December 1973 25p

studio sound

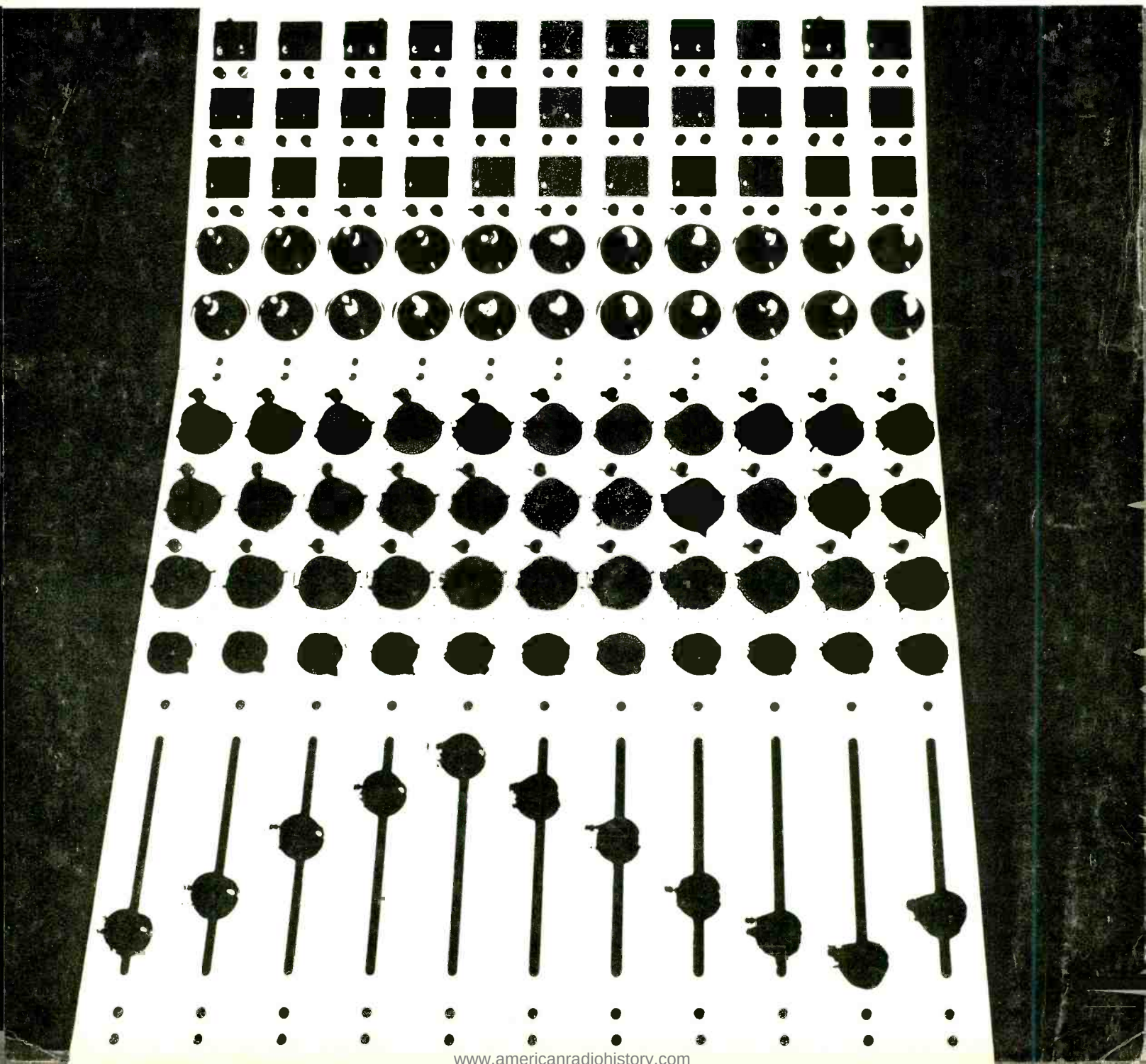
AND BROADCAST ENGINEERING

Noise in audio mixers ▪ Sound mixers surveyed

Constructing a peak-reading oscilloscope

Reviews: Bias BE106 mixer and Crown IMA distortion analyser

Broadcasting: Wither the Beeb?



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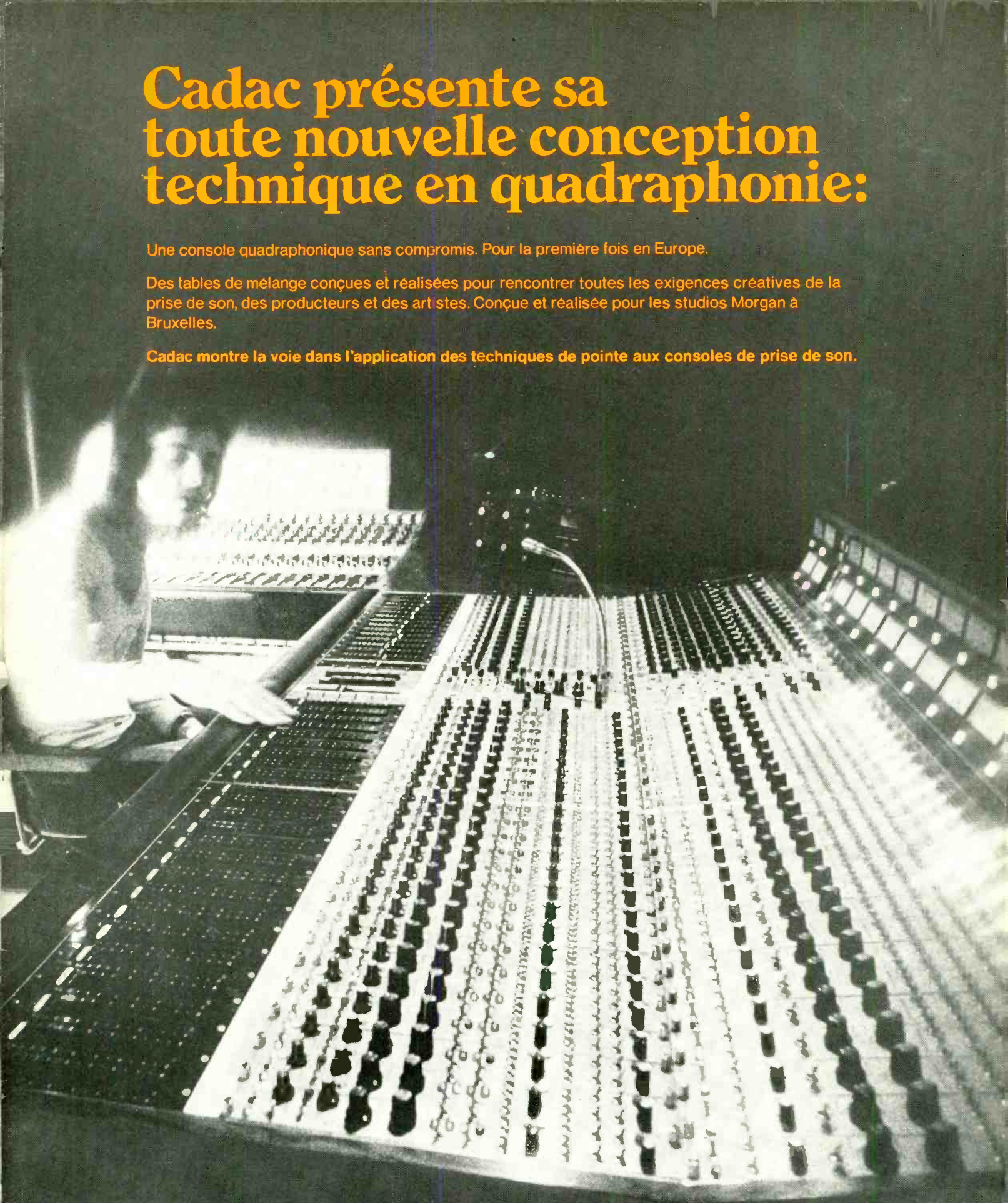

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CORRESPONDENCE AND ARTICLES

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.*

Articles or suggestions for features on all aspects of communications and musical engineering will be received sympathetically. Manuscripts should be typed or clearly handwritten and submitted with rough drawings when appropriate. We are happy to advise potential authors on matters of style.

BINDERS

Loose-leaf binders for annual volumes of STUDIO SOUND *are available from Modern Bookbinders, Chadwick Street, Blackburn, Lancashire. Please quote the volume number or date when ordering.*

COVER PICTURE

Section of the Cetec-Electrodyne 2000 audio mixing console

DECEMBER 1973 VOLUME 15 NUMBER 12

SIR DONALD Stokes, one of the loudest noises in the raucous bedlam of the motor industry, recently issued a riposte at the Little Grey Men forming the centre of the European Economic Community. Their attempts increasingly to control commercial affairs, he claimed, threatened to strangle the individual initiative upon which commerce thrives. His fears are understandable; the Men in Grey have already taken steps towards a European Standard Apple and (who knows?) might soon be insisting that all motor vehicles conform to reasonable standards of safety.

Within the confines of the British audio industry, 'free-enterprise' is almost synonymous with disorder. If two ways exist of tackling a problem, somebody somewhere will always find a third. Pity, then, the buyer faced with the task of comparing specifications of audio mixers. Perhaps he begins by requesting all available data from all contactable manufacturers. Or perhaps he simplifies comparison by asking (as we did when preparing the survey on page 76).

(a) How many basic modules are available for your modular systems?

(b) What is the detailed specification of your equaliser?

There are three standard replies to the foregoing questions. (1) The manufacturers may actually read your letter and respond to it precisely. (2) They may read only your location and flood you with every brochure within immediate reach. (3) They may run off a few mucky sheets from a duplicator, announcing that they can make anything you desire, that their circuits use semi-conductors and that the finish is high-grade Fablon. A few follow a fourth course and do not reply at all, perhaps hoping you'll telephone them and save them the stamp.

Collating audio equipment manufacturers' specifications into a meaningful uniform style would present few difficulties if one dealt only with the largest and most widely respected companies. Even in their case, the lack of any formal standard presentation raises occasional anomalies when dealing with anything more complex than a single simple circuit. But peruse the issue of many small companies and you have immediately to *assume* that all unqualified measurements relate to 1k Hz, to *assume* that bandwidth may refer to −3 dB points, to *assume* that voltages are nominal rms, to *assume* that specified distortion measurements are relevant to normal programme levels, to *assume* that unqualified noise figures are unweighted, to *assume* that . . . but where do you stop? You stop when the material submitted is so crudely collated that you are tempted to omit from a survey concerns in which you have no confidence. And you hope that, sooner or later, the Little Grey Men in Brussels will interfere firmly in the audio industry.

SUBSCRIPTIONS

STUDIO SOUND, *published monthly, enables engineers and studio management to keep abreast of new technical and commercial developments in electronic communication. The journal is available without charge to all persons actively engaged in the sound recording, broadcasting and cinematographic industries. It is also circulated by paid subscription to manufacturing companies and individuals interested in these industries. Annual subscription rates are £3 (UK) or £3.30 ($8 or equivalent) 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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What would you do if you saw an orchestra drowning?

We didn't just watch
Seven years ago, musicians all over the world were drowning in tape noise. We jumped in and began saving everyone we could, with our Dolby professional noise reduction system.

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That takes care of the professionals.

Meanwhile, at home . . .
Then we made a simpler Dolby system to save orchestras from drowning at home, especially on cassettes. Now, more than forty companies are making recorders and adapters with the Dolby B-type circuit. With one of these, home listeners can make Dolbyized cassette recordings that sound every bit as good as discs – and stay that way longer.

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Many pre-recorded cassettes are already made in this way. In fact, more than half the pre-recorded cassettes sold in America, England and Japan are Dolbyized.

On an ordinary cassette player these cassettes sound ordinary; but played with the Dolby circuit they are unlike any cassettes ever heard before. The same system is already being used in FM broadcasting, too, bringing Dolby-equipped listeners reception improvement which would otherwise require a tenfold increase in transmitter power.

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The model 41/SR shown here features electronic speed control, exceptional picture brilliance, gentle film handling, magnetic and optical sound heads, and solid-state amplifier with built-in loudspeaker. The unit is mounted on lockable castors and the top section can turn down within the legs so it can easily be wheeled through narrow spaces.

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SSI

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SPA60

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The SPA60 is a dual channel power amplifier of true complementary symmetry design having virtually zero crossover distortion and very low harmonic distortion up to waveform clip level. It is rated at 60 watts average continuous power per channel into any impedamce from 4 to 8 ohms. Loudspeakers have a varying input impedance and phase angle with frequency but in most high quality loudspeakers the impedance does not fall below 5 ohms. The SPA60 is able to maintain its maximum output voltage at 5 ohms which is equivalent to approximately 90 watts. Loudspeakers provide the quoted response characteristic when driven by a constant voltage at all frequencies at the terminals. If the amplifier is unable to maintain a constant voltage at varying impedances, selective overloading with frequency and transient colouration will occur if the amplifier is driven near clip level. A reduction in the drive to eliminate overlaoding will reduce the rating of the amplifier to the power it can deliver into the lowest impedance of the loudspeaker. Valve amplifiers do not have protective circuits to limit power output and have a broad power/impedance curve.

Another weakness of most transistor amplifiers is the inability to drive a complex load impedance such as a frequency dividing network using ferrite or iron cored inductors. The charge energy from the amplifier to the network is returned to the amplifier in the form of sharp spikes which charge the supply rail and can break down theout put transistors. These spikes also arrive at the high frequency drive unit producing a cracking sound as though the amplifier were overloading. The SPA60 incorporates a special design feature which completely eliminates this effect.

These weaknesses in transistor amplifiers together with bad crossover distortion and other design faults too numerous to mention have shown transistor amplifiers to be not always what they are imagined to be.

The SPA60 amplifier is unconditionally stable and safe with any form of output load of any phase and impedance characteristic from short circuit to open circuit and is therefore able to drive transformers. Under working conditions with conventional input sources the amplifier does not exhibit any undesirable inherent characteristics when drivng any type of loudspeaker. Its near perfect performance makes it suitable for comparative testing of input sources, loudspeakers and other amplifiers. The presentation is a low format suitable for shelf mounting. The front fascia is an extruded aluminium section fitted with an etched anodised front panel on which the characters are screen printed.

It is available as a standard model; with L.E.D. peak overload indicators (A model); with 10k ohm line bridging transformers (B model), and both facilities (AB model). A descriptive leaflet giving full specification details is available upon reques'.

Size: 17in. wide x 4¾in. high x 9½in. deep overall. Weigh 18lb.

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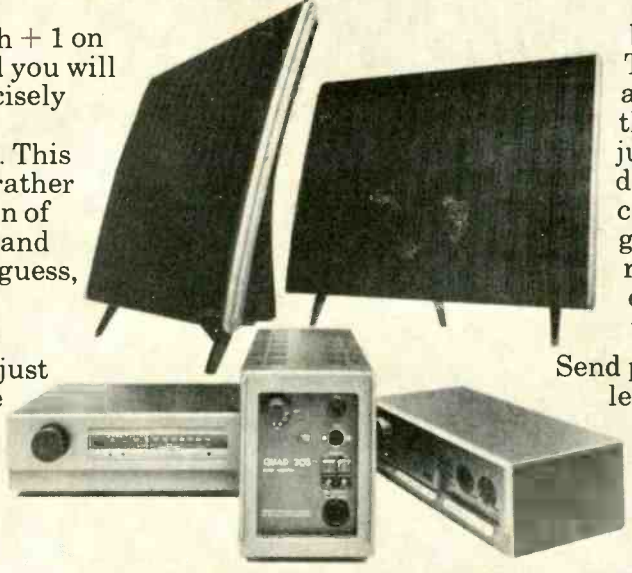

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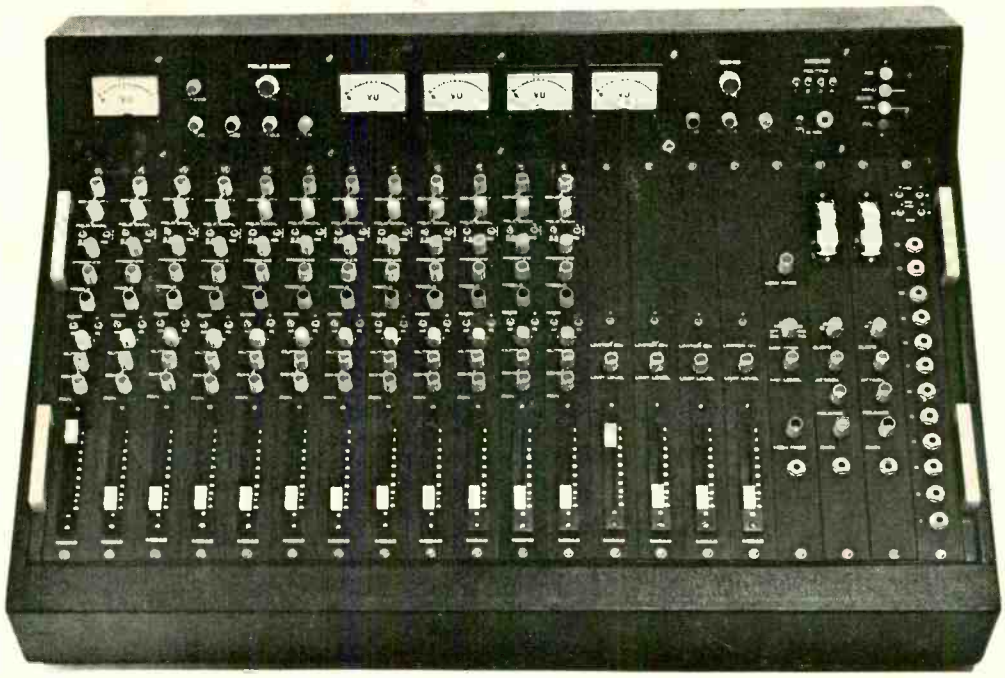

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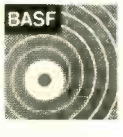

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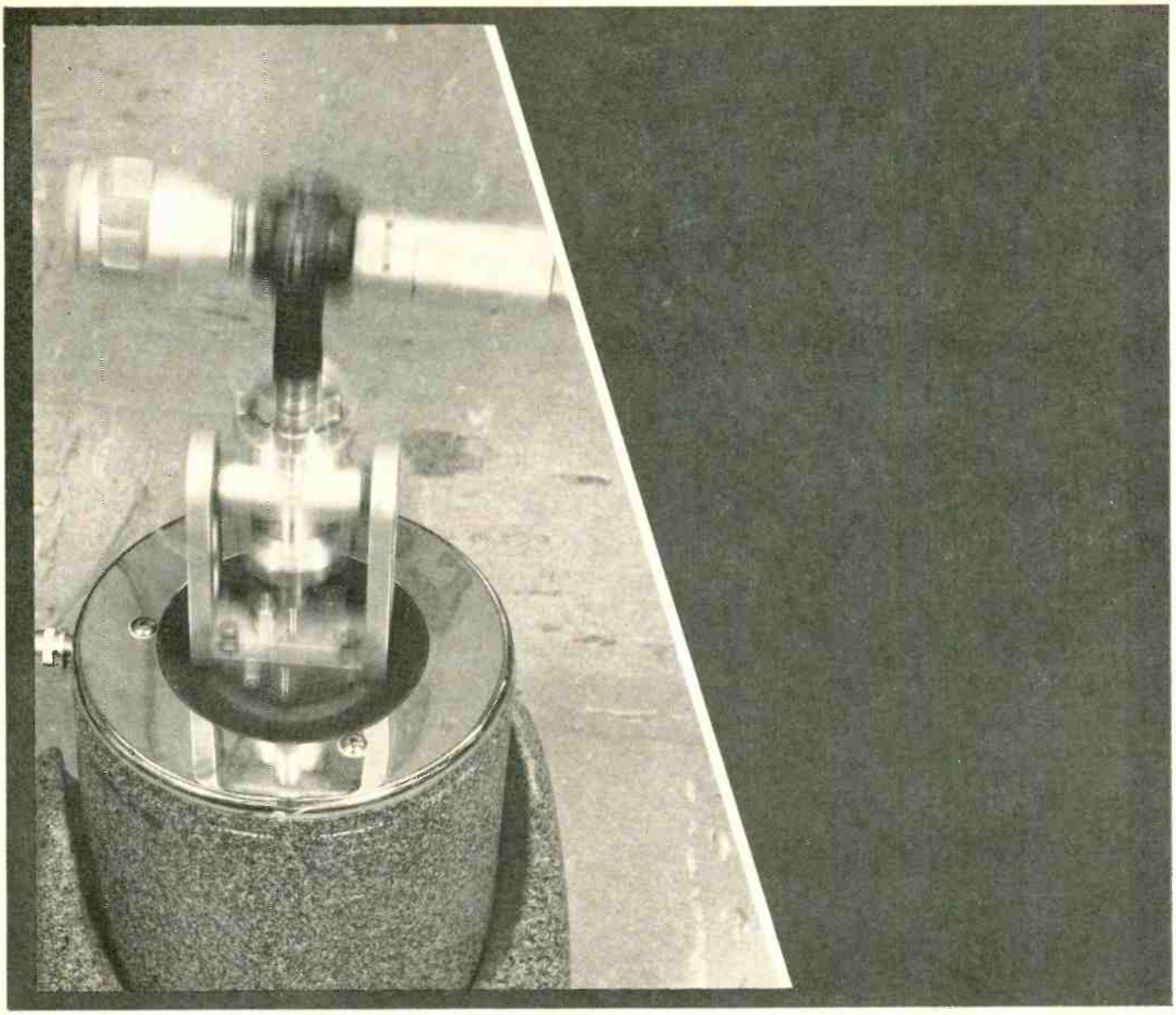

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13

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And especially a high signal-to-noise ratio – the reproduction you associate with good *reel-to-reel* recorders.

Not surprising, since this new deck conforms to the same DIN Hi-Fi Standard when used with CrO_2 cassettes.

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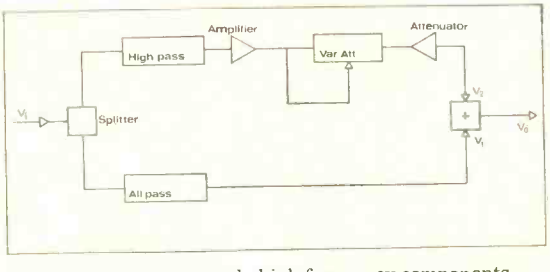
A tachogenerator on the motor shaft senses the slightest variation from a reference signal and promptly corrects the motor speed.

And friction can't affect winding torque, as the drive depends on hysteresis effects produced by a rotating magnet on the take-up spindle.

The deck takes either chromium dioxide or ferrous oxide Compact Cassettes, adapting itself automatically to the correct equalisation – most chromium dioxide cassettes have the special lugs that operate the deck's sensing device.

A Philips Dynamic Noise Limiter with defeat switch is built-in.



DNL suppresses only high-frequency components of low amplitude – tape hiss.

Active only during silent or quiet passages and when it is not detrimental to the music, DNL increases the subjective signal-to-noise ratio, suppressing hiss.

Besides autostop at end of tape, there's a zero-stop pushbutton linked to the tapecounter.

This halts the tape when moving through zero from either direction, automatically releasing the pinch roller and pushbuttons.

The hard, highly polished magnetic heads give low clogging, small losses and a better signal-to-noise ratio.

Gap widths are set accurately to 1·7 microns to ensure ample bandwidth.

And the double-gap erase head is extremely effective on the deeply magnetised CrO_2 tape.

Separate preamplifiers for the microphone, radio and phono inputs mean the best design can be used for each.

There's no 'doubling-up' with the head preamplifiers, which each have a signal-to-noise ratio of 60 dB when equalised for CrO_2 tape.

This music input has 19kHz and 38kHz active filters to eliminate stereo pilot tone interference, and ferrite beads in all input leads minimise h.f. radiation interference.

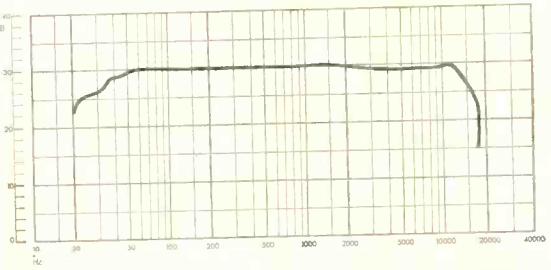
Low-noise silicon transistors are used throughout (almost 100 of them).

Three sliding faders let you mix two microphone inputs with a separate stereo source. And a low-level output enables the sum signal from all inputs to be monitored through loudspeakers (via amplifier).

The N2510 is a no-compromise design and you must be expecting it to cost the earth. Yet the suggested selling price of £125* is far lower than that of many lesser cassette decks.

Technical Data

Frequency response (CrO_2 tape)
25–14,000 Hz (DIN45 500).
Signal-to-noise ratio >48dB (DIN45 500).
Wow and Flutter <0·2% (DIN45 500).



Typical 'flat response' frequency curve of Philips N2510.

PHILIPS

Simply years ahead.

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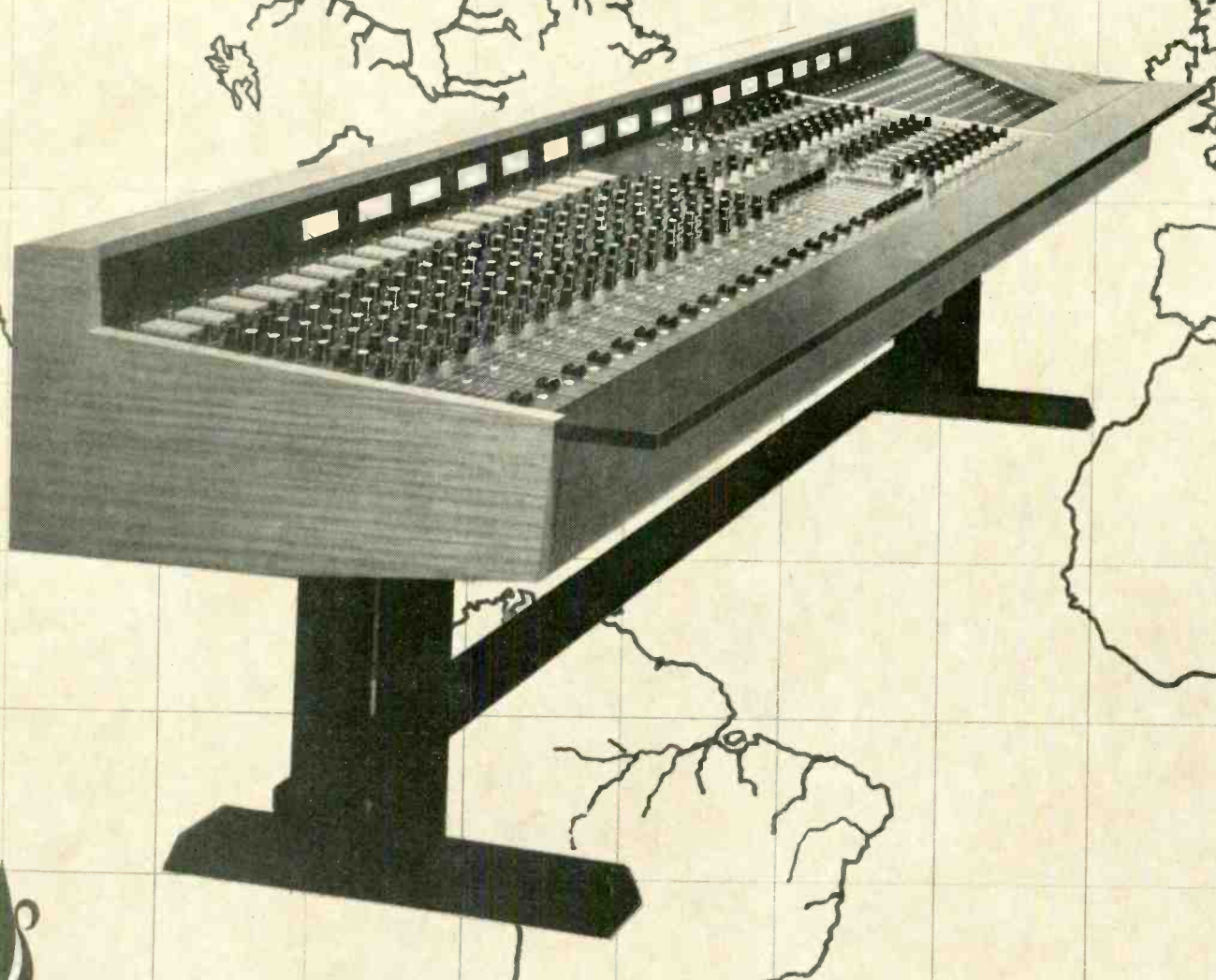
So we've built another TWO!



System 24

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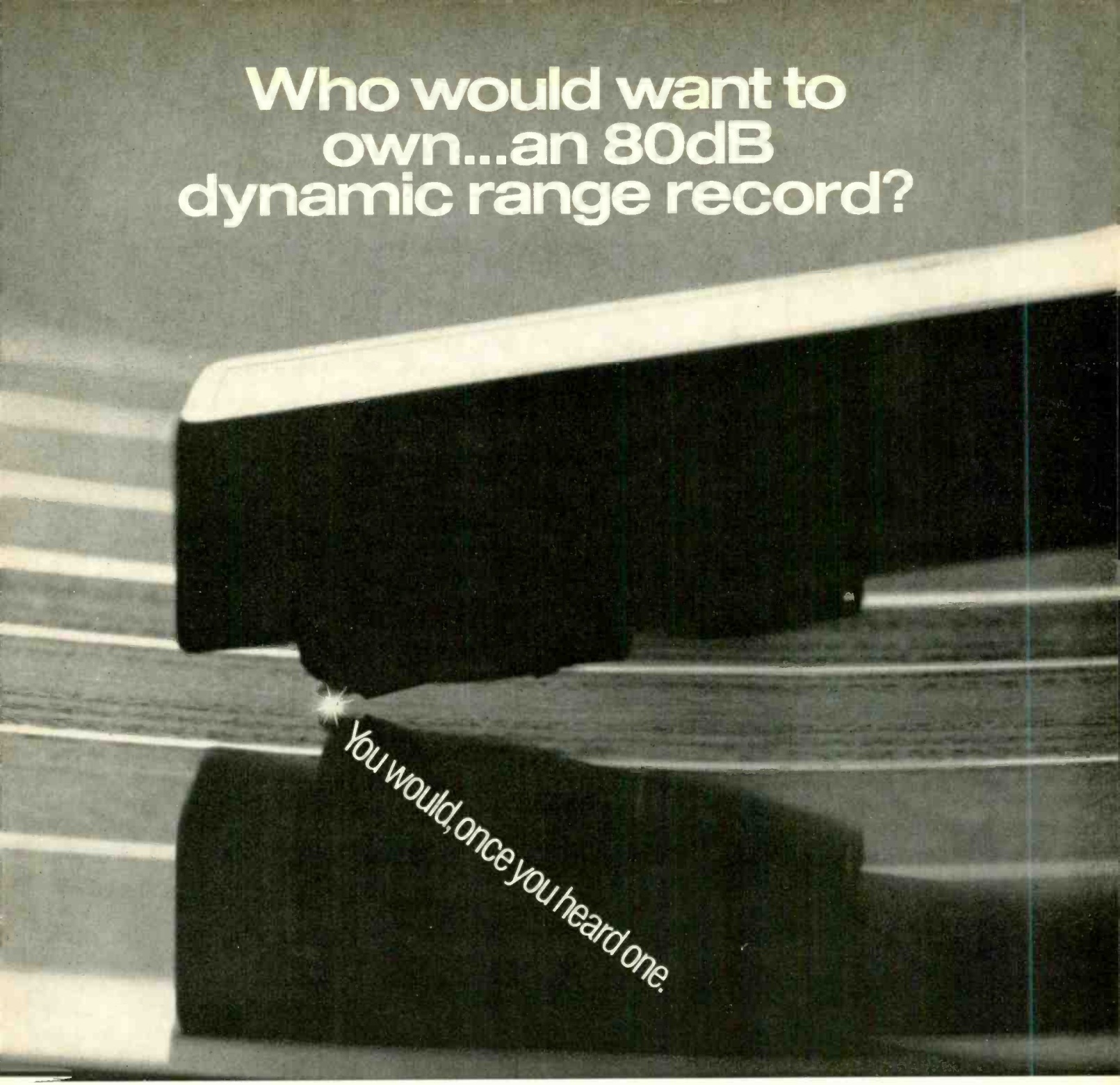

Examples of records selling because of superb sound, alone, are becoming more numerous. And small wonder!

