscillation causes the diode 43 to produce a dc signal which reduces the resistance between the source and the drain of an fet 36. Thus the input of amplifier 45 is shunted to earth. In this way the overall gain round the loop is controlled so that oscillation just occurs at about 20k Hz but not at lower, audible frequencies.

I can imagine the 20k Hz whistle annoying many people but the patent suggests that, provided the loudspeaker and microphone have reasonable sensitivity at higher frequencies, the oscillation frequency can be raised accordingly.

audix

SOUND SYSTEMS AND ELECTRONICS

Broadcast Systems



Broadcast audio system design, manufacture and installation by Audix. Standard and custom built mixing and continuity consoles, distribution, monitoring and signal switching form part of the extensive range of Audix Broadcast Equipment.

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(4 lines) (STD 0279)

After 45 years in the recording industry, Gus Cook retired in June. Having been general manager at EMI's Abbey Road studios for five years, he will continue with them in an advisory capacity.

Gus Cook

JOHN DWYER

ON THE last Friday in June EMI studios formally bid farewell to their general manager, Gus Cook, and wished him a happy retirement. He had been with what is now EMI since before the Gramophone Company and the Columbia Graphophone Company combined in 1931 to form Electric and Musical Industries. In 1929 the Gramophone Company had merged with Marconiphone, and it was in that year that Gus had joined the recording department of Columbia Graphophone.

Describing the man is like picking your way through a minefield of clichés, such as 'sprightly', 'energetic,' 'alert' and so on, the problem being that all of them are true, but that all of them are more than faintly patronising. Nevertheless it is hard to imagine that Gus, fitter at 66 than most people of 35, was in recording only two years or less after Warners produced the first talking picture in October 1927. Suffice it to say that he's neatly dressed, meticulously shaven, very articulate, and enthusiastic almost to the point of being over-lively. It is certain that he hasn't any intention of spending his time growing roses, although if that were what he wanted to do his new home, a cottage in Oxfordshire, sounds as if it would still get the part. As Gus met his interviewer at the top of the stairs to the third floor flat next to Abbey Road studios, he apologised for the mess (of which none was in evidence) and explained that they were in turmoil because of the removals. He and his family have lived there for 28 years.

It was 1925 when Gus left the Borough Polytechnic and joined the post office as a telephone engineer. He had done a three-year technical course in general engineering, including some electronics, though he explains that that part was pretty primitive: 'Valves were only just coming out'. Although the gramophone had been around for some years and the national wireless service, soon to become the BBC, was rapidly becoming part of life, he had no thought of going into sound recording. Indeed, around 1928 he looked set for a good career in the post office, and was supervising the installation of the first automatic telephone exchange in London to use the seven digit system.

Until then recording was acoustic. There would be two rooms with a horn pushed through a hole in the dividing wall and the singer would be put in one room with the horn, the engineer with the acoustic disc-cutting machine in the next. The engineers were mechanical engineers with no knowledge of things electrical. But the development of the valve and improvements in microphones led to the introduction of electrical recording in the mid-twenties and the nature of the job changed: 'For those days it was an extremely complicated piece of apparatus. There was a microphone, an amplifier and a cutter, and to work it all they had to get hold of what they considered were a lot of boffins.' Many of the boffins recruited to use and develop the new art were from the post office. Gus says he wasn't interested at first, but then his interest awakened and, in 1929, he went to Columbia.

Columbia had themselves been responsible for a number of developments in recording up to that time. In 1922, for instance, they had discovered that record surface noise could be reduced by using extremely finely-ground materials for the record surface. The Western Electric Company had developed a monopoly in electrical recording, having made and installed the equipment for the first talking pictures. They had patented the condenser microphone, with its one-stage valve amplifier built into a wooden box underneath, and the moving armature electrical cutter. Consequently Columbia and others had to pay a royalty to Western on each record and a fee for the use of the equipment.

Columbia rapidly tired of this, as well they might, and they engaged a young man called Alan Blumlein to design a patent-free cutter and microphone, which he did in 1930. Thus Blumlein invented the moving coil principle, and used it in both microphone and cutter.

Like most of us he's a great admirer of Blumlein: 'What a brain that man had. If you look at the list of patents he brought out . . . He was far ahead of his time. In 1931 he had developed stereo—we still have 78 discs of him walking across the stage from left to right giving instructions as to how to set it up. The frequency response was to 5000 Hz. He thought the film industry might be interested because they could use it instead of a swinging boom, but they weren't so it was shelved until Goldmark of CBS took it up.'

Gus remembers that when he arrived at Columbia in 1929 he was paid £3 10s a week—at the post office he had been paid £3. 'I thought I had a handsome increase, too.' Soon he was head of the electrical department. 'It shows you how fast things moved. When I went there I was on three months' probation because my electronic knowledge wasn't too good and I did evening classes at Regent Street Polytechnic. Things moved so fast that at the end of two months I was in Athens.'

So around 1930 he did a tour of Greece, Albania, Norway, Switzerland and Holland showing the engineers in those countries how to install and use their equipment. 'They had no technical knowledge. I did the first electrical recording in South Africa. Up to that time, you see, they used to send artists to England to record. It took from about 1927, when electrical recording came in, to about 1938 for the rest of Europe to be capable of producing their own technicians.'

In 1931, as well as the South Africa trip he went to India and Burma. Also in that year Columbia merged with the Gramophone Company: 'The Gramophone Company had installed Western Electric gear and so in Abbey Road it was replaced with moving coil equipment. There hadn't been enough work for two staffs and Mr Dart of the Gramophone Company went to the BBC and took some engineers with him and that's how they formed the BBC recording unit . . . As far as I know they developed their own system.'

In the following year he went to Greece and Turkey. In 1933 he had a spell at home. He spent nine months in the new EMI company's production department involved in making moving coil recording equipment, 'but my heart was in the studio work'. Thus he was glad to be asked to go to Italy in 1934.

From then until 1936 he was the engineer in charge of the studios in Milan, where he met his wife. It was a difficult time. Mussolini had been in power since 1922 and foreigners were made to feel uncomfortable about taking jobs in preference to Italian workers. He tells one story, though, of how he partially, and tempor-

arily, overcame the problems: 'You couldn't stay there without the approval of the Sindicato, the trade union. They didn't like two Englishmen working at the studio but one day they needed someone to dub the voice of a Scotland Yard detective. I could speak Italian by this time and they wanted it in Italian, but poor Italian, with an English accent. So I did it.' Thus he gained membership of the Sindicato.

By 1936, however, it had become impossible to stay any longer, though as he left he had the satisfaction of knowing he had helped to make classic recordings of Verdi's Requiem, Puccini's Tosca and Madame Butterfly, and many others. He made these, he says, with two microphones in front of the orchestra and soloists and two more for the chorus and effects. He remembers the recordings with great pride.

He had also recorded one or two other historic items of a less usual nature: 'Myself and a colleague recorded all of Mussolini's speeches. Ironic really, that two Englishmen should have done it. The recordings eventually went into the state archives.'

He married in July the following year, and from then until the outbreak of the war made annual return visits to Italy and Turkey for two or three months of the year. 'When we saw the war was blowing up we joined a volunteer branch of the RAF. At first it was known as the Civilian Wireless Reserve, but then it was transferred just before the war to the RAFVR.' The first part of the war he spent fitting transceivers to Blenheim bombers; then he was stationed in Buckinghamshire installing and operating transmitting stations. 'By early '41 I was building Marconi short wave broadcast stations, high-powered stuff.'

Technical Warrant Officer Cook rejoined EMI in 1945. And for the next five years he was Engineer in Charge of Studios Maintenance. He confesses that the years that followed were a bewildering time to be involved in sound recording: 'It was an awful business to be an engineer in those days because no sooner had you got used to a technical development than something else would come along'.

The reason for the rapidity of developments was that during the war there had been almost no commercial recording, apart from those BBC broadcasts and for ENSA, the services' entertainments association. 'Records at the end of the war had a frequency response up to about 5k. It was supposed to be up to 7,500 cycles but it was about minus ten at that so the real response was up to about 5k. The first thing we did was to set about improving the frequency response and we got it up to 12k. That was about 1948.'

The next important step came with the widespread use of the tape machine, which the Germans had developed during the war to record and decode morse messages. A joint American and British team went to Germany after the war to look at their recording techniques and afterwards machines were developed here and in America. 'The lp only became practicable when you could edit on tape, because you couldn't expect an artist to go into a studio and sing continuously for 25 minutes without making a mistake, it wasn't possible . . . When we first started to use tape we used to record on disc at the same time. We'd process the disc and then we'd compare the tape and the disc very carefully. When we were quite sure about the tape we used that.'

Gus Cook

Gus says an important element in the development of the record was the invention of the lacquer disc in 1938. It was impossible to record direct on to wax for the microgroove discs so lacquers began to be used, though it took some time to get a good quality, flat aluminium core. Stereo was the next refinement —it's surprising to consider that the coming of tape made it possible to record in stereo in 1951 or earlier even though commercial recordings weren't generally available until 1958 or so. 'We made the first commercial tape machines, the BTR Series, which we developed for the BBC.' He's non-committal about the reasons for the discontinuation of tape machine manufacture, a move some of the EMI hierarchy must have bitterly regretted ever since, particularly when you can still find BTR2s not only in good condition but fought over—EMI themselves only pensioned off their last one a year ago. All he will say about the decision to stop making the machines is: 'It was a commercial decision'.

From 1950 to 1965 he was engineer in charge of Studios technical operations, after which he was deputy manager until 1969. He attributes the improvements in recordings to two obvious but important things: 'First of all the record has slowly but measurably improved with recording techniques and improved equipment, especially on the cutting side. Secondly the reproduction equipment has improved, although the product was always there in the records produced . . . it's there. The information is there in the groove if you take it off with the right equipment and what is more it always has been.' He was appointed general manager in 1969. He describes his now relinquished responsibilities as 'everything from the restaurant to operatic and pop work'. The staff at Abbey Road numbers about 90. 'Thirty per cent of his work was to give technical assistance to overseas studios. One of the things we prided ourselves on was our liaison with research and the close co-operation with the development side. There would be monthly meetings with representatives from the factory, the studios, and research, and we would discuss future policy and future developments.'

He admits EMI have been cautious about accepting new developments—they have yet to install 24 track, though that will come at the end of this year—but that is not because they dislike those developments. 'There are certain occasions with certain types of programme where multi-tracking is not always necessary. On the other hand if you have good creative groups like Pink Floyd and Argent it is necessary. In my opinion, once you get to 24 tracks then there must be serious thought to automation in the mixing console. Automatic mixing is not yet sophisticated enough, and it won't be adequate until you can extend it to equalisation and so on. We're now moving over to digital techniques. Well, if they are to be used to the best advantage then the tap erecorder must also be digital. It is only now that digital techniques can match analogue in signal-to-noise ratio. We're reaching this stage and it'll come.'

He estimates that for quad you need a minimum of eight tracks when recording classical music, and that if you're using eight tracks on one-inch tape you must have noise reduction. With fewer tracks than that we liked to think we were careful enough, and skilled enough, and took enough care so that noise reduction wasn't necessary. But people would come in and ask for those facilities so we provided them.'

Quad was one issue where EMI took the initiative. Gus is convinced they made the right decision. He gave full credit to the advantages of systems other than SQ. The JVC system, he considered, had minor faults which would be solved soon, if they hadn't already been, such as the need for a Shibata stylus and a special cartridge. But it had two failings that, in his opinion, were crucial. One was the wide band

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The tendency towards deploying larger numbers of mixer output groups has not until now been matched by improvement in metering convenience. The development of a crt display unit in the light of user requirements is described.

Simultaneous crt analogue monitor

TREVOR ATTEWELL

THE WORK to be described was triggered some two years ago, when a mixer at an exhibition was seen to be equipped with a formidable array of ppms in a double row, stretching the full width of the desk, which was considerable! It seemed clear that no operator could possibly make simultaneous use of all of them, and this raised the question —why so many? On asking a few users, it appeared that the ability to monitor every channel and group without switching was considered essential, even though only the groups could be monitored with any continuity. Further, it seemed that most users would ideally like a compact system in which all channels could be seen simultaneously within a small area but with suitable emphasis on selected circuits, normally output groups.

Various ways of realising such a system were considered, and one or two display arrangements were tried out, including lamp and led devices, but all suffered from the fact that the number of steps displayed was limited by the physical sizes of the respective indicators; moreover, some of the associated circuits began to look like the harbingers of a local component famine! True, custom-built leds and ics can now provide at least part of the answer, but users apparently do insist on a continuously variable display, any stepping motion being generally considered objectionable.

One solution seemed to lie in the use of a crt display, which can provide all the flexibility required. Calrec Audio Ltd were interested in the production possibilities of such a system, and readily agreed to finance the development of a prototype for evaluation. The following minimum requirements were assumed: **1.** At least 16 simultaneous information channels must be provided, with provision for increasing this number subsequently with only minor modification of the existing circuits. Smaller units should also be available easily. **2.** The display should consist of solid, vertical lines, one per circuit monitored, the line length representing the amplitude. The vertical bar motion must be continuous, i.e. true analogue presentation. **3.** Either VU or ppm characteristics should be available on any input, independently of all others. It should also be possible to modify any input to any alternative characteristic that may be specified in the future. **4.** Provision should be made for a visual warning when any selected channel exceeds a preset level. The level and choice of channel should be easily adjustable. **5.** It should be possible to emphasise any channel, regardless of level, for rapid identification, either continuously, or on demand, and this facility should be additional to (4). It should also be possible to adjust the horizontal separation between channels to give various groupings. **6.** The equipment should be capable of inclusion in a normal desk. There should also be an 'add-on' unit for existing desks and this should present a low profile to avoid clutter or loss of visibility over the desk top. The display unit should be mountable off the desk if necessary. **7.** 'Repeater' displays should be available, so that producers or artists can monitor all or part of the main display. **8.** All circuits must be temperature stable and require no setting up after installation. The characteristics should conform to accepted standards in so far as these apply.

A prototype has been constructed to prove the design feasibility. Considerations peculiar to this one model made it sensible to use a mixture of ics and discrete components in something like 50/50 proportions, but this ratio will change in favour of more ics in subsequent models.

A block diagram is given in **fig. 1.** In describing the operation, it is convenient to start with the signal inputs. Since a sampling technique is used, input information must be continuously available from all inputs if short-duration peaks are not to be partially lost, and the switching must therefore come after the input signals have been processed. In the prototype, all inputs have ppm characteristics. Each input is passed through a precision rectifier, followed by a logarithmic converter, the output being taken from the storage stage. The inputs are at normal line level (0 dBm at half scale) and may be balanced or unbalanced —no input transformers are needed. The outputs are in the range (approx) ½ to 12V. The ppms meet the usual BBC specification, with a good margin on many parameters, especially temperature stability. With a trivial modification they could be used to drive meters, though that is scarcely the idea here!

Each input must now be selected in turn for display, and this is achieved by a binary scaler of 16 counter driving a diode AND matrix (see **fig. 1**). Each AND gate in the matrix has one channel-switching busbar as its output, the busbar being allowed to rise in potential only when the counter output satisfies that particular AND condition. The channel-switching busbar is connected to a diode gate, so that its rising potential is caught by one diode (*D1*) at the prevailing ppm output level. The other diode (*D2*) lifts the voltage on the Y-signal busbar to a level which will be equal to the ppm output voltage if the diode forward voltage drops are equal. Selected diodes are preferable, but the errors using unmatched ones have been found to be in practice generally negligible. Each advance of the binary counter selects the next input in turn, all the others being isolated by the diode gates. To avoid clutter, only two channels are shown in **fig. 1.**

The binary counter is a straightforward set of four bistables, driven by a pulse generator through a monostable delay circuit, the waveforms being as shown in **fig. 2.** The pulse generator is asymmetric, and the shorter, negative-going part of its output is used as a blanking pulse for the crt. The changeover between channels is initiated at the end of the monostable pulse, so that it occurs during the blanking period, and all the necessary transitions of the bistables and other triggers are complete before the blanking pulse terminates.

A 'staircase' waveform is needed for the X-deflection of the crt, and is conveniently derived by adding suitable proportions of four of the counter outputs, using a virtual-earth mixer. By making the proportioning resistors partly variable, it is a simple matter to separate the displayed channels into various groupings, as required, by the appropriate variations in step heights.

The next problem is to display the fixed voltage for each channel in turn as a vertical line. A changing voltage is needed, and this is produced by a sawtooth generator, which is

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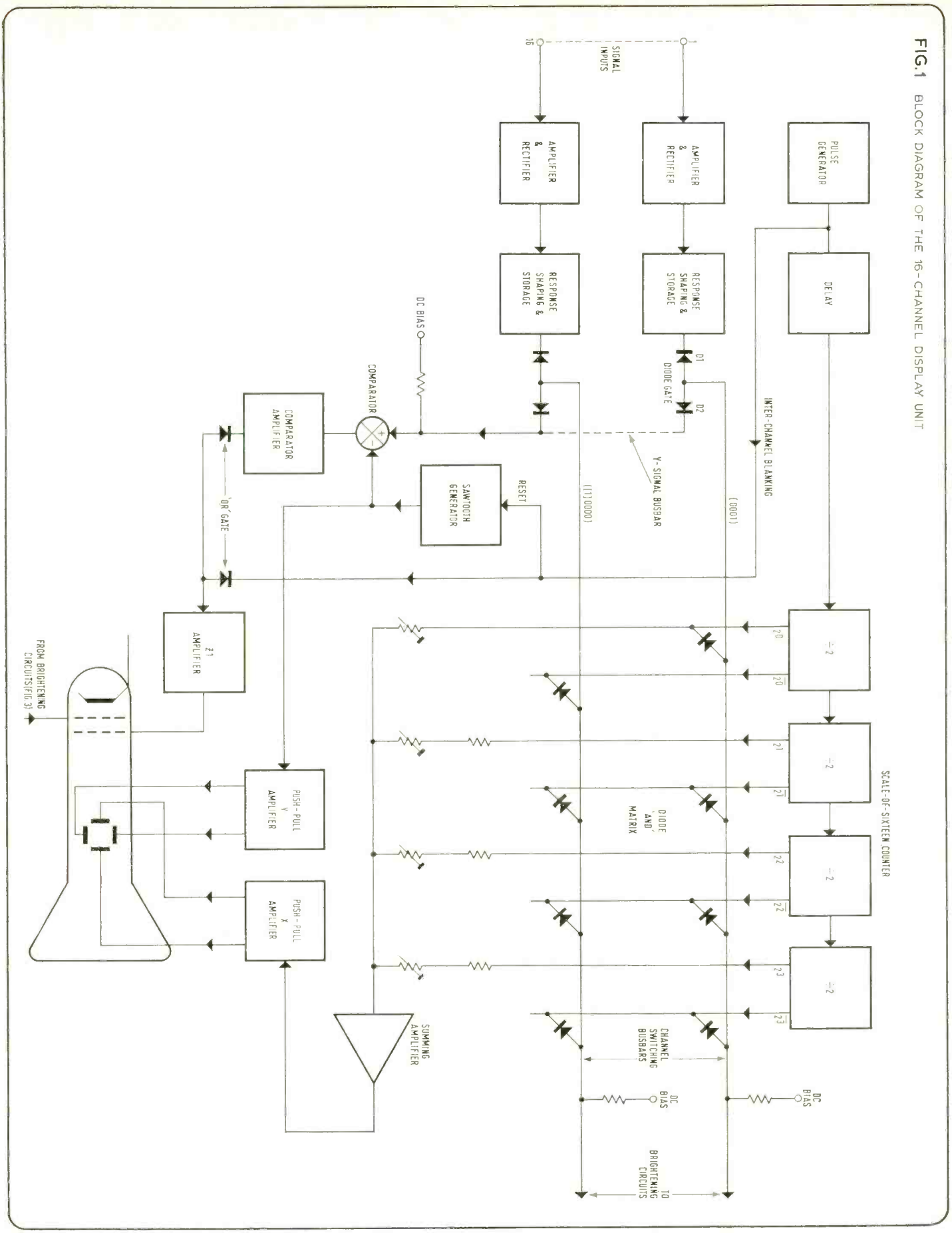


FIG.1 BLOCK DIAGRAM OF THE 16-CHANNEL DISPLAY UNIT

reset by each blanking pulse (see **fig. 2**), and then makes a vertical sweep, covering the complete tube height, for each channel in turn. This alone will not do, of course, because each vertical line must stop at the level representing the current Y-busbar voltage. For this to happen, the difference between the sawtooth and busbar voltages is detected by the comparator (**fig. 1**). As soon as the former exceeds the latter by a few millivolts a large output is obtained from the comparator-amplifier, and this is used to blank the crt for the rest of the sweep. On the flyback the comparator unblanks the crt at the same level, but the trace does not reappear, since it is then being blanked by the inter-channel blanking pulse which is mixed with the comparator blanking output in the OR gate shown in the figure.

It may be seen that the sawtooth amplitude is not critical—it must be large enough to deflect the spot fully, but not so large that needless time (and hence brightness) is lost before the next sweep starts. By taking the Y-amplifier input directly from the Y-signal busbar instead of the sawtooth output, a dot display is obtained. This could, conceivably, have some use, but does not seem appropriate for normal desk monitoring.

The repetition rate of the system is determined only by the need to avoid flicker effects. For 16 channels, a 1k Hz clock rate for the pulse generator allows about 60 complete displays per second, which is more than adequate. A low clock rate also permits slower pulse edges—a deliberate feature to cut down the risk of crosstalk into the ppms, though the likelihood of this is not great at line level, given reasonable layout and decoupled power supplies.

The X- and Y-amplifiers are conventional push-pull circuits, with the usual shift facilities, and need no comment.

To deal with requirements (4) and (5), brightening pulses are derived independently for the two functions using the arrangement of **fig. 3**. Switches A and B are provided for each of the channel-switching busbars, and the A switch is closed for any channel which is to be brightened throughout its length, i.e. to emphasise its presence. The trigger following the switch senses the rise of the channel-switching busbar voltage when that channel is selected before the crt is unblanked, and a brightening voltage is passed through the Z2 amplifier to the tube modulating grid. For overload warning on any channel, the B switch is closed, and the second trigger circuit operates if the preset reference voltage is exceeded. Using an OR gate as shown only two brightness levels are provided (normal and channel identification or overload respectively), but an adder may be switched into circuit in place of the OR gate, in which case an identified channel is doubly brightened above the overload level. The channels may be divided between several overload trigger circuits if more than one overload level must be distinguished. In all cases any trace brightening is overridden by the tube blanking. It should be added that the brightening facilities have not yet been built into the prototype, and hence do not appear in the photograph of a typical display which accompanies this article.

A conventional tube brightness control is used to set the overall picture brightness and can be adjusted if desired so that a faint trace appears in the background over the full height of each channel, the operating portion being brightened—one or two users have expressed a preference for this mode.

The vertical lines on the tube face could of course be widened into bars of appreciable width by additional horizontal signals. However, this would involve the use of rf and it was felt that this likely source of interference might be better avoided. Deliberate misuse of focus and astigmatism controls gives a horizontally elongated spot, and magnetic methods could also be used. In practice, such broadening has not been found particularly useful by those who have tried the system, and the slight complication may well prove unnecessary.

Finally, a few additional possibilities of the system might be mentioned. Since each input is quite separate, it is a simple matter to replace the ppms with boards having VU characteristics. Other special requirements could equally well be catered for, and this method might well be able to provide responses which would be quite impossible with mechanical movements.

It can be seen that the system is easily expanded to (say) 32 channels by adding the extra input circuits, plus one extra divider and a second diode matrix. The existing matrix would require two more vertical busbars and 16 diodes, but these are readily prepared for in advance. To obtain an eight-channel version it is merely necessary to equip eight channels of the existing arrangement, with a simple conversion to 16 channels when wanted.

Having generated suitable signals for one crt there is no difficulty in feeding any number of remote indicator tubes, inserting line amplifiers where the cable lengths make this desirable. The remote (or local) indicators are not confined to instrument type crts—television or even projection tubes could be used if large displays are needed. Repeater installations could also be used for silent cueing, if one or more channels are used to carry the cues.

The system also offers the possibility of introducing certain potentially useful forms of automation, some of which are being considered at present.

The work described here has been carried out exclusively for Calrec Audio Limited, and their permission to publish these details is gratefully acknowledged. Any requests for further information should be addressed to the company, please.

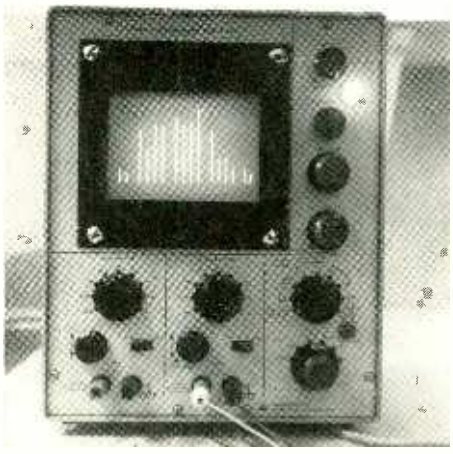


FIG. 2 TYPICAL WAVEFORMS (NOT TO SCALE)

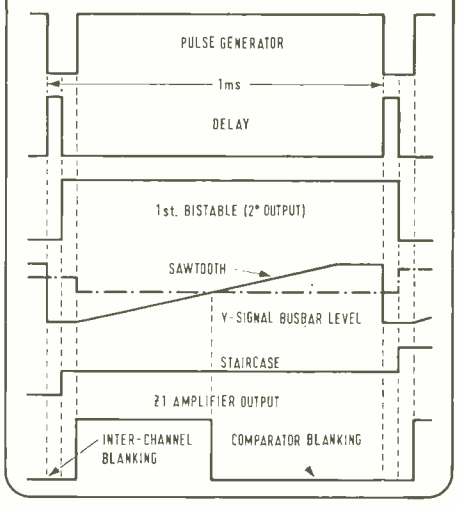
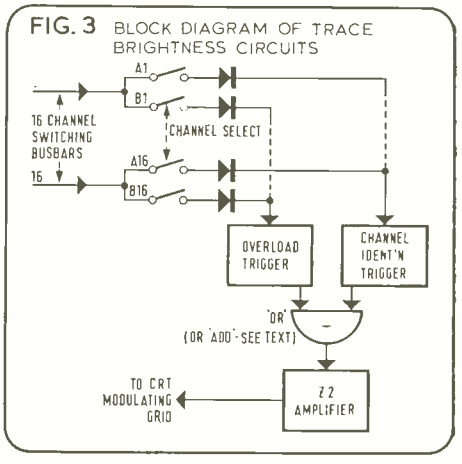
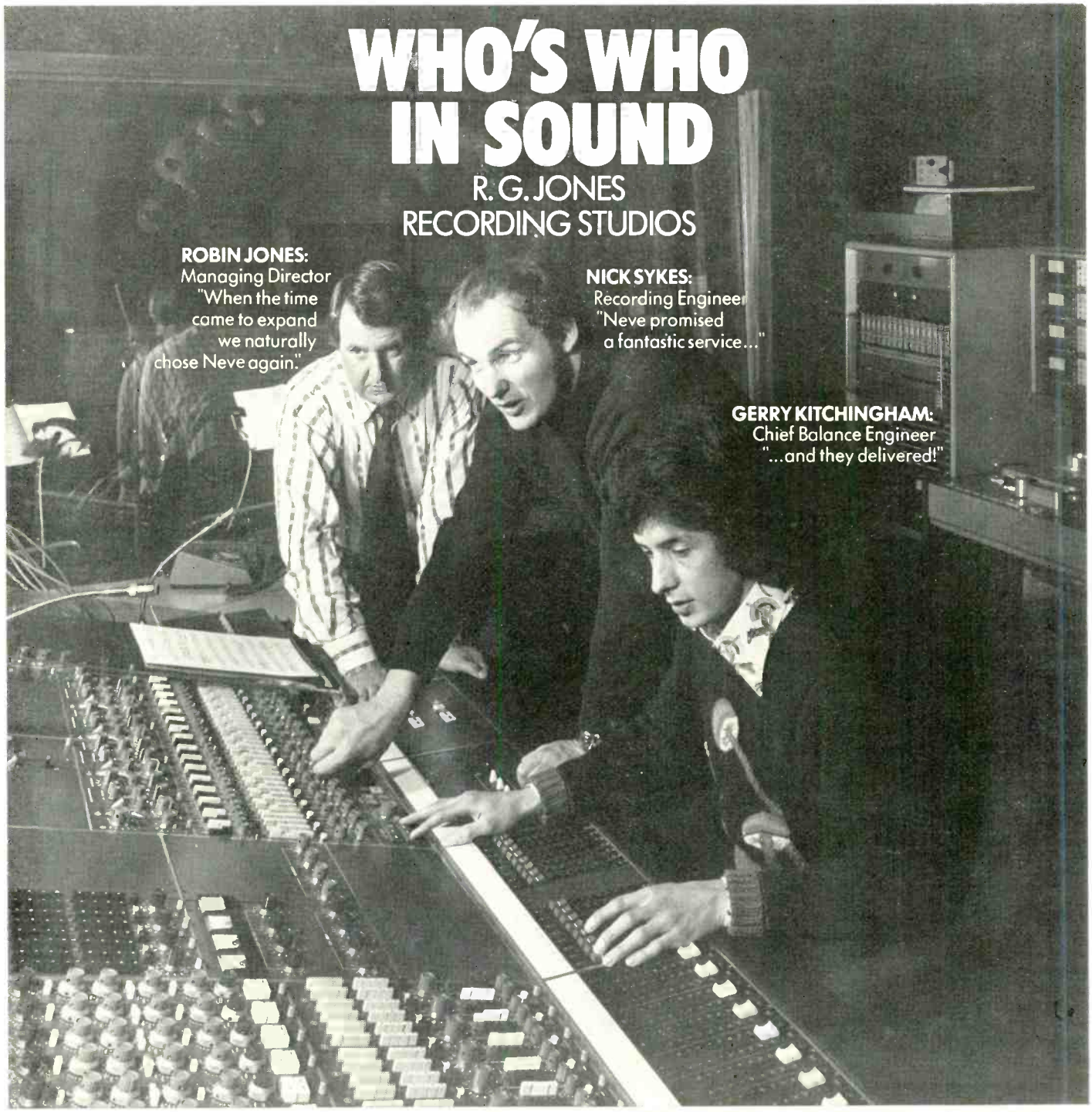


FIG. 3 BLOCK DIAGRAM OF TRACE BRIGHTNESS CIRCUITS





In sound recording when you get big you've got to get better no matter how good you were in the first place. Which is why R. G. Jones installed a new Neve 8038 sound control console in expanding their Wimbledon studio. With 24 input channels and 16 output groups their potential and facilities are more than equal to any demand.

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Opening a recording studio (May STUDIO SOUND) is one thing, but establishing a good name and firm footing can take time and money. Denis Comper gives his idea of how to manage your studio efficiently and economically.

Sound recording studios: moving in

FOUR BARE walls, a floor and a ceiling . . . a wave of the fairy wand and hey presto, there is your recording studio, a dream come true. Well, not quite like that. You will have to wave something more substantial than a wand if you are to get what you want and while fairies can have their uses they are something else again. But you will have found premises you think will be suitable, Permissions have been granted, Laws have been respected, Byelaws observed and Regulations obeyed even unto the latest Amendment to the most obscure sub-paragraph. Money has changed hands, contracts signed and you're in. In the premises, not in business . . . there is still a long way to go.

Now dreaming is no bad thing, conjuring up visions of that magnificent control console flickering with a myriad of meters, aglow with tiny lights of every hue, bristling with knobs in all diversity of shapes, and peppered with switches, some which push, some which click, and a few which pop up into the air when the button comes off. No bad thing to dream if it helps the preliminary planning process which should have been going on during the search for a home. Nothing very definite can be done about choice of equipment until you know where you will have to put it. But knowing where to put it is only one of several factors which will influence that final vital choice.

Keeping an eye on the market, weighing up the offers, watching technical developments during the early stages of setting up the business will save a lot of time when you move in. Even at the very start of the project you will have to decide what facilities you wish to offer your customers in order to estimate how much capital you require. If you borrow the capital, your financier will want to know in detail how you propose to spend his money. But, if your final choice of console rests with B rather than with A and your master recorder is a this instead of a that, your financier is unlikely to care even if he understands the difference. When all is said and done the equipment must suit the studio and the studio be tailored to suit the equipment. But the studio is subject to more definite limitations, in the physical sense, than the equipment, though both are confined within the total budget.

One of the delightful things about the recording business is that for every opinion expressed on some fundamental problem there will be at least two opposing views and few of them can truthfully be said to be wrong, or absolutely right for that matter. Gather together two or more recording engineers in one place at one time and there you have the makings of a discussion if not an argument. They will argue about anything: mic types for particular jobs, whether meters should read to and fro or up and down, and if he really did what she said he did. Now this is a healthy thing symptomatic of a young art science which is developing in a most exciting fashion. But however high-flown the discussion and complicated the reasoning there is one quality which ultimately solves all problems in the recording business as in any other and that is basic commonsense. Anyone might be forgiven in these present troublesome times for thinking that commonsense was one of those rare esoteric things indulged in by politicians never, union leaders seldom, and business tycoons hardly ever; only grey-bearded dotards have time for it.

Think long and hard when planning the interior of your studio and all that will go inside it. What has been done cannot be undone without a lot of time, trouble and expense, and the raising of doubts in your customers' minds that you didn't know what you were doing in the first place.

Architect design

Now there are those who have their studios planned for them by architects, acoustic consultants, audio engineers and a whole range of experts in this and that. There's a lot to be said for it. It will cost a lot of money but what of that if the result is right? And if it doesn't work out, you can have still more expensive fun issuing some pricey writs. On the other hand, who is so arrogant he thinks he knows it all and can ignore the helpful advice always generously given by those with, perhaps, just a tiny bit more experience of some small area of this complicated business? Whichever way you go about it, employing the experts or your own commonsense or a combination of both, be guided by one overriding consideration. It is to be your studio bearing the imprint of your personality and you will have to work it and make it work for you and your customers. Studios are booked because of the engineers and the management, not for the equipment . . . that is taken for granted to be the very best. The atmosphere, the ambience, the good vibes, call it what you will, created by the combination of staff and studio, must give the customer a feeling of complete confidence plus one more thing—enthusiasm for the job to be done. Recording is a once and for all time performance, the only indestructible medium. Like a butterfly in amber, the artist's very life is caught in mid-career for succeeding generations to judge. There is no tomorrow night's performance to cover the imperfections of tonight's, there can be no dressing room excuses, no sycophantic audience lulled by reputation. The metal ear of the mic hears it just the way it is and any subsequent tape doctoring can only succeed in removing the essential sincerity and integrity of what might have been a fine recording. Little wonder then that faced with the mic even great artists get twitchy and greater artists get twitchier. So everything in the studio must be right, must feel right, must be seen to be right, and must sound right.

If you haven't already decided that deep-sea fishing might be more in your line, let us consider the layout of the average studio, what accommodation might be necessary, and for what purposes. The total floor area can be divided into two categories: revenue earning and non-revenue earning. The reception area is non-revenue earning but will give the customer his all important first impression, so is a good place to start. By the way, if you put up a sign outside you will need planning permission and probably police permission as well if it is illuminated. But back to the reception area, which should be in proportion to the size of the actual recording part of the studio. Thus if the studio is big enough for an orchestra, and you often have orchestras in there, you will want a reception area big enough to hold 20 people, 15 seated. Contrariwise, smaller studios can do with smaller

reception areas.

However carefully you plan your bookings, and you will be keeping the earning periods as close together as possible, you will always have spare bodies hanging about waiting to get into the studio or just hanging about. They bring things with them like sets of timps, double basses, drum kits and gigantic speaker cabinets, and they arrive early trying to get in while the previous lot are trying to pack up and get out. The alternatives are then to provide a reception area big enough to avoid congestion and prevent the risk of unpleasantness as sweating roadies are heaving out a Hammond just as an orchestra manager is rushing in bearing a Chinese gong, or to allow a sufficiently long period between sessions so that never the twain shall meet. Obviously an acre of reception is going to lose money and so is allowing a couple of hours between sessions; somewhere 'twixt the two must lie the right answer. Your local Fire Officer may insist on it anyway but a way-out separate from a way-in can solve a lot of problems. You must have somewhere for visitors to sit and wait. The session musicians will want somewhere to sit for a rest while they check the racing results during union tea-break. The tape company reps will need a place to wait until you can spare a moment for a chat. Those chats with the reps perform a most important commercial function not exclusively connected with the product represented. Always make time for the reps or you never know what you may have missed. So weighing one consideration against another you will arrive at a floor area to suit your needs. It will have a dark carpet of the kind which thrives on fag ends and spilt coffee, lots of solid ashtrays for decorative purposes, and a girl for the same purpose who is a Kung Fu expert and will deal with enquiries while watching the telephone. Other furniture will be some comfortable seats, a table with boot-proof top and a suitable desk for the girl. The whole assembly must give the correct and vital first impression, whatever you may wish that to be. Colour scheme and lighting demand careful choice, in the reception area no more than in the rest of the place. The atmosphere must be one of friendliness, security, cosiness almost, and must express your meaning of 'good vibes'.

Diplomacy

One thing you must *never* do, as a large studio once did with unhappy results, and that is to adorn your reception with a uniformed Jobsworth. Only the record companies' studio should employ actual genuine commissionaires and they are skilled to a high degree in tact and diplomacy.

Lockable storage space is needed for your virgin tape stock and it must be cool and dry. It is a bad habit of customers, which should be gently discouraged, to leave behind their multitrack originals taking with them only the master tape ready for transfer to disc. These multitrack originals can take up a lot of shelf space and present a heavy responsibility to the studio for safe keeping, a responsibility the customer does not expect to pay for. You must have storage space for tapes in course of production, and 50 mm tapes are both bulky and heavy. It is very important to ensure that the tapes you must hang on to for a few weeks are kept secure, catalogued, and in an atmosphere recommended by the tape manufacturers. Few things worse than being unable to find a master tape, and, when you do find it, it's damaged. Well-ventilated wooden racks are best. With metal there is always just that outside chance of a stray magnetic field floating around, however weak and cannot afford the smallest risk.

It is a good thing to get your customers to take all their tapes with them at the end of a job. If you don't, you're not only accepting a responsibility you don't need but you can get the whole place cluttered up with tapes in no time. Some studios make a policy of keeping customers' tapes in an effort to ensure return bookings. This is a fallacy. Customers only come back because they like you and your place better, or they can't get in anywhere else. The exception to the rule against retaining tapes is the occasional necessity to retain a control copy. But then every good rule must have an exception to prove it.

Office box

You will want a sort of broom cupboard just large enough to put your feet up in to act as an office. Studios are not run from plush offices but you will need somewhere to do the books and the bookings unless you can persuade the girl in reception to do it. It is better not to have too many different customers all on the same session and when a line-up becomes a mix-up that's bad, so you keep an eye on the bookings, whoever actually does the writing bit.

Try not to grow in studio corners pathetic little petrified forests of unused mic stands bearing a harvest of dust-encrusted mics and don't blame missing headsets on light-fingered roadies. No efficient roadie is going to risk arriving at a gig under-equipped so if by mistake and commendable zeal he takes some of your gear with him after a session the blame lies squarely with you for not keeping things out of the way, easily identifiable or screwed to the floor.

A well-stocked workshop is a must. Recording equipment has to be given frequent checks and rechecks to keep it right on spec. The big stuff will have to be done in situ but in these happy days of modular construction a few spare modules can be kept in stock to replace those needing repair in the workshop. It is a good place, the only place, to keep replacement headblocks, test tapes, and the hundred and one bits and pieces which you must keep hoping never to have to use them in that nightmare emergency which only happens when you are out of stock.

Just one more non-revenue earning area (apart from clean lavatories) which helps to keep the cash register turning and that is a kitchen. Well, call it a kitchen, but all it is is a nook to make the coffee in, always better than that machine stuff, and a bachelor-girl type cooker; maybe a fridge if you can run to it. A cup of hot soup served during the break in a hairy all-night session can do wonders for customer relations. Your customers may not go that much on your recording technique but if the soup's good they may forget all about that unfortunate matter of the wiped vocal track.

Now to the areas which directly earn the money, starting with the studio itself. We are back to four walls, floor and ceiling but to be used for a very special purpose. So look at it as an enclosure full of fluid (air) which has predictable behaviour like water in a bathtub. It is a prime factor that the dimensions are in suitable ratio each to the other and that walls and ceiling are treated in a manner which will control the propagation of sound waves, and don't forget the floor. All this comes under the broad heading of acoustics and there are quite a few learned works on the subject. As a recording engineer you will know a thing or two about acoustics and there are a few highly competent acoustic consultants who will apply their expertise in return for a fee. When it comes down to the nitty-gritty technicalities of day-to-day operation, books are not very helpful. They don't say anything about having plenty of pedestal ashtrays of the kind which won't knock over easily (buckets are better) or how tiring and distracting strip lighting can be because of its affect on fringe vision. Having isolated power supplies can avoid a nasty accident and audio and power cables must be kept right apart by the height of the walls, one at floor level the other at the ceiling. Even though audio cables are down at the floor the mic input fields don't have to be. They should be up on the wall at a convenient height to avoid unnecessary gymnastics every time you change a channel. Put a D bar at floor level to wrap the mic cable round, so there won't be a direct pull on the plug, and another D bar just below the field so the plug doesn't fall on the floor when you pull it out.