For, in a recent survey of customers who already own high-quality, home sound systems, over 80% of those who responded to a request for suggested improvements said, "Do something to get better sounding records, tapes and FM."

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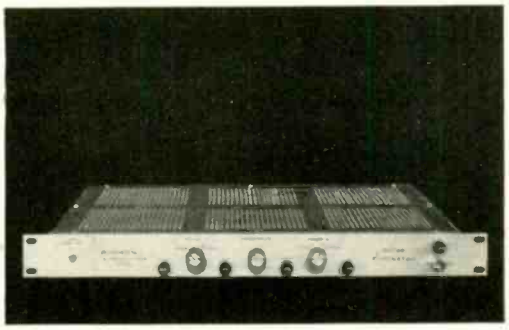

To get complete facts on the Burwen Noise Eliminator, Model 2000 . . . just call or write:

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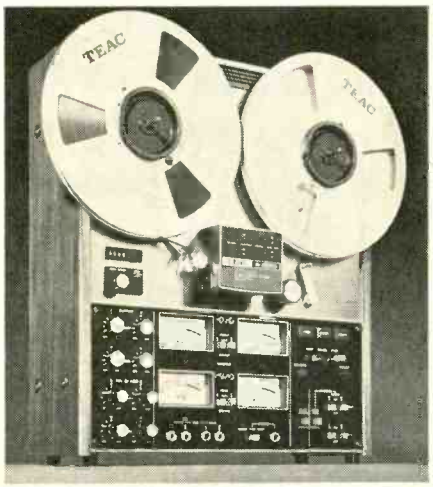

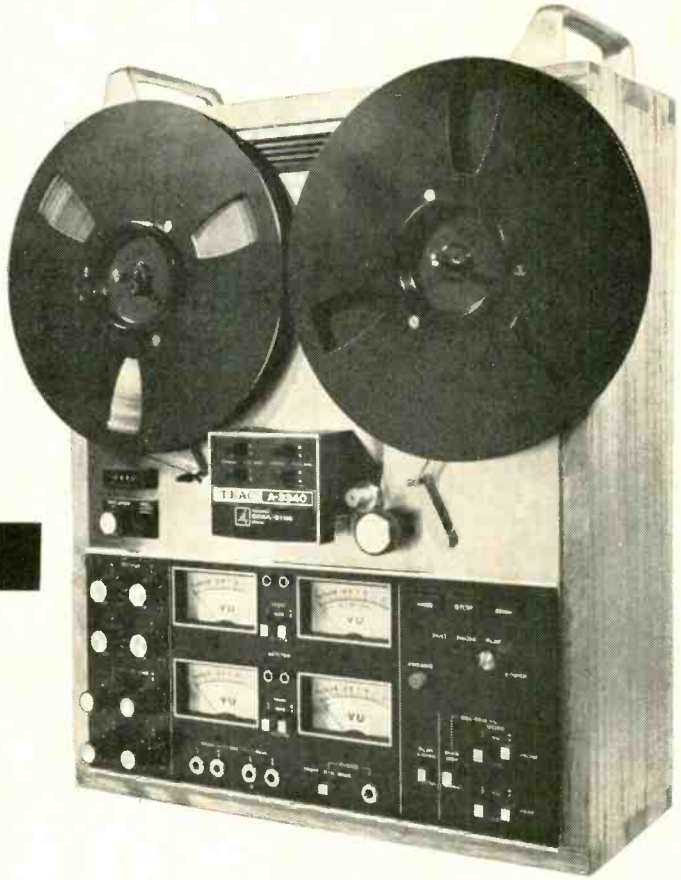

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The research behind the BOSE 901.®

By now almost all Hi-Fi enthusiasts know about the performance of the BOSE 901, about its unprecedented series of rave reviews and its unparalleled acceptance by musicians, stereophiles and the public. But few people know how this unconventional speaker was born. In this article we would like to share with you the highlights of the twelve years of university research that led to the 901.

The research begins.

In 1956 a basic research programme on musical acoustics was started by Professor Bose. The motivation for this research came from the apparent discrepancy between the acoustical specifications and the audible performance of existing loudspeakers. Musicians were quick to observe the boomy and the shrill sounds produced by loudspeakers for which engineers claimed excellent specifications.

Dr. Bose's research began by making exacting measurements on loudspeakers and setting up experiments to correlate these measurements to aural perception.

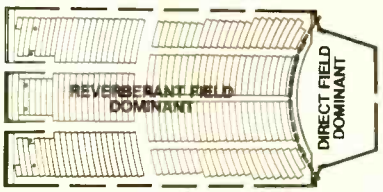
By 1959 it was clear that not only were the existing measurement standards (established 30 years before) incomplete, but worse, they were often misleading. For example, measurements of frequency response and distortion made in anechoic chambers not only fail to indicate what a speaker will do in a room, but speakers with better chamber measurements can actually give inferior performance in the home—and vice versa!

Probing psychoacoustics.

By 1960 it became evident that basic psychoacoustic research was necessary to relate the subjective performance of loudspeakers to objective design parameters. This research was launched and the first major results were reported in November 1964 at a joint meeting of the Audio and Computer groups of the Institute of Electrical and Electronic Engineers held at M.I.T. It was this research that established the validity of the then controversial concepts of multiplicity of full range drivers, speaker equalization, and flat "power" response. It was also shown, with the help of computer simulations of ideal acoustical radiators, that electrostatic, or other types of speakers have no potential performance advantages over properly designed cone speakers—a result that was not known prior to 1964.

Significance of reflected sound established.

At the time of the 1964 meeting, however, little was understood about the spatial properties of speakers. There was some evidence that direct radiating speakers caused shrillness in music but the reasons were not known. From 1964 to 1967 the research concentrated on these spatial problems. With the co-operation of the Boston Symphony Orchestra, measurements were made during live performances to determine characteristics of sound incident upon the listeners. Theoretical studies, verified by experiments, showed that in live performances sound arriving at the listeners' ears from different directions was much more evenly balanced than was the case for loudspeakers in home environments. Experiments then linked this spatial difference to the strident sounds produced by loudspeakers. Then it was discovered that the desirable spatial characteristics could be produced in the home by directing a large percentage of sound away from the listener at precise angles to the rear wall.



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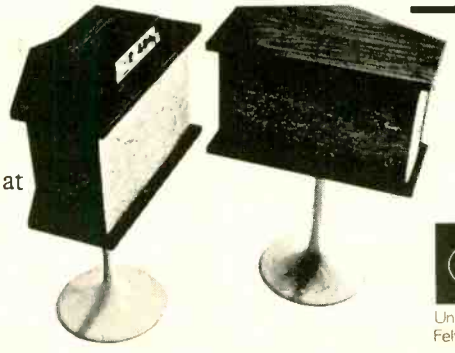

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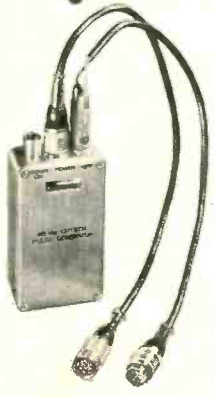

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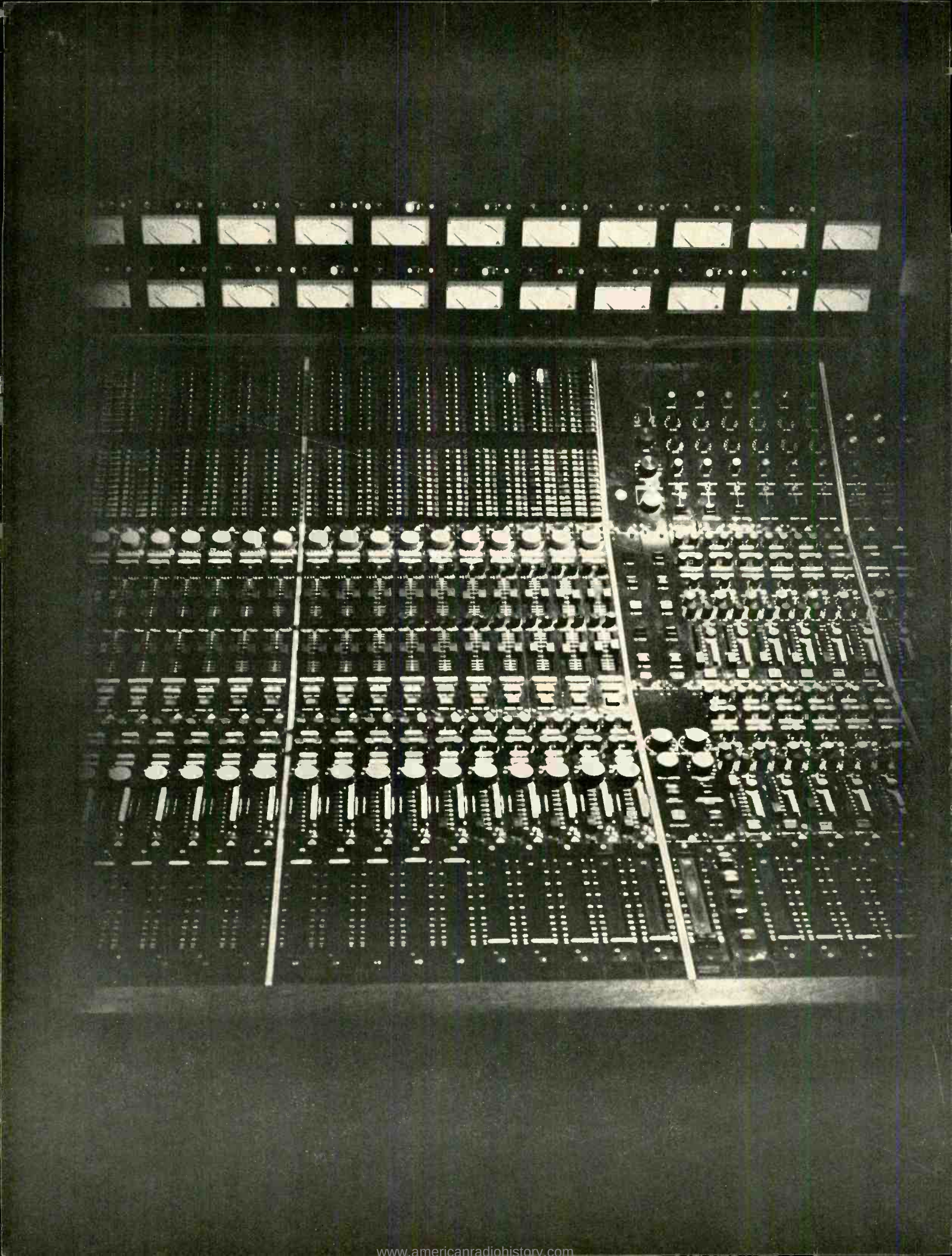

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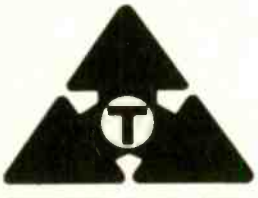

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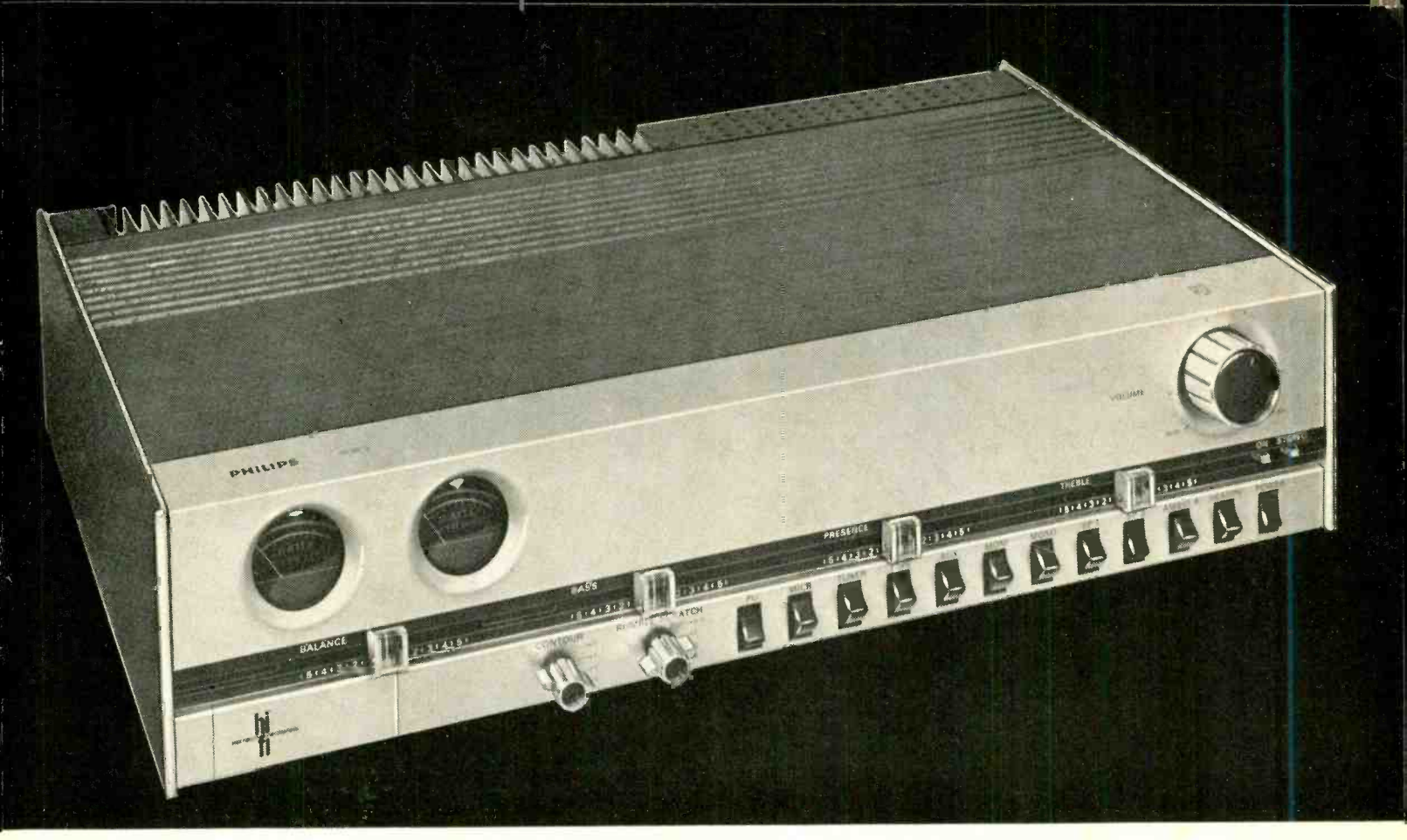

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Other controls for precision adjustment of sound include sliding potentiometers for balance, treble and bass; scratch and rumble filter switches to suppress high and low frequency noise; and a sliding potentiometer for 'presence', to strengthen or reduce the middle frequencies of a recording – such as the vocal section, or brass instruments.

You can connect a microphone for Public Address use, and headphones for private listening. The sockets for these are conveniently positioned in the front panel, concealed beneath a sprung aluminium flap.

You also get inputs for magnetic pickup, tape, tuner, auxiliary, and monitor (permitting A-B monitoring of tape recordings). And outputs for tape and two pairs of loudspeaker enclosures.

You can select either pair of loudspeaker enclosures for stereo – so that you could provide stereo in two separate rooms, for instance. Or you can select all four in one room for Philips Stereo-4 'surround sound', achieving a quadrophonic effect at a fraction of the cost of the available discreet systems.

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Ask your Philips dealer for a demonstration. And write for a free 44-page Audio Guide – to Philips Electrical Limited, Dept SP, Century House, Shaftesbury Avenue, London WC2H 8AS.

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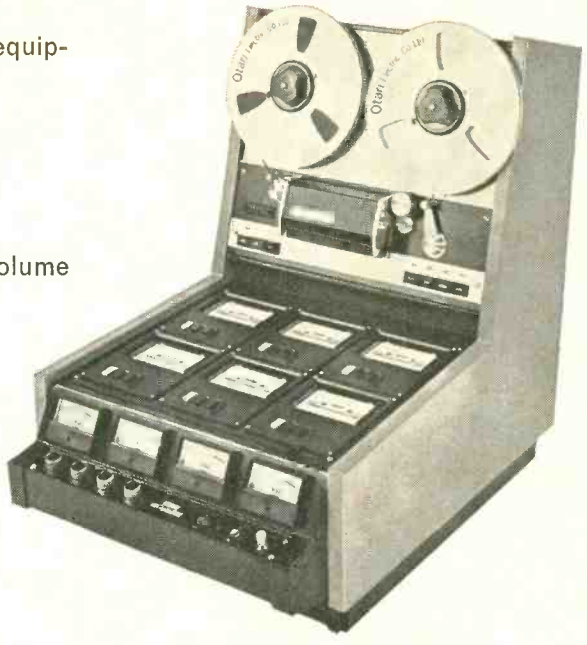

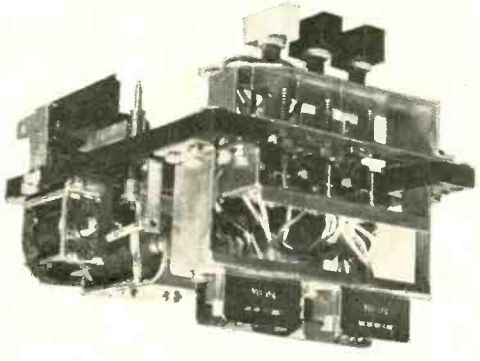

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NEWS

DEMANDS FOR STRICTER NOISE CONTROL

DEMANDS FOR strict legal control of excessive noise have been recommended by the Association of Public Health Inspectors in their annual report on the environment. The report, published towards the end of September, said there had been 13,342 noise complaints from the public of which 1,600 were about roadworks, construction and demolition. More than a third concerned industrial premises. Only 5,899 of the complaints were found to be justified as statutory nuisances. A nuisance is something which causes distress and is continual. Consequently the association wants the law strengthened by assessing the noise climate of a district and making regular checks that noise in a given area does not increase.

Two days after the report was published the Institute of Biology met in London and were presented with a paper on some of the effects of noise. Dr P. J. Dickinson of Southampton University said that not much was known about low-frequency noise, and that certain types of noise produced bouts of nausea, comas and tumours of the brain. The Institute of Sound Vibration at Southampton University had been measuring various noise levels from a mobile laboratory van. They had toured working and living areas taking noise level measurements. They were not just concerned with traffic and machine noise but with low frequency noise which occurred naturally but which was not normally heard. They found that buildings, trees and telegraph poles, but particularly buildings, amplified these noises until they affected the people in and around them. During their experiments the staff on the experiment experienced sickness and nausea and other illnesses. In another research project carried out elsewhere on the same subject, the entire team had been found in a coma induced by amplifying these sounds. Some illnesses in people who were unusually sensitive to the noises could be explained no other way, Dr Dickinson said, and a single low frequency vibration of 38 Hz dominated everything else.

In the House of Lords in March this year Lord Somers had demanded that legal measures be taken to control the noise in discotheques because the noise levels used in them could damage the hearing of the young people who went into them. Lord Kinnaird said, in a maiden speech in which he took the opportunity of telling a funny story about a man with six horns on his motor car, that a medical survey of people living near Heathrow Airport had shown the number of people admitted to hospital for mental disturbances was eight times the national average. Lady Summerskill then said that it should be considered whether industrial noise contributed unconsciously to the desire of workers to strike as an escape from their intolerable working conditions. Lord Sandford replied to the debate by saying that a working group of the Noise Advisory Council had examined the working of the Noise Abatement Act and noise in urban situations and had suggested legislation. A special working group of the NAC was looking at the problem of discotheques. The government had accepted in principle the recommendations of the NAC and had indicated their intention to introduce legislation in the lifetime of this present parliament. A code of practice had been established to protect people from noise at their workplace.

At the Conservative Party Conference in Blackpool Mr Page, Minister of Local Government and Development, said that he would be in charge of new legislation on noise which would be introduced in the next session of parliament. The bill will seek to create noise abatement zones in which a noise above a certain limit would be an offence. The bill will be directed mainly to reducing noise caused by industrial plant and building operations. Presumably it will be illegal for employees to work in noise levels above a certain level.

PLASTICS SHORTAGE AFFECTING AUDIO INDUSTRY

RECORDING STUDIOS in Great Britain are going through the busiest period most of them can remember. There have even been reports of bands and solo musicians having to take time in other studios because the ones they want are fully booked. Some have been recommended to other studios. Sleeve-printing firms have been working to full capacity. On the other side of the Atlantic the industry is expressing growing concern over the shortage of plastics, which has affected all the industries who use plastics. The record industry is growing short of raw materials at a time of the year when demand is usually high anyway, because of the Christmas season, and during a year when demand has never been higher for its products.

The shortages have, of course, affected the tape manufacturers as well as those making discs. The shortages are because, for the first time, the consumption of plastic, particularly pvc, by all sections of industry exceeds the supply. The basis of the plastics industry, its raw material, is oil. As readers will know, the world economy has been affected by shortages of oil. These have been caused not by any threat that the world's oil is running out—this will not happen for some time yet even at the present rate of consumption—but by the determination of the United States, for example, not to rely on oil from the Middle East. Were the United States to depend on Middle Eastern oil the Arab nations would be in a position to extract certain guarantees from the United States over its support for Israel. Thus the American Government intends to ration oil and petrol until consumption falls below a level that makes it necessary to import it from the Middle East. The Middle East War which is still going on as we go to press will have disrupted supplies completely and made a bad situation worse.

EMI would not comment officially on the supply of plastics and the effect it was having or on the demand for pressings. Over the summer EMI have had some of their 18 cm records pressed at Decca. There are unconfirmed reports that EMI's pressing plant has had to add the plastics shortage to a series of other difficulties which particularly affect the smaller labels. Decca said that the shortage of plastics was affecting everybody equally. Decca said they had no spare capacity though the spokesman added 'wish we had'.

RCA would not comment.

Other companies are getting some of their pressing done in France, which has its own supply of raw materials. The generally understood situation is that supplies of PVC and polystyrene will last until Christmas, after which the industry will go into a lull anyway. One member of the industry said he considered that supplies of pvc would be diverted from record manufacturers to 'more important areas'.

At the beginning of September delegates of the British Plastics Federation met officials of the Department of Trade and Industry to express their concern. They said that urgent action was needed unless Britain was to become dependent on imported polymers and forced to stop exporting. British companies could not remain competitive in the world market with the price levels currently being imposed on the home market and that they hoped the government would be more flexible in its attitude to plastics prices in phase three.

They denied allegations that the British industry had been ignoring the home market and going for the higher prices available abroad, causing the shortage of supplies here to become worse.

The BPF said in a statement later that the

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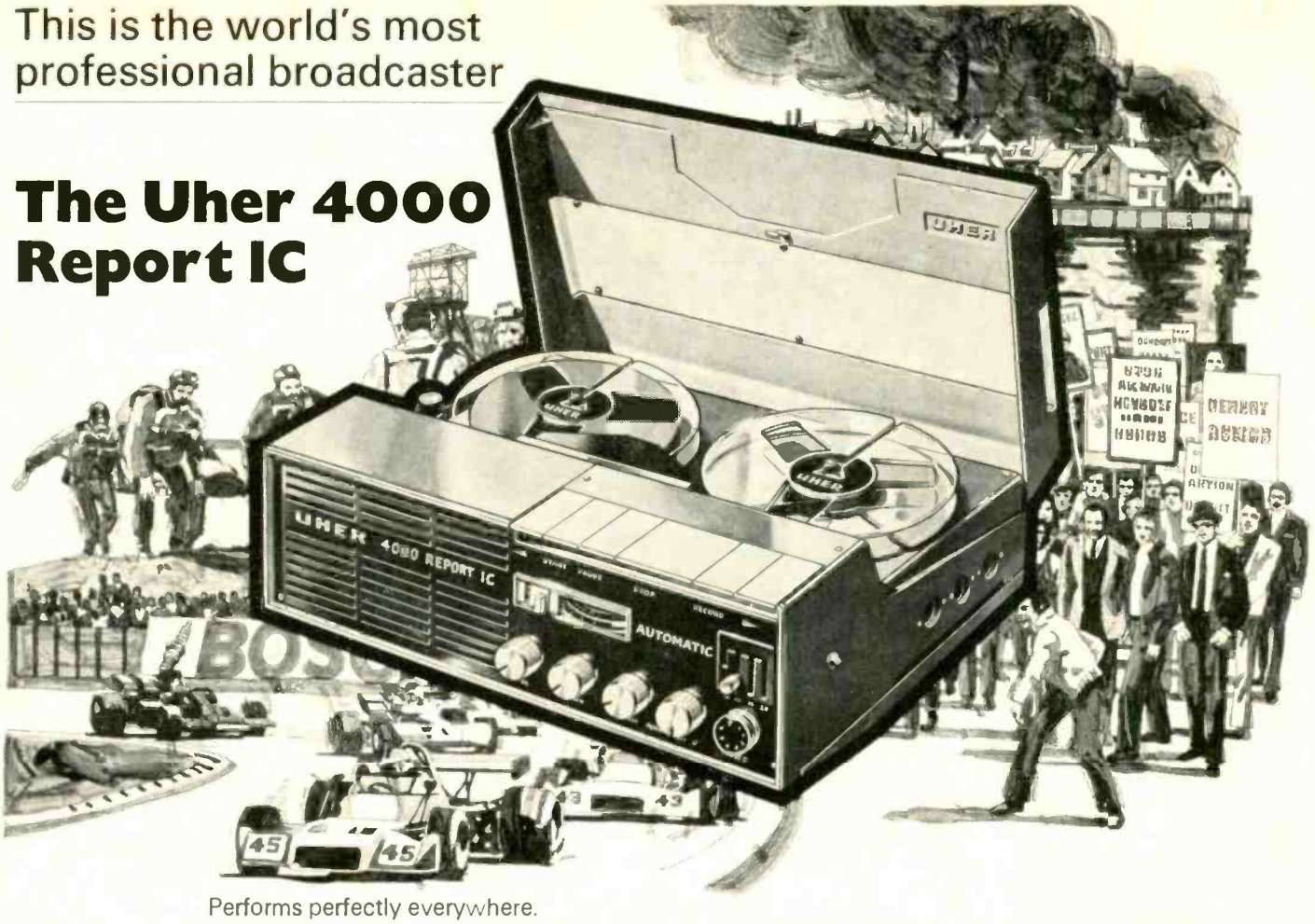

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Frequency range @ $7\frac{1}{2}$ I.P.S: – 40Hz – 20KHz +0 – 6dB

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1. Microphone: – 200-600 ohms dynamic or special low voltage capacitor types. 0.12mV-40mV
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Fitted with switchable automatic level control with 2 alternative time constants for speech or music.

Outputs:

1. Line: – 15K; 1v
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Alternative Power Supplies:

1. 5 HP2 cells
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Stereo versions (without automatic level control) available as 4200 IC (½ track)/4400 IC (¼ track)
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current growth of demand for plastics in the UK was running at a record of 20 per cent.

At the same time, the marketing manager of Pye has referred to what he describes as a 'phenomenal boom' in audio sales. Mr John O'Neill said that total industry sales of audio units in this country would top the £125,000,000 mark, which he said was one-third as much again as the nation is spending on colour television. 'It would be foolish to suggest that colour television sales have passed their peak,' he said, 'but when they level off—as they must in the next two or three years—then there is no doubt the unit audio craze, which is only part way to its peak, will take over'. In 1968, he said, only £3,000,000 was spent on unit audio. Last year the spending was £72,000,000. He estimated that spending next year would almost double to £125,000,000, a third of what was being spent on colour tv, which was on average three times as expensive.

Ampex report

THE CHAIRMAN of the Ampex Corporation reported at the annual meeting that the company had 'made major improvements in its financial position'. The chairman, Richard Elkus, said that obligations had been reduced by over $91,000,000 and that $23,000,000 in interest had been paid. They had also financed $21,000,000 of research and development. He declared that Ampex was now 'a viable company'.

The meeting was held on August 21 in Redwood City, California. Arthur Hausman, the company's president and chief executive, said that during the first quarter of the new year Ampex had been taking orders at the rate of $1,000,000 for each working day. The backlog of orders had increased by ten per cent during the quarter and Ampex had entered the second quarter of the new financial year with a backlog of around $100,000,000. The bookings had been stronger in the international division than in any quarter of Ampex's history.

Mr Hausman said that this was the fifth successive quarter of establishing a new record in bookings. International orders for Ampex's major product lines had increased between 25 and 70 per cent compared with the same period last year. He made particular note that Ampex's *ACR25* professional broadcast video cassette recorder had 'continued to demonstrate excellent acceptance in the market place'. Speaking of magnetic tape he said he saw a slow transition in this area which could benefit Ampex in the future. 'Gradually the more sophisticated technology from our research and development efforts should be felt and, independently, we should begin to see the growth of significant demands for pre-recorded video tapes.

'The technical knowledge which Ampex has and continues to develop regarding recording media should serve us well in evolving superior products as a result of our joint technical efforts between media development and hardware development.'

He added a note of caution: 'We clearly recognise that we are only part way . . . toward achieving our goals. We continue to need better overall profit margins from [the mixture of products in our factories].'

He also pointed out that Ampex carried an extraordinary interest cost which 'under the present-day high prime rate acts as a depressant to profits. Last year alone, our interest payments were the equivalent of $1.42 a share.'

The annual report shows a net profit of $3,654,000 compared with a loss of nearly $86,000,000 in the previous year, and a loss of $13,000,000 in the year before that, 1971. Last year Ampex made a number of board changes and, in his speech, Mr Alkus referred several times to the 'new Ampex', which seems to indicate something of the reasons for the company's turn-round.

APRS Course

THE APRS HAVE organised a summer training course for sound engineers. The course, which will run for one week next year, may be repeated if it is a success. In the September newsletter the APRS announced the course and said that it would be open to engineers at studios in the APRS and would include the live recording of both pop and classical music. Engineers would have to be between 18 and 25 but the only other qualification would be that they would have to be working at a studio in the Association. After the course, which will be held at the University of Surrey, Guildford, there would be an assessment of students' work and a report would be issued. The cost of the course will be £45 a student for those not staying at the university, and an extra £20 a week for bed, breakfast and dinner. All those on the course will get lunch and coffees. Those wishing to stay on the Sunday night before the course starts can do so for £3.