Spend some thought to make it easy for yourself. There is always a better way of doing it, whatever it is though to look at some studios you would be right to wonder. There are enough musts and should-bes for smooth and efficient studio operation to fill a fair-sized book and perhaps it is a classic paradox that, because there are so many, so few are generally employed. But then, of course, your studio will number among the select handful which have been the subject of a lot of careful thought and are really together in consequence.

Control room

The control room is where it all happens and if it doesn't then nothing else will. The acoustics are vitally important for obvious reasons and that means an adequate volume to start with, a volume which is inevitably lumbered with great lumps of equipment. Planning a successful control room is one hell of a job and of such complexity that it is not easy even to recognise all the factors unless you devote diligent study to the problem and its solution. Unless you feel supremely confident to do it on your own, and who does, seek advice and be prepared to pay for it, and get a second opinion and a third if need be. You will probably get contradictory information, or it may seem like it, but no matter. You will be able to boil it all down to what must be the right answer for your particular circumstances. Compared with planning the control room acoustics, choosing the equipment is almost simple. Early on you will have decided what track configuration you will be offering. While multitrack recorders make small studios bigger it is no good reason to go 24-track merely because some other studios have. For example, you may have greater flexibility for the sort of work you want to do by having

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MOVING IN

two eight-track machines.

Whatever you decide to have, all the top-class machines are much the same in performance and are a matter of personal preference. It is how they are used that matters, not what they are called. As with all the rest of your equipment, you will get what you pay for and you will present yourself with loss-making difficulties if you try doing things on the cheap. Monitor speakers present a more tricky choice than tape machines. The perfect monitor speaker has yet to be invented but there are some mighty good ones available. Your choice of speaker must match your acoustics and, though some studios boast four, two of the right sort properly used work just as well. Then there is all the ancillary gear: limiters, compressors, gadgets which do both at once, monitor amplifiers, noise reduction systems, echo plates, and all sorts of things some of which are hardly even invented yet. Shop around, buy the minimum and the best, remembering that any piece of equipment lying idle is costing you money. A lapsed time meter to help you log performance and a combination of frequency meter and voltmeter across the mains are useful things to have. Neither frequency nor voltage supplied should vary but they do and it is nice to know when it happens.

The control console is the heart of the matter. It is the most important and expensive piece of equipment you will buy and deserves a paragraph on its own.

They come in all sizes and all prices, with every conceivable facility which you may or may not want. They range from standard units at reasonable prices to custom-built beauties (which cost a packet) but, considering the amount of highly skilled work which goes into them, they are incredibly good value. You must have the best for your purpose; nothing less will do. Many console manufacturers are enthusiasts to whom the profit motive seems to be of secondary consideration. Go to those of your choice with all your facts and seek their advice. You will always find them helpful and most unlikely to pressure you into buying more than you need. To serve you best they must have a detailed specification and only you can provide it. The console will have to work for you in the way you want it in your studio, night and day, week in week out. All the controls must fall to hand and work perfectly at three in the morning when you can hardly see the meters for cigarette smoke, the bass player wants to kill the drummer, the producer is stoned and the lead singer's girl friend is having hysterics in the corner. If the design and layout of the console are such that you have to hesitate or get off your seat now and then to make some adjustment it is the wrong one for you. The fault will be yours for not taking advice when it was given, not thinking about it hard enough before making a commitment, not giving the manufacturer the right specification.

There are those brave enough to design and build their own consoles. It is certainly a way to get what you want; at least you can start out in the right direction. It requires a great deal of advanced knowledge to be successful and it is certainly the most expensive way of doing the job. If you do an accurate costing, pricing your own labour at a realistic figure, your product is bound to be more expensive than an identical product bought from a manufacturer, and there is no one to complain to except yourself if it doesn't work. It has to be admitted though that you can't put a figure on a sense of achievement and at least three UK console manufacturers have gained a world reputation for excellence and they started in this same way.

At last you will be fully equipped. The running-in period will be over. You will open your doors with confidence that you really can do the job. Constantly alert to new techniques while striving to improve the old methods, you will be a professional in a business where only the highest standards prevail and those practising to those standards survive in the long run. And you will never be guilty of uttering that infamous phrase: 'Oh, it's only a demo!'.

GUS COOK

width, which prevented broadcasting in quad. The other: 'In my opinion CD-4 will not be a viable proposition until you can cut it in real time'.

Like many other engineers he sees the main difficulty in the standardisation war as being between matrix and discrete systems. 'The gap between the matrix systems is being closed.' As far as the choice of SQ was concerned he was certain that the right choice had been made: 'We had to choose either a matrix system or a discrete system. We chose a matrix system because it was the simplest . . . We regarded SQ as a suitable vehicle for presenting quad to the public until such time as a high density alternative comes along.' He foresees a great future for sound recording as a by-product of the research which has produced the various types of videodisc: 'From the high density discs we have the possibility of a packing density from which a new type of commercial gramophone record will be developed. The limitation of tape is the difficulty to identify the programme, and that difficulty will be with us for sometime yet, but the disc is nowhere near finished. People aren't just going to throw all their equipment away; the disc will be here for years yet.'

He considers the public are getting good value for money from their records: 'What the public doesn't realise is that the price you pay for the modern product is cheaper now than it was 20 years ago. Think about it. On a 12-inch record they used to get four and a half minutes a side, that's nine minutes a disc. On an lp they get a 50 minute programme.'

One of the things he has found most impressive among the changes in the approach to recording that have taken place over the years is that the demarcation between engineer and artist has become blurred: 'You can have a crack recording team, apparatus in perfect condition and they can start a recording and they can record something and get perfect results and finish the recording before time. You can have those same people and the same equipment next day and you can run into difficulties and achieve very little.'

Another related change he had found, and one that he totally approved of, was that studios now went out of their way to produce a relaxed atmosphere. On one occasion, just before the war, he recounted, Abbey Road was visited by Winston Churchill. An edict had gone out that the staff had to be distinguishable from the visitors, 'so they gave us all white coats. We looked like a lot of dental assistants. Well I remember I was standing at the top of the stairs, and Churchill started to come up them, and he puffed up to about half way. Then he stopped and looked up: "My God," he said, "I thought I was in the wrong place. It looks like a hospital." Now the aim is to merge the engineering with the decor in such a way that the artists can relax and devote their efforts to producing the best results they can.'

EMI may yet see something of him: 'I'm not severing the connection immediately. It's been a hectic life, and if you go from being hectic to nothing it wouldn't be good, would it?' He will be advising EMI on the installation of those Neve desks they ordered this year. 'I'm still enthusiastic. I still want to go and see what they're doing.'

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The seventh APRS exhibition of industrial sound recording equipment was held in London on June 21/22.

APRS 1974

DAVID KIRK

THE SEVENTH exhibition of industrial audio hardware organised by the Association of Professional Recording Studios closed its doors at 18.00 on Saturday, June 22. As in previous years, it provided a quiet and informal meeting place for manufacturers and customers. It was also, as ever it seems, uncomfortably hot: one can't have everything.

A report issued by the APRS shortly after the exhibition quoted an attendance of some 2,000 visitors arriving in a ratio of 60 per cent Friday and 40 per cent Saturday. Between them they represented 641 companies of which 88 were located overseas. A higher proportion of 'serious' visitors was noted than in 1973. One more statistic: the value of equipment on display this year exceeded £900,000. Possibilities there for a time-wasting competition next year since this observer would have placed a much higher estimated value on the equipment displayed.

In reporting upon an exhibition which STUDIO SOUND has already previewed, the problem repeatedly arises as to how much it is worth repeating product information already published. Once again we shall follow our normal policy of reporting on companies and equipment that, for whatever reason, did not find their way into the preview in our July issue. Tradition again dictates an alphabetical approach.

A is for **Allotrope** who this year exhibited products from Inovonics, Pearl and HES. Four Inovonics items were shown, models *355* and *360* being updated electronics for such tape machines as the Ampex *350*. The *200* limiter offered dual functions of average and peak level response while the *210* limiter offered independent control of broadband peaks and high frequency programme level, the latter aimed at high speed tape copying applications.

From Pearl, three new capacitor microphones and, from HES Electronics, an improved version of their telephone balancing unit—the *TSV* differential amplifier.

A broadcast cartridge machine conforming to NAB standards and incorporating a fast cue facility was seen on the **Amity-Shroeder** stand in the company of a 24 track mastering recorder.

Two *MM-1100* compact multitrack recorders were exhibited by Ampex and are available in eight, 16 or 24 track formats. The new **Ampex** *Time Code System* had its first exhibition airing in this country and offers total synchronisation between independent audio and/or video tape transports. Also seen for the first time was Ampex *Grand Master* audio tape, now being offered in 6.25 and 50 mm configurations.

The **Audio Developments** exhibit centred on their *AD007* portable mixer. This features a basic eight inputs into two or four groups, expandable to 18 via an extender unit. A small stereo mixer and variable speed motor unit have been added to the Audio Developments range which also includes complimiters, ppm drivers and mixer modules.

Automation Facilities need little introduction as makers of aerosol-packed cleaners. To *AF-Spray* and *Ultraclene* they have now added *Stericlene*, designed to provide users of language laboratories with a cleaning agent for mouthpieces and headphones. Where static is a problem, Automation Facilities offer *Statiklene*, while *Permagard* is claimed to protect equipment against corrosion.

Faced with the unquestioned success of the Philips *Compact Cassette* and with occasional complaints about the suitability for broadcasting of cyclic tape cartridges, **BASF** surfaced this year with the *Unisette*. Bearing some resemblance to the Philips *C60*, the *Unisette* format employs 6.25 mm tape and has a recommended (though in this case not rigidly specified) running speed of 9.5 cm s. It is being aimed simultaneously at broadcasters, the audio-visual aids market, and at domestic software consumers. A substantial advantage of the *Unisette* over existing forms of cassette and cartridge is the care BASF have taken to minimise the container's influence on tape motion. They have evidently eliminated cassette squeak, let alone variations in speed stability from one mass-produced cassette to another. A detailed description of the design is available on request from BASF; a printed copy of an address by K. Goetz to this year's Copenhagen AES Convention.

Microphones, stands, goose necks, clamps and related accessories were exhibited by **Beyer Dynamic**. The *M201* hypercardioid dynamic microphone was featured again this year, having been introduced to Britain in 1973, sales effort also being concentrated on the *M260* ribbon.

Two items of outstanding interest on the **Calrec** stand were the *Sound Field* microphone being developed in connection with the NRDC ambisonic system and the multichannel audio level crt display which latter is described elsewhere in this issue by Trevor Attewell. The microphone incorporates four capacitor transducers and is based on the work of Michael Gerzon and Peter Fellgett. It is claimed to combine the simplicity of coincident microphone operation with the flexibility during mix-down normally associated only with close-microphone techniques.

The **Pandora** *Time Line* digital audio delay unit was seen on the **Feldon** stand. Alongside it, from the Eventide Clockworks table, was the *1745A* delay line. Feldon are now handling the CBS *SQ* encoder/decoder and a range of capacitor microphones from Schoeps. Scully's *280-B* stereo tape recorder and the new JBL *4330* loudspeaker were displayed in the company of a reverberation unit and *Compumix* automatic remix desk from Quad-Eight. Particularly fast delivery time—averaging three to four weeks—was claimed by Feldon for MCI mixers and multitrack recorders. The new *JH-416-S* extension unit raises any 24 input MCI mixer to 36 inputs and joins the MCI range at the same time as the *JH-110* series of 6.25 and 12.5 mm recorders. Auto-locate, switchable IEC/NAB equalisation and a three-speed phase locked capstan motor are standard features of the *JH-110* range.

Sharing the Allotrope stands, **Future Film Developments** exhibited a variety of audio connectors and conducting cables. Jackfields and wiring accessories were also displayed.

The *636* spring reverberation unit and related *666* ambiophonic unit were again shown by **Grampian**, accompanied on the stand by 50W and 100W versions of the *Series 7* power amplifier. Designated *7433* and *7443* respectively, the latter feature extended bandwidth to meet studio monitoring requirements. Each 7 amplifier carries a three-year guarantee and, if

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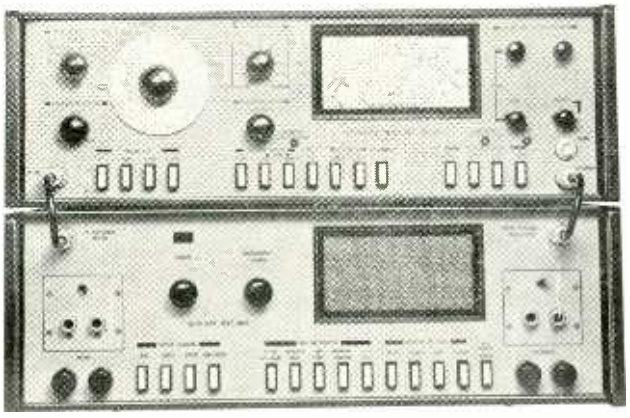

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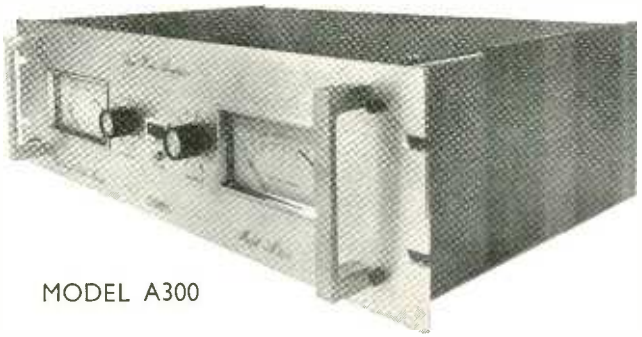

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desired, the unit may be employed in conjunction with the *730* modular mixer preamplifier.

Richard Swettenham, Neil Adams and Roger Knapp manned the **Helios Electronics** stand, concentrating on the *PS* series of audio mixing consoles which are now available in formats for up to 24 track working. As agents for Countryman and Orban, Helios also demonstrated the former's phase shifters and the latter company's Parasound reverberation generator.

Stand 58 was not so much a stand as a barrow, laden with apples and decorated by Malcolm Jackson in traditional Rickmansworth costume. The **Jackson Recording Company** have an informal approach to the business of selling second-hand recording equipment which makes a welcome change from the turgid product lists normally distributed by hardware brokers. If you are looking for a 16 track Edison *Phonograph*, a hand-made vicuna Stupex with antelope horn tape guides, or even just a kilo of used apples, Malcolm Jackson is your man.

Three versions of the *2000* series tape recorder were this year displayed by the Kidderminster-based manufacturers **Klark-Teknik.** These comprised a 6.25 mm two track, 25 mm eight track and 50 mm 16 track, capable of operation at 38 and 19 cm/s (internal crystal oscillator locked). The *200* 's servo-controlled dc capstan drive also permits synchronisation with an external reference or varispeed from an internal variable oscillator. If its specification and clean exterior design are anything to go by, this design has a very promising future. In addition to the *2000*, Klark-Teknik exhibited five items representing their range of compact graphic equalisers: models *7s*, *9s*, *11s*, *11+11s* and *27s*. No modesty here, false or otherwise. Klark-Teknik quietly claim these to give better performance than any other make of graphic equaliser in the world.

Walton-on-Thames-based **Lee Engineering** are the British agents for five North American companies all concentrating on audio broadcast equipment. Products on display included items from the Gates range of studio turntables and a matching Microtrak viscous-damped pickup arm. In the field of cartridge machines, hardware by International Tapetronics and software by Audiopak. IT cartridge recorders are now being used by several commercial radio companies and have also been supplied to the BBC. For the open-reel market, two recorders were exhibited. From Electro-Sound, the *ES-505* is offered in 6.25 or 12.5 mm formats, one, two or four track working, and is available with an optional third reel for faster editing. Logging recorders by Metrotech were offered in several formats based on the two or four channel *400L*. The single deck 2.375 cm/s version gives up to 12.8 hours continuous logging on a 27 cm reel while a twin-transport model provides automatic protection from electronic failure or tape breakage. A separate timing track is rendered unnecessary by the *4400* time signal write/read unit which codes its output on to the programme track.

Focal point of the **Leevers-Rich** stand was a new four track 12.5 mm recorder based on the established *E200* and designated *H400*. If desired, this can be supplied in 6.25 mm two track form ready for rapid extension to the four track format. Another new design from this company was the *BE2000* 10/2 mixer developed for the broadcast market. This was accompanied by a smaller 6/1 mixer for educational applications. Leevers-Rich are now handling cartridge equipment by Ampro, available with a wide choice of track and cue control permutations. From their own stable again, they exhibited the *LR720* graphic equaliser and a selection of bulk erasers—the latter starting in price at £25 and suitable for tapes of 6.25 to 25 mm width.

Wow and flutter meters and a matching wave analyser by Woelke were exhibited on the **Lennard Developments** stand. Three ver-

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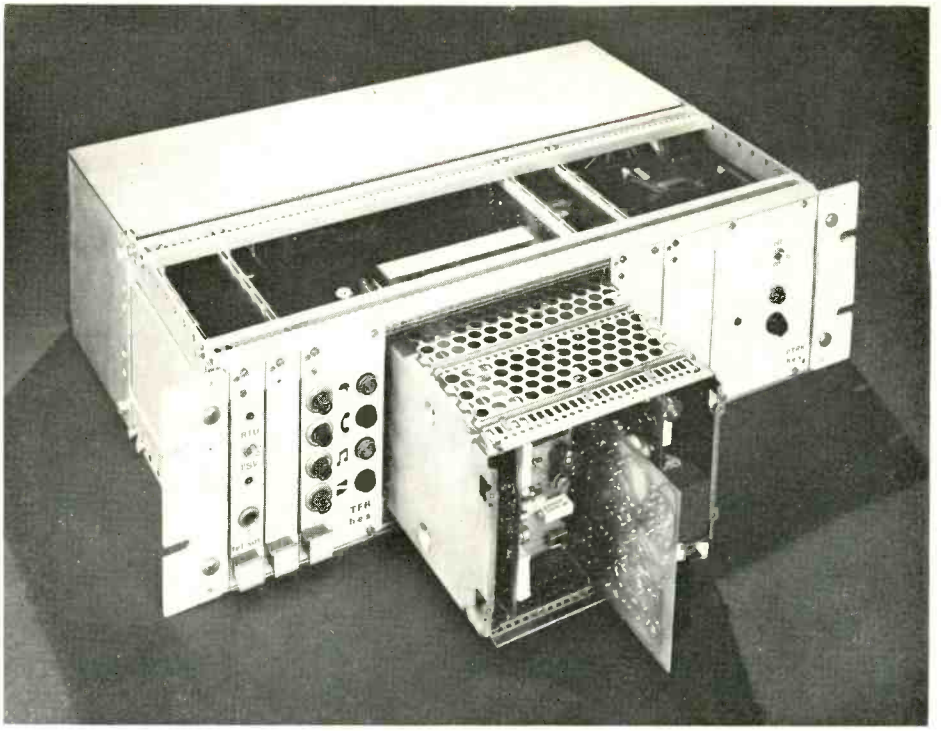


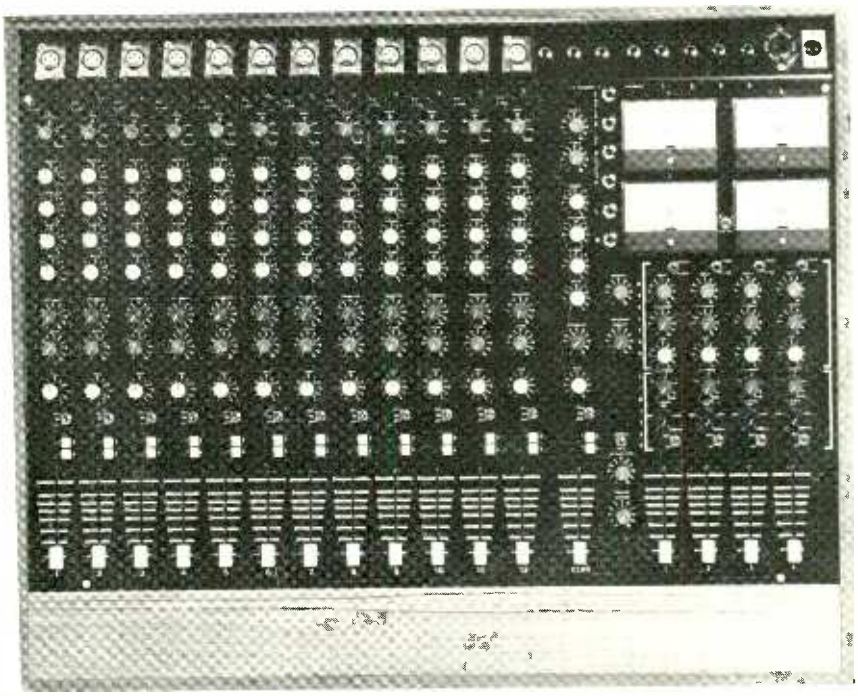
Above: The HES telephone balancing unit.