Students will be able to use a Neve 16/4 console, a Calrec 8/2 mobile console, six H/H amplifiers, four Spendor speakers, a number of Neumann and AKG microphones, an EMT stereo plate, 12.5 mm Scully four track tape machine, Studer *A80* and *B62* tape machines, a stereo Nagra and three Revox machines. The APRS newsletter said the organisers wanted to know:

(a) if members were interested in the course.
(b) Would they consider sending one or more of their staff?
(c) Were any of the studio staff interested?
(d) Had members any other comments?

The APRS said they would proceed with this course if between 12 and 20 students were sponsored. The course might become an annual event. The newsletter ended: 'We suggest that students should pay a proportion of the fees'.

For further details of either the course or the books or membership in general contact Mr E. L. Masek, Secretary, 23 Chestnut Avenue, Chorleywood, Herts WD3 4HA.

Tyne contract

THE TYNE and Wear commercial radio contract has been won by Metropolitan Radio. Metropolitan are a local radio group headed by the chairman of the Swan Hunter shipyard, Sir John Hunter, and were named by the IBA two months ago as the leading contenders of the six who applied for the contract. The contracts were advertised in mid-February. Tyneside is the sixth area to get a local radio station after London, which has two, Birmingham, Manchester, Glasgow and Swansea.

Metropolitan have not yet announced any full details of the composition of the company, which will begin broadcasting next summer. The general manager is Mr Bruce Lewis, a presenter and newscaster for Tyne-Tees Television for the past five years. Among the other directors are Mr Bill Elliott, Conservative MP for Newcastle-upon-Tyne North, Mr James Harper, regional secretary of the Union of Construction Allied Trades and Technicians, and Mr Paul Nicholson, joint managing director of Vaux breweries.

Broke

TAPE RECORDER DEVELOPMENTS, part of the Audio Developments and Walsall Timing Developments group, have ceased trading. A spokesman for the firm said that, although Tape Recorder Developments had stopped production and no longer employed any labour, they would continue to supply spares.

The reason for the firm's failure, according to TRD, was that although they considered they had a good product they found themselves unable to make a profit at the price at which they were selling it. Had they applied to the Prices and Incomes Board for an increase in price they would then have found themselves unable to compete in their chosen market.

No receiver has been appointed. When asked how the closure would affect Audio Developments and Walsall Timing Developments TRD said the two firms would not be affected at all as far as they could see at the moment. TRD admitted they could not say what might happen beyond the present. At the time of going to press the information about Audio Developments' mixers in our survey is correct and they are still being produced.

In a statement Walsall Timing said they would no longer be able to subsidise their

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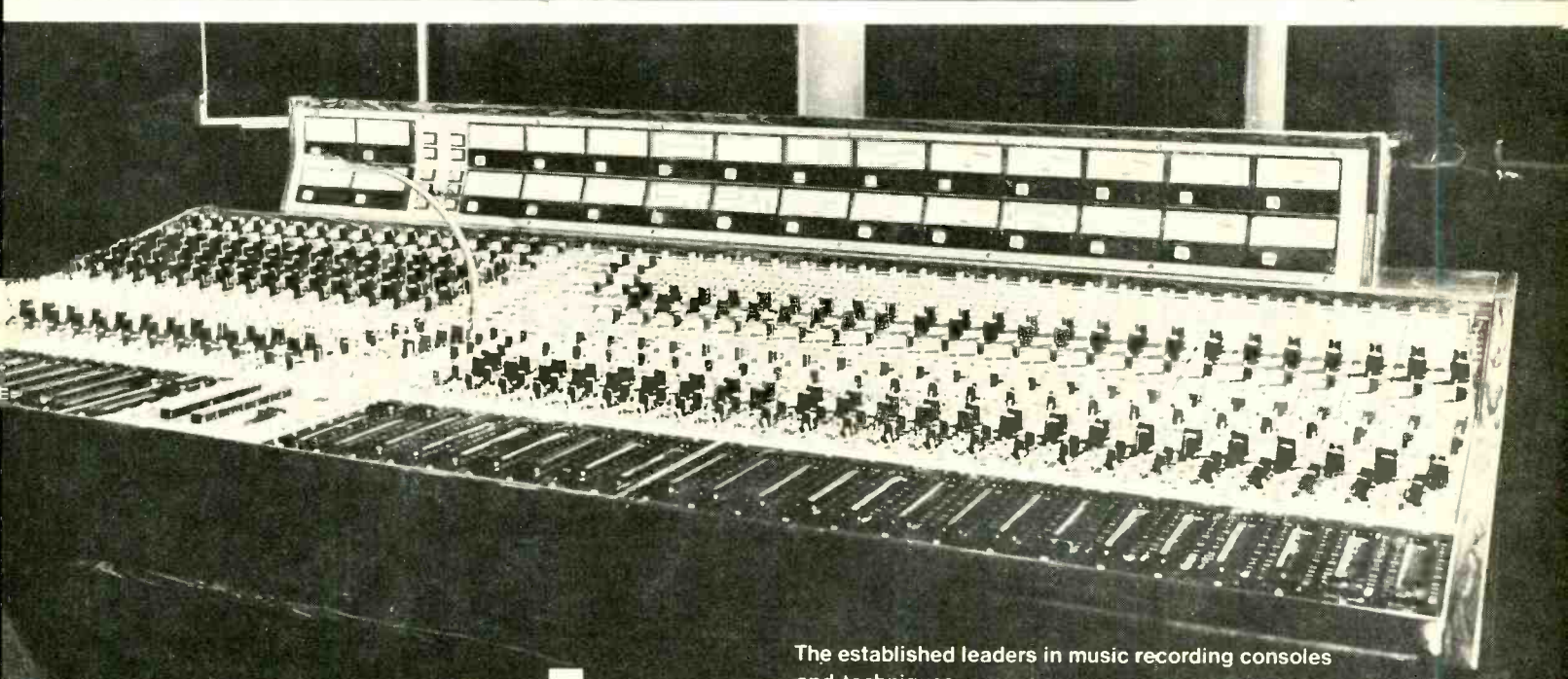
Cadac and Quadraphonics

Morgan Brussels – the first studio in Europe to be designed and built from scratch for quadraphonic recording – chose the new Cadac quadraphonic music recording console – not a standard stereo console with a few joysticks added, but one specifically designed and built to handle all types of recording in this medium.

Our close relationship with studio practices and techniques consequently is reflected in the console engineering and logic systems, which makes Cadac the obvious choice of people engaged in the art of sound recording.

So? Don't ask us.... ask them.



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subsidiary company, Tape Recorder Developments Ltd, in the manufacture of the *700 Series* recorders . . . the problem was that it became increasingly obvious that the financial and labour resources of the company had to be concentrated on the Audio Developments side of the company which makes the *AD71* studio mixing console and the new *AD007* portable mixer. Both of these products plus other special studio equipment . . . require concerted effort to meet customers' delivery requirement.' About half the work-force of a dozen were moved to production of Audio Developments' products, and the rest made redundant.

Walsall Timing Developments say they are 'actively looking for a company suitable to take over and continue the production of the TRD *Series 700* recorders'. They said that the decision they had taken was particularly unfortunate because 'the new TRD *700* recorders were so well received at the APRS 73 exhibition'.

Fighting

AUDIO APPLICATIONS have ceased trading. A spokesman for the firm said that, although the company's small sound mixers had been well received at the APRS and New York AES exhibitions, Audio Applications had been working on such a small margin that they could no longer meet their commitments.

A last-minute attempt to save the firm failed. Negotiations to secure capital to manufacture Response mixers on a sub-contract basis with the present staff running a marketing-only operation broke down at the beginning of October.

Bias order

BIAS ELECTRONICS report that Radio Clyde have ordered 11 of their tape machines. The order comprises eight *BE1000* stereo machines with modified front control panels, two slow-speed logging machines, and one *BE2000* four track, 12.5 mm tape machine with VU metering, track selection and sync replay.

The logging machines will give 24 hours' recording time from a 27 cm reel of 6.25 mm tape. This is achieved by using four tracks and a tape speed of about 1.2 cm/s. Bias say that if the record bias or the dc supply should fail the signal will be switched to another machine, as it will if the tape breaks or finishes. The order also included two small mixers.

AES

THE EUROPEAN office of the Audio Engineering Society have announced that the next AES European convention will be held in Copenhagen between March 26 and 29.

Racal growth

RACAL ZONAL expect to get £300,000 worth of business from the recording industry alone in the current financial year. This forecast has been made, they say, on the basis of substantial orders from LBC, Capital Radio, Radio Clyde, and GMIR. The company is to supply the major part of their requirements for both stereo broadcast-quality tape and communications logging tape. All the stations have chosen the Spectrum *Low Noise* tape. As more stations come on the air, Racal say, they are confident of £250,000 worth of extra business. Racal are already supplying the BBC, the British Forces Broadcasting Service and the Central Office of Information. One unofficial source, not at Zonal, indicates that at least one major record company will be going over to Zonal tape for its studios before long.

In June, after Film 73, Racal Zonal reported sales of £250,000 for its magnetic sound-recording film, an 'all-time-high' they claim. They have secured orders with Italian television, who wanted a year's supply of 10,000 reels, Australia, Canada, Ceylon, Czechoslovakia, Ghana, Holland, Hong Kong, Hungary, New Zealand, Turkey, West Germany and the USA.

Here in the UK, Zonal have said they will be supplying Anglia, ATV, Border, Grampian, Harlech, London-Weekend and Westward with magnetic film.

Change of Address

SOUND COMMUNICATION, the Leeds educational-tape production company, have moved their offices and some of their technical facilities to York. The move is a temporary one. While they are waiting for new buildings to be finished in Leeds their address will be 86 Micklegate, York YO1 1JZ. The phone number is 0904 27844.

Conference Centre

EMI HAVE equipped what they describe as the most advanced conference complex in Europe, the York Theatre at the Heathrow Hotel, which was opened on September 26. EMI say the centre has about £250,000 worth of visual aids. There are seats for 262 delegates each of which has a console built into the seat in front which comprises a 23 cm television monitor, a microphone, simultaneous translation earphones and a folding desk. EMI say the means which delegates respond to whatever is being said are computer controlled. They describe the seats as 'luxuriously-upholstered'.

The centre also has a colour television studio based on the *2005* broadcast colour camera; monochrome closed circuit tv network using EMI *2004* CCTV/broadcast cameras; audio and videotaping and telecine facilities; film projection equipment; an EMI surveyor document scanner; two and four channel stereo pa systems; and an internal audio communications network.

Richard Siefert designed the Heathrow Hotel for Lex Hotels, part of the Lex Garage Group (see February 1973 STUDIO SOUND page 28).

Creeps

IN AMERICA the committee to re-elect the President (CREEP) has published a list of those who made contributions to its fund to put Nixon back in the White House. According to a recent report in the *Sunday Times* the campaign raised more than £7,000,000. Among the contributions, made quite legally, were £55,000 from Theodore Ashley, chairman and president of Warner Bros, and Jack L. Warner of the same company gave £40,000. Other interesting showbiz contributions included those of the chairman of MCI and its vice-president, Jules Stein (who gave £47,000) and Taft Screiber (£24,000), and Bob Hope and Howard Hughes, who each gave £20,000. William McKnight of the 3M company gave £34,000.

What, gone?

COLIN WALTERS, General Manager of BBC Radio Nottingham, has been appointed programme controller of Greater Manchester Independent Radio. Walters left the BBC in October at two days' notice, even though the normal BBC contract for someone in his position is three months. GMIR say his first job will be to tour the United States to absorb new ideas about radio.

People

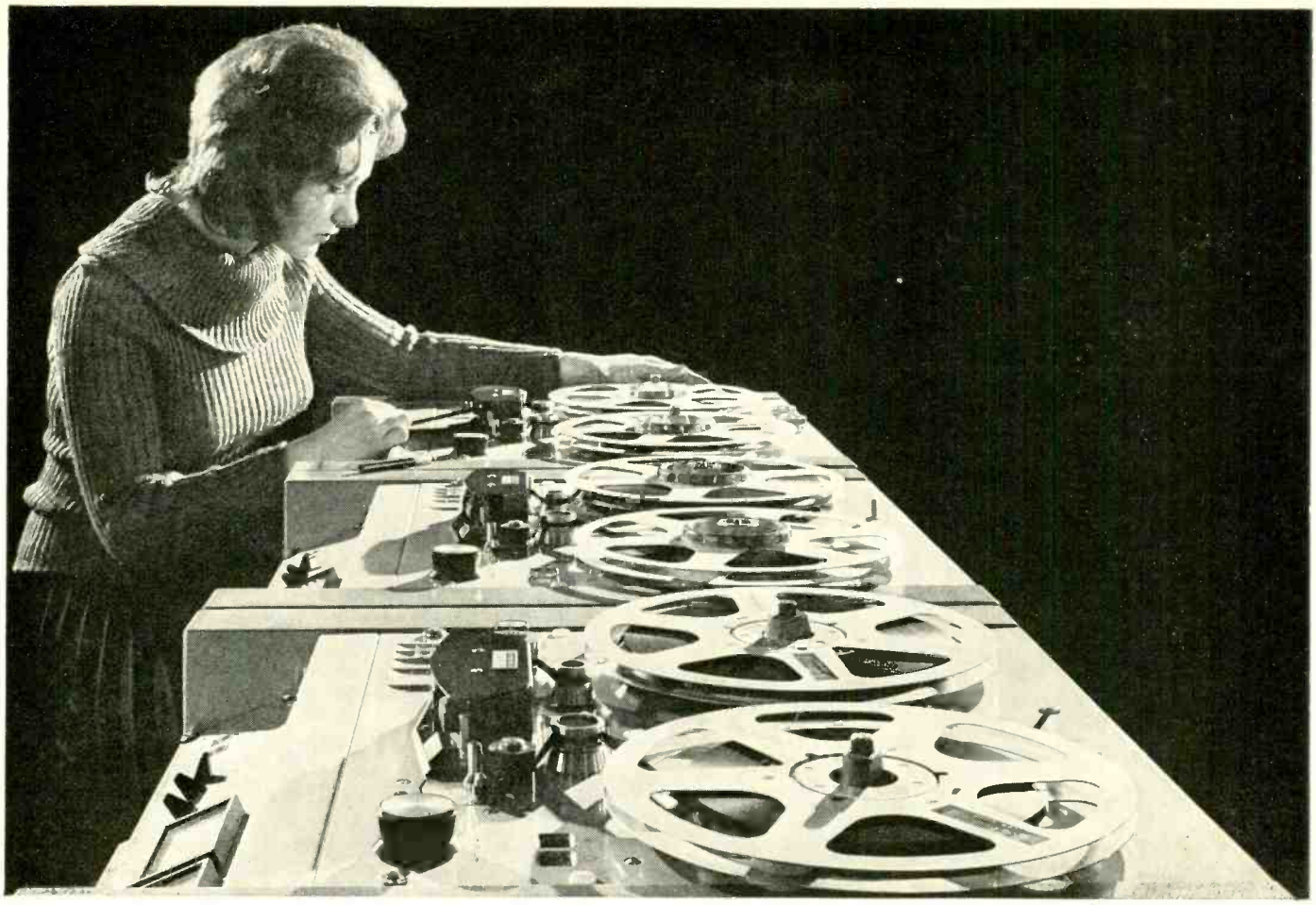
MR K. BARTON has been appointed marketing manager for the audio products division of Ferrograph. Mr Barton spent many years at Philips, where he eventually became the audio sales manager. He will be based in Slough. Ferrograph are part of the Wilmot Breedon Group.

Scully

WE HAVE RECEIVED the following statement from Scully Metrotech UK Ltd: 'In his AES report, Stephen Lampen is slightly misleading in his comments about the Scully Metrotech *400 Series* Logger. The recorder makes up to four passes with automatic end-of-reel reversal, but a further four passes can be made on the second side of the tape if the reel is turned over. Regarding the *4400* time code generator/reader, this is "matrix" inasmuch as the code can be superimposed on a signal track, but the fast search facility is not as yet offered on the *400 Series*.'

Bonochord

BONOCHORD forecast that they will make profits of £600,000 in the current financial year. The interim forecast, which takes into account five months of Neve's business and two months from EAE, says that profits in the first six months of the year grew 81 per cent to £370,000. All divisions except for the language laboratories continue to make improved profits and Bonochord seem sure that the trend will continue until the end of the year.



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A MEMBER OF THE MCP GROUP

DIARY

By John Dwyer

'DIARY' DOESN'T often report on factories, and it isn't going to become a habit. But when Dick Swettenham's assistant, Neil Adams, phoned me and suggested I take a look round Helios I thought I'd make an exception. For one thing, Dick Swettenham's professorial form is one of the most familiar around the watering-places where people gather to discuss and display audio equipment; for another this issue is about mixers; and for another I'm far too nice a guy to refuse. Quiet in the ranks, there.

For some reason I associate Helios with wrap-around desks, and as I walked round the back of the car repair shops behind which Helios have their factory I wondered if that might be due not so much to the limited space available to the customers as to the limited space available to the makers. But the space at the back of the garage opened out to show a building quite as big as they need for an operation of their size. In fact, once inside, Dick Swettenham told me that only about a third of their desks were wrap-around. At any one time there are about five desks going through the factory, though there is no simultaneous production: 'We like to finish them just one at a time'.

Dick Swettenham left Olympic to start Helios in 1969. He had begun his career at EMI studios, after which he became Argo Records' chief engineer and then Olympic's technical director.

Since then Helios have made at least one desk each for Olympic, Island, Apple, Topic Records, Strawberry, TPA, Precision Tapes, the Who's Ramport Enterprises, Alvin Lee, Munich's Musicland and Studio 70, Lagos's ARC, the Essen School of Music, Berlin's Hansa Tonstudio, and Oklahoma's Paradise Studios. In addition, they've supplied private studios owned by Eric Clapton, Paul McCartney, Steve Miller, Steve Winwood, John Entwistle, Steve Marriott and Ron Wood. I got a taste of how Helios's international business is going when I phoned Neil Adams to check this piece; he asked if he could ring me back as he was in the middle of talking to some Japanese customers.

So Dick is a busy man. He is also a man who can rarely keep physically still for long. The longest I ever saw him in one place was at the AES convention in Rotterdam earlier this year when a crowd of us pinned him to the dinner table at his hotel. I remember thinking at the time that, although he talked lucidly about each of the many subjects that were brought up on that evening, he would much rather have been poring over a circuit diagram or putting some new idea on to paper.

My visit to his factory didn't change the impression. He would stop and chat for awhile, explain something special about this or that. Then he would be gone, having disappeared into his office, only to reappear about five or ten minutes later to talk about something more. Then you'd turn round and he'd somehow have spirited himself up to what I took to be his own workbench on the factory floor next to all the others. I suppose he's what the rest of us imagine a genius must be like.

While I was there Dick and Neil showed me the desk they had almost finished for Harry Johnson's studio in Jamaica as well as the shells of mobile desks, including one for Island. They've already built mobiles for the Stones (see STUDIO SOUND, September 1971), Ronnie Lane of the Faces, and Virgin Records. I think it's fair to say that Helios have had more experience than most other desk makers when it comes to making desks for mobiles, if only because they realised a long time ago just how important mobiles would become. They've been proved right, and are you listening, APRS?

The Harry Johnson desk is a 20/16 job with space for four more channels. It has a 16 track monitoring section. Helios will supply ppms or VUs or a meter which will switch from one to the other. The Johnson desk has Weston light beam VUs with a vertical scale. Dick Swettenham showed me an ingenious meter he'd devised for the American market which he hoped would wean doubtful ppm buyers away from the VU; it's a simple idea which comprises a ppm movement and a ppm scale with a red end that makes it look just like a VU.

Other facilities on the Johnson desk include monitor, echo send, foldback and pan on each track and a track solo and cut. The drop-in and drop-out facility operates both the tape machine and any Dolby units, as well as transferring the foldback from sel-sync back to line. You can monitor in mono in various combinations on the speakers as well as in four channel and the more normal stereo.

I noticed that the Johnson desk had a gooseneck talkback microphone. These seem to be going out in favour of mics set flush with the mixer panels—whether because gooseneck mics get knocked about or because they look rude I'm not sure.

Stud quadpots

Helios have found that four channel pots aren't yet as good as they could be and I was surprised to learn that they're going over to a quadpot which works on the stud principle instead of the continuously variable type. Of course the steps are pretty small but nevertheless the panning is done via fixed resistors on a small printed circuit board. Not only do they feel better, as I found out for myself, but they're considerably smaller than the ones Helios were using before. There is also the advantage, Neil pointed out to me, that with a wiper sweeping pads on a circuit card the levels are electrically accurate and repeatable. Another advantage is that when you push the pot up against the end stop in any direction it really is off; the attenuation is almost perfect. These pots are made by Audiotek and I suggest that if you're looking for quadpots you should give them a try.

Helios have a staff of 20 at the moment and, although they're by no means cramped, they have already started to think about moving to somewhere large enough to enable them to increase production. I wish them well.

One warm day in August I and STUDIO SOUND's resident photographer Tim Bishop took Kenny Everett's advice and went Awayday to the seaside. Since I'd made a few ribald remarks in a previous 'Diary' about sand-dunes and bloater sandwiches I felt I owed it to **Saturn Studios** to size them up at first hand.

The diminutive Andy Cowan-Martin, resplendent in a Saturn Studios' T-shirt met us at the station. We crossed the road, wilting in the heat. Tim, the photographer, was sinking under a heavy weight of doubtless totally unnecessary leather and aluminium photogear and wishing he'd brought an *Instamatic*. At the studio we met Dave and Barry Ruffell, the Saturn engineers, who, despite my protests, insisted that we go round to their local pub for a drink.

Saturn have a 21 year lease on some of the ground floor of the eight bedroom Victoria Hotel, not far from Worthing station. It is easy to imagine that building a music studio into a hotel might create difficulties. Andy and the crew have tried to reduce these to nothing. The mains supply to the studio, for example, is on a different phase from that of the mains supply to the rest of the hotel. Another precaution they have made is that the studio and control room have been screened with metal and earthed. Andy admitted that they had had some problems with taxis. 'We lose a small amount of time from this even now, about five minutes a day, but then we go a week without any trouble at all.'

But Saturn have many advantages over some other studios. For one thing they don't have to worry about underground trains or aircraft. For another there are no parking or accommodation problems: Andy told me producers could stay at the hotel free if session fees were paid at the time of the session. Otherwise hotel fees and services were normal and hotel bills were not added to the accounts. But what Andy stressed most of all was that Worthing was a place where musicians could come to enjoy themselves. 'Off Oxford Street or somewhere it's all hurry and sweat; there's much less pressure here. The lads know that if they want a day off they can go and loll on the beach. We're only a short walk from the sea . . . and the Downs are right behind us.'

Saturn were started in 1971 and took two years to build. They now have a Triad *B* range 16 track desk in glorious Midnight Blue; Ampex *M1000* 16 track and Ampex four track tape machines; Tannoy *Golds* in Lockwood

View of the Helios assembly floor showing prototype wiring engineer Dino Georgiades (foreground) and chief development/test engineer Brian Crony.

cabinets; an *A62* Studer two track; and a Revox *HS77* for copies and tape loops. They also have a couple of Mike Beville's ubiquitous limiter expanders.

The desk has 18 inputs and round the studio there are six boxes with two mic lines on each as well as six floating mic lines. The mics are Neumann, AKG and Beyer. 'We've never yet had to use all 18 lines at the same time.' Dave told me. The boxes also provide access to the two separate foldbacks and talkbacks and they can each take four sets of cans at a go. The cans are by AKG, Beyer and Koss. There are 12 power points. Saturn use one of the large stereo EMT plates which, for the moment, stands in the studio but they hope to wall it in somewhere before long. Their control room window measure 8 by 5 m. 'We spent a fortune on acoustics', Andy said. None of the surfaces in the studio is parallel, either on the walls or the ceiling. The studio area is about 70 m², large enough for about 25 trombone players.

Triple cavity ceiling

The walls of the studio are double cavity and the ceiling, dropped 30 cm and hung from the walls, has a triple cavity. Dave Ruffell told me the business next door didn't even know a studio was there. It follows, too, that clients of Saturn won't know the business next door is there. At the back of the hotel is an area where musicians can unload their vans. It is connected to the studio by three doors.

The studios are not yet equipped with Dolby units, although buying some for the benefit of clients who bring in Dolbyed tapes is one of their priorities. At the moment clients wanted Dolby units Saturn could hire them, as they did for the Virgin and Trident-WEA sessions.

Saturn seem to be done a fair bit of work for large record companies: Motown UK, Warners, CBS, and Decca as well as Trident Productions and Virgin Records—it was recording Kevin Coyne that helped them make the transition from a demo studio to one that now makes masters. Andy told me the Virgin engineer, Simon Edgeworth, has said the Trident desk was one of the quietest desks he'd come across, and that Motown producer Phil Cordell had told him it was one of the best desk sound he'd ever heard.

Dave Ruffell recalled that he'd recorded Stackridge on crutches after he'd hurt himself falling off the roof. Why on the roof in the first place? 'Well that was when the studio was just getting started. The ventilator started playing up so I went up on the roof to kick the fan. And I fell off'. Another time, he told me, they had to record a loo flushing. The artist on this occasion had difficulty in hearing the foldback above the noise of his instrument and had to keep shouting for more.

Saturn charge a flat £12.50 an hour. The only discount is one of ten per cent if you pay for your session three days in advance. Otherwise, there are 'no discounts, no deals'. I approve of the idea because the client knows exactly where he is. I hope the habit spreads. Saturn's number is Worthing 201767.

It seems a long time ago now, but as the mens' finals were being thrashed out at the All-England Lawn Tennis Club, only a short distance away the Portsmouth Sinfonia were engaged in a similar struggle with some of the more familiar classics.

It was clear from the outset that the classics would win, and just as clear that when they did it would be a pyrrhic victory; had he been alive to see it, Tchaikovsky might well have repeated what Pyrrhus said after the battle at Herculaneum: 'Another such victory and we are lost, Fred'.

The scene of conflict was St John's Hall in Wimbledon. It was another hot day. Bees buzzed in the flower beds and, at first, birds sang in the trees. **Bob Woolford,** possibly mobile recording's most genteel exponent, had been asked by the Portsmouth Sinfonia to record one of their rehearsals. It seemed that for some reason Transatlantic wanted to release a record of the PSO's interpretations of major classics.

At the APRS exhibition Bob had asked me along to the rehearsal, which preceded an evening concert. I had taken our photographer, expecting to hear stirring renderings of the stuff we all love but pretend we don't. You know the kind of thing: the *1812*, *Ride of the Valkyries*, *Air on a G String* . . . . As it turned out, it was more a case of rending than rendering.

The musicians dribbled into the hall past the place where Bob's van was parked outside. Our first clue was the way they were dressed. Somehow they looked very ordinary and not a bit as if they were used to wearing a white tie and tails—no weals on the neck, you see.

A good part of the time was spent tuning up. That suited us because the hall was difficult to photograph and we wanted to try some different angles before they started in earnest. Perhaps I ought to rephrase that.

Then there was that pause as the conductor raised his baton. He waited for quiet. Then he gave the signal for the off and . . . .

'My god, they're tuning up again,' I said to the photographer. Tim didn't reply; his jaw was open and his eyes were just a mite glazed. A second or two after the first shock had passed, I began to detect definite strains of Beethoven's *Fifth*. Strains was right. Beethoven's *Fifth* in a truss.

Long afternoon

That long afternoon continued for most of the day. At first I thought it was a joke. 'How satirical', I joked to my companion. But 'twas no jest. They were all playing as seriously as they possibly could, the knuckles white on the violin bow, the eyes wide over the puffing cheeks that filled a trombone.

I went out to Bob's van and asked one of the orchestra's fans who had come along what it was all about. He told me the idea was to play the classics as well as they knew how, without worrying whether they could play or not. They didn't have to have any musical training and, indeed, such training might be considered a bar to entry. There was an air of the casual about the whole thing. The lead violinist, Robin Mortimore, spoke: 'An announcement to the bass section: In the bass parts all the G's should be flat'. Occasional contagious spasms of giggling from orchestra and audience accompanied the music constantly, rising and falling with the sound of the music. Other sounds were the noises of babies crying, crisp

40 ▶

packets being rustled, beer cans clanging, matches striking.

Robin again: 'It's six before the Boomtish'.

Robin to the conductor: 'John, it's only two and a bit bars at the end there'.

The members of the orchestra cued one another by what seemed to be a highly developed semaphore system which was not necessarily related to the gyrations of the conductor. 'Where's John?' asked one. Someone else replied to the effect that he had gone to relieve himself. 'Oh well, we'll do it without him then'. And they did. It sounded just the same.

Bob's van, as the pictures in the September 'Diary' showed, is equipped with a Sound Techniques *System 12* desk, and he recorded with a single crossed pair into a Stellavox *SP7* recorder with extension arms to accommodate 27 cm reels.

It was Bob's first session with the desk and he had a little trouble at first because he found he couldn't monitor in stereo. As is usually the case with a new desk, though, it was something he'd forgotten to switch into the right position and, by the time the orchestra was ready, all the problems had been sorted out. Bob uses an Ampex *CC324* monochrome cctv camera for visual monitoring. The microphone was a Schoeps stereo coaxial, placed about 3 m back and about 2.25 m up.

Bob monitors on two *DM1* Bowers and Wilkins. The meters are two Surrey Electronics ppms mounted in a box placed on top of the mixer. Bob hopes to replace these with two Surrey meters which have double movements, one movement for each of the desk's four output channels. Like Bob's present meters, the left and right meters will be turned through +90° and –90° respectively to make it easier to compare levels.

Bob is available for avant-garde and classical mobile music recording music at any time. You can reach him by radiophone on 01 834 0612 when you ask for Gold 362.

For some reason there aren't that many recording studios in Birmingham, even though Birmingham now has two local radio stations.

Birmingham Broadcasting aren't operating yet but it won't be long before they are. Of the few studios that there are, two of the best known are Hollick & Taylor and Zella.

Hollick & Taylor have re-opened after making big changes. To describe exactly what they've done I must swallow my pride and admit I can't do better than repeat what John Taylor wrote to me about it. He began by saying that the premises would be open towards the end of the year under the new name of **Grosvenor Studios.** 'From one studio, control room and dubbing room the facilities will be doubled to give two studios, two control rooms, a film room and a tape room. Sixteen track operation will be available in studio One on Studer machines. The mixers will all be Triad throughout and monitors will be Spendors. Film mixing will be available in 16 mm 'Rock 'n Roll' format by PAG Equipment and other film facilities will include transfer, dubbing, and projection in 35 and 16 mm.

'Studio Two will provide comprehensive facilities for commercial radio and film work for advertisements and commentaries etc.'

John also told me that studio Two could double either as a four track studio or a reduction suite. Like the projection room and the tape and dubbing rooms, the speakers would be Spendor *BC1* but in studio One there will be four *BC2*. I asked John if this meant he would be doing quadraphonic work and he said that, although he was not advertising himself as a quadraphonic studio, it would be a simple matter to plug up for quad if the need arose.