Bottom: A version of the Klark Teknik *2000* series tape recorder.

Below: The Malcolm Jackson stand.

Industrial Tape Application's stand.

THE STAR OF THE SHOW



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sions of fluttermeter were seen—the *102C*, *104C* and *105*. The *104C* has identical facilities to the *104* which it replaces but has been brought within the family style of the *102C* and *105* meters shown in 1973.

Modular mixing equipment in three separate ranges was exhibited by **Midas Amplification,** working in association with pa equipment designers Martin Audio. A 20/4 desk in their *Portable* range was listed at a basic £1,800 including bass cut, three-band lift and cut equalisation, and Penny & Giles *1820* faders on all inputs. At £3,500 for a typical 16/8 desk, the *Studio* series features conductive plastic faders, phantom powering and peak programme metering as standard facilities. And at the top end of the Midas price scale, a 16/8 console from the *Comprehensive* studio range would cost in the region of £6,000.

MSR Electronics displayed their *2000* series disc cutting lathe, incorporating an Ortofon *GO701/GE701* cutting amplifier and *DSS661* stereo head. The 400 mm diameter turntable is servo-controlled and so independent of mains frequency variations. Varigroove control of cutting pitch and depth are standard features. A quadraphonic version of the lathe, model *4000*, is currently under development.

Low-cost modular audio mixers are the **Partridge Electronics** speciality, the modules themselves being available either as kits or fully assembled. A wide variety of pc board sub assemblies and complete modules were displayed on stand 21 together with a selection of mixer face panels. First-time visitors to an APRS exhibition are often surprised to find the event almost entirely devoid of loudspeaker-relayed demonstration programmes. Partridge were one of several companies who managed to demonstrate their equipment on programme without falling foul of the no-noise stricture. Microphone signals and recorded music were

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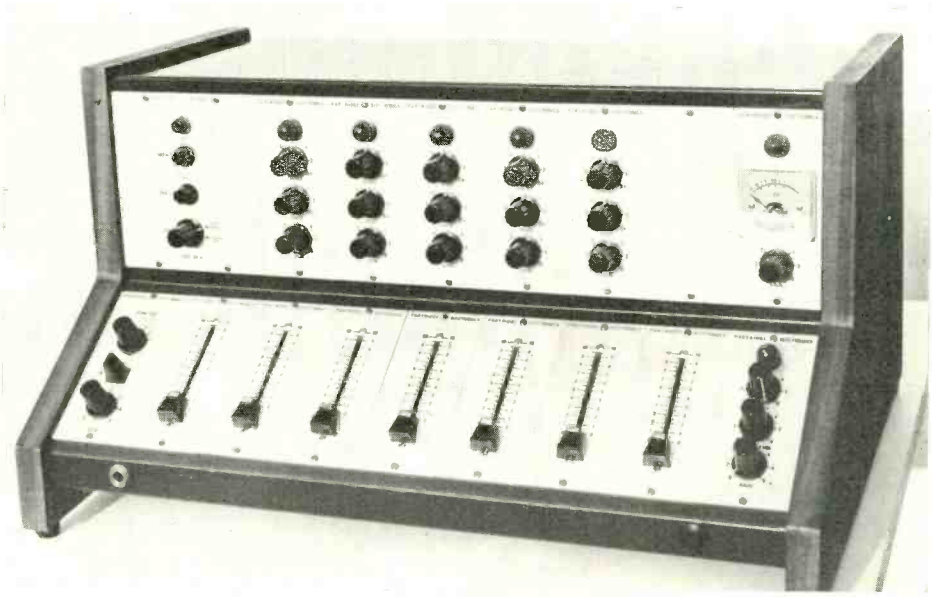
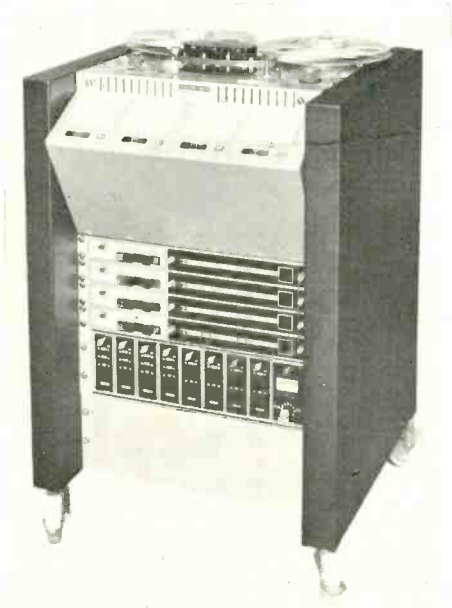
Electrosonic digital multiplex clock



Partridge's deluxe version of the Consolette mixer.

Leevers-Rich four track machine.



Triad mixing console *A* series.

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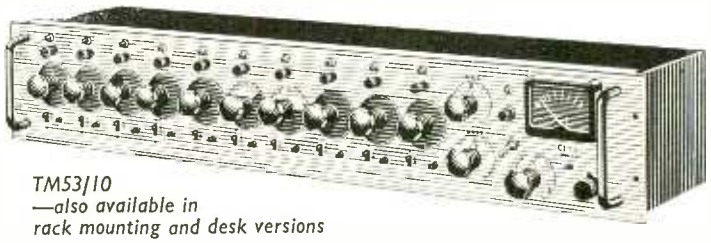

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fed through several of their mixers and thence to headphones.

For this visitor, one of the most interesting and certainly the most colourful stands at APRS '74 was that staffed by **N. Tonnes Pedersen Electronik.** This Copenhagen-based company recently took over their own marketing arrangements in Britain and offer large or small audio control systems assembled from a wide range of modules. The colourful item was their *377-100* multichannel audio level display which presents up to 28 channels on a single 625-line colour tv monitor. Virtually any 625 monitor may be utilised, peak indication being to IEC/DIN standard. Subliminal overload indication (polite reference to half-asleep sound balancers) is given through an automatic colour change occurring when any one element of the bar graph reaches the overload region. Different bar colours may be selected to identify one group of microphones from another via remote control from the mixing desk.

CJ86 is the name given to a new mastering tape launched by **Pyral** at APRS '74. Available in 6.25, 12.5, 25 and 50 mm formats (¼-inch through 2-inch to you, Michael), it was displayed with specimens from the Pyral range of lacquer disc blanks, helical video tapes, general-purpose audio tapes and Compact Cassettes.

High-output matt-backed *Spectrum* tape, again in 6.25 up to 50 mm formats, was exhibited on the **Racal-Zonal** stand.

For those who know not their *SQ* from their *QS*, a reminder that *QS* stands for Sansui or vice-versa. Three quadraphonic effects units were displayed this year on the Sansui stand: *QSE-4* and *QSE-5B* being industrial four-channel encoders, and the *QSD-4* a decoder. Each is designed for the production of *QS* encoded software, four channels encoded into two without degrading the lifetime, recording time, dynamic range, bandwidth or signal-to-noise ratio of the host medium. In Sansui's own words, the encoder and decoder retain the basics of the *QS-Regular Matrix* concept but with a new twist. The refined system is designated *Vario-Matrix*.

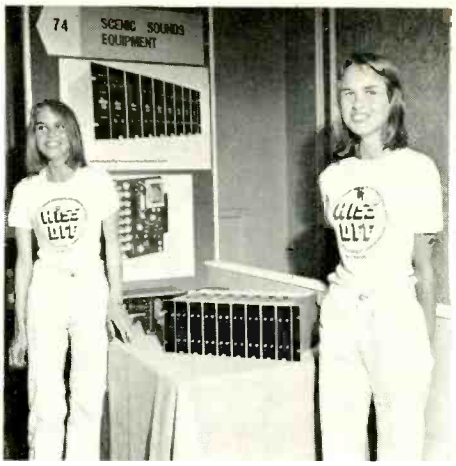
Cassette master production and cassette duplication were the main feature of this year's **Studio Republic** stand. SR now offer fast runs of 50 to 5,000 copies and can load blank or prerecorded bulk into cassettes of any length between C1 and C120.

STUDIO SOUND this year ran a gimmick-free stand for a change, off-loading the few remaining back numbers and meeting those readers able to run fast enough to catch its staff. Helped on this occasion by the nearness of Malcolm Jackson's apples and the remarkable scenery on the neighbouring AKG stand.

Studio loudspeakers by Altec were displayed on the **Theatre Projects** stand together with an Altec capacitor microphone—the *626A*. One of the most powerful Altec speakers shown was the *9846-8A*, seen alongside the *604E Duplex* monitor in Lockwood housing.

Mixing consoles in the *A* and *B* series are currently being produced by **Triad.** Aimed at large studio installations, the *A* range makes minimal use of transformers in order to minimise phase shift. Colour-coded controls are used throughout, led indicators being used in preference to lamps as a safeguard against bulb failure. For studios with more modest requirements, Triad produce the *B* series. Consoles from this range are available with virtually any number of inputs and groups, circuitry and components being similar to those employed in the *A* system. Standard basic configuration is 18/8 with 16 monitor returns. 16 of the standard 17 VU meters register group outputs or tape returns while the remaining meter can be switched to read echo, foldback or tone level. Dual scaled ppm/VU meters from the *A* series can be fitted on request.

Two concluding notes on the organisation



The display on Scenic Sound's stand.

of the APRS exhibition, without wishing to intrude on matters normally decided by the exhibitors and APRS committee members themselves. Assuming the exhibition remains at the Connaught Rooms, would the entry ticket collectors not be better placed at the bottom of the main staircase? This year, as last year, it was possible to tour one half of the exhibition without handing in any kind of identification. Similarly, a visitor to the main hall going up to the higher gallery and then returning to the main hall could too easily be confused with incoming visitors and have to display his ticket a second time. Secondly, the sight of so many visitors and exhibitors subjecting their clothing to the floor of the refreshment room, albeit carpeted, suggested a need for more seating facilities in that area next year.

Ending on a third and more positive note, who installed the public address system used in the Connaught Rooms? Without being objectionably loud, it was one of the clearest and most intelligible pa systems this writer can recall.

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The pension scheme. We're all too young to worry about that. But do something about it now and you will reap the benefits when you need them.

Sound pensions

J. C. VANN

THE WORD pension smacks of retirement and to many people their retirement seems so remote as not to be worried about, at least for now. Or they may feel that the whole subject of pensions is one best left to the specialists.

Yet come to ponder about it, a pension is essentially a spread-over of earnings into retirement—a way of currently building up rights which will ensure greater income in the future. For this reason pensions are of immediate and, indeed, urgent importance to us all, as the provision being made now will effect our lives for many years after we retire.

Whether we like it or not, if we should be employed persons or employers we are involved under the recent Social Security Act 1973. By this Act a new philosophy of pensions will be introduced when it comes into effect on April 6, 1975, as the existing pensions set-up has been badly in need of amendment for some considerable period. In fact, British State retirement pensions are among the worst in Europe. Thus the current preoccupation with occupational pension schemes is not only desirable but also essential.

Only recently I was discussing the subject of pensions in general with the proprietor of a recording company. 'How exactly are we involved under the new Act?' he asked. Well, everyone over the age of 21 in employment is to have two pensions when he or she retires after April 1975.

Modified flat rate

The basic flat rate old age pension is to remain, though in somewhat modified form. Currently all contributors pay a similar contribution. Under the new scheme, participants will pay according to their earnings. By this method the government will achieve an automatic regulator enabling them to review pension levels annually. As earnings rise, so do contributions—and pensions, too. The cost? All employees except those earning less than a quarter of the national average earnings (currently £9 a week as the average is £36 a week) will pay contributions based on all their earnings, but ignoring any excess over 1½ times national average earnings, i.e. over a ceiling of £54 per week. The contributions are to be 5¼ per cent from the employee and 7½ per cent from the employer.

The additional pension will be an earnings-related pension, too. This may be either an occupational or company pension arranged by the employer or, failing that, a State reserve pension arranged by the government but administered by an independent body, the Reserve Pension Board.

This means that every employer in the land has to make a decision before April 1975. If he cannot or will not set up an occupational or company pension scheme for his employees, then they will automatically be lumped into the State reserve scheme.

Obviously, prudent employers will want detailed information as to what benefits are available under both schemes before they come to a decision. So I suggest we initially look at the State reserve scheme. This scheme is referred to as a 'fall-back' scheme, which speaks for itself in that employers can fall back on it if they are unable to fix up anything better in the occupational sphere. But a leading actuary has declared that the reserve scheme is no pushover and that it will give value for money. Yet it is inflexible and the benefits under it will be minimal. It has other adverse features. Only very small pensions will be available for older employees. For example, a man of 55 in the scheme for ten years can only expect a pension of around four to five per cent of his final salary at the age of 65. Even a man aged 45 is not likely to fare all that much better with perhaps 13 per cent or so of final salary after paying in for 20 years to age 65.

Widows' benefits are to be only half of the pension which has actually accrued to the employee at the date of his death. For many years, therefore, the reserve scheme benefits for widows will be inadequate.

No benefits accrue on any earnings in excess of 1½ times the national average earnings. This means that any employee earning over £54 a week will be penalised under the reserve scheme.

Retire at 60

Why has retirement been fixed at 65 for males and at 60 for females? Lots of men retire at 60 these days and many women finish at 55. Occupational schemes have the flexibility to meet this kind of situation but the reserve scheme hasn't.

Flexibility is, in fact, the keynote of an occupational pension scheme. But before going on to a study of this type of scheme, what about the cost of the State reserve scheme? Contributions will be collected through the PAYE system and will total four per cent relevant earnings—2½ per cent from the employer and 1½ per cent from the employee. Relevant earnings are those earnings up to 1½ times the national average, i.e. up to £54 a week per current figures.

Occupational scheme

'Will an occupational pension scheme be costly?' the recording proprietor wanted to know. This is not easy to answer as there's nothing cut-and-dried about an occupational scheme. However, it is likely to cost more than the State reserve scheme, although the benefits can be considerably more attractive. It can provide higher pensions, more security for dependants, freedom to take a lump sum and extra benefits for widows. It really boils down to a matter of 'you get what you pay for' —the better the scheme, the more it costs. A point to note is that minimum standards are laid down under the Act. Thus a scheme has to comply or it will be rejected.

What about tax relief? Employers will delight in the knowledge that tax allowance is given on all their contributions, whether under the State reserve or an occupational scheme. Employees will not be pleased to learn that their payments into the reserve scheme receive no relief of tax, though what they contribute to an occupational scheme does receive a tax allowance.

One employer friend of mine in the sound recording world was a trifle anxious. 'I've only got a few employees, so I suppose my firm is too small for a company pension scheme—or is it?' he queried. No firm is too small. One

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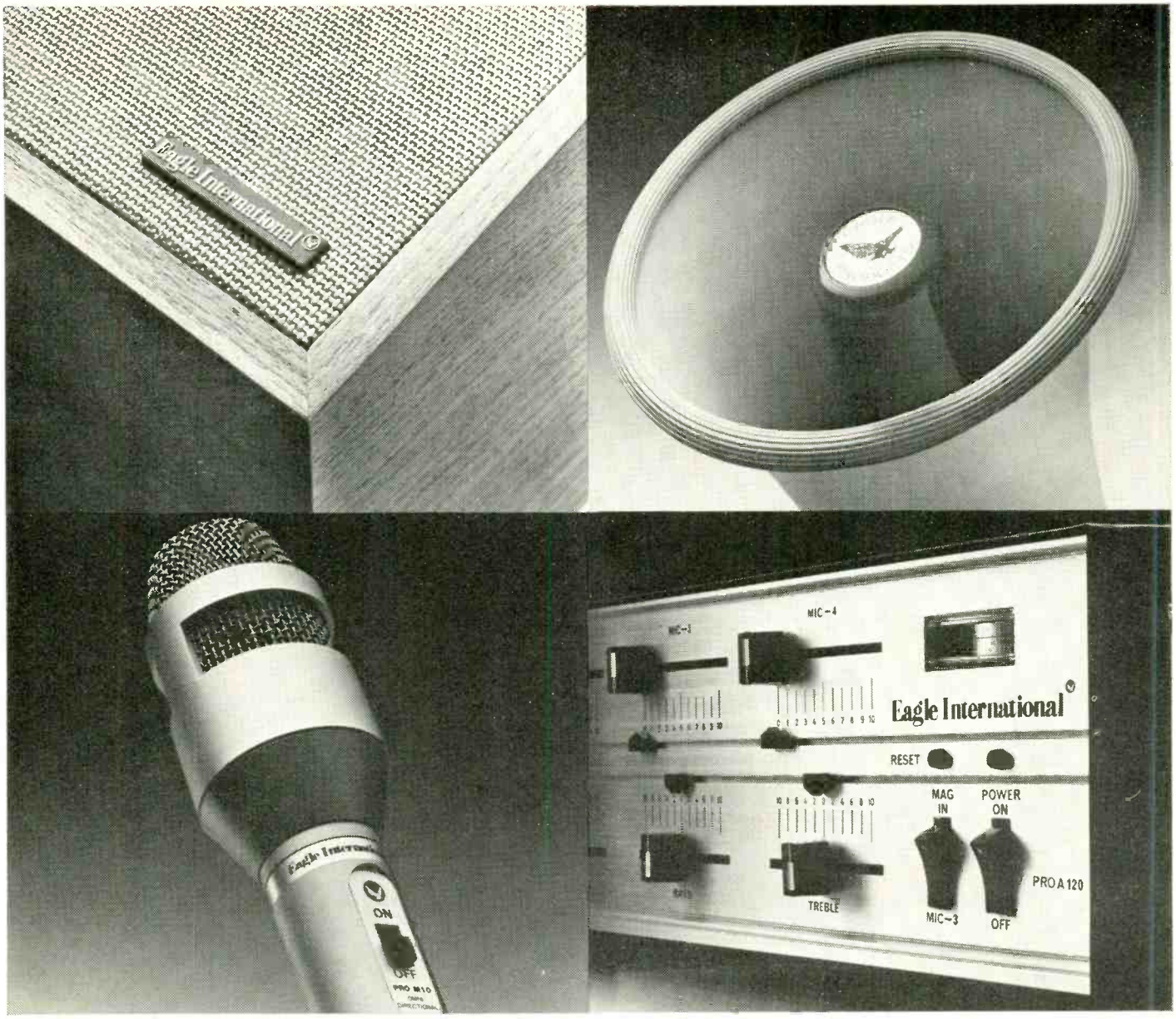

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of the advantages of a company scheme is that it is just as easy to put in a scheme for one employee as it is for 100 or 1,000 employees and the cost is roughly in the same proportion.

For the employer who is sufficiently interested in an occupational pension plan to require a quotation, it may be a question of knowing how to go about it. You may have seen in the national press or elsewhere one of the many advertisements singing the praises of a Recognised Company Pension (RecomPension for short). This is, in fact, an advertising exercise organised on corporate lines by 23 of the foremost life assurance companies in the country. Any of these companies can be approached for a quotation or for advice and assistance.

In addition

Additionally, many insurance broking organisations run a specialist pensions department. Information will be gladly given from such a source. If you use an insurance broker for your insurance in general, he may well be able to offer help in the pensions field.

Many employees think that April 1975 is far distant and in consequence have shelved the making of a pension decision with regard to their employees until later. But now is the time to act. The reason is that there are 65,000 existing schemes and obviously there are going to be many thousands of new ones introduced before the Act becomes effective. All these schemes, both old and new, have to be submitted to the Occupational Pensions Board, formed not long ago, for approval or otherwise. One can readily appreciate that this Board is going to be stretched trying to cope. Thus an early place in the queue for approval is strongly to be recommended.

Second pension

My self-employed sound recording friend then brought up another subject—himself. 'Where do I come in?' he asked. 'Do I get a second pension?' he went on.

The simple answer is no. In actual fact, self-employed persons are excluded from the provisions of the Social Security Act. This means that such people still have to make their own arrangements for a pension.

However, on the market today are various most attractive pension schemes specially aimed at the self-employed. The amazing thing is that lots of those in the self-employed ranks have not yet taken advantage, probably because they haven't heard about these schemes.

Self-employed penalised

Before 1956, the self-employed were penalised in so far as they could only make provision for their retirement from net or taxed income. Then in 1956 the Finance Act revolutionised the situation by allowing a self-employed person to save an annual maximum sum of ten per cent of net relevant earnings or £750, more if he was born before 1916, whichever was lower, towards retirement and also to obtain tax relief at the highest rate of tax paid. In case you are wondering, net relevant earnings are one's non-pensionable earnings less items which are deductible for tax purposes, such as normal business expenses, mortgage interest and the like.