He also mentioned that he had been doing mobile work for many years with an Audio Developments desk and a Nagra. Most of the work he has done for their own Grosvenor Records has been of organ works and light classical sessions. Now he is getting a new Trident 12.

I mentioned **Zella** in passing in the January issue. Zella are an eight track studio in Edgbaston, near Birmingham. They have a Klark-Teknik eight track machine, a TRD *Series 700* and a Revox. The mixing console was made by Klark-Teknik and has 14 mic inputs, full eq, echo and reverb on each channel, pan pots, compression, limiting, three direct-injection boxes and single fold-back via headphones or speakers. They have a separate eight channel monitoring mixer and echo can be added to each of the monitoring channels without going on to tape. I understand the microphones are by AKG, Beyer, Calrec and STC. The studio has a drum booth and a Chappell baby grand piano.

Custom pressing

The studio is only one of the services that Zella offer. They can supply custom record pressings in any number from £50 upwards as well as sleeves and printed labels. They'll also deal with mechanical copyright fees.

To cut demos, which they can do from studio recordings or (though only in mono) from your own tapes, they have an MSS *CB* 38 cm cutting lathe with a Grampian cutter head driven by a Quad *50E* amplifier. The replay machine is, again, a TRD *Series 700* and they use a Klark-Teknik complimiter. Half or full track tapes can be handled at any speed from 76 cm/s to 9.5 cm/s.

Zella have what they call a budget scheme for bands who want to make eight track demos. For further details of this and their tape copying service phone Johnny Haynes on 021 455 0645.

Since I wrote the above Johnny Haynes has told me Zella have acquired a new Sony *TC850* tape machine and eight Klark-Teknik graphic equalisers. They can now also deal with ¼ track tapes for disc-cutting.

The Kingsway Recorders opening binge on October 1 was quite something. I have only one serious technical complaint and that is that the beer was warm. Otherwise, provided they avoid the catering business and stick to recording it should be every bit as successful as they hope. I reported on the desk in August, so I won't repeat any of the technical details here. But I also see no reason why Raindirk, who made Kingsway's desk, shouldn't be just as successful. At the reception, one of the friendliest I've been to, Ron told me that they had measured the noise figures of each of the modules and got them down to minus one-hundred-and-twenty-does-it-really-matter but, when they went into the desk, the modules were 3 dB better even than that.

'The only click we could find was when the talkback button was pressed,' Ron said,' . . . and by that time it's too late anyway.'

Cyril Jones looked very relieved that all the hard work was over, and pleased that, at this stage anyway, things had turned out so well. Kingsway have now fixed their rates, which I was unable to report in August. They are £34 an hour for up to 16 track, £38 for 24 track, £28 for remixing from 16 and £30 for 24.

Kingsway told me they're still evaluating speakers. At the moment JBL is ahead of Tannoy by a short head but it's still anybody's race.

Talking of the binge it was good to see Mike Ford and his gang again. Even Louis Elman put in an appearance. Events like this prove just how valuable a recording industry social club of some kind would be.

While I was at Radio Medway a year or so ago researching for an article on local radio I met a guy called Bill Rapley. Bill went there as an engineer in May 1970 and during the next three years did most of Medway's outside broadcast work.

Recently I got a letter from him which opened with a plea to send his copies of Studio Sound to a spot best described as at the intersection of the Equator and the International Dateline.

For a minute I wondered what the man had done; cut Dave Penny's jibsheet, perhaps ? or bribed one of the BH canteen staff to put too much sugar in Trethowan's tea?

Nothing like that, though. Bill has been seconded from the BBC to the Gilbert and Ellice Islands Broadcasting Service (tuning signal: the sound of waves and bird cries superimposed with guitar theme and announcement in English, Gilbertese and Ellice. Ah, peace). The Beeb's new Arthur Grimble is supervising the existing station on Tarawa in the Gilberts and setting up a new broadcasting system on Funafuti in the Ellice islands. 'The system will include the usual studios for transmission and recording, means for receiving and rebroadcasting Radio Tarawa and the 2 kW transmitter.' Not all hula girls and Union Jack bathing drawers, I imagine, especially as Funafuti was devastated by a hurricane at the end of last year. Ominous, though, that the name of the hurricane was Hurricane Bebe.

Boob

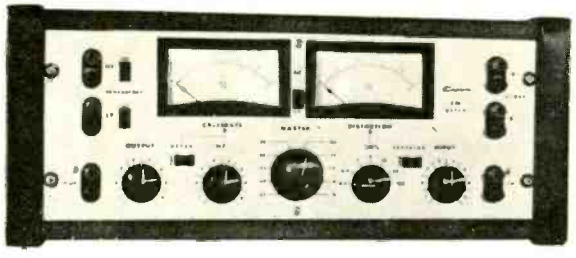
Ron Neilson of Quad Eight has told me off very gently for saying in September that the dubbing suite at the Burbank studios was to have an RCA console. Burbank had sent me a release on their plans which said: 'Dubbing five will have a very sophisticated console by RCA, a new high speed projector and all other new equipment needed for a compatible installation.' I don't rely on press releases as I used to.

My apologies to Ron. The dubbing console at Burbank is a Quad Eight console although the film equipment will be installed by RCA. Their second dubbing room will also be equipped with a Quad Eight console. My thanks to Ron Neilson for putting the record straight.

Finally, with an effort I'll refrain from commenting on some of our letters (p 44).

amcron

Model IMA



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Outputs: 10k output impedance SCOPE A and SCOPE B showing HF envelope and demodulated IM signal.

Output impedance: 600 ohm for all settings of OUTPUT Level control and MASTER attenuator.

Output Level: 25V peak (maximum) for either internal generator or any generator combination—internal or external. Level is adjustable by a 40 dB attenuator (in 10 dB steps) concentric with 15 dB variable (fine control.)

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Rotary Controls: OUTPUT Level controls, HF level control, MASTER attenuator switch, IM range, INPUT level control (continuously adjustable pot.)

Semiconductor Complement: 53 transistors, 12 diodes, 2 FETS and one zener diode. Size: 19″ (rack-mounting), width, 7″ height and 7½″ depth (from mounting surface).

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NEW EQUIPMENT

Audio compander

NOISE REDUCTION equipment manufactured by DBX (USA) is now being imported by Scenic Sounds. The basic system provides 2:1 compression in the ingoing rms programme level with high-frequency pre-emphasis; matching 2:1 expansion hf de-emphasis occurs on playback. The system is claimed to give 20 to 30 dB reduction of noise contributed by the recording medium. Three versions are available for small studios. Model *152* incorporates two channels of switchable code or decode, *154* four channels of switchable code or decode, and *157* two channels of simultaneous code and decode. For 16 track working, model 116 incorporates 16 channels of switchable code or decode while 216 provides 16 channel simultaneous code and decode.
Agents: Scenic Sounds, 28 Bryanston Street, London W1H 7AB.

Compressor/limiter module

CATHEDRAL SOUND announce a low cost complimiter module, the *CLA/1*. The unit is constructed on a glassfibre pc board and is available with or without a 15-way Painton connector. Compression ratio is continuously variable between 1:1 and limit, attack speed being specified as less than one cycle over most of the audio band. The *CLA/1* is based on a fet device and requires a 30V power supply.
Manufacturers: Cathedral Sound, Fourways, Morris Lane, Halsall, Lancashire L39 8SX.

Digital audio delay

MANUFACTURED BY Industrial Research Projects (USA) and imported by Knowles Electronics, the *ASD* digital delay line is available in several combinational options giving up to 140 ms continuous storage with a frequency response of 50 to 12k Hz (–3 dB). The 483 x 356 x 133 mm cabinet houses up to 14 modules plus input amplifier and analogue/digital convertor. Input sensitivity is adjustable from –10 to +18 dBm, output level being +18 dBm maximum. Output rms noise is specified as –45 dBm (20 to 20k Hz).
European agents: Knowles Electronics Ltd, Victoria Road, Burgess Hill, Sussex.

Audio test equipment

ELECTRONIC BROKERS announce the availability of two audio test units from TES-Milan. Model *WF971* is a wow and flutter meter giving separate metering of drift and flutter and working to 3k (CCIR) and 3.15k Hz (DIN) standards. Percentage flutter ranges are +0.1, +0.3 and +1 fds, internal stability being 0.1 per cent. Price is £295. The *D556B* distortion meter costs £319 and covers 10 to 1M Hz in five ranges at 0.03 per cent to 100 per cent distortion. Minimum input requirement is 300 mV at 100 kΩ (40 pf).
Agents: Electronic Brokers Ltd, 49/53 Pancras Road, London NW1 2QB.

Conductive plastic faders

LINEAR MOTION conductive plastic faders suitable for low cost audio control equipment have been introduced in the USA by Waters Manufacturing. The components are available in 600Ω and 10kΩ standard values and give a guaranteed 85 dB maximum attenuation and a minimum 100,000 noise-free operations.
Manufacturers: Waters Manufacturing Inc, Wayland, Massachusetts 01778, USA.

Instrumentation recorders

INTERNATIONAL INSTRUMENTS Ltd have been appointed UK agents for a wide range of instrumentation tape recorders, a real time digital correlator, a spectrum analyser, and a series of data acquisition systems manufactured in Japan by Teac. The recorders vary from the lightweight *R-70A* cassette portable, capable of recording dc to 625 Hz at 4.75 cm/s, to the *R-992* seven channel 12.5 mm tape machine handling dc to 1k Hz at 7.62 cm/s.
Agents: International Instruments Ltd, Cross Lances Road, Hounslow, Middlesex.

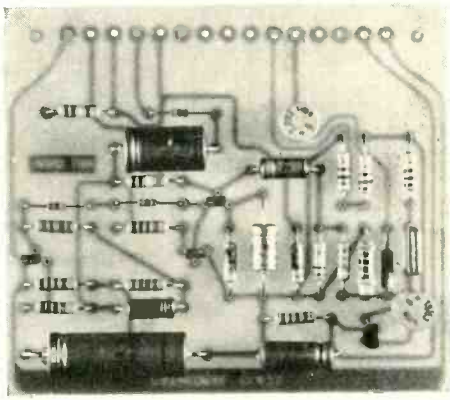
Centrifugal airblower

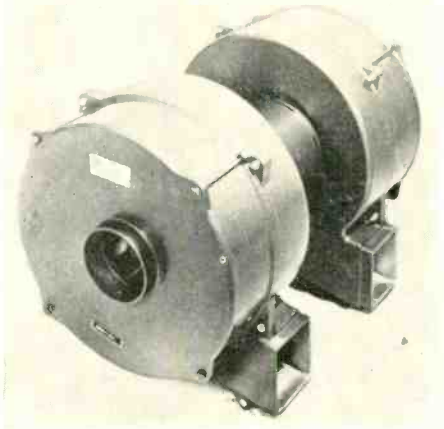
AIR CONTROL Installations are now producing a new high power air blower suitable for ventilating large electronic equipment cabinets. Model *2MS11/150 Duplex* consists of two centrifugal fans in tandem and is capable of delivering 1,292 m³ per hour. Drive is by internal induction motor and *Duplex* dimensions are 356 x 422 x 590 mm. Delivery is up to 24 weeks and prices, depending on quantity range from £65 to £95.
Manufacturers: Air Control Installations (Chard) Ltd, Boden Street, Chard, Somerset TA20 2AE.

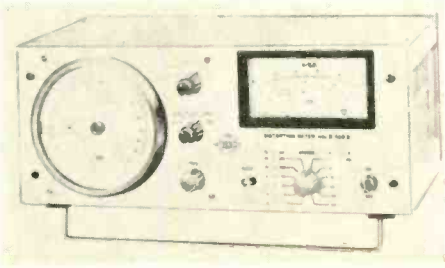
Publication

'TELEVISION TRANSMITTERS and Transposers' is the title of a 12 page full colour brochure available on request from John Hawes, Pye TVT Ltd, Colhams Lane, Cambridge. The publication details Pye TVT's long involvement with the television broadcasting industry and their co-operation with Philips in Holland.

Waters Fader


Cathedral complimiter


Air Control *Duplex*


TES distortion meter

Why travel miles for SHURE, AKG & CROWN? (AMCRON)

REW HAVE THE FULL RANGE IN STOCK AT FULL TRADE DISCOUNTS

REW's range of microphones is unequalled in the West End. We normally carry several hundred mics in stock as well as probably the most comprehensive range of stands and accessories under one roof.

SHURE

Microphones

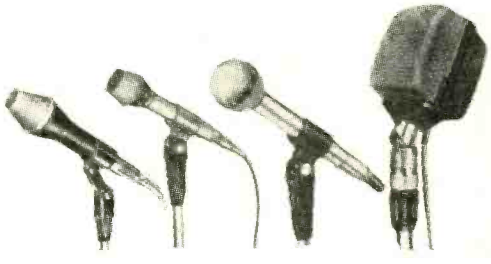
The most widely used range of microphones for Public Address and Stage use. REW are Main West End Distributors.

SHURE 515 SA UNIDYNE B. Inexpensive hand mic.
SHURE 588 SA UNIISPHERE B. Good all round P.A. mic.
SHURE 545 UNIDYNE III. Probably the most famous P.A. mic.
SHURE 565 UNISPHERE I. Unidyne III with pop shield.
SHURE 548 UNIDYNE IV. High quality solo P.A. mic.
STUDIO RANGE AVAILABLE FOR QUICK DELIVERY TO ORDER

AKG

Microphones

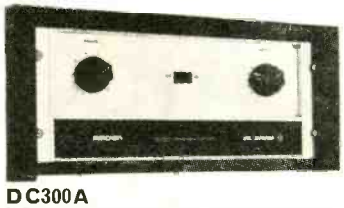
Accepted as the studio standard. Most models available over the counter including capacitors. REW are main West End Distributors.



AKG D190E. All purpose high quality mic.
AKG D109. Neck microphone.
AKG D202E1. 2 Capsule studio standard mic.
AKG D1200E. Highly versatile stage mic.
AKG D12. Studio mic for bass instruments.
AKG D224E. The ultimate dynamic mic.
AKG C451E. Famous studio capacitor mic.

REW are also main agents for BEYER, CALREC, SONY CAPACITOR, SENNHEISER, ORANGE, RESLO RADIO MICS. and LONDON DISTRIBUTORS FOR KEITH MONK MIC STANDS.

REW are LONDON DISTRIBUTORS FOR CROWN (AMCRON) AMPLIFIERS. All models of these superb amplifiers are available ex- stock for Sale or Hire. Amcron amplifiers set the standard for studio monitoring or P.A. amplification.
REW offer the Amcron amplifiers at the trade prices shown only to bona fide professional users or trade organisations.



DC300A
Will give up to 500 watts from one channel with distortion lower than 0.05%. Hum and noise is below 110 dB 150 watts, and the DC300A is now able to operate into loads as low as 1 ohm.
£376+VAT

D150
Offers up to 140 watts from each channel, or 330 watts as a mono amplifier. Again very low distortion, and rugged construction make the D150 ideal for smaller PAs and fold back systems.
£216+VAT

D60
Will provide up to 60 watts from each channel, and is of the same high quality as the D150. As a mono amplifier it will give over 100 watts. The D60 is only 1¾in. thin.£112 + VAT

IC150
Superb quality dual channel pre-amplifier designed to operate with D150 power amplifier. Signal to noise ratio almost immeasurable.
£142 + VAT

All Amcron Amplifiers are guaranteed for 3 years.
All products are only sold at professional prices against company orders.

REW AudioVisual© **The Professionals**

146 Charing Cross Road, London WC2. Tel. 01-836 3365
Video and Mail Order: REW House, 10-12 High Street, Colliers Wood, London SW19 2BE. Tel: 01-540 9684/5/6.

LETTERS

Electronics

Dear Sir, I read Adrian Hope's comment at the end of his description of the BP 1,300,246 and feel you may be interested to know that the Baldwin *Electropiano* has been designed and developed, not so much to have a tonal advantage over a conventional piano, but as an instrument for use in teaching laboratories. It has to be of low height to enable a young child to see and be seen by a teacher. It must have an electrical transducer to allow it to play into a headset communication system and must produce little or no body sound. It must have the range of a full concert piano, a similar touch response to a piano, and as close a tonal comparison as possible.

The *Electropiano* fulfils all of these requirements very well and the Baldwin Company in the USA have invested probably more than any other manufacturer into educational systems research. Mr. Hope's comment is perfectly reasonable when only the bare facts of the patent are available but the Baldwin patent is perfectly 'sound' from a wider viewpoint.

Yours faithfully, J. F. Edwards, Medway Organs, 101 Canterbury Street, Gillingham, Kent.

Thorne's article

Dear Sir, Being brutally frank, I didn't think Michael Thorne's July 1973 article ('Studio Microphone Technique') deserved any comment at all until J. L. Andrews's letter and Thorne's "reply" turned up in your October issue. Who do they think they're kidding? Andrews, of course, is generally right—if that's a synonym for "correct" and "acceptable" in this context. The truth is that:

(a) Dead acoustics are essential to almost any kind of modern recording technique using multitracks, and indispensable in studios smaller than 200 m^2.

(b) Microphone placing for any given arrangement of sounds from acoustic or electronic musical instruments is an art that requires continual experimentation and very young ears.

There now, that wasn't worth writing an article about, was it? I used *two* mics on my clarinet last time I recorded. Why not?

Yours faithfully, Sandy Brown, Sandy Brown Associates, 12 Conway Street, London W1P 5HP.

Studio microphone technique

Dear Sir, I feel I must rush to the defence of Michael Thorne's article in the July STUDIO SOUND in view of the vitriolic, pedantic, and ill-considered attack on it by J. L. Andrews last month.

I thought that the article was a solid piece of commonsense and, being a professional balance engineer, I certainly did not find it a source of amusement and/or dismay as Mr. Andrews implied I should. Indeed, I found that virtually everything Mr. Thorne said agreed with my own experience. Mr. Thorne had obviously gone to a lot of trouble to pass on to others the kind of information that one usually only acquires through trial and error over a long period. I imagine that the article would prove invaluable to anyone new to the field of recording, especially as it makes the point clearly that one's ear is the best arbiter of what is right, not a set of "unchallengeable principles". There has never yet been a principle that is unchallengeable, particularly when artistic judgement is involved.

How ridiculous to censure somebody for writing in a readable style! Better by far I should have thought to embody practical advice in such a style than to couch meaningless and unconstructive abuse in woolly-minded pomposity. If Mr. Andrews were to have offered his own views on how various recording problems should be overcome, one could perhaps judge if his ideas are any better than those of Mr. Thorne. He certainly should have taken the trouble to read Mr. Thorne's article carefully before venting his spleen. Quite clearly he has missed the point widely in several instances (the business about the acceptable spacial and dynamic distortion of sounds, for example). Also quite clearly, if Mr. Andrews does in fact have anything to do with actual recording sessions these days, he does not take much heed of what goes on, presumably because his preconceived ideas rule out the possibility that anything might have changed over the years. Otherwise he would recognise the truth in most of Mr. Thorne's observations, even those not directly concerned with microphone placement. It may be a generalisation to say that violin players are bad tempered, for example, but anyone who has worked with the usual crew of them will agree with that generalisation. And, far from being bad-tempered through hearing a playback, they never want to hear one, being interested mainly in (a) their money and (b) their newspapers.

As for vocalists, unfortunately the engineer does not usually choose who he records, and cannot select them for their professionalism, but in any case I see nothing in Mr. Thorne's section on recording vocals that suggested that he habitually records amateurs.

But this is mere quibbling and to attempt to deal with all the invective in Mr. Andrews's letter would be to descend to the same level as himself. Suffice it to say that it is well for the vigour of the recording industry today that most engineers are prepared to experiment and to learn from the experience of others, and that few adopt the attitude that their methods are the only correct ones. Correctness, as Mr. Thorne has pointed out, is often a matter of opinion. Handing down dictates from a would-be unassailable position and reviling iconoclasts is a sure way to stifle any form of free thought or enterprise, something which this industry can no more afford to dispense with than can any other.

Yours faithfully, Roger Beale, 76 Randolph Avenue, Maida Vale, London, W9 1BG.

Wot?

Dear Sir, The terms "correct" and "acceptable" used by Michael Thorne in the July issue cannot to us be synonymous, whether used musically or technically. We would suggest that the acceptance of any rule or reference, as necessarily implied by correctness, is even more to be argued within a musical context; perhaps the existence of any such is debatable.

In science we are more specific, though our concepts of perfection are influenced by experience. If scientific integrity is in doubt, then aesthetic judgements are surely less subject to restraint. We have the impression that a lack of objectivity is becoming more evident in audio publications nowadays, and may cause some confusion.

Yours faithfully, Rex Baldock, Roger Driscoll (no address supplied).

Spool adapters

Dear Sir, We refer to your November issue which showed on page 39 the photograph of a plastic AEG and NAB adapter. These adapters are available from Revox-Ela AG under part numbers *6868* and *6869* at two Swiss Francs each. Quantity discounts apply to large orders.

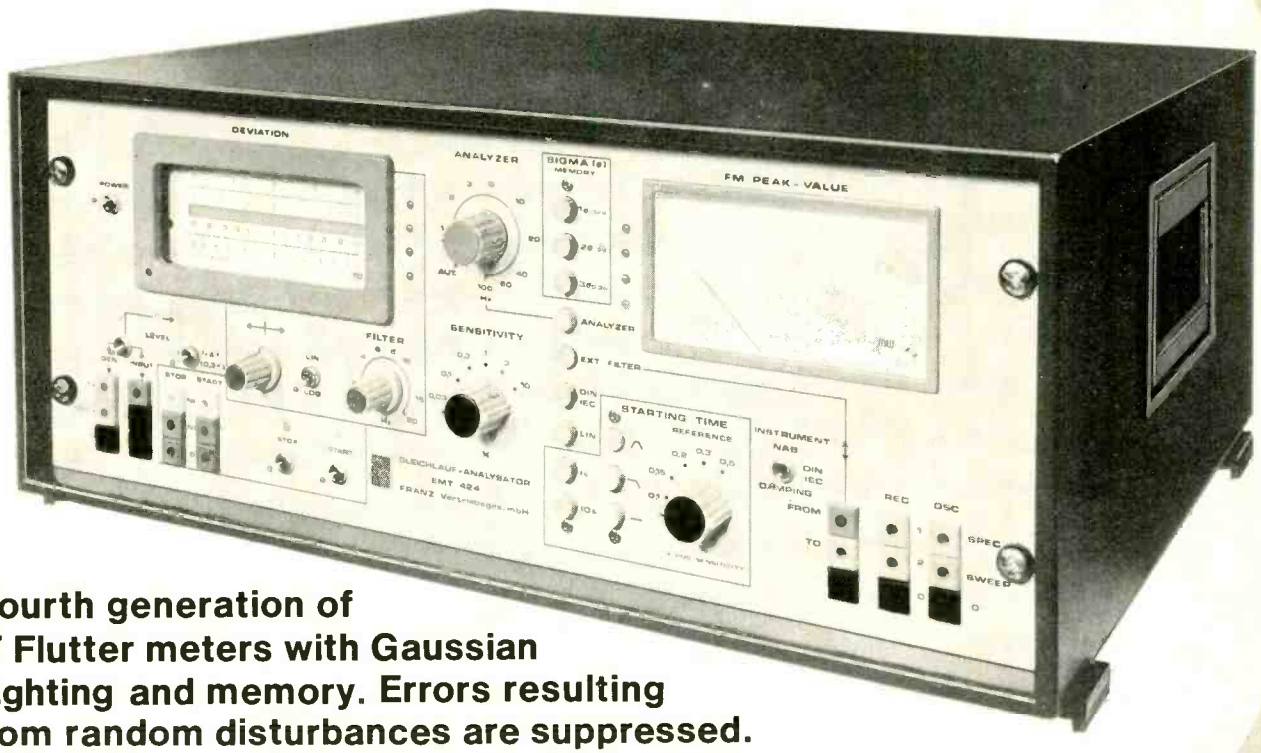
Yours faithfully, Revox Ela AG, 8105 Regensdorf-Zurich, Switzerland.

Dear Sir, The manufacturer of the adapter mentioned in your November issue, page 39, is Carl Schneider, KG-6106, Rohrbach, Darmstadt, West Germany.

Yours faithfully, Johan von Schoultz, Elfa AB, S-171 17 Solna, Sweden.

Our thanks to the many readers who suggested alternative sources of these adapters. Other possibilities include BASF (confirmed), AEG and EMI. **Ed.**

new: Wow and Flutter Analyzer EMT 424



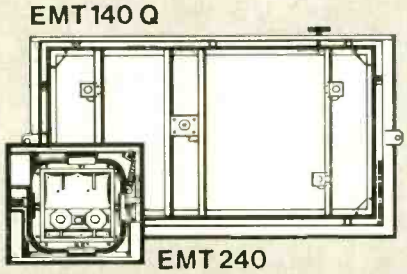
The fourth generation of EMT Flutter meters with Gaussian weighting and memory. Errors resulting from random disturbances are suppressed.

Unique, unmistakable flutter reading as a result of stationary pointer indication.

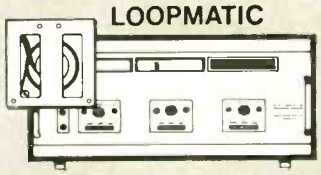
Drift and wow easily read on the built-in light beam indicator. Frequency analysis by means of automatic frequency sweeping filter.

Self-contained starting time analyzer for tape, film, and disk recorder.

EMT 140 Q

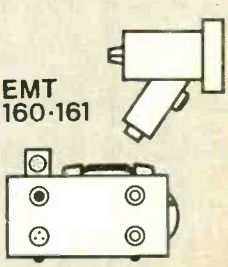


EMT 240



LOOPMATIC

EMT 927·928·930



EMT 160·161

FRANZ Vertriebsgesellschaft m.b.H.

PATENTS

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

September 5

1333759 Matsushita Electric Industrial Co Ltd.
Tape recorders.
1334019 Post Office.
Active filter circuit.
1334144 Ampex Corporation.
Magnetic tape transports.
1334216 Kawasaki Jukogyo KK and Furuno Electric Co Ltd.
Acoustic transducer for use under water.
1334411 Philips Electronic & Associated Industries Ltd.
Colour video recording.
1334445 Sony Corporation.
Recording and reproducing apparatus using magnetic tape cassette.
1334449 International Business Machines Corporation.
Acoustic coupler.
1334503 Pedrick, A. P.
Coloured light ray scanning system for NTSC-PAL colour TV transmissions.
1334523 Solartron Electronic Group Ltd.
Waveform expansion by sampling.

September 12

1334574 RCA Corporation.
Electro-optical memory.
1334657 International Business Machines Corporation.
Tape transport apparatus.
1334692 RCA Corporation.
Alternating voltage excitation of liquid crystal display matrix.
1334744 Nippon Telegraph & Telephone Public Corporation.
Arrangement for ultrasonic deflection of light.
1335006 Bosch Elektronik GMBH, Robert.
Method and device for transmitting data messages.
1335105 Marconi Co Ltd.
Transmitter receiver equipment.
1335243 Asahi Shimbun Publishing Co and Tyko Shibaura Electric Co Ltd.
Facsimile recording system.

September 19

1335522 Pavia-Farny Associates.
Sound enhancement equipment.
1335627 Periphonics Corporation.
Analogue signal recording and playback method and system.
1335764 Electronique Marcel Dassault.
Method and apparatus for reducing noise in a transmitted signal.
1335834 Nippon Electric Co Ltd.
Display devices using liquid crystals.
1335837 Ricoh, K. K.
Recording systems.
1335953 Hammond Corporation.
Keyed synthesis organ.

September 26

1336094 Electronics Corporation.
Liquid crystal display device.
1336157 Matsushita Electric Industrial Co Ltd.
Magnetic tape duplicating apparatus.
1336285 Holley, J. E. F.
Electrical test equipment.
1336345 International Business Machines Corporation.
Electro-optic switch.
1336498 British Broadcasting Corporation.
Television shot-change detector.
1336589 Olympus Optical Co Ltd.
Recorders.
1336698 Sony Corporation.
System for identification of burst signal phase in PAL television system.

Audio delay

IN KP 1,319,001, Sony suggest a very promising system for achieving variable delay in a pseudo-surround audio system. Sound to the two front speakers *SP1* and *SP2* is tapped off to a sub-tracking network to provide a difference signal between the left and right channels (l—r). This can be achieved (**Fig. 1**) by using amplifiers *13* and *14* including a phase inverter. The two amplifiers are connected via resistors *16* and *17* so that the left and right signals are combined at *15*.

The combined signal is now fed to an acoustic delay device *10*. This takes the form of an air pipe *18* with a loudspeaker *19* at one end. The loudspeaker converts the difference signal into sound which passes down the pipe and past microphones *20*, *21* and *22* which are spaced out along the length of the pipe (**Fig. 2**). These microphones are so spaced from the loudspeaker *19* that they pick up its sound 15, 30 and 45 ms after emission. The delayed sound is now amplified at *24*, *28* and *29* and passed

68 ▶

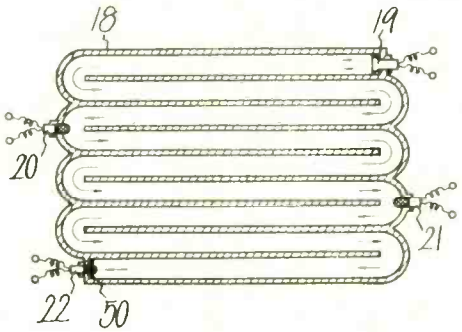


Fig. 2: Above right.

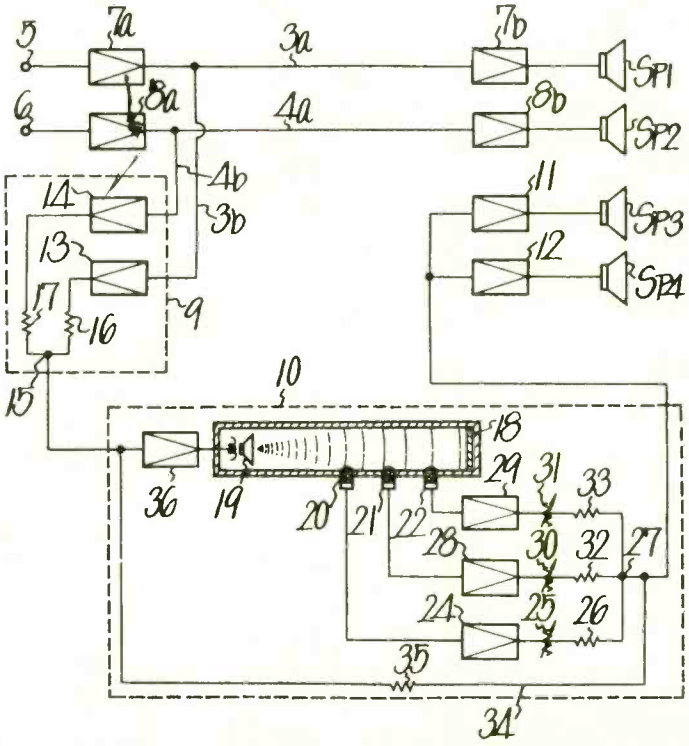
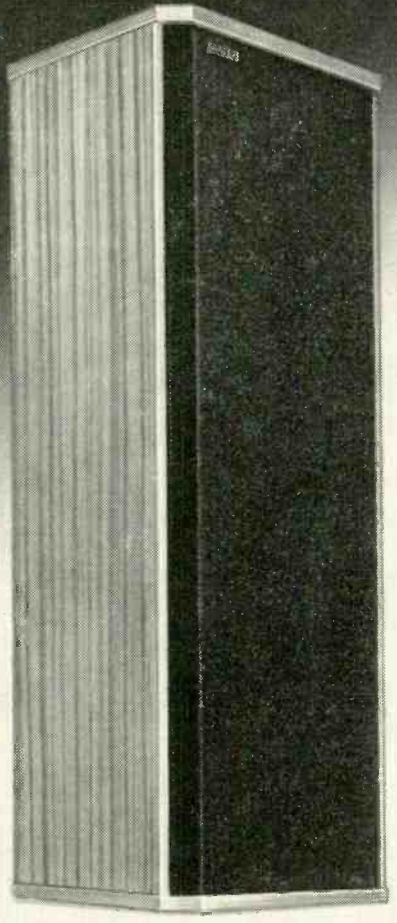


Fig. 1

Celestion Loudspeaker Engineering advances the state of the art to a new plateau

Ditton 66 Studio Monitor



1.) Celestion's new super tweeter. 2.) New design 'pressure' mid-range unit. 3.) Ultra Linear 12" Bass drive unit. 4.) A.B.R. ensures controlled bass down to 16Hz. 5.) Precision crossover for perfect system intergration.

A new Loudspeaker of advanced design suitable for studio use and for home installations of the highest quality.
UNITS: HF 2000 (dome 'pressure' type) MF 500 (Mid-range Dome 'pressure' type) Ultra linear 12" bass driver and 12" ABR. The crossover has resulted from considerable research and crossover points are at 500 Hz and 5000 Hz 80 Watts Maximum, 4-8 ohm. This monitor loudspeaker system has an exceptionally wide and flat frequency response. Very low order harmonic and inter-modulation distortion. Precise response to transients. Beautifully maintained polar response ensures absence of unwanted directional effects and provides a highly satisfactory stereo image throughout the listening area. Matched pairs.
SIZE 40 × 15 × 11½ Natural Teak or Walnut Cabinet

Celestion

Loudspeakers for the Perfectionist

ROLA CELESTION LTD.

DITTON WORKS, FOXHALL ROAD, IPSWICH, SUFFOLK IP3 8JP

For just over 30 years now RESLO have been making microphones of all shapes and sizes.

We believe that entitles us to a little trumpet-blowing about the quality and performance you can expect from microphones backed by that sort of experience.

There are some eleven different types of basic wired microphones covering a whole range of applications.

In addition RESLO make three superb radio microphones designed to add an extra dimension to your act by enabling movement free of trailing leads.

RESLO also make matched receiver units for the radio microphones and a wide range of accessories, stands, leads and clips for the other model types.

But after all's said and done, RESLO microphones speak for themselves, so for a start, why not send off the coupon below and we'll mail a brochure showing you our full range.

RESLO

Spring Gardens,
London Road,
ROMFORD, RM7 9LJ.
Tel: Romford 61926

It all sounds too good to be true . . .

I'd like your full brochure on the RESLO range ☐ I want to know about RESLO radio microphones ☐

Name.....

Address.....

.....

WITHER THE BEEB?

By John Dwyer

COMMERCIAL RADIO has arrived. Although its birth was attended by something of the same technical trouser-wetting that made the parturition of BBC2 so memorable, London Broadcasting began its programme on October 8. On the first day of broadcasting LBC released a thousand pigeons from near their office in Gough Square. Michael Levete said the gimmick was 'a symbolic gesture in honour of Reuters, who pioneered modern communications by this means.'

The national, trade and technical press have given a lot of coverage to the arrival of commercial radio, so it would be superfluous for me to add much to what has already been said about who is running the stations and what they intend to produce. But already we can tell that LBC and the rest are going to be something different.

I'm not referring to their advertising campaign, the slogan of which is 'You've never heard anything like it.' The temptation to jump at the comment of an anonymous Lintas agency man—Lintas are responsible for the campaign to promote LBC—is irresistable. 'It's a perfect advertising slogan, for it says everything, and nothing. It tells people that it will be different to the old Reithian concept of BBC news, but it doesn't commit us to anything specific because,' he admitted, 'we don't yet know what the station is really going to be like.'

The LBC programme team held a press conference the week before in which they said they would be 'playing it by ear'. So, at the time of writing, are their advertisers, who seem to be waiting for the publication of audited audience figures for the two new stations.

One reason why the advertising has been slow to come in, though it should soon pick up, may have been the astonishing refusal of *TV Times* to carry programme details without a guarantee that no-one else would be allowed to publish them. Neither station could agree to this because both of them have large newspaper groups as shareholders. Associated Newspapers, who own the *London Evening News*, have 16 per cent of LBC. Another 0.47 per cent is owned by Home Counties Newspapers and Dimbleby Newspapers. Fifteen per cent of Capital is owned by Local News of London, a consortium of 22 London newspaper publishers who represent over 100 local London papers. As well as that, the Local News group hold 23 per cent of Capital's unsecured loan stock; Beaverbrook Newspapers, owners of the *Evening Standard*, own another 23 per cent and the *Observer* have 11.5 per cent. These last two each have 8.5 per cent of the ordinary shares.

For that reason therefore, the stations refused to be blackmailed, at least not by the *TV Times*, and the *TV Times* won't carry any programme details. This situation hardly commends itself to a potential advertiser.

A healthy sign is that LBC, who will be competing with Radio 4, have set up a separate company to solicit advertising. The existence of Radio Sales & Marketing, as the new company has been called, may not save journalists the irritation we in the technical press sometimes suffer from of being asked about advertising rates—usually as a hint that it will be worthwhile to print this or that—but it should stave off the criticism that LBC is at the mercy of its advertisers, particularly if they stick to their intention, firm at the moment, to investigate and campaign on behalf of the public if they think it necessary. Certainly Michael Cudlipp, a member of a family which once had three brothers as editors of major newspapers and is himself the former deputy editor of *The Times*, is determined to make the station authoritative. Mr. Cudlipp, a journalist first and last, was recently quoted as saying 'We are not going to be trendy or gimmicky. I am interested in news: fast news, accurate news, interesting news. I hope we can provide a better service than the BBC'.

Indeed, what makes LBC stand out already is something we aren't used to from the BBC: candour. David Jessel, for example, who introduces LBC's crucial morning show throughout the week in competition with *Today*, said in an interview for *The World Tonight* that, with only about a week to go before the off, they had only one studio working out of five. He intimated that things had gone awry to such an extent that they had tried to get the date of the first broadcast put back. LBC were told they would have to begin broadcasts on the date they had said they would.

Commercial openness

The apparent openness of those in commercial radio contrasts strongly with what we're used to. Indeed, by far the most interesting aspect of commercial radio at the moment is the effect it will have on the BBC. Officially, however these things are conveyed, the attitude to commercial broadcasting on the part of BBC employees is to be one of 'eager anticipation'. In February this year, for example, Douglas Muggeridge, Controller of Radios 1 and 2, was uttering fighting talk. He was quoted in the *Financial Times* as saying 'I'll be happy if we retain our present audience.' After some intense questioning it appears that he conceded the audience would drop, but only by a fifth or so.

Although I have discovered that the official attitude prevails in some of the provincial local radio stations, elsewhere the anxiety for the sounds of battle is less marked. It is true that the biggest audience battles will be for those who listen to what Capital broadcasts in competition with Radio 2—to compete the BBC has moved Jimmy Young to Radio 2 and extended Jimmy Savile's contract for a further two years, even though I understand our Jimmy is getting past the stage where broadcasting excites him as it used to.

But the most prestigious audiences will be those who used to listen to Radio 4. This is not because Radio 4 programmes are all that prestigious but because, for the first time, for the reasons I have given, the BBC's historical position as the sole broadcaster of fairly reliable, authoritive news and information, a position it sometimes seems to think it holds by right, is under attack.

Officially the BBC seems to consider it highly unlikely that anyone could possibly be interested in listening to LBC's commercial newscasts. Unofficially the BBC is scared stiff.

On the day LBC opened, the BBC's head of radio news, Peter Woon, was quoted as saying that he was 'perfectly satisfied' with present standards. In the same article, in Monday's *Daily Telegraph*, Richard Last revealed that Woon had circulated a confidential memo the week before in which he had exhorted the staff to be on their toes but that they should try to enjoy the competitive situation; the memo is a perfect example of the dichotomy. Last also said that a senior news man had described the competition as 'potentially formidable'.

As the new station opened the BBC was still insisting that it had made 'no special plans' to meet the new competition. Yet they have increased the number of their news bulletins, extended them, brought in new stock market reports to supplement *The World Tonight* (additions obviously aimed at London audiences), and preceded all these innovations with a series of funereal trombone chords that sound like rejects from the Open University. No-one questions the BBC's right to do these things, and if they did they wouldn't get an answer. But I suggest it is questionable to insult the public's intelligence by insisting that the changes had nothing to do with commercial radio.

The Corporation is far from homogeneous, and depending at what level you go, it seems that the reactions vary from panic, around the middle levels, to complacency at the top, from where the 'official' attitudes come. The acknowledgement of this disparity between the policy makers and those, further down, who are faced with the difficult task of running a complex organisation like the BBC from day to day, seems to me to be essential to an understanding of the corporation and its workings.

If you talk to engineers, journalists or producers you get an overwhelming sense of their having an us-and-them complex. Frustration occasionally surfaces in the odd obscenely-titled broadsheet, less often in the form it took when Sir Michael Swann made that unsolicited public apology to six MPs who had appeared in an over-lively tv discussion. The programme,

the fourth in a series called *The People Talking*, was chaired by Desmond Wilcox. None of the MPs had complained to the BBC, and Desmond Wilcox wasn't consulted about the apology. He also had no idea that he would be humiliated by having the apology made public. Fifty members of the general features department, of whom Wilcox is the head, signed a letter of protest to Sir Michael Swann, the chairman of the board of governors. They felt particularly badly about Wilcox not being supported by Alasdair Milne, though I doubt if they were surprised, and considered that the apology was an attempt to get rid of Wilcox. A couple of weeks later one of the MPs on the programme, Mr. Raymond Fletcher, said the apology was neither encouraged nor welcomed.

Sometimes staff complain about interference from above. A journalist told me that he and his colleagues were once told that 'it would be a good idea' to produce weekly common market reports for The Year of Europe. But when they began to produce reports that were less than favourable they were told to stop it.

An angry producer, talking to me about commercial radio, said, 'They won't know what's hit them.' He isn't the only one who thinks like that; to some still working within the hulk of Broadcasting House the BBC becomes more like the Titanic with each succeeding day: there are too many passengers and there is too much talk about being unsinkable. While the party goes on the ship draws ever nearer the confounding iceberg.

But the passengers are leaving in great numbers. It is a symptom of the sickness that the BBC is losing some of her most prized television executives, and she can't blame commercial radio for that. John Howard Davies, the boy-actor turned director who was responsible for *Monty Python*, *Steptoe*, *The Goodies* and *All Gas and Gaiters* left in March to form his own company. In September the BBC lost its head of television comedy, Mr. Duncan Wood, to Yorkshire television. He had, in his time, produced all the *Hancock* programmes and *Steptoe*, and was responsible for hit shows like *Oh Brother* and *Dad's Army*. Lord Willis, originator of that BBC Institution, *Dixon of Dock Green*, joined Capital Radio at the start.

Of course it is only fair to point out that the BBC is bound to lose some of its staff, particularly since the training the BBC gives them is so thorough—perhaps thorough to the point of indoctrination. Perhaps it is the amount they spend on training that makes the BBC reluctant to lose anyone. A reliable source has told me that an edict went out some time ago inviting anyone thinking of going over to commercial radio to go and talk it over with one of the high officials in the radio department. Those who did so were advised to leave.

BBC loyalty

It would be wrong to deny, however, that those working for the BBC have considerable loyalty to it. I wrote last year about John Cordeaux, whose office at Radio Humberside is littered with plaques and momentoes of his career with the corporation. Sometimes it seems that the resentment that does occasionally surface does so as a result of the BBC's ignorance of that loyalty. The sacking of Charles Parker and the apology incident I have already described are just two examples.

A possible reason for this loyalty is the same as that for which recruits are attracted to the BBC in the first place. Some may have a vocation to a radio or television career which cannot be fulfilled in industry. Others, perhaps, find the ethics of big business distasteful to them; they would rather work in an organisation with the BBC's professed aims than towards someone else's profit in commercial television or radio.

It could be argued, too, that the first aim is more likely to apply to engineers than to journalists and broadcasters, and the second the other way round. It could be this curious consistency, a radicalism innate in journalists, that gives rise to suspicions that the BBC is Marxist-dominated. My favourite red-under-the-bed story about the BBC was that told by a Brigadier at a boozy lunch at an army camp at Wilton in Wiltshire. At a particularly difficult time during the Ulster situation, his unit was concerned about the country's infiltration by subversives who wished to bring about anarchy. Much of the pressure, he said, came from the BBC. 'Do you realise,' he said, 'that two-thirds of the corporation's intake of graduate trainees are known Marxists?'

The BBC is in the happy position, however, of being accused of bias by right, left and centre. Journalists at Television Centre are still talking about one case where the sub-editor of a television news bulletin 'cut down' the estimated number of people going into Trafalgar Square for a trade union rally against the Industrial Relations Act. The news report gave the impression that the TUC had had less support for its strike call than may have been the case. It read that 'tens of thousands' had gone into the square compared with the nearly one hundred thousand which ITN reported on the same night as the 'largest rally since the end of the last war'. In the subsequent encounters in the letters pages of *Radio Times* the BBC emerged bloody but intransigent. The sub shortly became one of tv news's chief subs. I should add that there are dozens of them.

In February this year Mr Anthony Benn asked Mr Peter Walker if he would ask the BBC and ITV to give more information about what the trade unions were doing to increase public safety during the gas strike that was on at the time. He complained that the public remained unaware of 'the arrangements agreed between the unions and Age Concern and others on behalf of old people.'

In radio, you have only to listen to the items selected for *Pick of the Week* to realise how silly the charges of left-wing bias are. Every week the same old things are wheeled out, creaking from over-use; animals, children, the Church of England, a talk from Lord this or Sir that, the monarchy . . .

Pick of the Week often ignores the most memorable programmes, such as *The Iron Box*, a brilliant biography of George Jackson. I've since discovered the producer was Charles Parker, whom the BBC later sacked with such unwelcome publicity.

Alasdair Milne, appointed as director of tv programmes in December last year, is hardly a Marxist. The son of an Aberdeen surgeon, he became head boy at one of the country's 'top five' public schools, Winchester. Sir Michael

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Swann, indeed, that consummate non-politician now chairman of the BBC, was regarded by many during his days as Principal and Vice-Chancellor of Edinburgh University as right-winger and an authoritarian. He once admitted his students had thought him 'somewhat to the right of Genghis Khan'. His interests have spanned zoology, natural history, fisheries and veterinary medicine. Not, I fear, broadcasting, but then you can't have everything. He too was at Winchester. When he was appointed, the National Viewers and Listeners Association first whooped and then sent a congratulatory telegram. Alastair Burnet, who occasionally chairs Panorama, is the editor of the *Economist*, hardly a left-wing journal. Ian Trethowan, controller of radios 1 and 2, is a close friend of Edward Heath, the Conservative Prime Minister.

At the lower, working levels of the BBC there are and have been some pockets of radicalism, mainly on the part of those who appear before the microphones and cameras, but these are in a minority. The BBC still gives the impression that its direction has been set by a bunch of establishment bureaucrats who have no real knowledge of or feeling for broadcasting. Increasingly over the last ten years they have had to give ground. Sensivitity to audience figures, introduced by Sir Hugh Greene, produced *TW3* and is the reason why Bob Harris of *Old Grey Whistle Test* was able to say, in a recent interview in *Music Week*, that he felt he had great freedom at the BBC. William Hardcastle's similar indispensibility is also the reason why he, too, has been allowed to be a law unto himself for years now. But now a reaction has set in, as shown by the appointment of Sir Michael Swann. Behind the scenes, despite the window-dressing, the BBC continues to promote and encourage a certain type of individual, one who will be aware, once he joins the exclusive BBC club, of how important he has become.

Discovering, then, that there is something wrong with the BBC, that some of the staff are unhappy and are prepared to leave even though they don't want to, that some staff sometimes find themselves in the humiliating position of having to utter transparent lies to the public, is easy. Offering explanations for these things is another.

Civil Service branch?

The trouble lies in the fact that the BBC has been established for so long now that it has come to resemble a branch of the Civil Service. This seems to be true even at the most superficial level. It is no coincidence that one of Sir Michael Swann's closest friends is Sir William Armstrong, the Head of the Civil Service, and that another is Lord Rothschild, head of the Downing Street think-tank.

In a recent report on the last decade of broadcasting, for the *Sunday Times* supplement, Francis Hope, assistant editor of the *New Statesman*, remarked that the BBC had a 'Whitehallish reluctance to get rid of anybody' which led to 'a long enshrinement of traditionalism'.

I have more to go on than a casual remark by Francis Hope. Charles Curran, the director general, was asked in an interview for *Cinema TV Today* last April what he thought of criticisms coming from within the BBC that it sacked its staff ruthlessly. He admitted, 'If there is a criticism of the BBC it is the fact that we are not ruthless enough in dismissing people, or in parting with them on fair terms.' Except of course, in the case of those pockets of radicalism I mentioned. Nevertheless, I have it on good authority that Robert Dougall will retire before the end of this year.

There are many other signs of a Whitehall mentality. There is the same proliferation of staff 'grades' and jealousy between them; the same inconsistency as to how important one branch of the corporation's activities is compared with another, particularly in the distribution of money; the same attachment to titles—even now the list of BBC Governors is littered with peerages, knighthoods, OBEs, KCMGs, DSCs, DSOs and CBEs, leavened with the odd trade unionist (window dressing again); and, worst of all, the same arrogance that admits of no necessity to account to the public who finance the Corporation. Imagine, for example, the arrogance of the corporate mind that banned all progressive jazz from its broadcasts. Often combined with it is an ambiguity of attitude, an inconsistency which arises from the stratification of the BBC that I mentioned earlier.

Public accountability

This explains the paradox that, although some of the BBC's most successful documentary programmes have been those that stressed the importance of, say, the accountability of public figures to the public, the BBC has never felt the need to be so accountable. Witness, too, the long string of records that the BBC has banned without explanation. The silliest example was probably Dr Hook's *Cover of Rolling Stone*. The gesture this time was to say that the record offended the BBC's rule against advertising. As many writers have pointed out, the BBC shows so much advertising anyway that this excuse was obviously transparent.

In the House of Commons on June 7, 1972, Mr Joe Ashton, the MP for Bassetlaw, asked the Minister for Posts and Telecommunications, Sir John Eden, if he would seek powers to restrict the amount of display advertising permitted in outside broadcasts. There followed what is usually called 'a heated exchange' between the minister and both Labour and Conservative MPs which centred round the advertising which occurs during football matches, golf tournaments and cricket matches. Sir John said, 'The Television Act specifically allows the broadcasting of items consisting of factual portrayals of doings and happenings appropriate for inclusion by reason of their intrinsic interest and which do not comprise an undue element of advertising . . .' I couldn't have put it better myself.

Mr Gregor McKenzie, MP for Rutherglen replied that the kind of advertising MPs were concerned about was not incidental advertising but 'a well-organised scheme of advertising used by tobacco companies and drink manufacturers to get cheap advertising on the BBC and elsewhere'. Sir John also said: 'There is nothing to prevent the BBC . . . coming to terms with the promoters of the event which they are supposed to televise.' News to me, I must admit.

On the same day Mr Philip Whitehead, veteran commercial radio enthusiast and MP for Derby North, said he thought the collaboration between Time-Life and the BBC, which allowed Time-Life to get free advertising in return for help in making programmes such as the series called *The British Empire*, was in direct breach of section 12 of the BBC Licence and Agreement. A Conservative MP, Mr Gummer, answered Sir John Eden's non-reply with the remark that the BBC had not, as Sir John had suggested it had, jealously guarded its financial independence (Labour cheers). For those who don't remember, Time-Life had been producing publications based on *The British Empire* as a part-work running concurrently with that series.

The pragmatism of the BBC in matters of this kind is, of course, famous. The BBC plugs *Radio Times* like mad, which is inconsistent though understandable, but it does the same for an interesting branch of its activities called BBC Enterprises. Just before the Cannes TV Programme Fair, into which the BBC lunged for the first time this year, Peter Dimmock, the new life in a once-ailing BBC Enterprises, came back from Washington with news that in a two day convention he had sold £156,000 worth of programmes for the company including, incredibly, *Dad's Army*.

At the end of September this year it was announced that BBC Enterprises had made a profit of £1.25 million in the year to June 30, with the prospect of making 'Much more' in the following year. Dimmock gloated that the 20 per cent return on capital which these figures represented was better than that of ATV. They had sold *War and Peace* for £300,000, the *Onedin Line* for £200,000 and *Elizabeth R* for £170,000. He said the reason for the improvement was the deal they had made with Time-Life, their main selling agents in the US.

Prepacked wedding

BBC Enterprises have used a number of gimmicks to bring in the folding stuff, among which have been the merchandising of tv characters like the Wombles and exhibitions of the costumes from the *Six Wives of Henry VIII* and special effects from *Doctor Who*. BBC Records sold 44,000 copies of the recording of Prince Charles's investiture, and the latest error of taste is that BBC Records will release a two album set made at his sister's Wedding. The entire revolting package will be available in the shops five whole days after November 14 to cash in quickly on the wave of sentimentality which the higher orders of the BBC expect to sweep the nation. There is no time to print the sleeve, so the nature of the contents will be printed on a piece of paper inserted into the record cover.

The week before LBC came on the air, Radio 4 started a new series of profiles called *Celebration*. The first was about the cartoonist and musician Gerard Hoffnung. The three-quarter hour programme was followed by an advertisement for a BBC record by Hoffnung in which the details of the record's number were followed by a brief description of the

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contents followed by a repetition of the number.

At the annual meeting of British Phonographic Industry in May this year, the organisation's chairman, Mr Larry Wood, said he was concerned about the activities of BBC Enterprises and had written to the BBC asking them for clarification of future plans. He was quoted in *Music Week* on that occasion as saying: 'I believe, and I may be quite wrong, that BBC Enterprises is not entitled to do some of the things it is now doing.' He had had a meeting with the BBC three years before at which he had received certain assurances, though these had not been completely satisfactory. Until now he had had no serious reason to complain but the activities of BBC Enterprises were now a serious and important matter for the recording industry. After the meeting he was quoted as saying that at the meeting three years ago he had been told BBC Enterprises would release only recordings of limited commercial appeal. He now wanted an assurance that BBC Enterprises would not become involved in the making of pop records. BBC Records have just signed a contract with Polydor for licensing outside the UK and distribution within the UK which the BBC said was worth £500,000 in advances.

Freelance freeze

All these things are signs that suddenly the BBC has, in some areas, become tight-fisted. There are other signs. The BBC has just won a ten-year campaign not to increase the fees of freelance writers working for radio. At the moment there are three official categories of writers: beginners are paid £2.25 a minute, established writers 50p more and well-known writers £3.75 a minute. In 1936 the BBC paid a guinea a minute. The dispute ended in the industrial relations court, who were told that many writers had given up writing for the BBC because it wasn't worthwhile.

The three categories of writer, introduced in 1962, are purely arbitrary. The head of BBC copyright, R. G. Walford, said that writers moved from the beginner class to the established class when various things had been taken into account including 'their status outside the BBC'. If you're a recognised name you move into the third category. But we learned, at the end of September, that there were various grades in between including minor established writers, established writers and major established writers.

Another disturbing symptom just about to surface is that some elements within the BBC appear to want to opt out of some of the less remunerative obligations implicit in the BBC's charter, but more of that in a future issue.

In March the BBC was ordered to pay more in royalties to the Performing Right Society. The Society had claimed £3,000,000 from the BBC, which had resisted strongly. The chairman of the Performing Right Tribunal, Mr H. E. Francis, QC, said that the BBC was paying substantially less than that paid collectively by the independent television companies, even though the BBC was allowed to use the repertoire on radio as well. The BBC made no comment on the decision, nor would it say how much more it would have to pay.

When *24 Hours* was replaced by *Midweek* in September last year, *Midweek* had to stop all filming five weeks after it had been on the air because they had overspent their budget by £3,000. Unofficial reports said that the budget had been £5,000 a week for a programme that ran three nights a week. London Weekend's once-a-week Sunday current affairs programme, *Weekend World*, had been allowed £25,000. *The Times* reported that, in the same week, Sir Hugh Greene asked in his Granada lecture 'Why have the more enterprising programmes, those which sometimes cause trouble, tended to disappear? I fear we are in for a spate of talk instead of the often daring and illuminating reporting of *24 Hours*.' The BBC commented: 'Sorry we don't discuss financial matters.' Sir Hugh turned out to be right.

Some groups no longer work for the BBC to record sessions for radio to be broadcast later. Money for these recording sessions is so scarce, it appears, that musicians have to do each of the items they are to record in a single take and to do the whole repertoire in a single session. One musician I spoke to said he was astonished when he was asked to record six songs in a half-hour session. This is fair to neither the musician nor to the audience.

The reason, I have been told, why *Nationwide's* filmed reports go out in black and white, thus giving the impression that nothing north of Watford is worth seeing in colour, is that colour film is too expensive. The truth is that if the BBC used their own crews instead of contract crews they could save the cost of colour a dozen times over.

In October 1972 the BBC said its research department at Kingswood Warren had invented what they called a Ceefax system. This would enable suscribers to receive written information for display on television screens. The corporation took out a patent and was assuming that industry 'would have the opportunity to produce units for sale to the public.' The units would cost under £100 plus the cost of the set and could be added to a conventional receiver to enable the viewer to choose from about 30 pages of information. Chris Dunkley of *The Times* commented: 'The announcement from the BBC yesterday was a surprise because although comparable systems have been discussed for years, they have always been thought of as profit making enterprises by commercial organisations.'

But the all-time classic must be the occasion when the BBC replaced all the soft white loo paper at Bush House, headquarters of the BBC's excellent external services, with the hard shiny stuff. Apparently there was an economy drive on. Eventually, after protests, the soft loo paper was brought back.

The reasons why the BBC has suddenly embraced the profit motive, having held it at more than arm's length for so long, aren't hard to surmise. At the beginning of this year the BBC and IBA charters were extended to 1981. By then it will have been decided what is going to happen to any fourth tv channel and where cable tv will fit into the firmament. The way that commercial radio and BBC local radio developed made the BBC realise it was not quite invulnerable to attack. John Gorst, the man who can take much of the credit for getting some form of commercial radio accepted by the Commons, though when he got it he didn't like what he got, asked the Minister for Posts in February if the BBC would be in deficit by 1975 and if so by how much. Sir John Eden replied that the BBC had estimated it would have an accumulated deficit of £15 million by 1975.

The director general of the BBC, Charles Curran, gave the same figure at a Variety Club lunch at the Dorchester during the same month. He blamed increasing staff costs which he said accounted for over 80 per cent of the corporation's expenditure. 'If we seem to be pretty tough in our money dealings these days there is a good reason for it. In a competitive world we have to choose where to place our bets.'

Thus the BBC has sought in the last year or so to make sure the BBC isn't losing money by the time the charters come to be renewed. Not that the BBC is consistent, even in its parsimony. They choose to 'place their bets' on some odd horses.

Whether you can rely on it or not, *Private Eye* reported at the end of the sixties, that, the BBC was spending £250,000 a year in taxi fares. You won't get an official answer, of course, but unofficially I've been told the reason is that the Corporation sometimes pays taxi fares for performers or staff who have worked late.

Then, of course, there are the refreshments consumed at Television Centre. At the end of a series of broadcasts there is usually some kind of celebration, fair enough, but the amounts of stuff consumed at these binges suggests that those present may not all have had something to do with the production. Entertaining foreign journalists after public occasions, like general elections, takes place somewhere on the top floor but there are any number of entertainment suites at Television Centre. In the BBC Club one afternoon Bill Cotton Jnr's secretary was heard to ask petulantly for another bottle of champagne: 'And can we have it at the correct temperature this time?".

Champagne aside

That aside, I think the higher orders at the BBC really imagine that whatever criticisms people have of the corporation will be silenced by the production of a black balance-sheet. The sad fact is that they won't. The politician objects to the BBC for different reasons to those of you or me, though those reasons have the same base. Politicians hate being nominally responsible for something they can't control; responsibility without power, the prerogative of the idiot throughout the ages. To the politician the BBC has become too big, too monolithic, and too self-important, and must be cut down to size. And 1981 is the date engraved on the politician's heart, as well as on that iceberg I was talking about.

The general public too have become fed up with the BBC's inscrutability, the irritating way it brushes aside enquirers into its affairs. This is not, I must emphasise, a criticism of any of the BBC's press or engineering departments, whom I've always found courteous and helpful. When I was compiling this the press office were as friendly and co-operative as they could possibly be within the limits set by those above them. I wonder if those above them realise that, in a vacuum of information, something far worse than the truth usually takes its place.

While the press office are helpful there seems to be a number of obstructions before you reach them. On the morning I wrote this I asked, in the way I usually did, to be put

through to the BBC radio press office. I was asked 'What's it concerning?' Later, in contacting the tv press office, I was asked if I was a journalist.

I remember going into Broadcasting House one day to ask for some information about local radio. I asked at the desk for the public relations department.

'We don't have one,' the girl said.

'You what?' I said.

'There isn't one,' she said.

She asked me what I wanted to know and I told her I wanted some information about Local Radio. She phoned someone on the internal phone and after a little while I was allowed to speak to him myself. During the conversation I said I was from the press and could I please have all the co-operation he could give me for an article on local radio. He said he would be delighted and told me how to get to the press office a couple of streets away.

As I put the phone down the women behind the desk were showing considerable irritation. 'Why didn't you say you were from the press ?' they asked *concertante*.

The BBC seems to have forgotten that an essential feature of the press in this country is that it must not have any more rights than the ordinary citizen. Then the ordinary citizen can determine what others would be prepared or not to tell him by what he reads in his paper.

Earlier this year, Mr. Evelyn King asked in the House of Commons about the publication or otherwise of the results of an investigation the BBC was carrying out into allegations of bribery within the corporation. Sir John said he wouldn't direct the BBC to publish anything and that the enquiry 'needs to be confidential if it is to be candid and frank. We must leave it to the governors to decide how much to publish.'

King then said that it was now two years since men had been named in charges of corruption and wasn't it time they knew if they were going to be charged. Sir John Eden replied: 'The BBC has received this report but is now waiting for the director of public prosecutions to decide what action to take.' Those of us outside the BBC can learn a lot about the corporation from that small exchange. Had the DPP not acted some weeks later I doubt whether we would have heard any more about it.

I have already given a number of examples of the BBC's refusal to account for itself. I gave another example in the July issue of STUDIO SOUND when I described how the BBC refused to tell me on what terms it had vacated its studio in Piccadilly. Yet, showing its regal disregard for consistency once again, the BBC had said, during its tug of war with the drama writers, that its revenue was limited and 'derived from public funds.' What agility. And not even the *Sunday Times* could prise from A. Spokeman the amount it had cost the BBC to buy the rights to Churchill's *History of the English-speaking Peoples*.