Better news

But in the 1971 budget came better news still, when the Chancellor announced that the maximum annual sum which could be put in was increased to 15 per cent of net relevant earnings, with a maximum of £1,500 in any one year, with extended limits for those born earlier than 1916. This is still the ruling today.

It isn't always appreciated that the self-employed under his pension arrangement has the option to give up part of his pension in return for a tax-free lump sum payment. This sum is limited to three times the remaining annual pension and the decision as to whether to take it can be left until the pension is due to start being paid.

The tax concessions are worth emphasising because they play a major part in the attractiveness of these self-employed schemes. Full tax relief is given on all contributions, no matter at what rate tax is being paid. For the standard tax rate payer, this means that for every £100 contributed he receives £30 back. That's not all. The pension or annuity fund into which the contributions go enjoys exemption from tax on the income from, and the capital gains on, the investments made for the participants. Thus gross, not net, income is employed to provide the pension.

Points to watch

There are several points to watch for those who may be thinking of taking out a pension scheme. Some insurance companies guarantee the pension for five years from pensionable age, which means that even if the pensioner dies within this period, the pension would still continue, being paid into his estate. Some companies only offer this extra cover for additional premium.

One sound and video recording expert I chatted with recently wanted to know what would happen regarding his pension if he died before pension age. Most insurers return the whole of the gross premiums paid plus compound interest of up to six per cent per annum, depending on the insurers concerned.

Leading pension insurer

Not long ago I met George Parfitt, the Chairman of one of the leading pensions insurers, Time Assurance Society, a friendly society with headquarters in Oldham. He mentioned a valid viewpoint. 'Sometimes there's no point in having premiums returned in the event of death before pension age or of having a guaranteed period after pension age,' commented Mr Parfitt. 'I'm thinking mainly of bachelors, single career women, widowers and widows without dependants, whose main concern is to provide the highest possible pension for themselves during their own lifetime,' he added. He then went on to explain that Time Assurance offer specially high rates of pension on request in such circumstances.

You want to see some figures? Taking Time Assurance as but one example, if you are, say, 40 next birthday and you save £300 annually for a pension, the net cost after tax relief will be £210, assuming you are a standard rate tax payer. At 65 you could receive a pension of £3,341, this being calculated according to current conservative estimates. This is guaranteed for five years and for it the net cost is £5,460. Thus in well under two years, before you are 67, you will have recouped your outlay and after that it will be all profit.

Lump sum

Alternatively, you could commute part of your pension for a tax-free lump sum. In this case you would receive, on retirement, £7,440 totally tax free, plus an annual pension of £2,480 for the rest of your life.

These are impressive figures and illustrate the advantages of investing contributions that enjoy full tax relief in a tax-free pension fund. And, of course, if you are taxed higher than the standard 30 per cent, then the returns are better still.

Director of pensions

So much for the self-employed. But you may be a controlling director of your firm. This means any director of a director-controlled company who himself owns or controls more than five per cent of its ordinary share capital.

The whole situation affecting the personal pensions of controlling directors has been completely changed by the recent 1973 Finance Act amendment. In fact, these directors should be cock-a-hoop! For the first time they become eligible to join the pension schemes of their companies on equal terms with their employees.

Important advantage

This has important advantages for such directors. Two-thirds salary may now be paid as pension, including up to 1½ times salary as a tax-free cash sum. Further, four times salary is available as a tax-free and duty-free death in service lump sum benefit, as well as duty-free widow's benefits on death at any time. Additionally, there is freedom from personal tax liability on company contributions towards such benefits and no upper limit applies on earnings for pension purposes. This is a bonanza indeed!

It is amazing how far the revised legislation will ease the burden of estate duty. Normally a married man may plan knowing that some £30,000 is free of duty to begin with. Because of the 1973 Finance Act, directors are now able to provide a tax-free and duty-free benefit on death in service up to four times salary. For a director earning £10,000 a year, this means that he is able to accumulate an aggregate of £70,000 duty-free against a death in service contingency.

Wise move

Directors would thus be wise to consult their financial advisers with the least possible delay.

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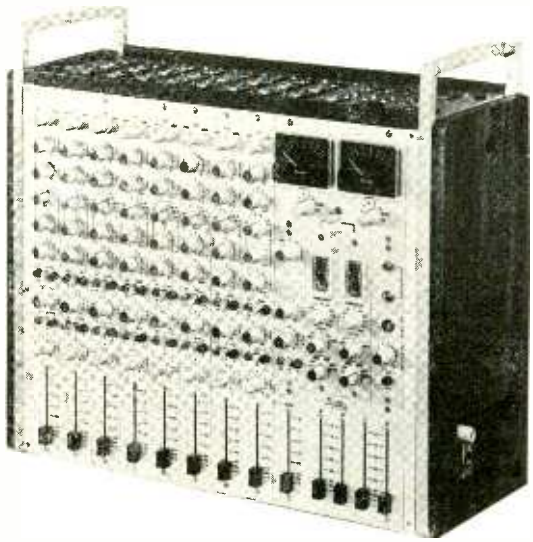

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The companies, their developments, and the background to the takeover

Wessex—Chrysalis

JOHN DWYER

THE BIGGEST news at this year's rather dull APRS show was that Chrysalis had taken over Wessex recording studios. The announcement was the surprising by-product of a Neve press conference held on the first and busier day of the exhibition to announce that Wessex/Chrysalis had ordered from Neve the first 32 track desk in London.

Even the holding of the press conference had its minor mystery. Neve say, probably correctly, that they announced nothing they shouldn't have, but Chrysalis press officer Chris Briggs later described the news as having 'leaked'. He had not yet written a press release.

Wessex must be one of the longest established recording firms in the country. Ron Thompson had been trained as a furniture designer but his hobby was sound recording. In 1949, after he had spent six years in the RAF as a signals engineer, he went to live in a thatched cottage in Wiltshire. What is now Wiltshire was part of the ancient kingdom of Wessex and it was in this unlikely setting that Thompson started the Wessex Recording Service.

'I had a disc cutting machine and a couple of mikes and I'd go round to the local pubs on a Saturday night and record the boys having a sing-song.' There were no tape machines then and the recording had to be cut directly on to 7in. discs. 'I'd cut a few copies and flog them to the boys with a special stylus that wouldn't damage the acetate.'

Shortly he set up a mobile recording unit with a photographic dealer friend from Andover. They carried the gear around to various musical events, one being a performance of the opera 'Merrie England' by the Salisbury Arts Theatre. To record that they used two disc cutting machines and recorded the whole opera on 7in discs overlapping one on to the next.

Around this time he was building a tape machine in his attic. It was based on the German Magnetophon and took 15 months to construct. 'I remember very clearly what a big thrill it was the moment when I first heard my son's voice on that machine.'

At the beginning of the fifties Thompson and his family moved to Bournemouth, where he ran a hi fi shop with a recording studio underneath. 'At that time nobody was making a living by recording alone. We made recordings of groups, choirs and local musicians and they'd order 50 or 100 pressings from a master acetate we cut. By 1953 tape was widely accepted and we did a series of stereo recordings for general release at the Winter Gardens Bournemouth, under the baton of Charles Groves, now Sir Charles Groves. We also recorded at Salisbury Cathedral. We were using an EMI *TR52* machine modded for stereo.'

Thompson had also started to offer a freelance film sound recording service for 16 mm industrial films. Among others Wessex produced films for ICT and the electricity board.

By 1959 Ron Thompson's eldest son, Mike, had joined him in the business. The recording operation had become successful enough on its own for Thompson to leave the hi fi shop and open a more elaborate studio in the centre of Bournemouth. It had a large control room, three EMI tape machines, a 16 mm magnetic sprocketed film recorder and enough recording space for 20 musicians. On the film side they were recording commentaries by Michael Aspel, Richard Baker and more. Having got to know a number of film technicians and others over the years they asked the staff of a just-liquidated film company to join them to form a new company, and that was the start of ICE Films.

Not long after that, Ron left his younger son Robin in charge of the Bournemouth studio with another partner and opened a second studio at 30 Old Compton Street, where Wessex began to record such people as John Barry and Max Bygraves and where the Thompsons first met Les Reed. Much of the support for this and later expansion came from one of the Wessex partners, a personal friend of Ron Thompson's called Harley Townley, a director of Midgate Finance Ltd. Thompson says Townley can take much of the credit for the company's growth.

Eventually they outgrew the studio in Old Compton Street: 'We found we were getting more and more work and the studio just wasn't big enough. So I started writing to the Church Commissioners. I thought they were bound to have a church hall or something they wanted to sell. The first two offers I got from them, I remember, were for premises within a mile of the main runway at Heathrow Airport, so that was no good!' Then Wessex were told of a church hall in Highbury New Park, where they have been ever since.

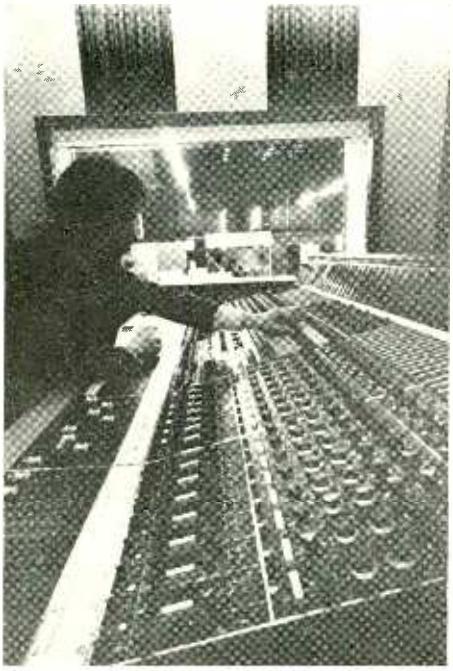
That was in 1966. They closed the Bournemouth studio and Ron Thompson and his partners went into partnership with Les Reed, writer of hit songs with Barry Mason. Reed had a fifth share in the new company, Wessex Sound Studios, and he did most of the recording for his Chapter One records there. Wessex spent £10,000 on a new desk, an eight track Neve, which was the third desk Rupert Neve had built since he had ceased to make hi fi equipment and had turned to making studio consoles. Thompson had known Neve since the hi fi days and they have been great friends ever since.

When Wessex first acquired the hall they had a lot of work to do before they could think of putting equipment into it. To get good sound insulation they had to build additional floors and walls within those of the main building—the walls ended up 18 in thick. The surface acoustic treatments then had to be designed and added.

In fact Wessex were making continual improvements. In Studio Diary in November 1971 Keith Wicks reported that they were altering the acoustics again: 'The Wessex staff are more concerned about acoustics than many of their competitors. One end of the studio has been finished with reflective lino tiles which enable the engineers to get a 'bigger' sound, particularly on strings. The other section is carpeted to deaden the sound, making that part suitable for rhythm instruments.'

Wessex built a vocal booth and control room into one end of the hall and, in a small room to the side of it, they built a reduction room. This smaller room had been used as a Sunday school and they could convert it only if they provided another small building for the Sunday school not far away. The reduction room was enlarged to include a separate control room and vocal booth. The other side of the building was extended to provide space for a plate room, workshop and kitchen area. The main control room was lengthened and a rest area built above

Wessex from the control room into the studio.



it. Ron Thompson admitted that the rest area had never been used as musicians tended to collect in the kitchen area.

When the studio opened they were using a four track tape machine but they went up to eight track almost immediately. Four years ago they bought a second Neve desk, one of the first 24 track consoles in Europe. It was used with a 16 track machine until February this year when they bought a 24 track Ampex *MM1100*. 'The business grew and grew. We did lots of work for America—people used to come from Nashville and Hawaii to record. Last year 34 per cent of our work was for direct export to America.'

In 1970 Robin Thompson got a Grammy nomination for the Moody Blues album 'To Our Children's Children'. His elder brother, chief engineer Mike, tended to work on sessions with larger groups; a couple of years ago Mike recorded the band of 50 called Centipede directed by Keith Tippett, and last year he won an award from Military Band magazine for the best album of military band music, one he made with the Royal Life Guards. He was also responsible for the Quincy Jones soundtrack album of McKenna's Gold, an operation which involved a typically modest Quincy Jones lineup of 73 musicians.

The list of artists who have recorded at Wessex also includes the names of Tom Jones, Engelbert Humperdinck, the Beatles (separately), the Four Tops, Johnny Dankworth, Cleo Laine, Mireille Mathieu, Alan Price, Georgie Fame, King Crimson, Millie, Morecambe and Wise, the Bachelors, Moody Blues, Bert Kaempfert, Frankie Vaughan, Tom Paxton, Charles Aznavour, Stevie Wonder, Gary Glitter, Queen, Pretty Things and the New Seekers—their 'You'll Never Find Another Fool Like Me' was engineered by Geoff Worksop, who joined Wessex five years ago as a junior tape op. He is now a successful engineer on his own and is currently working in America.

Not that there haven't been misfortunes along the way. Four years ago Ron Thompson suffered a stroke from which he has now recovered but which reduced the amount of work he could put into the company. Six months ago, too, his younger son Robin contracted an infection behind the ear which forced him to leave the music business. He is now rebuilding a 30 ft boat on which to take his wife and two children to America.

It was just over six months ago that Chrysalis became interested in getting a studio. They had already looked at Command (who hasn't?) and one or two other places when a mutual acquaintance introduced Chrysalis secretary and financial director Terry Connolly to some of the people at Wessex.

It isn't their fault, but reading the story of Chrysalis is like looking through the scenario of a bad early forties Hollywood biopic: two young college kids mad about music but not gettin' anywhere, then they meet and discover that one has the mew, the other has zic and together they make mewzic. (Cue for song: 'What a Com-bin-nay-shun'.) After their early struggles ('Don't look so down-hearted, pal. We'll make it, sure we will') they hit the big time and find the world at their feet, and they're busy, busy guys. (She: 'Oh, Nelly, he doesn't need Me, he has his music.') Chrysalis began just over five years ago when Terry Ellis and Chris Wright (Chris + Ellis=Chrysalis) discovered that the first release of a group one of them managed, Ten Years After, had sold out: they claimed the group's record company hadn't had the courage to make sufficient pressings.

View looking down from control room to studio

Ellis had left Newcastle University a couple of years before with a BSc in Maths and Metallurgy and had then spent six months with a London booking agent. After complaints from his family that he was wasting his degree he spent a year in industry doing organisation and methods work, while in his spare time he ran an agency to book groups on the college circuit. After that year he decided he definitely wanted a career in music. Three months later he met Chris Wright, with whom he was in competition as a booking agent for the college circuit.

Wright had run a blues club at Manchester University where, like Ellis at Newcastle, he had been social secretary. After he left Manchester with a BA he continued to run the club and worked out of a local agent's office, booking bands for colleges in the north west of England.

Ellis realised the limitations of booking bands only for the college circuit and Wright wanted to move to London so they joined up to form the Ellis Wright Agency in the summer of 1967. Their first office, so the legend has it, was the bedroom of Ellis's Shepherd's Bush flat. Ellis managed Jethro Tull and Wright Ten Years After, and these were the two groups the organisation was able to build on. 18 months later came Procol Harum, who had been recording for Regal Zonophone.

The first Ten Years After lp went out on Deram, distributed by Decca. Ellis and Wright say they ran round to various record shops but the album had sold out. Not enough pressings had been made and Wright said later: 'I still maintain that record could have gone to number one if the records had been available.'

Another frustration was that no-one would sign Jethro Tull for a recording contract despite the fact that, by the autumn of 1968, they were a very popular live act. 'So we did it ourselves,' Wright said. Jethro Tull, in fact provided Chrysalis with their first singles chart entry on their own label: 'Sweet Dream' went into the Top Twenty on Guy Fawkes day 1969 and eventually went to number seven, staying in the chart for five weeks. An earlier Tull single, 'Living in the Past' had gone to number three in June, but that had been released on the Island Label.

These annoying manifestations of the obtuseness of the established record companies determined Ellis and Wright to manage without them. They wanted to form a group of companies which would provide every service for performers from agency and management to recording contracts and, lately, recording facilities.

Chrysalis was formed towards the end of 1968. The Chrysalis label arrived just under a year later. After three years of consolidation 1972 was a big year for Chrysalis. In that year they signed the first band to the label that they didn't also manage, Steeleye Span; on June 30 the company gave the first concert, with Deep Purple, at the newly acquired Rainbow Theatre, which most people thought would never reopen; and in August they signed a contract with Warner Brothers for American distribution. In the UK, Chrysalis records are distributed by Island, who have a large ready-made sales force and who benefit from having Chrysalis's progressive rock acts in the catalogue. Chrysalis are distributed by EMI in Scandinavia, Phonogram in Germany and Portugal and WEA in France. The first album released on Warners, by Jethro Tull, went to number one and the first single, Tull's Living in the Past, went into the top ten.

The Chrysalis group have a company for just

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WESSEX-CHRYSALIS

about every aspect of the music business, and it wouldn't be surprising to learn that there were one or two outside it. There's Chrysalis Artistes, Chrysalis Agency, Chrysalis Music, Chrysalis Records, Chrysalis Designs, Chrysalis Publishing Company, Chrysalis Promotions and Chrysalis Properties. In addition they have interests in other companies, such as Biffo Music, and they recently added another to the above list by forming a film company.

The publishing company also administers two production and publishing companies, Hush and New Acme. Hush is the project of producers Shel Talmy and Hugh Murphy and businessman Jonothan Rowlands. Talmy and Murphy formed the company two years ago and lately formed the link with Chrysalis because they say it offered them a good publishing deal and the use of a worldwide organisation. Hush intercede for their own artists and productions with the various record companies while Chrysalis do their publishing for them. In the New Acme company production Murphy and Rowlands are joined by producer Tom Parker. In March the company had two albums released on Charisma, one by Doggeral Bank and the other, 'Betjeman's Banana Blush', by poet laureate Sir John Betjeman, who recorded some of his poems to music by Parker's brother Jim.

To add to the complexity of Chrysalis's own empire, the Chrysalis publishing company have *their* own record production company called Moth. As the name of that company perhaps implies, Chrysalis get first refusal on Moth's output but they stress that Moth is 'not merely a clearing house for unwanted product.' Some productions might be 'unsuitable' for the Chrysalis label and Moth is used to place such material elsewhere.

Now Chrysalis is 'a multi-million dollar concern with offices in London, New York and Los Angeles'. They won't be more specific about the multi-million dollars: their spokesman wouldn't give any further details, not because he was being unhelpful but because he didn't know and didn't think anyone would tell him.

There were three reasons why Chrysalis, who say they had always wanted a recording studio, were in a position to get Wessex. One was that Ron Thompson was approaching 59 and his health prevented him from being as active in the company as he would have liked. Another reason was that other partners in Wessex had by then developed other business interests and were ready to dispose of their interest in Wessex, and the third was that Les Reed wanted to concentrate less on the commercial aspects of his activities and more on writing music; he had already pulled out of Chapter One records a couple of years earlier.

Negotiations went ahead. The registered address of Wessex Sound was changed to Chrysalis's address in Oxford Street by a document dated May 21 and signed by Terry Connolly of Chrysalis. It is well known round the industry that Chrysalis were prepared to shell out about a quarter of a million to set up or acquire a complete working studio, but details of the deal are shrouded in secrecy. Reports of the sum they paid for Wessex vary, though Chrysalis are understood to have driven a hard bargain. The most likely approximation is that they paid roughly £170,000 for the existing studio and are using the rest of the quarter of a million for re-equipping and rebuilding. Even Neve won't disclose how much the order for the new 34/32 desk was worth, but it would be surprising if it were much less than £50,000.

With what's left Chrysalis will modernise the decor of the main studio and increase the size of its control room by a third, enlarge the reduction suite into a 24 track studio and control room, and build a small restaurant and bar upstairs and a new reception area. Chrysalis say there will be three engineers and six tape ops and a full time catering staff.

At the time of writing no decision has been taken as to which method of multitrack recording they intend to use. While it is significant that the desk is 32 track and not 30 it is reasonable to suppose that if 32 channels are available Chrysalis will be able to take advantage of any new technological developments that arise.

Chrysalis say they hope to have all the building finished by December, but with the building industry in its present state they have allowed for delays by ordering the desk for February. Mike Thompson will remain in charge of the engineering staff as Technical Director. A new studio manager will be appointed shortly. Chrysalis said he would be someone 'well known in the music business, probably a well known musician. We want to compete on the same terms with the big studios, like Morgan and Trident.'

Where Chrysalis go next is anyone's guess They denied that the next logical step would be to do their own distribution and indeed the present arrangements do seem satisfactory enough. Wright and Ellis have now separated their roles so that Ellis is president in charge of the American companies and Wright is managing director in charge of the English group. As far as label content goes, Doug D'Arcy, in charge of the Chrysalis label, has been quoted as saying 'We are not restrictive in our outlook and indeed we have been discussing a classical project.'

Officially Chrysalis say they aren't worried about image projection. In a fifth anniversary supplement in Billboard in March Chris Wright was quoted as saying: 'I don't care what Chrysalis is known as providing we're always known and recognised as a quality company.' He wouldn't discount the possibility of putting middle of the road acts in the Chrysalis catalogue. Partner Terry Ellis expressed dissatisfaction with Chrysalis's 'underground' image, and that people associated the company with particularly heavy music, drugs, long hair and albums.

It could be that they're more image conscious than they pretend. A symptom of this is the Moth operation, another is the idea of getting a well known musician to become Chrysalis's studio manager. A third sympton is that when the new studio opens the name Wessex will disappear, and Chrysalis will go up in its place. You could say that that is a natural thing to do but, despite what they say, there are reasonable grounds to suppose Chrysalis thought keeping the name of an old-established company like Wessex would have damaged them in some way, despite the fact that they might now lose some of Wessex's old business.

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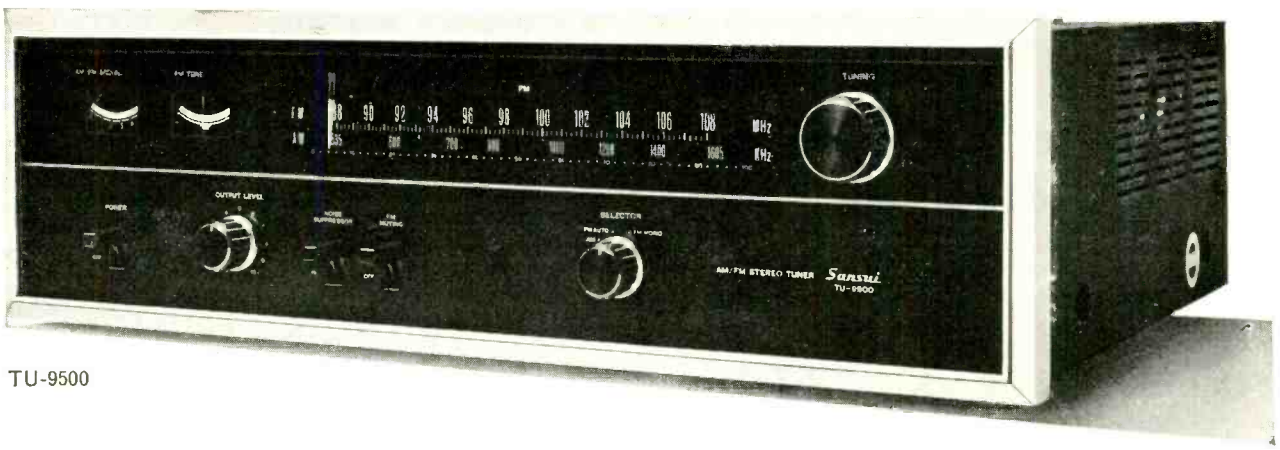
Twice.



TU-9500

Having made a brilliantly versatile amplifier, we felt we couldn't leave it there.

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It handles three pairs of speakers with ease. Not to mention two turntables and two tape decks. It guarantees less than 0.1% harmonic distortion over the entire frequency band of 20 - 20.000 Hz, with 75 + 75 watt continuous output power into 8 ohms both channels driven.
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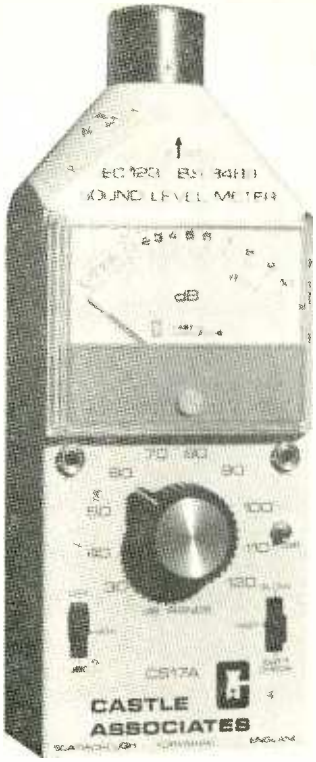
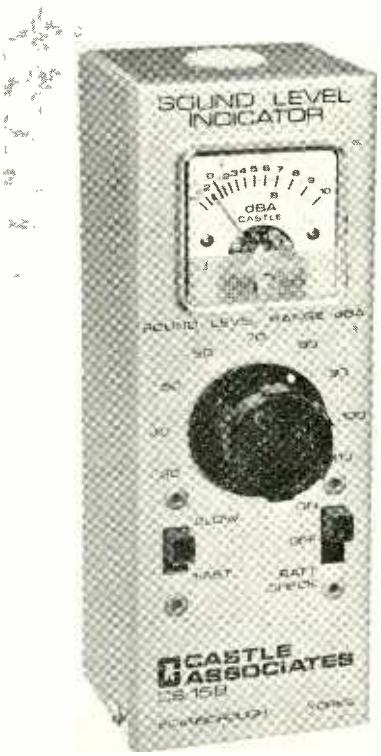
Survey: sound level meters





Above: Bruel & Kjaer type *2209* sound level meter.

Right: Castle Associates sound level meter.

ACOS
Cosmocord Ltd, Acos Works, Eleanor Cross Road, Waltham Cross, Herts.
Tel. Waltham Cross (97) 27331.

SLM3-10
Range: 50 to 130 dB in 7 ranges. Can be extended to 30 to 130 dB.
Response: Fast and slow.
Weighting: A.
Microphone: Moving coil.
Attenuator: None.
Outputs: To recorder.
Size: 102 x 219 x 78 mm.
Weight: 740g.
Price: £98.

BRUEL & KJAER
B & K, DK-2850 Naerum, Denmark.
Tel. 80 05 00.
(UK) Cross Lances Road, Hounslow, Middlesex TW3 2AE.
Tel. 01-570 7774.

2209
Range: Between 2 Hz and 70k Hz, 15 and 150 dB, depending on microphone.
Response: Impulse, maximum rms or maximum peak facilities.
Weighting: A, B, C and D built in.
Microphone: Accepts 25mm and 13mm B & K. Adaptor permits use of 6 mm.
Attenuator: 20 interchangeable scales for attenuator and meter.
Outputs: Low impedance ac to recorder, dc for recording meter hold.
Size: 320 x 119 x 88mm.
Weight: 208g.
Price: £695.

2203
Range: 10 to 25k Hz, 19 to 150 dB depending on microphone.
Response: Fast/slow.
Weighting: A, B and C built in.
Microphone: Accepts 25 mm and 13 mm B & K.
Outputs: Low impedance ac to recorder.
Size: 312 x 100 x 125 mm.
Weight: 2.70 kg.
Price: £440.

2205
Range: 20 to 10k Hz, 32 to 140 dB (A).
Response: Fast/slow.
Weighting: A, B and C built in.
Microphone: B & K type 4117, piezo-electric.
Attenuator: +10 dB.
Outputs: Ac to recorder.
Size: 182.5 x 82.5 x 50 mm.
Weight: 864g.
Price: £173.

2206
Range: 20 to 18k Hz, 36 to 140 dB (A).
Response: Fast/slow.
Weighting: A, B and C built in.
Microphone: B & K condenser type 4148.
Attenuator: +10 dB.
Outputs: Ac to recorder.
Size: 230 x 82 x 50 mm.
Weight: 110g.
Price: £354.

2208
Range: 20 to 10k Hz, 32 to 130 dB (A).
Response: Maximum rms.

Weighting: A built in.
Microphone: B & K piezo-electric type *4117*.
Attenuator: None.
Size: 182.5 x 82.5 x 50 mm.
Weight: 864g.
Price: £267.

CASTLE ASSOCIATES

Castle Associates, Redbourn House, North Street, Scarborough, Yorks YO11 1DE.
Tel. Scarborough (0723) 66348.

PSI202A
Range: 20 to 35k Hz, 24 to 140 dB depending on microphone and weighting.
Response: Fast, slow and impulse.
Weighting: A. B, C, linear and external 600Ω.
Microphone: 25 mm type *MK 102*. Can be fitted with 13 mm and 6 mm versions.
Attenuator: 10 dB steps.
Outputs: 1.5V ac into open circuit, output impedance 200Ω.
Size: 260 x 120 x 180 mm.
Weight: 3.5 kg.
Price: £600.

CS17A
Range: 20 to 140 dBA, 26 to 140 dBC.
Response: Fast and slow.
Weighting: A and C.
Microphone: Ceramic.
Attenuator: 30 to 120 dB in 10 steps of 10 dB.
Outputs: Ac and dc to recorder.
Size: 50 x 76 x 210 mm.
Weight: 720g.
Price: £75.

CS11B
Range: 55 to 115 dBA.
Response: Slow. Slower than BS 3489.
Weighting: A.
Microphone: 25 mm ceramic model *PZT*.
Attenuator: 12 positions, 5 dB steps.
Outputs: None.
Size: 38 x 63 x 140 mm.
Weight: 500g.
Price: £21.

CS16A
Range: 60 dBA to 130 dBA.
Response: Slow. Fast available as special option.
Weighting: A.
Microphone: 6 mm electret condenser.
Attenuator: 70 dBA to 120 dBA in 6 steps of 10 dBA.
Outputs: None.
Size: 76 x 51 x 178 mm.
Weight: 800g approx.
Price: £49.

CS15B, CS15C, CS15D, CS15E
Range: 26 to 130 dB depending on type.
Response: Fast and slow, as BS 3489.
Weighting: A.
Microphone: Ceramic.
Attenuator: 10 dB steps, number depends on range.
Outputs: Ac or dc provided as optional extra.
Size: 177 or 203 x 64 x 51 mm.
Weight: 600g.
Price: CS15B £40; CS15C £29; CS15D £46; CS15E £38.

CHANNEL ELECTRONICS (SUSSEX) LTD.

Channel Electronics (Sussex) Ltd, Cradle Hill Industrial Estate, Seaford, Sussex BN25 3JE.
Tel. Seaford 894961.

SLM77A
Range: 60 dBA to 120 dBA.
Response: rms.
Weighting: A.
Microphone: Electret. 6.25mm.
Attenuator: 10 dB steps.
Outputs: Optional extra.
Size: 177 x 51 x 76 mm.
Weight: 1.02 Kg.
Price: £51.

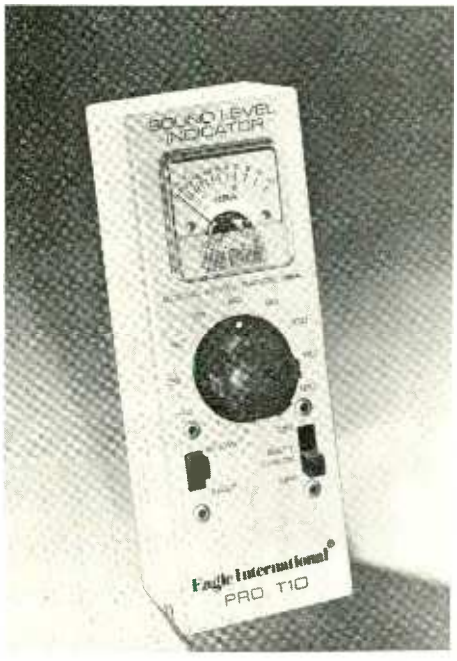
SLM16A
Range: 26 dBA to 120 dBA
Response: rms.
Weighting: A.
Microphone: Ceramic Piezo.
Attenuator: 10 dB steps.
Outputs: Optional extra.
Size: 177 x 64 x 69 mm.
Weight: 0.64 Kg.
Price: £39.

DAWE INSTRUMENTS LTD.

Dawe Instruments Ltd, Concord Road, Western Avenue, London, W.3.
Tel. 01 992 6751.

1404B
Range: Between 20 Hz to 20k Hz, 40 dBA to 120 dBA.
Response: rms.
Weighting: A.
Microphone: Built-in 12.5 mm capacitor.
Attenuator: 10 dB steps.
Outputs: None.
Size: 70 x 95 x 300 mm.
Weight: 860g.
Price: £198.

Eagle International sound level meter.



1420A
Range: 20 Hz to 20k Hz, 30 dBA to 120 dBA.
Response: rms/octave band filters, switchable.
Weighting: A, B, C.
Microphone: 12.5 mm capacitor.
Attenuator: 10 dB steps.
Outputs: 1V rms ac at 1.5K, 100 mV dc at 15K.
Size: 102 x 314 x 254 mm.
Weight: 5.1 Kg.
Price: £525.

1400G
Range: 24 dB to 140 dB.
Response: Slow, fast rms.
Weighting: A, B, C.
Microphone: Ceramic.
Attenuator: 10 dB steps.
Outputs: 1.5V rms at 10 KΩ.
Size: 64 x 111 x 311 mm.
Weight: 1.25 Kg.
Price: £172.

1419D
Range: 30 dB to 140 dB.
Response: Slow, fast rms.
Weighting: A, B, C or type R octave band filter.
Microphone: Ceramic.
Attenuator: 10 dB steps.
Outputs: 1.5V at 10 KΩ. 100 mV dc at 15 KΩ.
Size: 108 x 248 x 254 mm.
Weight: 3.5 Kg.
Price: £298.

1405C
Range: 40 dB to 120 dB.
Response: Slow, fast rms.
Weighting: A.
Microphone: Ceramic.
Attenuator: 10 dB steps.
Outputs: None.
Size: 70 x 95 x 240 mm.
Weight: 0.73 Kg.
Price: £89.

EAGLE

Eagle International, Precision Centre, Heather Park Drive, Wembley HA0 1SU. Middlesex.
Tel. 01-903 0144.

PRO T10
Range: 36 to 130 dBA.
Response: Fast and slow to BS 3489.
Weighting: A.
Size: 177 x 64 x 51 mm.
Weight: 600g.
Price: £50.66.

GENERAL RADIO

300 Baker Avenue, Concord, Mass. 01742, USA.
Tel. (617) 369-8770.
(UK) General Radio Ltd, 26 High Street, Wimbledon Common, London SW19. Bourne End, Buckinghamshire.
Tel. Bourne End (062 85) 22567.

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THERE is a great variety of sound level meters on the market, with a parallel variety of prices ranging from the £30/£40 region to over £1000 for the more sophisticated equipment. For run-of-the-mill noise measurements the most complex equipment is not necessary and the very cheapest equipment is unlikely to meet the performance and accuracy required for professional measurements.

At the time of writing there are three British Standards relating to sound level meters, one of which will probably be of little interest to readers because it relates only to the noise emitted by motor vehicles. The remaining two standards do, however, relate directly to the instruments which should be used and specified for general purpose noise measurements and furthermore generally conform to the IEC standards. These British Standards are BS 3489:1962 'Specification for Sound Level Meters (Industrial Grade)' which generally conforms to IEC Publication 123 'Recommendations for Sound Level Meters' and British Standard BS 4197:1967 'Specification for a Precision Sound Level Meter' which, with one minor exception, conforms exactly to the IEC Publication 179 'Precision Sound Level Meters'.

The two standards are written in very similar terms and specify the characteristics of microphone, amplifier, attenuators, weighting networks, rectifiers and meters among other things—the difference between the standards is that a precision sound level meter is required to meet very much tighter tolerances in virtually all respects.

The choice of sound level meters for these reviews was based on the likely requirements of studios and broadcasting organisations, and therefore does not include the cheap instruments that do not claim to meet accepted standards; and similarly it does not include equipment required for the analysis of noise spectra etcetera. However, the special Nagra recorder is included, as not only does this claim to be a sound level meter but it is specifically designed for recording noise for subsequent analysis.

BRUEL & KJAER

SOUND LEVEL METERS

By Hugh Ford

MANUFACTURERS' SPECIFICATION

Measuring Range: Type *2205* 32 to 140 dB(A, B and C). Type *2206* 39 to 140 dB(A), 43 to 140 dB(B), 51 to 140 dB(C).

Signal-to-noise ratio: . . . better than 5 dB for the lower limit.

Weighting networks: . . . A, B, and C weighting.

Meter scale: Graduations from —10 dB to +10 dB. Range displayed in window.

Meter damping: Fast and slow to IEC standard 179 and DIN 45 633.

Rectifier accuracy: ±5% for signals with crest factors less than three.

Input impedance: Type *2205* 10M Ω/140 pF. Type *2206* >2000 MΩ/40 pF.

Output impedance: . . . less than 50 Ω.

Minimum load impedance: . . . 5 kΩ.

Output voltage: Approximately 2.5V rms for full-scale deflection.

Maximum output: . . . 20V peak-to-peak.

Distortion: Less than 1% for full-scale meter deflection.

Noise: Type *2205* less than 1.2 μV relative to input with 4000 pF across the input. Type *2206* less than 2.6 μV relative to input with 17 pF across the input.

Microphone type: Type *2205* B & K 25 mm Piezoelectric type *4117*. Type *2206* B & K 13 mm condenser type *4148* (28V dc polarisation voltage).

Microphone frequency response: Type *2205* linear ±3 dB between 4 Hz and 10k Hz for incidence perpendicular to the diaphragm in a free field. Individual calibration curve supplied. Type *2206* linear ±2 dB between 4 Hz and 16k Hz for incidence perpendicular to the diaphragm in a free field. Individual calibration curve supplied.

Microphone sensitivity: Type *2205* approx. 3 mV per N/m^2. Type *2206* approx. 14 mV per N/m^2.

Microphone capacitance: Type *2205* 4000 pF, Type *2206* 17 pF.

Microphone temperature coefficient: —0.015 dB/°C.

Battery type: Single 'C' cell, IEC R14.

Battery life: . . . Ten hours continuous operation.

Operating temperature: . . . —10 to +50°C.

Storage temperature (battery removed): . . . —20 to +70°C.

Humidity range: . . . Up to 90% relative humidity.

Dimensions l x w x h: 186 x 84 x 51 mm (*2205*), 235 x 84 x 51 mm (*2206*).

Weight: Type *2205* 0.80 kg (including battery). Type *2206* 0.83 kg.

Accessories included: Type *2205* Piezoelectric microphone *4117*. Windscreen *UA 0207*.
Type *2206* Condenser microphone *4148*. Microphone adaptor *UA 0208*. Windscreen *UA 0237*.
Both types Carrying case *KE 0060*, Pistol-grip handle *DH 0129*, Wrist strap *DH 0128*, Screwdriver *QA 0001*, 1.5V battery IEC type R14 ('C' size) *QB 0009*.

Accessories available: Set of six spare windscreens: type *2205 UA 0253* 6m extension cable *AO 0061*. Condenser microphone *4148*. Microphone adaptor *UA 0208*. Set of six windscreens for 13 mm microphone *UA 0254*.
Type *2206 UA 0254* 3m extension cable *AO 0063*. Input adaptor for accelerometer cable *JJ 2615*. Sound level calibrator *4230*, Pistonphone *4220*, 1.2m output cable *AQ 0037*, tripod *UA 0049*, input adaptor for accelerometer cable *JJ 0037*.

Price: Type *2205* £173, Type *2206* £279.

Manufacturer: Bruel & Kjaer, 2850 Naerum, Denmark.

UK agent: B & K Laboratories Ltd, Cross Lances Road, Hounslow, Middlesex.

THESE two sound level meters, which are identical in many respects, meet the standard for precision sound level meters in the case of the type *2206*, and the relaxed 'industrial grade' standard in the case of the type *2205*. In fact, the only difference between the two models is the type of microphone used and the addition of a microphone preamplifier in the case of the type *2206* which incorporates a condenser microphone. In fact the 'Precision Meter' may be converted to the industrial grade instrument simply by purchasing a piezoelectric microphone type *4117*.

Both instruments are supplied in a plastic carrying case which incorporates a formed inner with compartments for the instrument, an alternative microphone, spare battery, pistol grip and finally a sound level calibrator type *4230* (a device which gives a known sound level within ±0.25 dB at 1k Hz). This calibrator is not only useful for calibrating the sound level meters, but is also particularly useful when the output of the meter is being recorded on to tape when a standard level tone can be recorded as a reference level. A sample sound level calibrator was lent to me during this review, and a brief check on its performance showed that the frequency was 1003 Hz which is so close to 1k Hz that the difference is insignificant so far as the common point of the standard weighting networks is concerned. Measurement of the sound pressure level as compared with my standard pistonphone, which is within ±0.1 dB, shows that the sound level calibrator was within 0.1 dB with a 25 mm pressure microphone and within the same tolerance with a 13 mm free-field microphone when the appropriate correction was made to the nominal 94 dB SPL from the calibrator.