Altogether, I think the public have now become dimly aware of something that journalists have lived with for years: that the dark-brown voice that issues from the continuity suite behind that mesmerising whirling-blue globe is still Reithed in evening dress, and that the dry-cleaned sentences it utters are even now stamped with Rule Brittania and the changing of the guard.

Having said all this, there will be those who say, as any civil servant would, that it is unfair to attack the BBC because it cannot answer back. Even were this true it is a spurious argument, one that has long been used to silence any criticism of either the civil service or the monarchy. John Grigg, a member of the House of Lords, once observed in a book on the monarchy that those who argued thus were mistaking privilege for penalty. Silence was, he said 'a privilege not enjoyed by, for instance, ministers of the crown, who would often be glad of its protection. That the nation's highest office-holder, being immune from the necessity to answer critics, should on that account be immune from criticism, seems to me an argument of the purest absurdity.' Surely that also applies to the nation's highest transmitter-holder.

The BBC should know that a large group of its critics do not belong to the commercial lobby. They find much to admire in the BBC both as an idea and in much of what it broadcasts. They do not necessarily think that programmes ought to be mere enticements to watch or listen to advertising. But they—we if you like—are seriously worried that, unless the BBC makes substantial changes to itself it cannot survive, and that is why we make those criticisms. To the outraged shouts of 'it would never be allowed happen' let me say that it would indeed be allowed to happen if the BBC kept its name but continued in so emasculated a form that the name no longer had any meaning. Those, in parliament, who would have the power to do this are no more accountable to the BBC than the BBC seems, at the moment, to be to them.

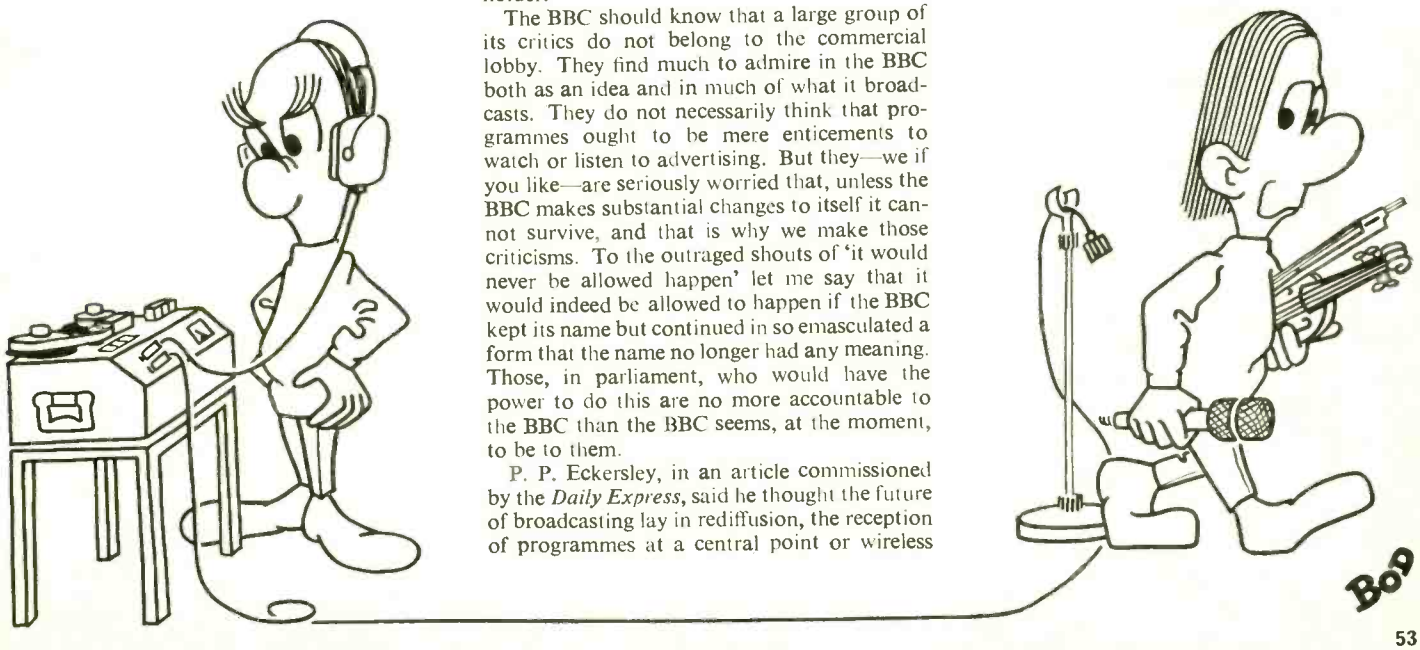
P. P. Eckersley, in an article commissioned by the *Daily Express*, said he thought the future of broadcasting lay in rediffusion, the reception of programmes at a central point or wireless exchange for distribution to loudspeakers in the houses of the district. He also quoted a passage from the current BBC handbook, which said, 'The particular aim of a wireless exchange is to provide clear and constant reception . . . and a service on easy payment terms . . . to those without much capital. The system, however, contains within it forces which, if uncontrolled, might be disruptive of the spirit and intention of the British Broadcasting Corporations' charter.' The writer commented: 'The British Broadcasting Corporation thus emphasises its monopoly at the expense of both technical development and better service for poor people.'

He wrote those words in 1933. History shows that Rediffusion was not allowed to develop as he hoped it would. The corporation successfully halted rediffusion and, by implication-impeded the coming of local radio. The invention of the transistor made further progress in wireless-with-wire unnecessary.

Now we are trying to develop local, cable television. It seems clear to me that the BBC will never again be allowed to impede whatever others regard as progress in broadcasting. If the BBC needs to be emasculated in order for others to achieve large profits from broadcasting, that is what will be done. There is far too much at stake for the BBC to be high handed.

What has to be done right away is to change the arrogance of a public corporation, responsible to everyone and therefore to no-one, for at least the superficial humility that companies acquire when they're answerable to shareholders. The BBC's shareholders are those who have paid for television licences.

The trouble is, of course, that it can't be done. The 'BBC attitude' is the same as it was in 1933, and the people the BBC needs to rid itself of in order to survive are the only ones with the power to accomplish the transformation.



Patents: the perils and rewards

By ADRIAN HOPE

There is no point in trying to patent an idea unless you have the resources of a fairly large company to stand legal action against infringers. This simple fact has been ignored by a legion of inventors for whom their patent serves merely to promote the dissemination of their idea. And it'll be even worse when Patent Office goes to Munich . . .

DESPITE WHAT their non-technical friends may think, electronics enthusiasts are really quite normal people. So, along with eating, drinking and sleeping, they sometimes have ideas which seem (to them at least) to be world shattering. Then they wonder about how to protect these ideas and make money.

There are two ways of keeping an idea to yourself. Firstly you can keep it totally secret or tell only a few people and pledge them to confidence. But secrets shared inevitably leak out so the alternative approach is usually better in the long run. This alternative is to patent, which inherently suffers from the disadvantage that it is by no means cheap. And right from the start, it has to be made clear that, despite what I implied a few lines above, you cannot actually patent an idea. You can patent a piece of machinery or electronic equipment or you can patent a method of making something which produces a saleable end product. You can even patent a method of testing which is related to some such production technique. But you cannot patent an idea, a scheme or a plan.

Over the past 350 years or so the legal profession have devoted much time to, and earned much money from, arguing the finer points of what is and is not patentable. The legal climate is always changing but various basic guidelines still persist.

Patents are not granted for computer programs as such but patents *are* available for new methods of programming computers to operate in a particular way, or for computer storage tapes or the like which contain the program. Merely to line up and connect up simple collocations of known equipment, or to use well known existing techniques in a simple system, is not an invention. But where extant gadgetry or techniques have been 'welded together' into some working interrelationship that produces a surprising or new end result, then a patent will usually be granted.

There is virtually no hope of patenting clever arrangements of words, electronic symbols or formulae on a sheet of paper but a patent has been allowed for cinematograph film carrying a distorted image for particular use at projection. Log tables are not patentable, but a slide rule would be if it had some new construction or function. Methods of actually operating a machine (perhaps a studio mixing console) by using known controls would almost certainly be unpatentable.

Surprisingly, a patent for a method of producing electrical oscillations was allowed after it was argued that electrical oscillations are only one of many forms of electricity and electricity can be bought and sold. But this kind of argument is rather academic because a patent for new circuitry for producing such oscillations would sail through the Patent Office without any real objections. Less academic is the spin-off from this kind of decision, which means that patents are now readily available for new methods of reproducing sound, for example, by splitting and recombining signals in a particular way as in the Dolby systems.

The problem with trying to give guidance on the patentability or otherwise of any new invention is that by definition no new invention is the same as an old one so past decisions can never be entirely relevant to current problems. Hopefully the examples mentioned above will give some useful guidance. Inventors should remember that trends are always towards liberalism so if in doubt (and if funds permit) it is usually well worth while having a go.

This suggestion, of course, raises the question of funds and how best to go about patenting a brainwave from the moment of its conception. In terms of pounds and new pence, patenting is an expensive luxury. It is cheaper if the inventor does it himself, but this is likely to be about as successful as a self-appendectomy. The simple answer to the question of how best to go about patenting an invention is: go to a patent agent, give him all the facts, take his advice and pay his bills. But the bills will be large since patent agents, like solicitors, accountants and lawyers, charge heavily for their skilled services and experience.

Inventors with limited funds are in the cleft stick of either doing the best they can themselves, for a cost of around £25 from application to acceptance, or paying a patent agent to do the job properly for around £100.

Cash outflow does not stop with acceptance and publication of the patent papers by the Patent Office. Official fees are payable when the patent is actually granted (sealed). Then, from the fifth year onwards until the final possible year (the sixteenth), annual renewal fees must be paid to keep the patent in force. And these fees move upwards on a sliding scale to around £30 per year towards the end of the patent life. By now the casual inventor will be horrified at the costs involved; but remember that any invention which is worth its salt should be producing a tangible reward by the time substantial renewal fees have become payable otherwise it is better to let the patent fall by the wayside. Of course the inventor must remember that, once a patent has been allowed to lapse, its disclosures and claims for monopoly become part of the public domain and no one, but no one, can prevent anyone else from freely using its content.

Incidentally the patents pieces which appear in STUDIO SOUND are all based on the 1,000 or so accepted patent specifications that are published every week by the British Patent Office. These are laid out for public inspection.

The patent specifications published each week are open to opposition by any interested third party for a period of three months after their publication on the grounds that their content may be as old as the hills. If no opposition is lodged, or if an opposition is unsuccessful, the patent is then granted and comes properly into force. It can still be challenged by interested third parties but challenge becomes more difficult and more expensive as time goes on.

Incidentally, the content of all patent applications is rigidly secret up to the date of this laying open of their specification by the British Patent Office. From then on they are regarded as formally published.

Whether or not an inventor employs the services of a patent agent, the basic procedures for patent application will be the same. But whereas on the one hand he will need to take decisions himself, on the other hand the patent agent will advise on the decisions for him.

For the lone wolf a multitude of pitfalls exists and an understanding of the application system is essential. A patent application is

examined by the Patent Office only when it is filed with a complete specification, claims and formal drawings. No working model is ever required by the Patent Office but the complete specification should set out in fairly considerable detail the exact nature of the invention, the purpose behind it, and the way in which it works. The drawings should clearly show anything that is necessary for an understanding of the invention. Thus the complete specification in effect amounts to working plans. The plans need not give non-essential details of shape, colour, size or component values, although often some values are given to aid an understanding of how the invention works. So the first golden rule is to ensure that the specification clearly distinguishes between what is essential and what is optional.

The linguistic difference between the phrases 'may be' and 'is' can be crucial at some time during the life of a patent. For instance, if it is explained that a capacitor *may* have a value of 100 μF, this will have room for argument at some later stage that other values will work equally well. But if a misguided amateur states categorically that the value *must be* 100 μF then he may well find himself with that specific millstone round his neck until the end of the patent's life.

Although it can be amended to overcome the various objections that inevitably arise from the Patent Office examination (each case is referred to an examiner skilled in the particular subject matter of the invention) it is usually quite impossible to add any extra details to a patent specification or broaden out any definitive statements without losing the original application date. To lose this date may well be disastrous for an inventor in a competitive field.

Each complete specification must end with a set of claims. The purpose of the claims is to set out clearly the actual scope of desired monopoly. The complete specification will of necessity contain all kinds of descriptive material which is not new. It may for instance be necessary to describe an entire noise limiting circuit of known form to be able to emphasise clearly one particular by-pass change. Perhaps one extra RC circuit makes all the difference. Clearly the scope of monopoly, in other words the patch which the patent will protect, can only involve the actual small change. Thus the claims must emphasise and centre round this change, whereas the descriptions and drawings will explain the whole background to the system and the problems with old systems of the general type, as well as the exact nature of, and the advantages accruing from, the radical new change.

Unwary inventors often fall into the pitfall of trying to claim too broadly. Thus, if the invention proper is an added RC circuit and an RL circuit will not work, the claim cannot reasonably refer broadly to a resonance circuit. The danger would be that at a later date some angry third party might be able to show that an RL resonance circuit (although implicitly claimed) does not work and that this invalidates the claim. And such broad claiming can also make difficulties for the inventor when the application is examined by the Patent Office. The Patent Office examiner may be able to show that it is known how to use other kinds of resonance circuits in a manner which will anticipate the broad reference a greedy inventor has insisted on putting in. In such a case, the inventor will have to climb down and limit his claim to what in fact his invention is all about—in the hypothetical case discussed, the RC circuit.

Another pitfall is for an inventor to be too restrictive in the claim that he files. I have mentioned above the risk of specifying component values without any inference that they are only given by way of example. A real problem would exist if an unwary inventor wrote a component value into the main claim. To return to the 100 μF example, a claim to an RC circuit with a capacitance value specified as 100 μF would probably be very hard for the Patent Office examiner to object to (because he would probably find it difficult to locate any equally specific prior disclosures) but it could easily prove commercially valueless as a patent claim. Although infringers rigging up the same circuit with a 101 μF capacitor would not fall strictly within the terms of the claim, they would probably still be held by a court to have infringed. But what if they made the value 105 μF or perhaps 110 μF and the circuit still worked just as well? The court might then reasonably argue in favour of the 'infringer'.

Although a complete specification, drawings and claims can be filed 'in the first instance' at the Patent Office and will be examined about six months later, with acceptance of the patent probably following any time after that within the maximum 30 (or 33) month period, it is possible instead to file a provisional specification in the first instance.

A provisional specification is usually rather less specific in its description of the invention and can be accompanied by formal drawings. Provisionals are thus usually relied on where an inventor has cooked up a general idea but is not sure of the details. To go back to the resonant circuit analogy, he might perhaps realise from his experiments that an RC circuit did the trick but have a sneaking suspicion that other circuits might also work equally well. The answer in such a case would be to file a provisional specification explaining just these facts—namely that it is believed that any resonant circuit will provide the required end result but it is preferred to use an RC circuit including a capacitor of value for instance 100 μF.

A provisional specification does not have claims and is not examined by the Patent Office. It lies fallow for 12 (or 15) months in a Patent Office vault and its only purpose is to establish an original priority date for the basic idea. Within the 12 (or 15) months, a complete specification can be filed claiming back to the original date of the provisional. Provided that the complete specification is sensibly and fairly based on the content of the provisional, any patent eventually granted will stand a good chance of legitimately wielding the original date of the provisional. Thus by putting a provisional specification on file when an idea first shows promise, an inventor may well ensure that he stays ahead of competitors. Were he to keep his idea secret for a year while researching it further, and then file a full complete specification and claims, he might well find that in the meantime someone else had overtaken him. Provisionals are also relatively cheap.

Even when a patent application has been accepted or a patent granted, the pitfalls for the innocent inventor at large have not really been left behind. Curious provisions, for instance, exist which by law preclude a patentee from threatening third parties with infringement actions. There are in fact very rigidly defined ways of 'threatening' without falling foul of this law and suffice it to mention here that the problem of threats does exist. There are also ways of reducing the payment of renewal fees by offering the ready availability of licences under the patent and ways of protecting modifications of a basic invention by filing patents of addition on which no renewal fees are payable. For anyone interested in reading this kind of law at source, the relevant act is the Patents Act 1949. There are numerous respected text-books in most libraries, the generally recognised works being those by Blanco White and by Terrell & Shelley.

Electronics engineers baffled not only by this article but by the Patents Act and the textbooks on it will probably by now have concluded that the only real way to protect an invention is through a patent agent. A list of all such agents in this country is published by the Chartered Institue of Patent Agents, Staple Inn Buildings, High Holborn, London WC1 and is available in many libraries—including of course, the NRLSI Library in the Patent Office, Southampton Buildings, Chancery Lane London WC1. (Incidentally all that has gone before applies to the UK only—each country has its own patent system and a British patent is enforceable only in the UK and so on.)

By Roderick Snell

TEST CARDS AND SIGNALS

Part Two

NEXT TO the good quality monitor and off-air signal source discussed last month, the waveform monitor or oscilloscope is the most important measuring instrument in television. Providing it is accurately calibrated in both x and y axes which is to say in terms of time and amplitude, the oscilloscope is capable of checking all the most important parameters of the television signal without further equipment. The IBA Technical Reference Book (ref. 1) is a useful source of standards for the 625 line Pal system One used in the UK.

Pulse timings are as important as system bandwidth and phase response in small installations as much as in broadcasting, particularly where helical scan vtrs are in use. To give examples, the IVC *700* series 25 mm vtrs will not lock to the field sync pulses of Shibaden *SV700* recorders, the Philips *VCR* will not always accept edits made on an IVC *800* electronic edit vtr, and about 50 per cent of domestic tvs and 20 per cent of cctv monitors need modifying before they will work correctly with either the Sony U-Matic or Philips cassette systems, even though both have been designed specifically for domestic equipment. The latter problems result from line timing errors (or 'jitter') in the vtr and this parameter is best measured by locking the oscilloscope to the field sync pulses on playback, setting the timebase to line rate and observing the timing deviation of the line sync pulses. The field disturbances on edits can be observed by locking the scope to the power line and observing the field blanking signal.

Frequency response may be measured with an oscillator, although pulse and bar measurements on off-air signals can avoid the need for this extra equipment (see later). **Fig. 1** shows the broadcast requirements and these are usually met by all the purely electronic parts of the cctv system but it is only the very best cameras and vtrs which have respective resolutions and bandwidths equal to this. Camera resolution is best measured with a test card (preferably an illuminated transparency), and a sine wave oscillator is adequate for frequency response checks (if not for phase measurement), but vtrs require sync pulses, so the frequency response test signal has to be inserted into a tv synchronising waveform.

Sweep generators

For test and evaluation of cctv equipment, most particularly vtrs, the video sweep generator is valuable. It generally covers a range from low frequencies (say below 100k Hz) to 5 or 10M Hz with a sweep rate that can be externally

FIG.1

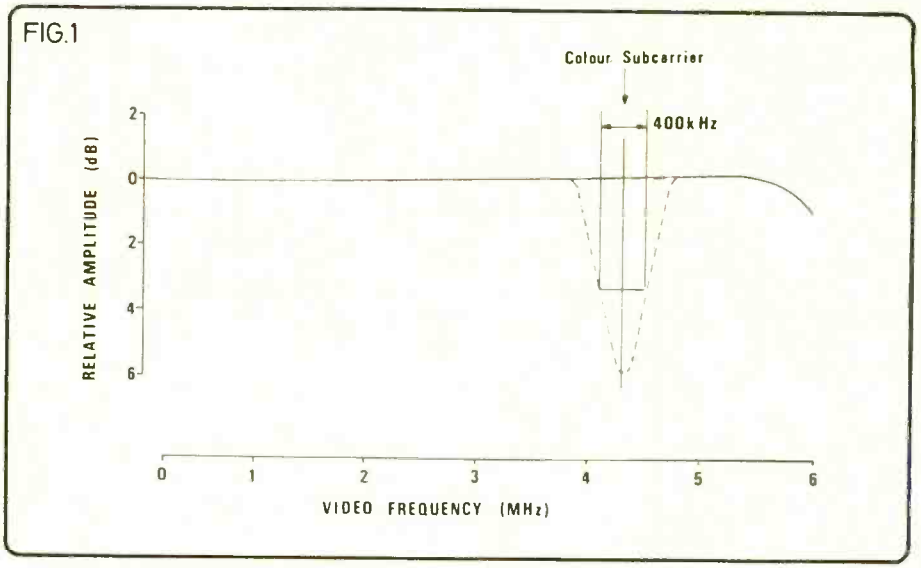


FIG.2

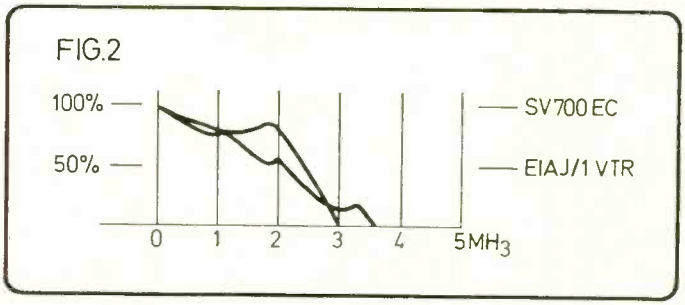
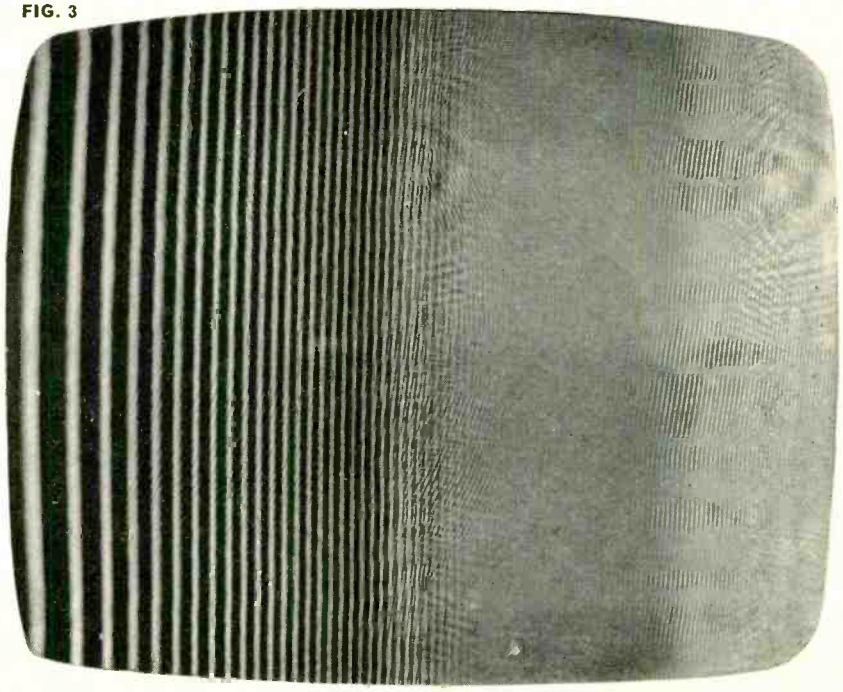


FIG. 3



triggered by tv line or field pulses. Best frequency techniques are generally needed for the wide frequency range, although some of the latest of American function generators from General Radio, Kronhite, Telonic and Exact manage with a single oscillator. The Marconi *TF1099* is an earlier, valved example which uses two vhf oscillators and conventional bfo techniques to generate a sweep which is adjustable between 50k and 20k Hz. The sweep takes 20 ms and another 20 ms is needed for the swept oscillator to reset, so the unit can conveniently be field synchronised to the tv system. Some means of frequency marking is needed for oscilloscopes scope observations of sweep waveforms, and the *TF1099* uses a detector and tuned amplifier whose two tuned circuits give marker signals at 1M Hz intervals.

Link Electronics make a modern example, with a very compact sweep generator that can be included in a 480 mm rack with sync pulse generators and other tv test generators. Specifically designed for tv use, the Link video sweeper is driven from live and field blanking and synchronising signals, producing a video sweep at tv line rate or from 0 to 6M Hz using two transistor oscillators at about 30M Hz, one of which is frequency modulated by a varactor diode. The marker system is very simple, merely using a 0.5 µs interminated delay line to add ripples at 1M Hz intervals to the sweep waveform. This system is inferior to the Marconi, for example, as the markings are difficult to see, but the generator is nevertheless very useful and, at under £200, a 'best buy'.

The rather vague claims for frequency response and resolution made for the lower cost vtrs and vcrs can best be verified with sweep measurements. As an example of confusion caused by lack of a definite specification, the Swedish TRU report on vtrs (ref. 2) criticised the Shibaden *SV700EC* for frequency response. They found it 1.5M Hz or worse on all models tested, which seemed lower than that of any I'd seen. Since these machines generally *resolved* 3.5M Hz, the criticism seemed harsh. Actually viewing pictures from a typical *SV700EC*, they appear better than the frequency range of 1.5M Hz would suggest but on the other hand are not much sharper than the pictures from a good EIAJ/1 vtr which is known to resolve 3M Hz. The answer can be seen from **fig. 2**; the EIAJ/1 vtr has an inferior limiting resolution but its frequency response, or –3 dB point, at 2M Hz, is actually better. As with sound reproduction, the *shape* of the curve is as important as the limits of response and future vtr reports will include a video response curve obtained from a sweep test.

Moire patterning

After time base stability and bandwidth, Moiré patterning is the next most common fault with vtrs and is due to sidebands from both luminance and chrominance carriers beating with each other or with the video signal. In broadcast vtrs with their very high writing speeds, the fm carrier frequencies can be 7M to 9M, or even 9M to 12M Hz, which is so far displaced from the 0 to 5M Hz video band that noise can be –30 dB or more yet

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FIG. 4A

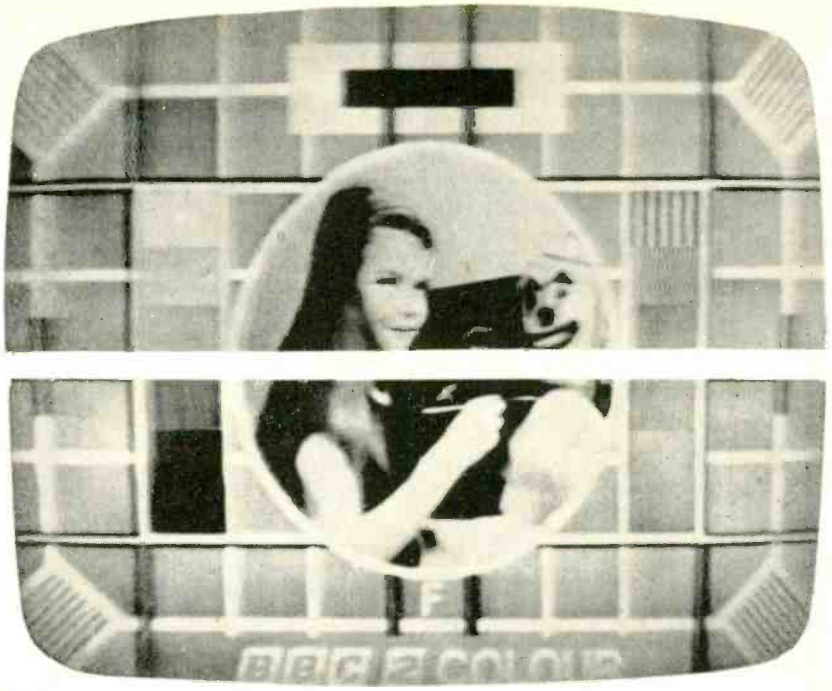


FIG. 4B

FIG.5 2T PULSE AND BAR TEST SIGNAL

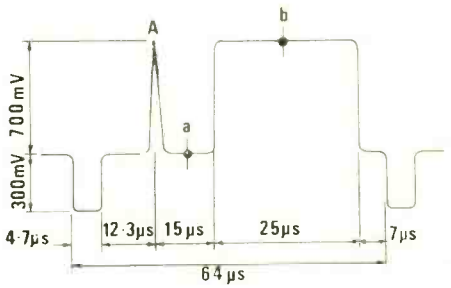
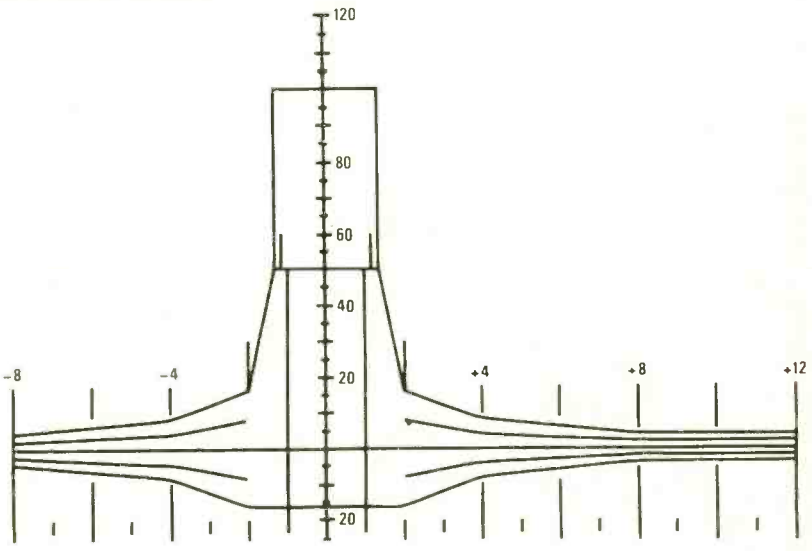


FIG.6 K-RATING GRATICULE



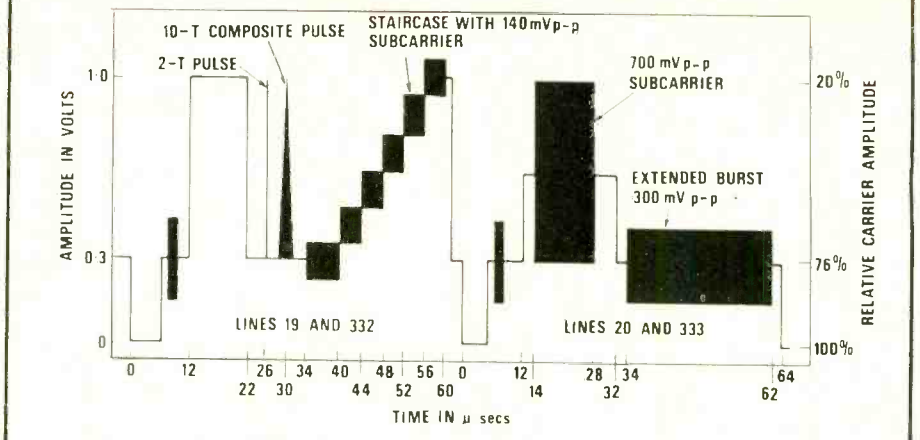
barely visible. On the other hand, in a helical scan vtr the carrier range often overlaps the video spectrum, and Moire interference is more severe. **Fig. 3** shows an extreme case and is an off-screen 0 to 5M Hz video sweep on a low-cost colour vtr. **Fig. 4** shows the performance of this machine on a normal test card. In this particular case, the cure lay in re-aligning the colour processor and resetting the lowpass filter in the luminance demodulator so that the resolution was reduced from 2.8M to 2.5M Hz. **Fig. 4b** shows that the effect was no longer objectionable.

Pulse and bar tests

For broadcasting and for cctv colour, phase response is particularly important and the controlled transient type of signal gives the best visual indication of the frequency and phase errors which will effect the picture quality.