The sound level meters have four operational controls, plus a recessed calibration control which is screwdriver-operated. The control switch on the lefthand side has four positions —'off,' 'battery check,' 'fast' and 'slow'—the latter positions corresponding to the standard meter ballistics. On the righthand side opposite this control is a further rotary switch which is a ten-position attenuator in 10 dB steps, the setting of which is displayed in a window at the zero point on the meter scale with legends from 30 dB to 120 dB. Above this main attenuator there is a 'press to make' 10 dB attenuator which is very useful if one is caught-out when making measurements on too

sensitive a range. The final operational control is a three-position slide switch which is used to select the A, B or C weighting network.

Both this switch and the main attenuator switch can be internally locked in any position to make the instrument 'more fool-proof' (to quote B & K) for operation by non-technical personnel. In fact the instrument is extremely simple to operate and read, the only shortcoming being that it is quite easy to forget to turn off the power as there is no indication other than the switch position.

Reading the instrument is simplicity itself, for all one does is to add the meter reading to the aforementioned indication in the window at the zero point of the meter scale. Furthermore, the scale calibration is clean and uncluttered, with half decibel increments above the zero mark up to 10 dB and 1 dB increments from the zero mark to −10 dB.

Mechanically the instrument has a very 'solid' feel about it, and the pistol grip makes it well balanced to hold with little sensitivity to handling noise. Two standard tripod bushes are fitted, one on the underneath of the instrument and one on the near surface. The single battery is changed by unscrewing a metal 'plug' with a coin (a 50p piece is the best fit, but ½p will still do the trick) which gives very positive location of the battery.

The final mechanical aspects are the input and output connectors. On the input end the microphones simply screw on to the instrument, with the option of various cable adaptors for use with accelerometers or to use the instrument as an amplifier (but weighting networks cannot be disconnected). The output connector is a B & K accelerometer connector, which is in the form of a micro-miniature co-axial socket which, while an excellent connector, is perhaps not the most convenient type to use.

The electrical performance

Initial measurements were made without the microphone, but with a direct electrical input to the microphone connection in the case of both meter types—the only difference was the presence of the capacitor microphone preamplifier with the type *2206* precision meter.

Measurement of the frequency response between the input and the electrical output confirmed that the characteristics of the 'A', 'B' and 'C' weighting networks were within 1 dB of the nominal curves from 20 Hz to 10k Hz, and within 1.5 dB at 20k Hz—this is far better than is required by any standard.

Similarly, checking the attenuator accuracy gave errors in the order of only 0.05 dB at 1k Hz, rising to a maximum error of 0.1 dB at 10k Hz; however, the +10 dB pushbutton was not so good with an error of 0.2 dB at 10k Hz —all the same well within standard precision tolerances. Linearity of the meter scale was found to be within the pointer readability over the entire scale length from −10 dB to +10 dB, which in all cases means a possible error of only a small fraction of a decibel.

Checking of the meter ballistics in terms of the 'precision' BS 4197:1967 gave the following results for the 'fast' and 'slow' meter time constants, both of which are extremely close to the nominal specification below:

	Measured result	British Standard
'FAST' Characteristic		
200 ms tone burst of 1k Hz	−1.2 dB	−1 dB ±1 dB
sudden application of 1k Hz sustained*	+0.6 dB	+0.6 dB ±0.5 dB
'SLOW' Characteristic		
500 ms tone burst of 1k Hz	−4.4 dB	−4.0 dB ±1.0 dB
sudden application of 1k Hz sustained*	+0.6 dB	+0.6 dB (+1/−0.5 dB)

*The reading was identical with tones from 100 Hz to 12.5k Hz as required by the standard.

Checking of the rectifier characteristic by the method of applying two non-harmonically related sinewaves of equal amplitude showed that here again the precision standard was met with ease, and the application of a 10 kΩ load to the instruments' output made no readable difference to the meter indication.

However, one possible shortcoming of the instruments is the dynamic range at the output terminal which was measured as follows in terms of rms noise to the rms sinewave output at full-scale deflection with 'A', 'B' or 'C' weighting:

Meter range	Signal-to-noise (Linear 20 Hz to 20k Hz)
120 dB	55 dB
110 dB	48 dB
100 dB	55 dB
90 dB	48 dB
80 dB	38 dB

Allowing for an extra 10 dB because the meter full-scale deflection is liable to be 10 dB below peak levels, we still end up with a signal-to-noise performance which cannot take full advantage of a modern tape recorder at the output of the sound level meter. On the other hand the performance is quite adequate for recording to the recommendations of the Department of the Environment's 'Code of Practice for reducing the exposure of employed persons to noise', otherwise known as the 'yellow peril'. Also, the output level at 2.5V rms corresponding to full-scale deflection was more than adequate, with a further margin of 11 dB before clipping point.

The other noise source of interest is of course the inherent noise level of the instruments' input stages. This was measured in terms of the equivalent sound pressure level with the appropriate microphone and with the input terminated with a capacitance equal to the microphone capacitance, with the following results:

	Equivalent SPL	
	Type *2206*	Type *2205*
'A' Weighted	30 dB(A)	22 dB(A)
'B' Weighted	34 dB(B)	22 dB(B)
'C' Weighted	40 dB(C)	23 dB(C)

These figures are in fact substantially better than both the instrument specifications and also the requirements of the two standards.

The electroacoustic performance

While the absolute sensitivity of the sound level meters is normally adjusted by means of either the acoustic calibrator or by means of a pistonphone, a matter of prime importance is the directional characteristic of the microphone. Here there are extreme differences between the

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■ BRÜEL & KJAER METER

requirements for industrial grade and precision instruments, as will be seen from the measured performance of the two Bruel & Kjaer instruments, both of which are well within the tolerances of their respective standards.

Summary

Both the instruments reviewed here are well within the accepted specifications, and the type *2205* is of particular interest because its electronics are in fact identical to the type *2206* precision grade instrument. Mechanically everything is to a very high standard and obviously much thought has gone into the ergonomics of the instruments.

The limitations of both instruments within their class is that there is no provision for external weighting networks and no unweighted setting, which can be of particular interest when recording readings on to tape. In this context the instruments also offer a rather limited dynamic range at the output sockets.

	Type *2206* (Precision)	Type *2205* (Industrial)
For angles of incidence of ±30°		
White noise in third-octave band up to 2k Hz	±0.5 dB	±0.5 dB
3.15k Hz	+0/—1 dB	+0/—1 dB
6.3k Hz	+0/—0.5 dB	+0/—1.5 dB
10k Hz	+0/—1.0 dB	+0/—2.0 dB
12.5k Hz	+0/—1.5 dB	
For angles of incidence of ±90°		
White noise in third-octave band up to 1k Hz	±0.5 dB	±0.5 dB
2k Hz	+0/—1.0 dB	+0/—1.5 dB
3.15k Hz	+0/—2.0 dB	+0/—2.0 dB
6.3k Hz	+0/—3.0 dB	+0/—6.0 dB
10k Hz	+0/—4.5 dB	+0/—9.0 dB
12.5k Hz	+0/—6.0 dB	

NAGRA IV-SJ

By Hugh Ford

MANUFACTURERS' SPECIFICATION

Intended for sound and vibration recording in applications which require truly portable equipment. Conforms to IEC recommendations for sound level meters when used with appropriate instrumentation condenser microphones. Simplified version available without input filters, and cue track.

Tape speeds (switchable): 38.1 cm/s, 19.05 cm/s, 9.525 cm/s and 3.81 cm/s.

Inputs:* Two line inputs: Level 10 mV to 120V. Input impedance 100 kΩ/800 pF. Two microphone inputs; sensitivity and impedance depend upon choice of plug-in preamplifier.

*Coarse and fine attenuators are provided on each channel to adjust the recording level from line or microphone input. Coarse attenuator 0-80 dB in 10 dB steps. Fine attenuator 0-10 dB in 1 dB steps.

Outputs: Two line outputs: 600Ω unbalanced 1V level. Headphone: 1V into 25 to 200Ω.

Switchable input filters: Six positions are provided as follows: 1. HP—Highpass (—12 dB at 50 Hz). 2. LIN—Linear. 3. A—To ASA 'A' weighting network. 4. B—To ASA 'B' weighting network. 5. C—To ASA 'C' weighting network. 6. D—To ASA 'D' weighting network.

Record/playback characteristics (for a record level 20 dB below max): ±2 dB 38 cm/s—25 Hz to 35k Hz, 19 cm/s—25 Hz to 20k Hz, 9 cm/s—25 Hz to 10k Hz, 3.8 cm/s—25 Hz to 3.5k Hz; ±1 dB 38 cm/s—200 Hz to 25k Hz, 19 cm/s—100 Hz to 16k Hz, 9 cm/s—50 Hz to 6.3k Hz, 3.8 cm/s—40 Hz to 2.5k Hz.

Recording down to 2.5 Hz is possible at 3.8 cm/s for replay at 38 cm/s. Third harmonic distortion at max record level . . . <2%. Max record level (corresponds to +20 on peak meter scale): 320 nW/m.

Signal-to-noise ratio for recording and playback (Scotch *203* tape):

Tape speed	weighted to ASA 'A',	linear 20 Hz to 200k Hz.
38 cm/s	64 dB(A)	57 dB
19 cm/s	63 dB(A)	57 dB
9.5 cm/s	62 dB(A)	56 dB
3.8 cm/s	60 dB(A)	50 dB

Amplifier chains: Overall frequency response 1 Hz to 40k Hz ±0.5 dB. Total harmonic distortion at 0 dB (0.1%).

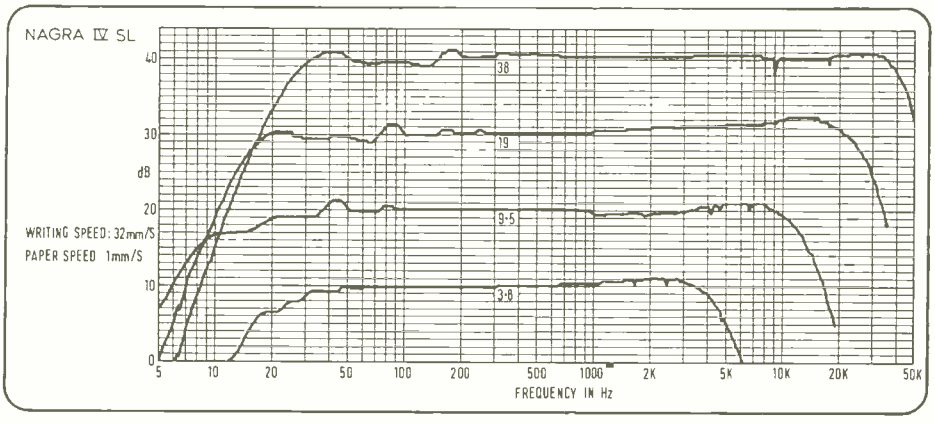

FIG. 1

Modulometer: The recording level is monitored with the aid of a moving coil meter with two co-axial pointers, one for each track. The meter is controlled by a switch with three positions: a) Peak; b) Average fast (integration time 200 ms for —1 dB ±1 dB); c) Average slow (integration time 200 ms for —4 dB ±1 dB).

Accessories: Supplied with a carrying handle. Optional carrying cases and many other accessories.

Cue track (only usable at 38 and 19 cm/s): A third channel is provided between the two main tracks. This is an fm system giving a wider frequency response range. It can therefore be used for a variety of applications, eg commentary (speech), time code pulses, reference frequency (50 Hz crystal), for facsimile, very low frequency signals (eg vibration). Recording can be carried out on this track during replay of other tracks. Carrier frequency 17k Hz, linearity 2%, deviation ±30%, frequency response 0-3500 Hz ±2 dB, 4000 Hz at —3 dB, sensitivity ±2.8V (2V rms), signal-to-noise ratio 40 dB. For speech recording accessory QSCM is recommended. This consists of a condenser microphone, automatic level control and pre-amplifier mounted in a lightweight case approx. 152 x 50 x 12 mm with cord attachment for wearing around user's neck.

Price: Model IV-SJ £1160.50.
Commentary Microphone QSCM £92.07.

Manufacturer: Kudelski SA, 1033 Cheseaux, Switzerland.

UK agent: Hayden Laboratories Ltd, 17 Chesham Road, Amersham, Bucks.

THE Nagra *IV* model *SJ* and its simplified brother the Nagra *IV* model *SJS* are modified versions of the familiar Nagra tape transport which has been specifically modified for sound and vibration recording. In fact, the mechanics of the Nagra *IV-SJ* are, with the sole exception of the lower speed available being 3.81 cm/s, identical to those of the Nagra *IV* reviewed recently in STUDIO SOUND. I do not, therefore, intend to repeat my review of items which are common to both types of machine, such as much of the electronics.

However, I would remind readers that the Nagra *IV* previously reviewed gave a really excellent performance in all directions, and was only subject to minor criticisms in the review by myself and in the field trial by Angus McKenzie.

The basic Nagra *IV-SJ* is available with either CCIR or NAB equalisation and, as is to be seen from the specification, has an extended frequency response with the additional

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NAGRA IV SJ

capability of recording and reproducing information with a 10:1 frequency multiplication or division by using the 38 cm/s and 3.8 cm/s tape speeds. This facility is of course very convenient for making a spectrum analysis of very low frequency signals which can be brought into the range of normal spectrum analysers when the frequency is multiplied by ten.

Accessory sockets and outputs are virtually identical to the stereo *IV-S* model previously reviewed providing for remote start, external powering, a commentary track etc. Also, the output facilities are very similar, but the output is unbalanced at 1V level.

The main modifications are centred about the input arrangements, which are specifically designed for instrumentation work. The metering is aimed at sound level measurement, but also has a peak reading switch position, and the attenuators, which consist of a pair of stepped attenuators for each channel, provide both 10 dB and 1 dB steps.

Two line inputs are provided as standard with a specified sensitivity of 1 mV into 100 kΩ, which is completely compatible with the outputs of common sound level meters and vibration meters. On the microphone side a number of options are available, the review recorder being equipped with the *QSJC* accessory which provides various dc supplies for external microphones including a +200V polarisation supply for capacitor microphones, and also the type *QSJA-SK* microphone preamplifier. The latter provides three switchable gains of +40 dB, +60 dB and +80 dB and is compatible with the Nagra type *QSPB* preamplifier which accepts many of the types of Bruel & Kjaer condenser measuring microphones.

Alternatively, accessories are available for connecting the Bruel & Kjaer preamplifiers to the Nagra, all the necessary power supplies being provided by the *QSJC* accessory within the Nagra recorder.

Clearly this offers a very versatile system for recording sound or vibration, as the Bruel & Kjaer microphone preamplifiers also act as preamplifiers for a large selection of Bruel & Kjaer accelerometers.

Sound level measurement

Because this system accepts a variety of standard microphones I do not propose to consider the electroacoustic performance parameters, but to concentrate on the electrical properties of the Nagra so far as they affect its performance as a sound level meter in the context of the current British and IEC standards.

Investigation into the accuracy of the A, B, C and D weighting networks showed that all four were extremely close to the ideal curve, the A, B and C characteristics being very well within the tolerances specified in the British and IEC standards for precision sound level meters.

Likewise, the attenuators exhibited an extraordinary accuracy, the 10 dB step attenuators being within 0.06 dB and the 1 dB step attenuator exceeding this performance. Also, the meter graduations were within the readability

of the scale, which means that in spite of the scale being rather cramped in parts and also the meter pointers being a little too short for the outer scale, the meter meets the requirements of the precision sound level meter standards.

Measurement of the meter ballistics gave identical results for the two channels, as over.

These results show that the meter ballistics is always on the margin of the precision sound level meter requirements, and in fact just outside the specification in the case of the sudden application of a sustained tone in the slow mode.

Unfortunately the recorder became really unstuck from the point of view of all sound level meter specifications when the meter rectifier characteristic was investigated. As is stated in the specification (somewhat to my surprise!) the rectifier characteristic is an average law which gives an error of 2 dB on the recommended method of determining the rectifier characteristic, where a maximum error of 0.25 dB is only accepted for industrial grade instruments. It was similarly found that the characteristic in the 'peak' mode did not indicate genuine peak, not that this mode relates to standardised sound level measurement.

Checking the overload capability of the electronics showed that waveform clipping did not occur until the input signal was raised some 18 dB above the signal required for full-scale meter deflection—this is more than adequate. While not necessarily particularly meaningful, the noise at the output of the recorder was 60 dB below full-scale meter deflection at maximum gain of the attenuators with the line input shorted, going to 76 dB below full-scale deflection at minimum gain, the measuring bandwidth being 20 Hz to 20k Hz using rms metering.

Of more interest is the inherent noise in the complete measuring system including the type *QSPB* preamplifier. This was measured in terms of equivalent sound pressure level with the input of the preamplifier shunted by 17 pF (which is the capacitance of a Bruel & Kjaer type *4133* condenser microphone) and assuming the use of a microphone with the same sensitivity. The resulting measurement shows that the equivalent sound pressure level of the inherent noise was 44 dB unweighted over the bandwidth 20 Hz to 20k Hz, 32 dB(A), 36.5 dB(B) or 42 dB(C); all are respectable figures which are very close to the Nagra specification.

Finally, a check on the polarisation voltage showed that the nominal 200V dc was set at 195V which is accurate enough for most purposes.

The record/replay performance

Because this is primarily a review of sound level meters I will deal briefly with the record/replay performance, it also being borne in mind that this machine is in many ways identical to the Nagra *IV-S* model previously reviewed.

Checking the replay frequency response at the two upper tape speeds by means of the BASF DIN calibration tapes, showed that the replay equalisation had been set with such extreme accuracy that the maximum deviation throughout the calibration tapes was ±1 dB.

NAGRA IV SJ

That is, from 31.5 Hz to 18k Hz at both 38 cm/s and 19 cm/s—this performance does justice to both Nagra and BASF!

The reference level (320 nW/m at 1k Hz at 38 cm/s and 19 cm/s *or* 250 nW/m at 333 Hz at 9.5 cm/s and 3.8 cm/s) was measured as follows:

Tape speed	Reference level to noise
38 cm/s	75 dB(A)
19 cm/s	69 dB(A)
9.5 cm/s	63 dB(A)
3.8 cm/s	58 dB(A)

The above figures give a satisfactory margin on the noise from modern low noise tapes, particularly at the higher tape speeds.

Recording naturally adds to the bulk erase noise from tapes, which is itself above the measured replay noise figures without tape; but at the tape speed of 38 cm/s a reference level to tape noise of some 64 dB(A) was measured, which when added to the 3 per cent third harmonic distortion level gives a signal-to-noise ratio of 67.5 dB using Scotch type *223* tape.

Fig. 1 shows the overall record/replay frequency response at the four tape speeds with the curves for all four speeds being far better than the manufacturers' specification. Possibly even more impressive was the performance when recording at the low speed of 3.8 cm/s and replaying at 38.1 cm/s when the replayed tape gave a flat response within ±1 dB from 28 Hz to 20k Hz, representing a recorded frequency spectrum from 2.8 Hz to 2k Hz. This clearly shows that the record equalisation at the 3.8 cm/s speed has been chosen with considerable care.

Distortion performance was checked at reference level (corresponding to an indicated record level of +20 dB when the meter is set to peak), and also the record level determined for 3 per cent third harmonic distortion with respect to the appropriate reference level:

Tape speed	Third harmonic at reference level	Reference level to output for 3% third harmonic
38.1 cm/s	0.9%	+3.5 dB
19 cm/s	1.0%	+3.0 dB
9.5 cm/s	1.7%	+6.0 dB
3.81 cm/s	1.6%	+6.0 dB

All these figures indicate a satisfactory performance and give an adequate margin on the record level metering, both in the peak mode and in the average mode where full-scale deflection is 10 dB below reference level.

The final concern in the record chain is the performance of the highpass filter, which was not dealt with when considering the performance as a sound level meter. In fact, the filter has a −3 dB point at 200 Hz and then cuts at about 12 dB per octave being 26 dB down at 50 Hz, all of which is around an octave above the manufacturers' specification.

Meter ballistic measurement

	Measured result	Precision standard
'Fast' Characteristic		
200 ms tone burst of 1k Hz	−1.5 dB	−1 dB ±1 dB
sudden application of sustained tone	+0.1 dB	+0.6 dB ±0.5 dB
'Slow' Characteristic		
500 ms tone burst of 1k Hz	−3.7 dB	−4 dB ±1 dB
sudden application of sustained tone	no overshoot	+0.6 dB (+1 dB/−0.5 dB)

Finally, a brief check was made on the wow and flutter and on the relation between tape speeds, the latter being particularly important when considering the use of the recorder for frequency transformation. Wow and flutter to the weighted DIN measurement was measured only at the beginning of a 178 mm spool of Scotch type *223* tape with the following results:

Tape speed	DIN weighted wow and flutter
38 cm/s	0.056%
19 cm/s	0.06%
9.5 cm/s	0.06%
3.8 cm/s	0.12%

These figures are in line with the specification and represent excellent performance, but even more outstanding was the precision of the relation between all four tape speeds which was within 0.02 per cent in the worst case—the figure being obtained by measuring the average periodicity of a 10k Hz tone recorded at 38 cm/s over 10s periods at each tape speed.

Another facility which is available with the Nagra is the commentary microphone type *QSCM* which enables a commentary to be recorded on a pilot tone track when the main recorder is in either record or replay at the two higher tape speeds. While the performance of this system was not measured as such, it was found to be completely satisfactory in use and offers a very valuable facility when recording sound or vibration—particularly in the latter case. Checks were made to ensure that the crosstalk between the commentary track and the other two tracks would not be troublesome; it in fact turned out that crosstalk between tracks was not measurable using wide band measurement and furthermore was completely inaudible.

Summary

Considering the use of the Nagra type *IV-SJ* as a sound level meter it has one very serious failing: the rectifier characteristic of the metering is 'average' when the IEC and British Standards for the two grades of sound level meters insist on an rms rectifier. Measurements cannot therefore be made to accepted standards.

This does not however preclude the recording of sound levels with the use of an appropriate microphone for subsequent analysis, provided that the analysis is undertaken with meters complying with the accepted standards.

As an instrumentation recorder I have nothing but praise for the performance of the Nagra *IV-SL*, which is both well built and offers a really excellent performance in all respects.

In particular the facilities offered by the commentary track are very valuable for instrumentation work, leaving the two other tracks available for data recording.

DAWE 1400G
SOUND LEVEL METER

By Hugh Ford

MANUFACTURERS' SPECIFICATION

Sound level range: 30 dB to 140 dB with reference to the standard sound pressure level of 0.0002 dyne/cm² on A, B and C weightings. Measurements down to 24 dB can be made with reduced signal-to-noise ratio. Up to 200 dB with high level microphone Type *1352A*.

Frequency characteristics: Three standard A, B and C weighting curves (BS & IEC) are provided over the frequency range 31.5 Hz to 8k Hz.

Accuracy: To BS 3489:1962 and IEC 123.

Microphone: Highly stable ceramic microphone. Minimum temperature —30°C. Maximum temperature 95°C. Maximum relative humidity 100%.

Nominal capacitance: 460 pF.

Attenuator: 30 dB to 130 dB in steps of 10 dB.

Meter: Calibration from —6 dB to +10 dB. 'Fast' and 'Slow' response provided to BS 3489:1962 and IEC 123.

Calibration: The overall acoustic calibration is set for the microphone supplied with the instrument against a reference microphone, the sensitivity of which is periodically checked by the National Physical Laboratory.

Output: Full-scale deflection of the meter corresponds to approximately 1.5V rms into a resistive load of 10 kΩ.

External filters: Jacks are provided for connecting external filters which require a source impedance of 600 Ω and a load impedance of either 600 Ω or 10 kΩ.

Power supply: One dry cell BS style R20 (U2), Ever-Ready LPU2 or equivalent.

Mounting: Extremely compact and portable cabinet fitted with 6.25 mm Whitworth bush for tripod mounting. Leather carrying case supplied.

Dimensions: 310 x 110 x 64 mm overall.

Weight: 1¼ kg.

Price: £172 with case and microphone.

Manufacturer: Dawe Instruments Ltd, Concord Road, Western Avenue, London W3.

DAWE Instruments are one of the very few British firms that manufacture, and have manufactured for a long time, a range of sound level meters for industrial use. The type *1400G* instrument reviewed here is but part of the available range, which also includes accessories such as vibration adaptors, alternative microphones, calibrators and windshields.

The type *1400G* is supplied as standard with a hard leather case which has two pockets for spare batteries etc and a shoulder strap. The case itself is equipped with a lock.

The mechanical construction of the instrument comprises a medium weight two-part metal case, with all the controls mounted on the upper surface and the microphone plugging into the 'working end'. The battery is located within a removable panel under the instrument, adjacent to which is a standard tripod bush. Unfortunately the battery compartment cannot be opened without the aid of a screwdriver or a similar instrument.

Internally, the components are mounted on three good quality printed boards, two of which are directly attached to the front panel controls. The standard of wiring is high and with the possible exception of the two variable pre-sets the instrument incorporates good quality components.

Reverting to the front panel, the upper part is occupied by an easily read meter which is scaled in 1 dB steps from −6 dB to +10 dB and also has a battery check marking. Under the meter there are three vertical rows of push-button switches, which are interlocked where appropriate. The lefthand row includes the power on/off, battery check, choice of the 'A', 'B' or 'C' weighting networks and finally the switching for external filters which excludes the weighting networks, but offers the option of either 600 Ω or 10 kΩ termination. With the exception of the 'fast'/'slow' pushbutton the remaining nine pushbuttons select meter ranges. The righthand row of buttons selects the zero level in the range 30 dB to 70 dB in 10 dB steps, and the centre row provides a possible further attenuation up to 60 dB in 20 dB steps.

While these attenuator steps are clearly identified, the system could be confusing for the less experienced operator; also, the meter's accuracy is reduced if the 20 dB step attenuator is used in conjunction with the lower settings of the 10 dB step attenuator.

The remaining items on the front panel are three 6.25 mm jack sockets which provide for the external filter input and output, and also give an ac output of 1.6V rms corresponding to full-scale deflection for feeding tape recorders or other devices.

The electrical performance

Measurement of the characteristics of the three weighting networks by means of a direct input to the microphone socket and taking the output from the output jack on the front panel confirmed that the networks met the requirements of BS 3489:1962 and IEC 123 by a very safe margin; as is to be expected they do not meet the requirements of the 'precision' standard.

Similarly, checking of the accuracy of the 10 dB and 20 dB step attenuators at 100 Hz, 1k Hz and 10k Hz revealed that they were far more accurate than the Industrial Grade Standard requires, generally being within ±0.2 dB.

Linearity of the meter scale between indications of −2 dB and +10 dB was within the readability of the scale marking. Below the −2 dB mark a cumulative error appeared with a maximum of 0.4 dB—however this is within the British Standard requirements. Measurements on the meter ballistics in both the 'fast' and 'slow' modes showed that the metering was correct in the 'slow' condition, but that in the 'fast' mode there was a possible error of 0.7 dB as compared with the British Standard Industrial Grade requirements.

Checking of the rectifier characteristic by the addition of two sinewaves of different (non-harmonic) frequency as prescribed in the British Standards reveal that the meter was extremely accurate—there was no measurable error using this method. Similarly, the application of a 10 kΩ load to the output terminals of the instrument did not make any readable change in the meter indication.

The signal-to-noise ratio at the instrument's output in terms of rms noise to the rms sine-wave output for full-scale meter deflection was quite adequate, the following results being obtained—with any weighting incorporated:

Meter range	Signal-to-noise (linear 20 Hz to 20k Hz)
130 dB	66 dB
110 dB	61 dB
90 dB	51 dB
70 dB	51 dB

From the point of view of tape recording the output, 10 dB can be added to the above figures to allow for the peak output from the sound level meter, which in fact has the capability of delivering an output 12 dB above the equivalent full-scale deflection output.

The inherent amplifier noise of the sound level meter was measured in terms of the equivalent sound pressure level at the microphone, and worked out as follows:

'A' Weighted	19 dB(A)
'B' Weighted	21 dB(B)
'C' Weighted	20 dB(C)

All the above figures are substantially better than the instrument's specification would suggest.

The electroacoustic performance

The absolute calibration of the Dawe meter is set at the factory, but can be adjusted by means of calibrators available from Dawe; as the microphone diameter is somewhat over 25 mm, competitive calibrators cannot be used.

Checking the calibration at 1k Hz in com-

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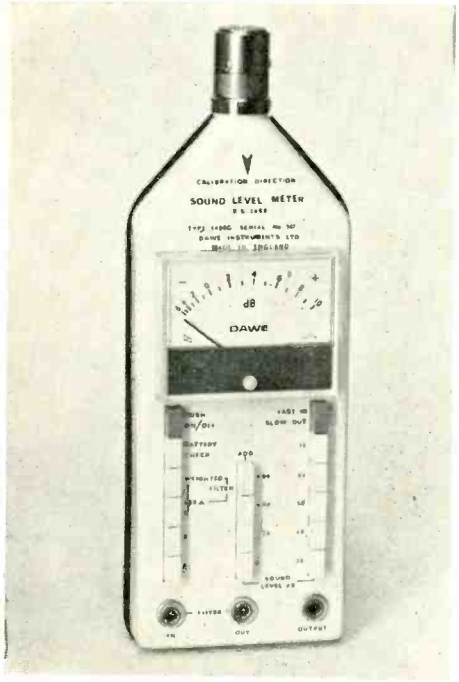
	Measured result	British Standard 3489:1962
'FAST' Characteristic		
200 ms tone burst of 1k Hz	—1.5 dB	—1 dB, 0 to —4 dB
sudden application of 1k Hz sustained (also 8k Hz)	+1.8 dB	+0.6 dB, ±0.5 dB
'SLOW' Characteristic		
500 ms tone burst of 1k Hz	—3.5 dB	—4 dB ±2 dB
sudden application of 1k Hz sustained	+0.5 dB	+6 dB (+1/—0.5 dB) +0.6 (+1/—0.5 dB)

DAWE 1400G



DAWE Type *1400G* off H axis response

For angles of incidence of ±30°

White noise in third-octave band up to	
2k Hz	±1 dB
3.15k Hz	+0/—1.5 dB
6.3k Hz	+0/—3.0 dB
10k Hz	+0/—3.0 dB

For angles of incidence of ±90°

White noise in third-octave band up to	
1k Hz	Less than ±1 dB
2k Hz	+0/—1.5 dB
3.15k Hz	+0/—1.5 dB
6.3k Hz	+0/—8.0 dB
10k Hz	+0/less than —12 dB

parison with my standard measuring microphone confirmed that the original factory calibration was correct.

Investigation of the microphone performance off-axis in terms of the British Standard for industrial grade sound level meters confirmed that the Dawe instrument was within the required tolerances, as is to be seen from the above figures:

Summary

With the exception of the meter ballistics in the 'fast' mode, all the measurements show that the sample instrument was within the requirements of British Standard 3489:1962 and IEC 123 for industrial grade instruments. Bearing in mind that the review sample was a sales demonstration instrument, this does credit to the design.

The instrument has a slightly clumsy feel about it compared with some modern sound level meters but does offer many facilities, including high sensitivity, the use of external filters and an electrical output which has a good dynamic range.

NB Our apologies to John Fisher, who should have been credited for the Brenell Field Trial (August STUDIO SOUND) and not Hugh Ford.

SURVEY

GR 1933
Range: 10 to 140 dB, depending on microphone. 5 to 100k Hz.
Response: Impulse, octave band, rms. Fast and slow.
Weighting: A, B and C and flat.
Microphone: 25 or 13 mm electret condenser.
Attenuator: Automatic: single range control for on-scale indication.
Outputs: Ac and dc for recorder.
Size: 165 x 225 x 76 mm.
Weight: 2.5 kg.

GR 1563 and GR 1565-B
Range: 40 to 140 dB.
Response: Rms, fast and slow.
Weighting: A, B and C.
Microphone: Ceramic.
Outputs: Jack for headphones or recorder.
Size: 92 x 137 x 53 mm.
Weight: 500g.

MINOPHON
Hird-Brown Ltd, Lever Street, Bolton BL3 6BJ.
Tel. Bolton (0204) 27311.

Range: 40 to 125 dB. 25 to 125 dB with amplifier-microphone.
Response: Slow and fast.
Weighting: A, B and C.
Microphone: Moving coil dynamic.
Attenuator: None.
Outputs: Earphones. To recorder.
Size: 125 x 85 x 40 mm.
Weight: 480 kg.
Price: £82.59.

OPEN UNIVERSITY
Level indicator produced for the Open University by Castle Associates.
Distributor: Lock Instrumentation, Neville Street, Middleton Road, Oldham, Lancashire.
Tel. 061-624 0333.

CS 15C
Range: 31.5 to 5k Hz, 36 to 110 dBA.
Response: Fast and slow
Weighting: A.
Attenuator: 7 positions.
Outputs: None.
Size: 177 x 64 x 51 mm.
Weight: 600g.
Price: £29.

RCA
(UK) Ardente Industrial Services, Ardente House, Thames Avenue, Windsor, Berks.
Tel. Windsor (95) 61657.

WE-130A
Range: 70 to 110 dBA.
Response: Slow.
Weighting: A.
Microphone: Ceramic.
Attenuator: None.
Outputs: None.
Size: 175 x 76 x 50 mm.
Weight: 320g.
Price: £34.50.

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Wow & flutter (din weighted)	·05%
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Dimensions (ins) Width	25½
Depth	19½
height above deck	4
height above deck*	13½

*Allowing room to tilt deck up through 90° for service.

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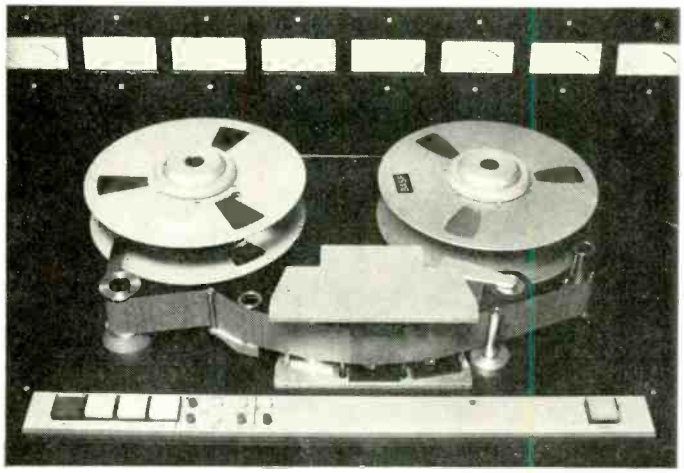

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Mono Record/Play	£485 + VAT
Mono Play only	£445 + VAT

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01-836 7811 TELEX: 23197

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AMITY BROADCAST CARTRIDGE MACHINES ☐

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NOTE: Advertisement copy must be clearly printed in block capitals or typewritten.
Replies to Box Nos. should be addressed to the Advertisement Manager, Studio Sound, Link House, Dingwall Avenue, Croydon CR9 2TA, and the Box No. quoted on the outside of the envelope. The district after Box No. indicates its locality.

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★**A new dB tamer** from Cathedral . . . Compressor/Limiter module CLA 1, £15.50 post and VAT paid. Low distortion oscillator module OSC/2 £15.50 post and VAT paid. Quantity discounts available. S.A.E. details Cathedral Sound, Fourways, Morris Lane, Halsall, Lancs. L39 8SX.

★**Nagra III** and IV and SN models available. Immediate delivery. Write or phone J. J. Francis (Wood Green) Ltd., Manwood House, Matching Green, Harlow, Essex. Tel. Matching 476.

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Ilford and Scotch 1" instrumentation tapes with spools type 37/12 556 BPI. 158 intermediate band ·0015" thick (Ilford) 143 wide band ·001" thick (Scotch). Excellent clean condition. Anticipated further 500 tapes later. Offers for all or part quantities to:
M. J. NELSON
Rolls Royce (1971) Ltd., Derby
Tel. Derby 42424 extension 488

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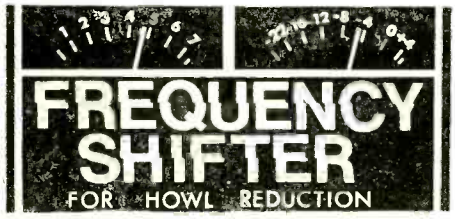
TWIN MOVEMENT, scale 86 x 54mm £31·00.



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PRICE	£58	£68	£84

SHIFTER CIRCUIT BOARDS FOR WW July 1973 article
Complete kit and board £21 Including p.s.u. and
Board built and aligned £28 mains transformer
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Tel. 2273

★**County recording service** stereo and mono masters and lacquer discs from your tapes. Telephone Bracknell 4935. London Road, Binfield, Bracknell, Berks.

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★**Sound News Productions.** Britain's oldest full-time Tape/Disc/Tape transfer service. Direct transfers, pressings for private and for the trade. Fund raising advisory service for societies, choirs, bands. 18 Blenheim Road, London W4. Tel. 995 1149.

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★**1 Scully** 4 track (approx. 12 months old), £2,000. Audio mixer 8/4 £900. Various reverb units, control boxes, microphones, etc. H.P. available. Tel. 0905 20279/21112. Only reason for selling, gone 8-track.

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FOR SALE—PRIVATE
(Continued)

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★**4 track** fully equipped working recording studio for sale. Offers Box No. 680.

★**E.M.I.** BTR/Z all sub-units inc. p.p.m., monitor amp. Best offers or swop for studio equipment. Box No. 681.

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★**Teac A-3340.** 15 i.p.s. "Domestic" 4-channel recorder with full sel-sync, 14 months old, perfect condition, offers around £300. Phone Leven (Fife) 3203 evenings.

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★**Natural history** sound recordings available. Enquiries to: Richard Margoschis, 80 Mancetter Road, Mancetter, Atherstone, Warwickshire CV9 1NH. Tel. Atherstone (08277) 2925.

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★**Bias Electronics** stereo transportable recorder, 7:5/15. Medway Organs, 101 Canterbury Street, Gillingham, Kent. Medway 55888.

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★**Maintenance** Engineers, with good audio engineering background, required by London sound studio. Practical studio experience advantageous, salary negotiable. Write Box No. 677. (Own maintenance staff have been advised of this advertisement.)

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Communications House, Gough Square, London, E.C.4.

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The Positions will involve shift work. Salaries in accordance with ACTT/ABS agreement.

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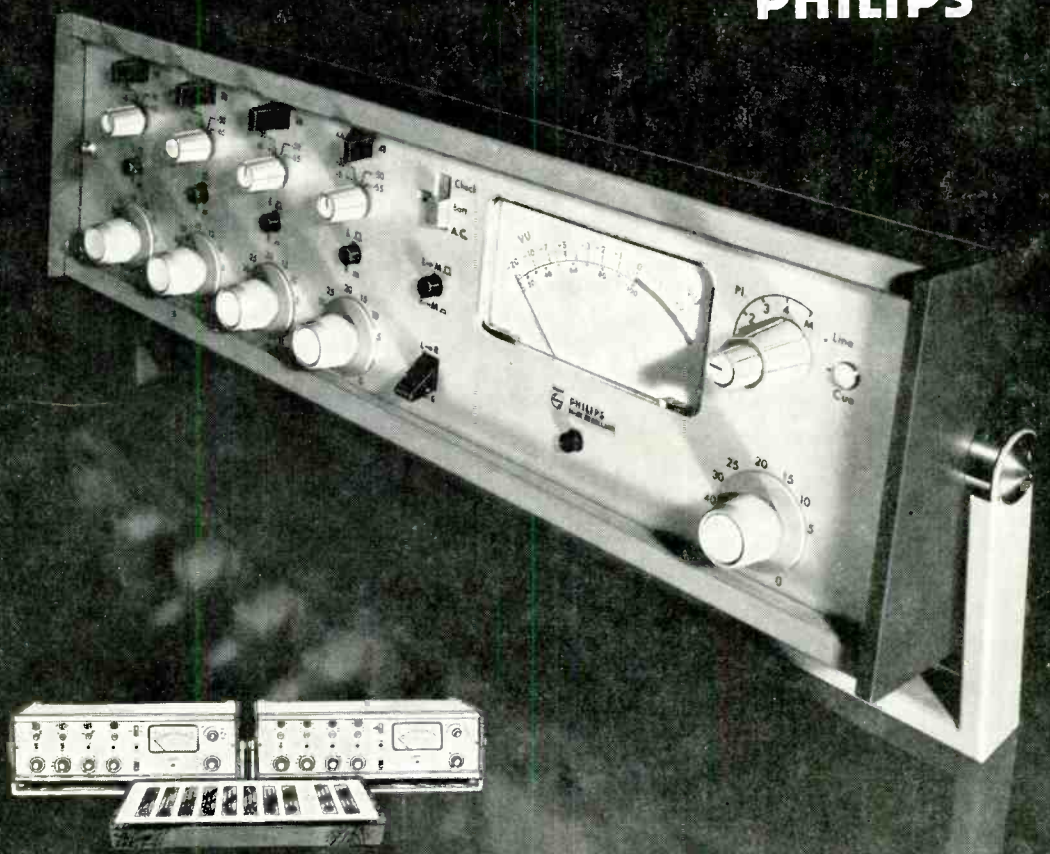

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