Rectangular, triangular gaussian and $\sin^2$ pulses have been tried and the choice depends on frequency range, spectral distribution and ease of visual detection of errors. The $\sin^2$ pulse is the best compromise, and the 2T pulse and bar waveform has established itself as a common test in broadcasting (**fig. 5**). Transmission errors change the width of the 2T pulse and its height relative to the 10μS bar and, if a special graticule is used on the waveform monitor (**fig. 6**), the results can be formalised to give the well known K-rating. A 2T pulse and bar are included in the vertical interval test signals found in broadcasts from both the BBC and IBA (**fig. 7**), but this is a big subject. For those interested, further reading may be found in refs. 3, 4 and 5.

FIG.7 NATIONAL INSERTION TEST SIGNALS



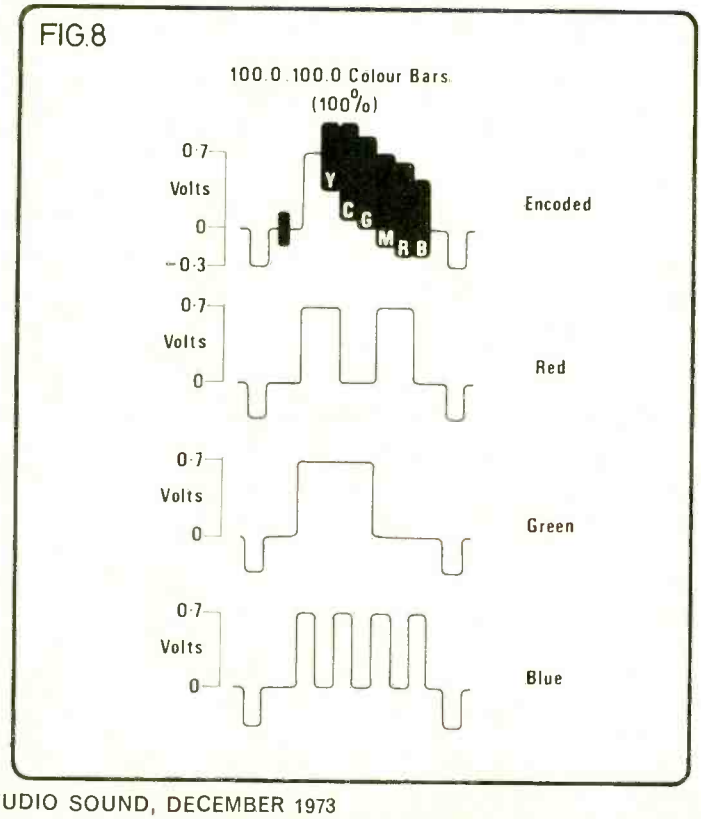
Colour Bars

'Standard' colours are arranged in vertical columns in descending order of brightness so that, if the signal is viewed on a monochrome monitor, it will appear as a grey scale or staircase (**fig. 8**). Colour bars are useful for colour decoder alignment as well as for setting picture monitor chrominance and luminance levels.

The Philips *PM5508* test pattern generator, seen in many labs and small studios, generates five other colour test signals, as well as standard bars: fully saturated red (for colour purity on monitors but also useful for chroma noise on vtrs), and four special types of bar for decoder adjustment. Outputs are available at standard video level (1V into 75Ω) as well as through a modulator tuneable through vhf and uhf channels, enabling direct connection to the tv aerial socket. For most users, the *PM5508* manual is as useful as the generator itself as it includes detailed descriptions of the three methods of analysis: colour plates for off-screen observations, scope traces for colour decoder alignment, and vectoscope photographs for the better-equipped laboratories.

The ultimate test pattern generator is again from Philips, the *PM5544* using digital circuitry and a ferrite memory core to generate an ideal test pattern (**fig. 9**). This pattern has almost everything, including a circle for picture geometry, colour bars and multiburst signals. Texts from external sources such as station identification can be inserted. Engineers used to test cards *C* and *F* (covered last month) will find the *PM5544* straightforward to interpret. others will find the key in **fig. 10** worth study,

FIG.8



Video bandwidth and resolution

Many people seem unsure as to why our broadcast system requires a frequency range of 5M Hz and a horizontal resolution of 400 lines for full performance from 625-line transmissions. At least one reason for this among engineers is that the relationship is empirical and cannot be derived from first principles.

Of the 625 lines, 50 are lost during the vertical interval, leaving 572 for picture information; as the frame rate is 25 per second, the line *frequency* is simply 25 x 625=15,625 per second.

The greatest possible amount of vertical information corresponds to one luminance change per line—say black to white. To resolve an equally fine pattern horizontally, allowing for the 4:3 aspect ratio of the picture, the number of brightness changes per line would be 4/3 x 575=766 lines. There are 15,625 lines per second, each with a duration of 64 μS but, due to the 12 μS blanking period, the 'active' time is 52 μS. To accommodate the 766 luminance *changes* per line, the signal must have a *frequency* of 766÷2 cycles per line, so the video frequency response for this 766-line resolution is 766÷2 cycles per 52 μS, or 383÷52=7.35M Hz.

This resolution would, however, only be needed to resolve a pattern in which each tv line exactly registered on the centre of the horizontal parts of the pattern, which is very

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This is a book:
contents: approximately 100,000 words.
50 illustrations
reading time, 5-6 hours
It can be read by any literate person (2 out of 3 adults). It's probably the greatest invention since the wheel.

This is a video cassette:
contents: approximately 200,000 words, two languages. 90,000 pictures in colour
reading time: 60 minutes
It can be read by a child of 3 or an illiterate peasant. It's probably the greatest invention since the book.

...and this

is a teacher, entertainer and salesman all rolled into one — with a difference. It'll work 24 hours a day (weekends too) needs no paid holidays or Christmas bonuses and if it goes sick it is instantly replaceable. It will never replace people but it is a good understudy.

Action Video now have stocks of U-Matic video cassette recorders adapted so that you can use this exciting medium in the way that you want. Machines are available with options to fit into an existing set-up, while the U-Matic system possesses the flexibility and supporting equipment to form the basis of a new installation.

Blank cassettes cost less than £14 and give a full 60 minutes playing time and may be used time and time again. Recordings can be made from any TV camera, off the air, or from existing film material and can be played back on any monochrome or colour monitor or TV set. We are compiling a pre-recorded library too.

If you feel you could use an addition to your staff Action Video can help you (with some assistance from Sony, National Panasonic & Nivico).

Complete and return the coupon for full details of Action Video's adaptions of the U-Matic video cassette system.

Please send me details of the specially adapted U-Matic video cassette units. I am particularly interested in the following:

- ☐ Play only
- ☐ PAL/SECAM colour
- ☐ Remote Control
- ☐ Play/Record
- ☐ NTSC/PAL/SECAM colour switchable
- ☐ Pre-recorded programmes
- ☐ NTSC colour

Name_____ Position_____

Address_____

ACTION VIDEO LTD 45 Great Marlborough Street, London W1 01-734 7465

ALLISON GAIN-BRAIN

By Angus McKenzie

MANUFACTURER'S SPECIFICATION

Gain Reduction Range: 30 dB

Noise Level (20 Hz to 20k Hz): At least 83 dB below threshold of peak limiting.

Distortion: Total harmonic distortion is less than 0.3% from 40 Hz to 15k Hz.

Attack time (peak section): Less than 1.5 dB overshoot one microsecond after application of 50k Hz tone burst exceeding the threshold of limiting by 15 dB.

Attack time (rms section): 7 ms to 40 ms form 90% of ultimate gain reduction. Dependent on waveform complexity, amount of limiting and position of function control.

Release Time (peak section for transients of less than 50 µs duration): Less than 1 µs.
(for other peak signals): Variable by release control from 50 ms to 5s.

Release Time (rms section): Variable from 250 ms to 5s.

Limiting ratio (peak section): Approximately 50 to 1.

Limiting ratio (rms section): Approximately 40 to 1.

Limiting thresholds: With function control in peak position all thresholds are at —20 dBm with input level control fully clockwise.

Separation between thresholds: Rotating the function control from peak to rms raises peak thresholds by 6 dB, while lowering rms thresholds by 6 dB. This allows a separation of thresholds which is continuously variable from 0 dB (peak position) to 12 dB (rms position).

Frequency response: ±1 dB from 25 Hz to 80k Hz.

Output Level: Up to 18 dBm into 150Ω or higher (+24 dBm may be obtained by using a 150 to 600Ω output transformer).

Multiple Limited Coupling: Connection provided for tandem limiting functions.

Front Panel Controls (Five): Input level, output level, release time, function (peak rms), in/out switch.

Power requirements: Regulated 24V dc to 28V dc negative ground at 70 mA.

Gain Reduction Meter: Seven increment sequential light emitting diode array indicates gain reduction from 2 to 24 dB.

Meter accuracy: ±1 dB (2 dB to 12 dB gain reduction); ±2 dB (18 dB to 24 dB gain reduction).

Meter speed: Virtually instantaneous. Permits accurate reading of short term fast release limiting.

Peak limiting indicator: Light emitting diode indicates when peak limiting is taking place.

Rms limiting indicator: Light emitting diode indicates when rms limiting is taking place.

Structure: Card form with high impact plastic panel, controls and metering 25.4 wide, 177.8 high, 139.7 mm deep.

Price: £153.

Manufacturers: Allison Research Inc, 7120 Sunset Boulevard, Hollywood, California 90046.

Agent: F. W. O. Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts.

THE FIELD trials of this unit should be read in conjunction with Hugh Ford's review in the May 1972 STUDIO SOUND. Whereas Mr Ford made the electrical measurements on a single *Gain Brain*, I tested two coupled for stereo operation. I also checked the performance of a single unit. For all the field trials, a laboratory power supply was used giving 24 Vdc with very low ripple. For most of the tests, the units were inserted through break points in a Calrec mixer.

I must agree with Mr Ford's comment that the input impedance is too low. In my own installation this did not matter since the equipment was driven from modules having very low output impedances. However, a bridging loss of approximately 1.5 dB was noted when some tests were done with equipment having a 600Ω source impedance. This is fairly academic for most applications but could become significant if for any reason several devices were all bridging the same 600Ω line.

On the front panel, the *Gain Brain* has four potentiometer controls and a limiting in/out switch. Light emitting diodes permit the amount of limiting at any moment to be approximately noted. Two additional indicators show whether the limiting function has been mainly caused by peak or rms clipping. All controls were easy to operate, but I must criticise the in/out switch which on one unit failed continually and on the other was intermittent. A third unit was obtained and this alone proved free from switch trouble. Such unreliability after only a few hours use is very worrying and the manufacturers would do well to take up this point. The tests were all made with output loaded effectively by 10kΩ since it was felt that this would be the load most likely to be used in practice.

The limiting threshold control is in the input circuit. I found it simple to set the threshold limiting to the desired level audibly. However, the absence of more than a few threshold markings scaled in dB made it time-consuming to set up at a predetermined precise level. For ease of operation, therefore, it would be better to have a 4 dB per step switched input attenuator in perhaps ten steps. This should be followed by a carbon track potentiometer having the calibration points accurately given when the control is wound fully clockwise. It was rarely necessary to adjust the output control and the output clipping level of +19 dBm was adequate for all normal applications.

When the unit was not limiting, no audible distortion or insertion effects were noted and the noise level was found to be completely inaudible in normal use. The differences between the various stages of limiting from peak to rms were assessed on several types of material and transient distortion became very apparent when peaks (primarily) caused limiting action. Short and sharp clipping cracks were noticed on piano and choral music. On pop type material this distortion was less marked but still audible. The decay time is variable from 50 ms to a nominal 5s, although Mr Ford's measurements showed the latter to be nearer 3.5s.

In operation, the variable decay time was very useful although only comparatively few dB of limiting could be used on most material if a fast decay time was chosen. If more limiting was attempted, pumping became rather objectionable as would be expected theoretically. With a fast decay rime and with the clipping mode on rms, audible distortion was only infrequently noticed and then only when the limiter was driven very hard. With rms limiting and with any position of decay time the limiter behaved extremely well, with a clean recovery and fast attack. This did not seem to allow through any peaks that caused distress on tape recorders running at 38 or 19 cm/s, when reasonable recording levels were in use. For broadcast applications, however, a limiter employing a delay line principle would be more suitable, this limiting the delayed signal just before the peak.

After initial tests on a single unit, two were linked for stereo operation. Both models had their controls in identical positions so that the sound on both channels would be limited equally at any given moment, and with the same decay characteristics. It was very quickly

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■ GAIN BRAIN FIELD TRIAL

realised that severe central image shifting took place immediately after limiting and for the duration of the decay to normal gain. It was then found very time consuming to adjust the internal presets accurately following the method described in the instructions. An approximate lining up was quite insufficient and only after some two hours' work did the limiter give a reasonably stable central image at peaks.

Although it is usual to notice an accentuation of bass frequencies when heavy limiting is in use, large excursions of a loudspeaker cone became alarming when a programme containing very low frequencies at high volume was processed. In some cases there appeared to be an odd audio effect on middle and high frequencies present at the same time as high intensity low frequencies. Upon investigation it was found that very low frequencies were progressively limited less than higher ones as the limiting threshold level was reduced by increasing the input gain. Some further electrical tests were therefore made and it was found that the frequency of an apparent 3 dB bass boost became progressively higher as the input gain was raised. Below this 3 dB point, the bass response continued to rise. Under very heavy limiting conditions an alarming 10 dB boost at 10 Hz was noted, while at 50 Hz over 2 dB boost occurred. Considerable trouble could therefore be caused by pickup of studio rumble at very low frequencies being boosted by equalisers before limiting. In some circumstances such rumble can approach normal peak levels and, with NAB characteristic tape machines having their inherent bass boost on record, severe tape distortion can result. This characteristic appears to be a design fault, possibly due to insufficient low frequencies being allowed to pass through the side chain at high levels. The manufacturers should also attend to this.

Both the peak/rms clipping indication and the degree of limiting display operated most efficiently and the number of leds used for the latter provided an adequate range of display. Although electrical tests had shown a form of instability when a programme level hovered near one of the led thresholds, in practice there did not appear to be any noticeable audible effect, unless the programme was continuous tone.

The unit slid in and out of its case and can be fitted neatly into slots specially provided in a control desk. The current consumption did not appear to be excessive and the controls are well laid out. The *Gain Brain* can be recommended as a most useful general purpose limiter. I am not, however, convinced that the advantage of having peak clipping available can outweigh the disadvantage of the distortion produced when this facility is used. Give a less skilled engineer a knob to twiddle, and he may well use it wrongly...

■ VIDEO

unlikely in practice. It was R. D. Kell who first carried out tests in the USA to establish just how much horizontal resolution was needed to be apparently as good as the vertical resolution (which itself was fixed by the number of active lines in the tv system). This ratio, known as the Kell factor, turns out to be approximately 0.7, so that the horizontal resolution must be 575 x 0.7=402 lines, and the frequency range 7.35 x 0.7=5.145M Hz. Rounding off gives the following relationship:

Frequency range (bandwidth)	Horizontal resolution
2.5M Hz	200 lines
3M	240
4M	320
5M	400

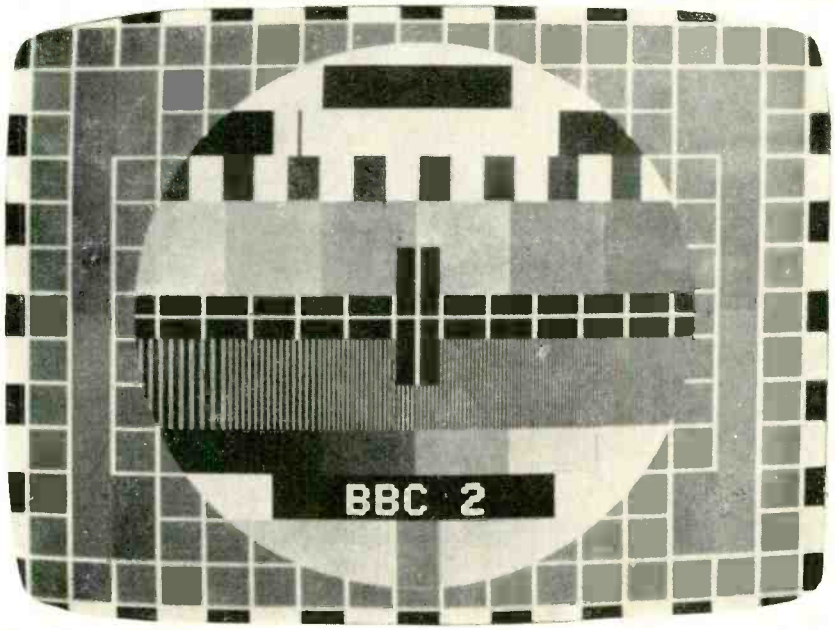
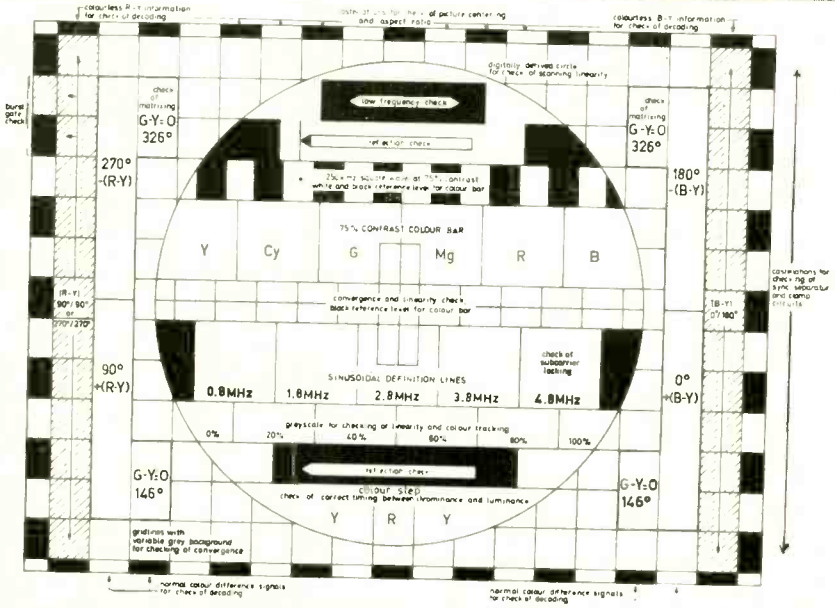


Fig. 9

FIG. 10



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1. *IBA Technical Review*, September 1972, parts One and Two.
2. 'Investigation of video recorders for educational purposes.' Committee for TV and Radio in Education (Sweden).
3. 'Waveform distortions in tv links.' MacDairmid, *PO Engineers Journal* Vol 52.
4. 'Measurement techniques for television broadcasting.' *Journal of the Royal Television Society*. Vol 9 no 12, 1966.
5. *IBA Technical Review*, September 1972, part One.

Acknowledgements

H. Harris of Bournemouth, for help with sources from his technical library.
Pye Unicam for information on Philips test generators.

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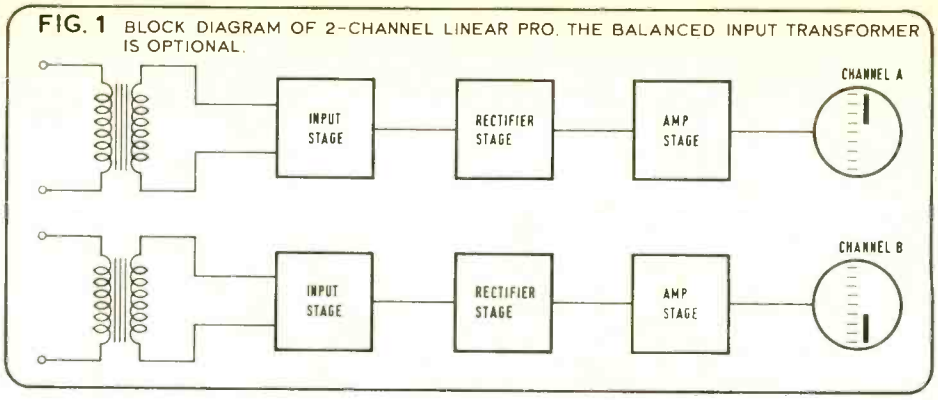

FIG. 1 BLOCK DIAGRAM OF 2-CHANNEL LINEAR PRO. THE BALANCED INPUT TRANSFORMER IS OPTIONAL.

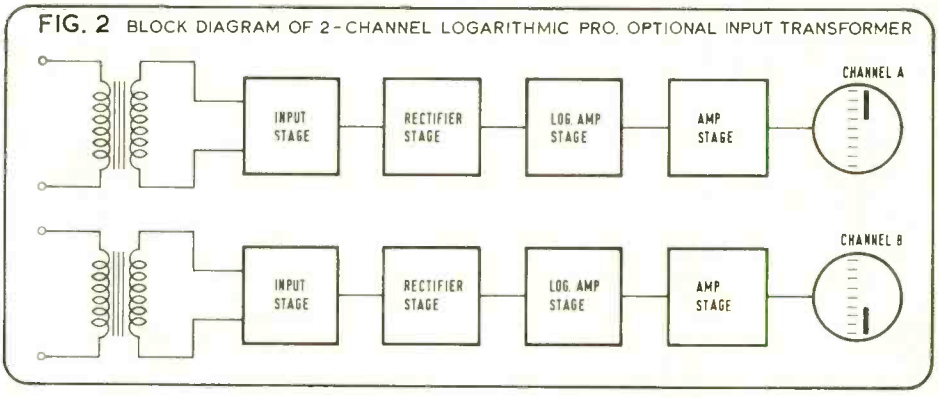

FIG. 2 BLOCK DIAGRAM OF 2-CHANNEL LOGARITHMIC PRO. OPTIONAL INPUT TRANSFORMER

Constructing a peak-reading oscilloscope

By JAMES CRABBE

Although a motionless human eye embraces a wide angle of vision, the angle of usefully high definition is much smaller than most people realise. Hence the danger of relying on off-axis vision when monitoring a wide array of programme level meters. The author describes an unusual method of displaying up to four signal channels on an oscilloscope.

THE MONITORING system to be described in this series of three articles incorporates a new device for the visual display of up to four channels on a single oscilloscope tube. The device was developed for use with signals in the audible 20 Hz to 20 kHz frequency range but, because of the nature of the visual display, it could equally well be adapted for use at higher frequencies, the only restriction then being the hf bandwidth of the amplifiers used.

I have called the monitor a pro or Peak Reading Oscilloscope. This nomenclature has two functions: (a) It describes what the equipment actually does, i.e. it uses an oscilloscope to register signal peaks; (b) It implies a similarity with, even an evolution from, the ppm.

Up to four channels can be monitored on a single screen, and the device, being thus relatively compact, would be eminently suitable for recordings made on location, using mono, or two or four channel 'stereo'. In the studio, monitoring inputs and outputs of large mixing desks and recorders could be made much more compact.

Visual monitoring has always been a bone of contention among recording engineers. As in many areas, it all depends upon what one is used to. The ppm versus VU meter controversy has been dealt with many times in STUDIO SOUND, with the balance heavily on the side of the ppm. Of course it *is* possible to record on tape using VU meters and produce excellent results, as is ably shown by one of Britain's top recording companies. Most, or at least many, engineers prefer the ppm and the reason is not hard to find. In a medium where it is important not to achieve overloading, one must be able to monitor the *peak* level at any point in time. The ppm ably accomplishes this, whereas the VU meter was designed to monitor levels of *loudness*. A simple illustration shows the difference; when connected to a sine-wave of voltage sufficient to give reference deflection under steady-state conditions, a VU meter will read 80 per cent of that deflection after 25 ms, a ppm will read 80 per cent of that deflection after 4 ms. Further details of the specifications of both instruments have been dealt with before in this journal and so will not be mentioned here.

Excellent as the ppm undoubtedly is, it does suffer a number of disadvantages when compared with an 'ideal' system. It is a mechanical device with a sensitive movement using many precision engineered parts. It is therefore expensive, especially when many meters are used in monitoring multitrack recordings. Most four, eight, 16 and 24 channel mixing desks and tape recorders have at least that many meters associated with them. Usually they are of the VU type (presumably that many ppms would make the cost prohibitive) and one may be forgiven for thinking they are just there for decoration. On recording sessions lasting several hours, the balance engineer must be subjected to considerable eye strain when trying to concentrate on so many meters over a large lateral distance. Muscles in the eyes and neck are constantly in a state of tension and movement, resulting in physical and also mental strain. This strain is probably increased when also monitoring over loudspeakers at levels near the threshold of pain.

With the pro, four channels can be accurately read on a tube of about eight to 13 cm diameter. This would enable 24 channels to be incorpora-

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ted into a length of about 60 cm. This distance would be decreased if the tubes were placed vertically as well as horizontally. The operator would then suffer less eye strain as (a) the physical distance covered would be less so the muscles of the eyes and neck would not have as much work to do; (b) the white beam of light on the green screen should be more relaxing over a greater length of time than observing a meter needle. Also, the intensity of the light beam can be varied to suit the user and the ambient light conditions.

These advantages also apply to light emitting diode (led) displays (five), but as yet these contain complex digital coding electronics, with consequent high cost per channel. Hopefully, in the future this type of display will come into more prominence.

And now to the design, which is based more or less on conventional ppm circuitry. The device uses discrete transistors but no doubt it could easily be adapted to the use of integrated circuits, for example as used in the ppm designed by Hugh Walker (March). One possible disadvantage of the present design is that transformers are used, but full details of these are given in the text. **Figs 1** and **2** show block diagrams of two channel linear and logarithmic pro circuits respectively. Both designs incorporate high impedance input stages, rectifier stages, and output amplifier stages.

In an experimental system, or indeed if the pro is used in situations which do not warrant the use of a linear scale display, it will probably be found that the less complex linear amplifier will suffice. However, for the highest accuracy in registering wide dynamic ranges the logarithmic amplifier is the preferred choice. This will give a trace that is easier to read, although harder to set up initially.

The circuit diagram of the input module is shown in **fig. 2a**. **Fig. 3b** illustrates the rectifier stage and linear amplifier, while **fig. 4** shows the logarithmic amplifier.

The signal is applied, possibly via an input transformer, to the high impedance input module. A Gardners extra wide band type (or its equivalent) is best used here. The input consists of a Darlington pair arranged for voltage gain. A preset resistor enables the base bias at the collectors to be adjusted to just over half the supply voltage. An emitter follower stage then provides a low impedance output. The *120C* series resistor prevents excessive currents through the transistor on switching transients. The signal then goes to the rectifier and linear or logarithmic amplifier modules. Dealing with the former first; one is required for every two channels. The transformers must be broadband with a centre-tapped bifilar wound secondary. The turns ratio is approximately 1:4+4, with a primary inductance of 600 mH, a primary resistance of 40Ω and a secondary resistance of 400+400Ω. I have used a microphone transformer of similar specification with success; the experimenter has ample scope for trial here, the important thing to remember is that too low an inductance will cause an impairment of the low frequency response. The output from the first channel is rectified into positive-going pulses and that from the second channel into negative-going pulses. Both are mixed at the input of an emitter follower buffer stage which provides a low impedance output. Two logarithmic amplifiers (**fig. 4**) are required per channel, the specification of the transformers being the same as for the linear amplifier. Again a Darlington pair is used which presents a very high input impedance even at very low currents. Silicon diodes must be used throughout, as in the linear amplifier. The *OA202* rectifier diodes marked with an asterisk in the logarithmic amplifier must be reversed in one channel relative to the other. This gives one channel of positive-going pulses, the other of negative-going pulses. Both channels are combined at the output, which can be fed either to an emitter follower stage as used in the linear amplifier or straight to the input amplifier stage of the oscilloscope.

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FIG. 4 LOGARITHMIC AMPLIFIER FOR 1 CHANNEL, WHICH FOLLOWS THE INPUT MODULE. DIODES OA202* SHOULD BE REVERSED FOR CHANNEL 2 AMPLIFIER.

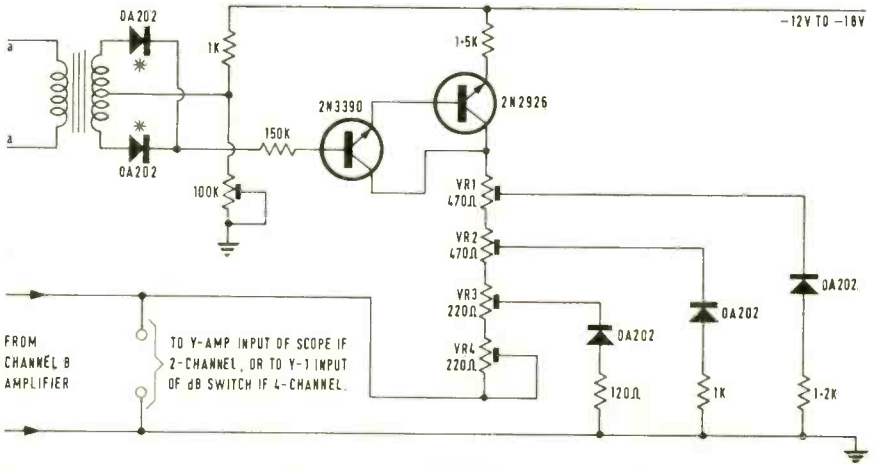
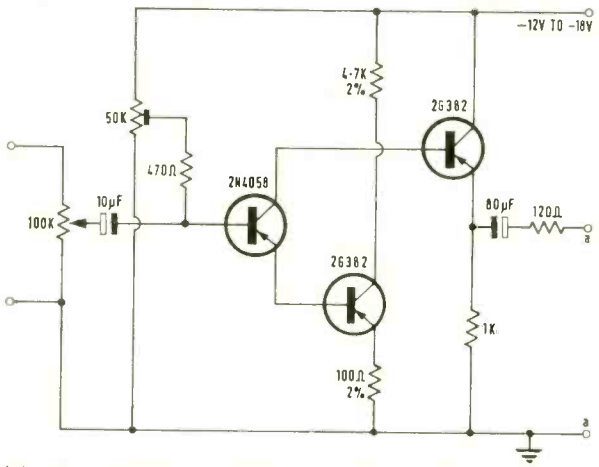
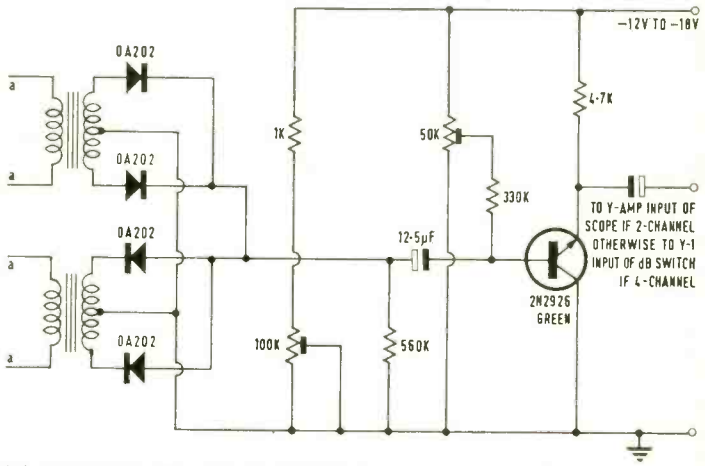


FIG. 3



(a) INPUT MODULE FOR PRO. IF AN INPUT TRANSFORMER IS REQUIRED A GARDNERS EXTRA-WIDE BAND TYPE COULD BE USED AT THE INPUT.



(b) RECTIFIER AND LINEAR OUTPUT MODULE OF THE PRO.

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Mid 1 – Peak & Trough	·35, ·7, 1·4, 2·8, 5·6 and 11·2 KHz
Mid 2 – Peak & Trough	·5, 1, 2, 4, 8 and 16 KHz
Bass – Shelving	35, 60, 100, 170, 250 and 400 Hz

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MONITOR UNIT

This is a dual unit and comprises routeing to Loud Speaker Sends, Pan, 3 Aux. Sends with PRE – OFF – POST switching, Monitor level, Mon. ON/OFF and a solo switch with a choice of momentary or hold action.

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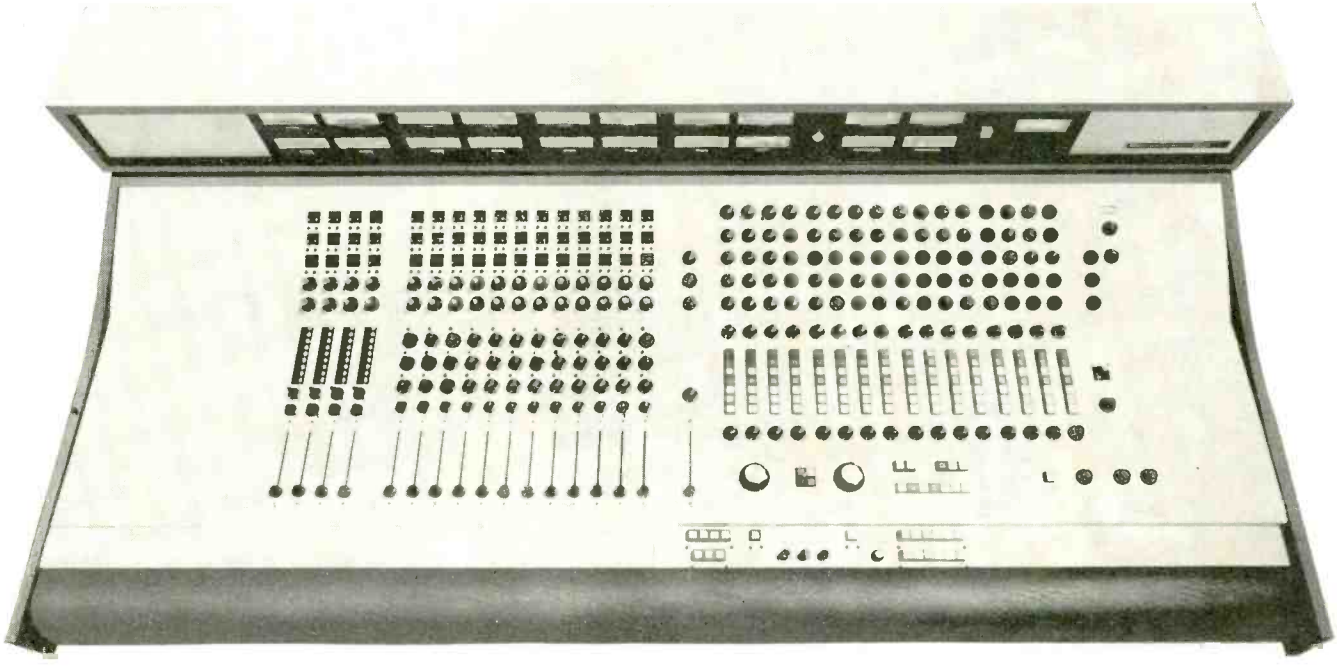

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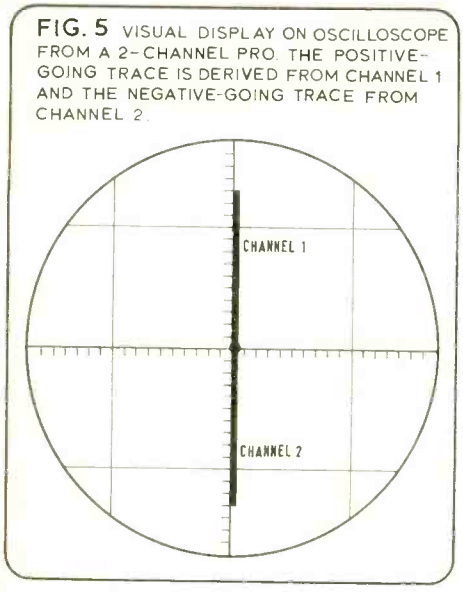


FIG. 5 VISUAL DISPLAY ON OSCILLOSCOPE FROM A 2-CHANNEL PRO. THE POSITIVE-GOING TRACE IS DERIVED FROM CHANNEL 1 AND THE NEGATIVE-GOING TRACE FROM CHANNEL 2.

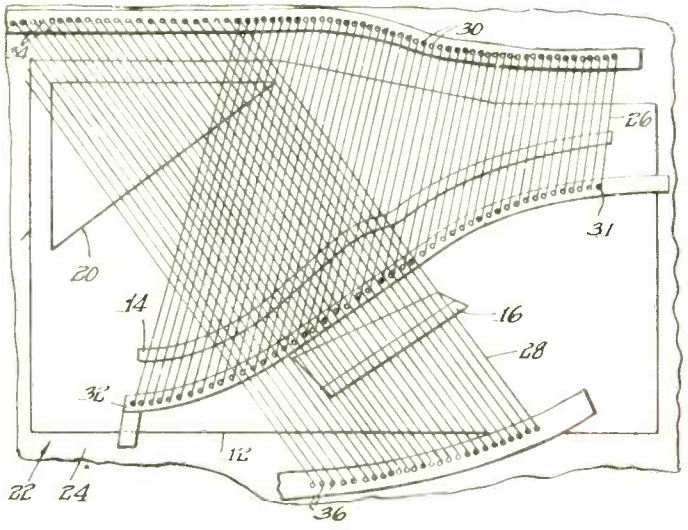
Whether a linear or log amplifier is used, both are fed into an oscilloscope input amplifier. For initial trials, the amplifier outputs can be fed into a 'service' scope, providing that it has a sufficiently high input sensitivity. Connecting an audio source to the inputs of the first amplifier modules will produce a trace similar to that shown in **fig. 5.** The amplitude of the positive and negative traces can be varied by altering the volume controls for the individual channels. If channel One gives the trace from zero to positive (i.e. upward) and channel Two gives the trace from zero to negative (i.e. downward) then increasing channel output over that of channel Two will produce a longer trace in the positive direction than in the negative.

If the initial trials show any untoward symptoms, faulty diodes could well be the cause. However, all this assumes that the constructor has an oscilloscope and various power supplies available; this may not be the case.

If not, then do not worry. The pro was originally designed as part of an integrated systems monitor, a function to which it lends itself admirably. For the busy recording engineer, especially one who does a lot of location work, it is very useful to have a complete piece of equipment for accurate monitoring, rather than relying on one or more series of meters which might not be conveniently placed. I have found that the fewer pieces of equipment around on a tight session, the smoother everything flows! That being the case, I designed the pro as part of a complete audio visual monitoring system, the whole providing loudspeaker outputs and talkback facilities, which may not be available on small transportable mixing equipment. As very few of the facilities normally found in an oscilloscope are required in this particular application, a special monitoring 'scope was designed specifically with this use in mind. For monitoring four channels with a single tube, a double-beam 'scope is required. Again, as many double-beam 'scopes are expensive and provide facilities not required in this application, a simple double-beam switch enables two traces, i.e. four channels to be monitored simultaneously.

Part Two gives details of the power supplies and oscilloscope monitoring equipment, to ether with constructional details.

PATENTS



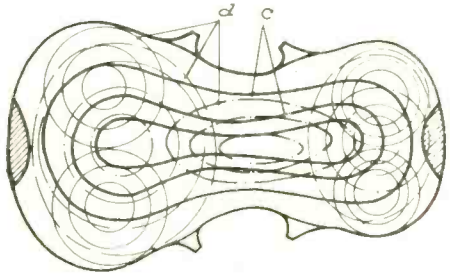
via individual volume controls *25*, *30* and *31* to a mix point *27*. The composite delay signal is now fed to rear left and right speakers *SP3* and *SP4* and as feedback to the loudspeaker *19*. Thus the pipe loudspeaker *19* is being supplied not only with the difference signal (l—r) but also with the composite delayed signal. Thus what comes out of the rear speakers *SP3* and *SP4* contains an infinite range of delays over and above the basic delays introduced by the pipe. Because the level of each separate delay channel is individually controllable, the system can be set up to personal preference. **A.H.**

Modified violin

A ROUMANIAN state organisation with the formidable name of Complexul Pentru Prelucrarea Lemnului Reghin in BP 1,324,866 patent a new form of musical instrument. The intention is to allow the first and second violins of a string quartet to sound slightly different and record producers with an interest in obtaining new sounds could perhaps be interested.

The instrument looks like a violin but the belly and back have a map of grooves on their inner surfaces as in **fig 4**. In addition to these various grooves, two bars are fastened to the inner surface of the instrument belly. One bar is oblique to the longitudinal axis of the belly and the other is parallel to its transverse axis of symmetry. The bars have portions chopped out along their length.

The claim is that the grooves and chopped up resonant bars together combine to produce a timbre somewhere between that of violin and a viola. **A.H.**



Piano tone balancer

THE WURLITZER Company of Chicago in BP 1,324,962 are hopeful of providing the wherewithal to make good piano soundboards from laminated wood rather than from solid timber. So far laminated soundboards have had poor tone, they claim, largely due to the difficulty of tapering laminated wood accurately and reliably. The Wurlitzer soundboard has ribs positioned on its rear side to provide rigidity (*Isn't a soundboard meant to be flexible?* **Ed**) and treble and bass bridges for the strings on the side. The soundboard itself is made of three-ply mahogany wood and is tapered. Usually this tapering would produce unpredictable sound quality but Wurlitzer glue a tone balancing element on the strung side of the board. This tone balancer is simply a triangular piece of wood with its apex in the board corner (*20*. **fig. 3**) and its hypotenuse facing the main resonant area of the board. In practice the tone balancer prevents any tendency for vibrations to locate at the board corner and is supposed to redirect standing waves back towards the board centre. In a modified tone balancer, semi-cylindrical scallops are scooped out of the hypotenuse; this apparently further helps to redirect the vibrations of the board back towards its centre. **A.H.**

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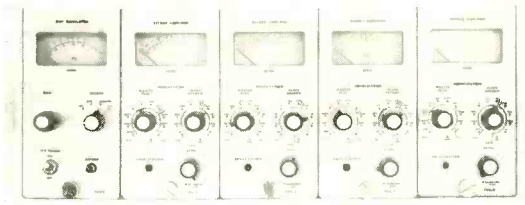

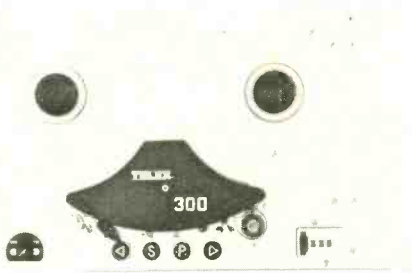

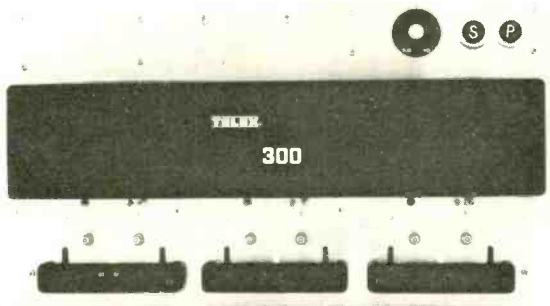

The Telex series 300 is more than just another tape duplicating system. It is a concept based on modules which complement each other and provide total flexibility for tape duplicating. It solves the problems of interfacing between open reels and cassettes. It is a system designed for future expansion. Engineered to make tapes of true, professional quality. And it's priced within your budget. The Telex system consists of basic units.

Solid state modular electronics containing amplifiers, meters and controls. This unit works with any combination of ten cassette or reel slaves.
Cassette master play transport.
Open-reel master play transport.
Cassette slave record transport. Records three cassettes simultaneously.
Open-reel slave record transport.

The units are totally compatible. Intermix cassette and open-reel master or slave transports to suit your duplicating requirements; cassette to cassette, reel to cassette, reel to reel, or even cassette to reel. All units fit into table top consoles of uniform size so when your requirements change, you just add more units. It's that simple. Telex series 300 is heavy duty equipment with hysteresis synchronous motor tape drives, momentary push button controls and time delay circuits for smooth positive tape handling. Selected premium grade duplicator heads provide long life and excellent frequency response. And fail safe, automatic features enable non-technical personnel to operate the system efficiently. Telex modules make a totally flexible and complete duplicating system. It's the sensible approach, designed to meet your needs today, next month and in the years to come. Prices from £1513.00.

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Tel. 01 749 2201

How quiet is a mixer?

By TED FLETCHER*

The theoretical noise generated within a 300Ω resistor should be —131 dBm between 400 and 10k Hz. Defying the laws of nature, a microphone amplifier was produced that achieved —131 dBm from 35 to 16k Hz. Shelved for production reasons, it became known as Ted's Wonder Perpetual Motion Machine . . .

*Alice (Stancoil) Ltd

THERE ARE a host of factors influencing a prospective mixer buyer coming under the same heading and this article may shed a little light on one of these factors, namely—how quiet is a mixer?

Noise may be divided into three sections: Thermal noise; spurious noise picked up by an amplifier from an external source; and other self-generated noise.

1. Thermal noise in its purest form is generated within a resistive conductor and is pure white noise caused by particle movement.
2. Spurious noise usually takes the form of hum from mains electrostatic or magnetic coupling but may be radio interference or mains borne clicks and bangs.
3. Other self generated noise can arise from leaky capacitors, noisy resistors and random particle movement within transistors.

All of these forms of noise are present to some extent in all mixers—the art of the designer and systems analyst is to reduce 2 and 3 to a level substantially below 1. In this way a system can approach theoretical perfection. Before considering actual methods of noise measurement it may be useful to look briefly at a related subject: output levels. If a mixer is fitted with peak indication meters, it is immediately clear what the output actually is. A reading of 5 on a ppm indicates an rms output of +4 dBm or a transient peak of about 2V (see later about short duration transients). With a known output level at all times, it is easy to allow for an overload margin of say 14 dB throughout a recording chain and know for certain that clipping level will not be exceeded. For equipment fitted with VU meters the situation is totally different. The VU meter, developed in the United States in the 1930s, is intended to be an indication of loudness and, as such, is a mean level. It must be clearly understood that a VU meter bears very little relation to peaks and is completely at variance with the physics of a mixer. As an artistic device, its merits are obvious but this article is not the place for this debate. Because of the mode of operation of a VU, considerable mis-reading is experienced with music and dialogue signals, 12 dB being not at all unusual. It is, therefore, necessary for any equipment with VU readout to possess a considerable overload margin.

The connection between the above and the study of noise is that, in the final analysis, all electronic amplifying equipment fitted with VU meters must possess a higher noise figure in absolute terms because of the overload requirements.

The nature of noise

It is a well known fact that the human ear has a frequency response that is far from flat. This is particularly noticeable in the low level regions where the threshold of hearing follows a mountainous curve, peaking at 5k to 6k Hz and falling off at different rates above and below. Noise from a mixer is nearly completely white—a uniformly distributed random selection of peaks. The easiest way to measure noise is with extended flat frequency response and for purposes of comparison this is a valid method but it tells only part of the story. Of more interest to a studio customer is the audible noise and this can best be measured using a 'weighting' network which makes the measuring meter behave like a human ear by shaping its frequency response. By defining of weighting curves and measuring meter characteristics, meaningful measurements can be made and it is possible to judge how 'good' a mixer really is.

Methods of measurement

When considering noise measurement, it is easiest to assume that all noise originates in the early stages of a mixer. This assumption is valid because most of the gain is concentrated at the microphone amplifier stage and thus later self generated noise is masked by the amplified background from earlier stages.

In order of complexity, starting with simple measurement, the first method must be unweighted measurement with VU indication. Instruments required: signal generator, VU meter, calibrated variable gain amplifier suitable for VU drive, accurate load resistors.

Method

1. Feed a low level 1k Hz signal into the microphone input of the mixer.
2. Measure signal generator output while connected to mixer and adjust to a noted level of about −70 dBm with variable gain amplifier and VU combination.
3. Adjust mixer output level to a convenient figure, maintaining controls near normal operating positions; measure output and note.
4. Remove input and replace with resistor of value equal to nominal microphone impedance.
5. Measure noise output level and note.
6. Calculate gain of mixer from 2 and 3 and add value of residual noise in 5. This gives the noise present measured across the fixed input resistor.
7. Check that noise level drops when microphone gain is reduced.

Typical results

1. and 2. −70 dBm fed in at 1k Hz.
3. Equalisers out. Channel fader at −10 dB, group fader at −10 dB, output level adjusted to 0 dBm.
4. 200 Ω fixed resistor placed as input load.
5. Output noise level measured at −51 dBm.
6. Mixer gain 70 dB. Noise −51 dBm, therefore input noise across 200 Ω is −121 dBm. This figure is typical of a good quality mixer with unrestricted response say 5 Hz to 60 KHz.

The above method is useful for quick comparisons of performance but is of little use for diagnostics.

Second method

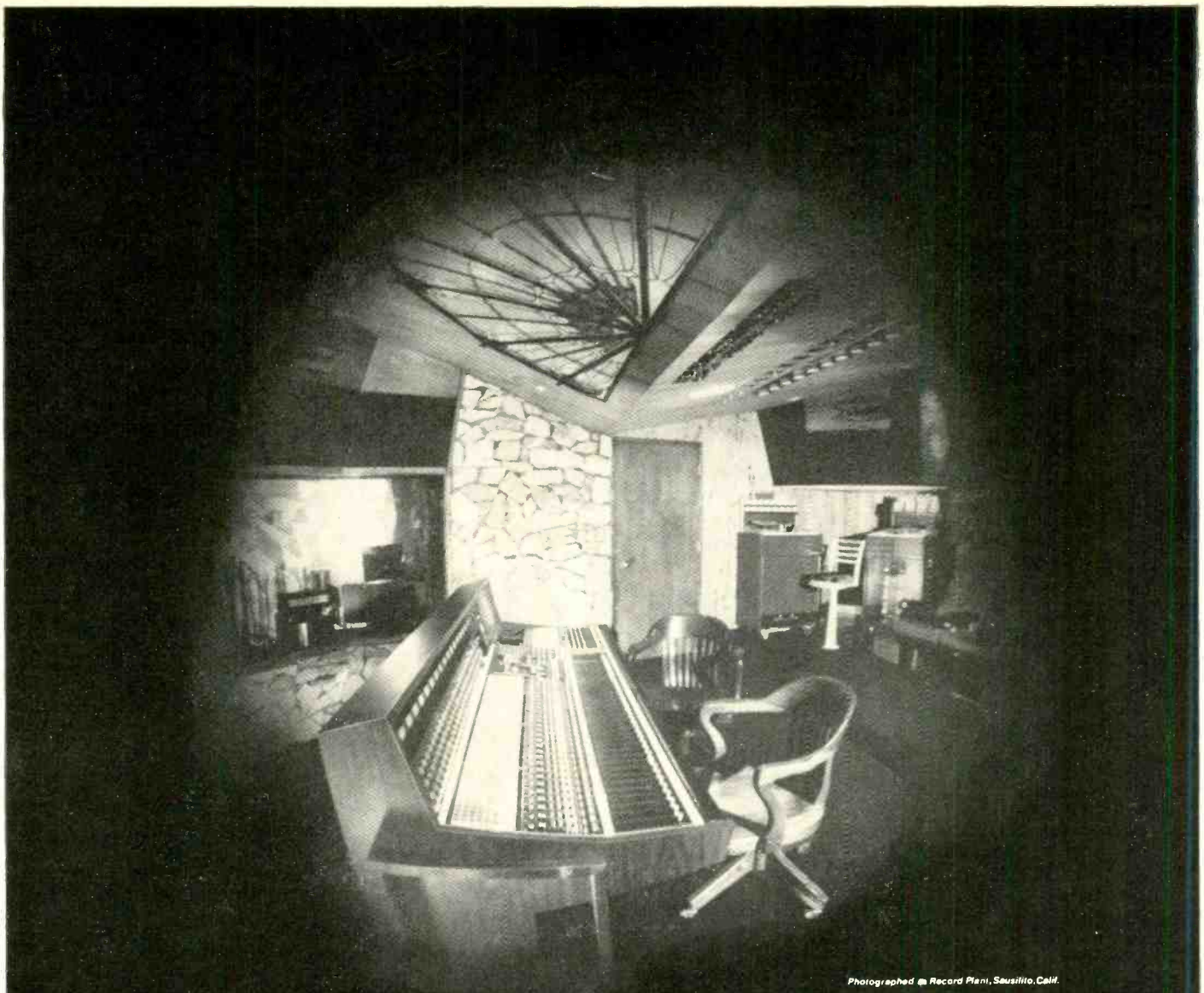
Rms noise measurement with limited bandwidth. Instruments required. As above plus calibrated true rms meter, unity gain, high and low pass filters (at least 12 dB/octave roll off at 20 and 20k Hz.) Oscilloscope with wide bandwidth.

1. Set up mixer as before, carefully check frequency response and set flat.
2. Insert filter between output and rms meter; recheck response.
3. Carry out tests and calculations as before.
4. Connect oscilloscope to output of rms meter and inspect trace to make sure that noise character is predominantly smooth and contains few high level spikes.

Typical results

Mixer gain 70 dB. Noise measured across 200 Ω resistor −53.8 dBm. Equivalent input

72 ▶



Photographed @ Record Plant, Sausilito, Calif.

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noise −123.8 dBm. This may now be quoted as 123.8 dB below 200Ω input, rms 20 Hz to 20 KHz.

We are now approaching the realms of accurate definition and absolute comparisons are possible. The theoretical minimum noise generated in a 200 ohm resistor at normal temperatures and with the given bandwidth is about −128 dBm. Our figure of 123.8 gives us an overall noise factor of just over 4 dB. (Noise factor here is taken to be the ratio of total generated noise to theoretical thermal noise within the defined bandwidth expressed in dB.)

Method 3

This (IBA standard method of measurement [Code of practice July 1972, Section 2]) although intended for complete transmission chains, is applicable here and is included because some valid points are raised. Instruments required: signal generator, peak programme meter to BS *4297*, calibrated amplifier, audio weighting network to CCIR *468* (see fig. 1). Input load resistor.

1. Inject 1k Hz sine wave at −70 dBm into microphone input and adjust mixer gain so that with controls operated in the normal manner 0 dBm is achieved at output.
2. Weighting network should now be interposed between mixer output and measuring instruments.
3. Terminate input and measure output noise.
   Requirement for operational acceptance: −40 dBm.

At this point I can visualise many readers convulsed with laughter at a seemingly ludicrous noise figure . . . but beware. Read through carefully and examine the weighting network which has a lift of 12 dB between 4 and 6 KHz. The method is designed, not to test equipment to its limits, but to guarantee that programmes passing through the system do not produce objectionable noise to the listener. It is a matter of coincidence that the figures demanded are approaching theoretical minimum.

To my mind, the IBA procedure falls down in an important respect. Although references are made in the Code of Practice to CCIR reports, there is no direct reference in the text to noise levels measured against a specific termination resistor. Even the term 'dBm' is vague in that, although obviously intended as a voltage reference, a power level would correct the above anomaly.

An interesting point arises from this method of measurement in the use of a ppm to measure noise. The ppm is by definition a peak reading instrument and, as such, gives clear indication of unwanted spikes which, while not showing on an rms meter, can be disturbing to the ear. To be a little more precise, the ppm is not an exact peak indicator but does interpolate and rejects signals below a certain duration. This function is the integration time of the meter and (in our own circuits) is independent of physical meter ballistics. If a ppm were produced with zero integration time, the needle would respond faithfully to the precise value of any peak transient present in the measured system, no matter how short. Thus an inaudible blip of high level would throw the needle on to the end stop and make the meter completely useless for meaningful readings. The answer to this problem is a finite integration time such that, if an inaudible spike is present, the indication will be minimal but, as soon as the length of the transient is appreciable, a real reading is shown. This value has been investigated empirically and a value of 10 mS adopted as the most suitable for general application.

Methods of noise measurement adopted by the BBC get the best of both worlds. Two methods are specified: The first employs rms measurement and excludes the effects of hum and If transients. The second makes use of a peak reading meter and measures total noise content.

Using rms measurement, the corporation require voltages measured at the output of a system not to exceed 5 dB greater than a voltage due to the thermal noise in a source resistor of 300Ω over a bandwidth of 400 Hz to 10k Hz, this criterion being taken as −131 dBm at normal temperatures.

Using peak measurement, the requirement is a noise level of −46 dBm for a system gain of 80 dB, bandwidth flat to 10k Hz and source resistor of 300Ω. The test ppm is allowed to peak to ppm 6 (this being a method of accurately defining the test instrument integration time). The two methods together provide full information on the level and character of self-generated noise and a clearly specified standard against which measurements may be made without undue difficulty.

So far, we have considered various methods of measurement and illustrated some of the problems that the subject presents. From these considerations and others (for example Australian Broadcasting Commission Code of Practice and DIN *45405*) and from experiments carried out on known equipment, it is clear that there is no magic answer to this measurement problem. Figures which mean anything at all must be a combination of readings with clearly defined limits. The readings must include rms and peak measurements over a wide bandwidth to establish the technical excellence of the equipment, and peak readings using weighting networks to establish annoyance value of the noise present. Up to now I have refrained from mentioning one all important supplementary test: listening. Putting the output of a mixer under test through a high gain amplifier and listening on a good quality loudspeaker must be an important part of evaluation. It is purely a subjective test and therefore has no place in a discussion where limits are defined, but it is a most convincing and informative tool to an engineer with a little common sense.

Erroneous measurement

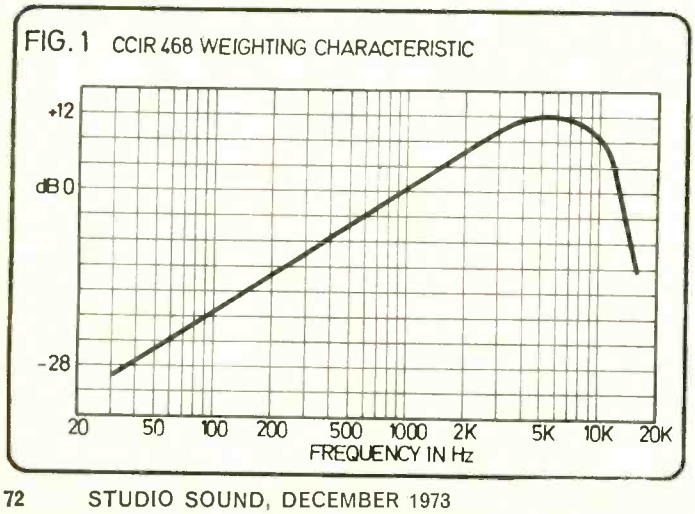
Finally, an example of erroneous measurement. Towards the end of 1968 we designed and developed a microphone amplifier making use of a front end without resistors and an fet as the primary amplifier—the theory being that, with high gain available from the fet and no resistive paths to add noise via biasing components, it should be possible to reduce the noise producing elements to the input load and the fet itself.

The results were startling and, using an rms method, we achieved a figure of 131 dB below the terminated 300Ω input at a bandwidth of 35 to 16k Hz. Referring back to a pronouncement via the BBC, the theoretical noise generated within a 300Ω resistor should be −131 dBm at a bandwidth of 400 Hz to 10 kHz so that apparently we had been defying Messrs Boltzmann, Planck and company. The device was shelved for production reasons and became a standing joke as Ted's Wonder Perpetual Motion Machine.

Recently, in an idle moment, I put the unit on the bench and decided to apply all the techniques possible to it, to the limits of our test equipment. The anomaly became apparent as soon as I applied a low integration time (1 ms) ppm to the output. The needle shot up to an inordinately high figure showing peaks outside the white noise band and further examination of the noise on a wide band oscilloscope confirmed the result. The amplifier remains somewhat mysterious in its noise energy distribution but clearly illustrates how we can be misled.

Dipping briefly into the subject of noise and its evaluation is a fascinating exercise. On one hand considering it from a purely technical standpoint and on the other, subjectively, only reinforces the argument that the two considerations are mutually exclusive. The designer and test engineer can only try to satisfy both criteria and be ever wary of falling between the two stools.

FIG. 1 CCIR 468 WEIGHTING CHARACTERISTIC



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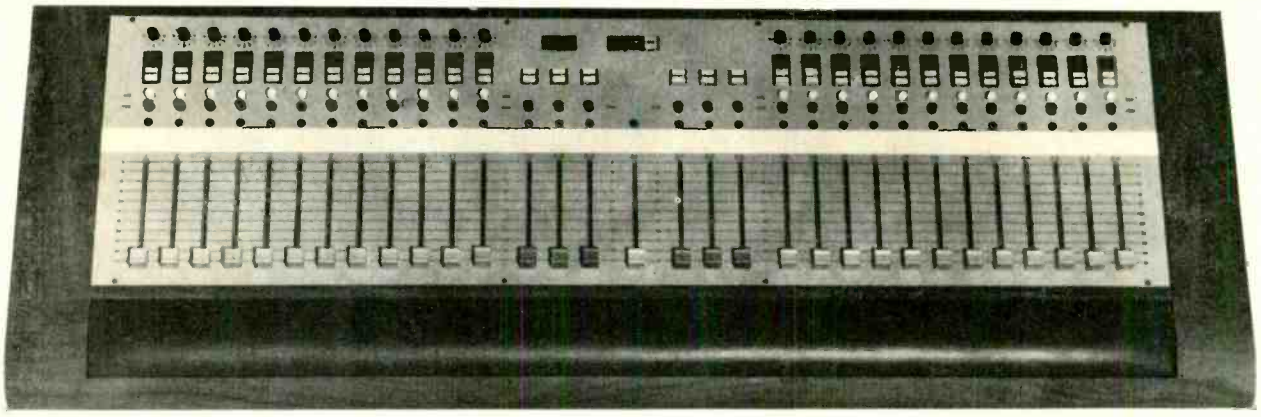
Mixing Consoles



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MCI JH-416

The *MCI JH-416 master recording console* stands alone in it's ability to perform both the normal and the complex-unusual mixing and signal routing functions with a minimum of programming by the operator. It's operation is simple and straight forward allowing even the most inexperienced mixers or producers to turn their attention to the real creative issues of recording and not be burdened with unnecessary complexities in equipment operation.

This simplicity of operation *has not* been at the expense of flexibility and the ability to easily set up quite complex recording or mixing situations. Exactly the reverse is true.

The prime philosophy of the *JH-416 console* that has been adhered to throughout the design and execution was, has been, and always will be that the normal every day functions of no compromise multi-track recording be accomplished with the absolute minimum of effort and confusion factor. And that as you progress to more exotic mixing and recording practices these techniques become a simple extension of basic operation with the console *never* becoming *the limiting factor.*

quad/eight electronics

Feldon Audio Limited
Distributors of fine electro-acoustic equipment for the broadcasting and recording industry.

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Two totally independent consoles in one housing.
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Quick one button remix and playback capability.
Functional design.
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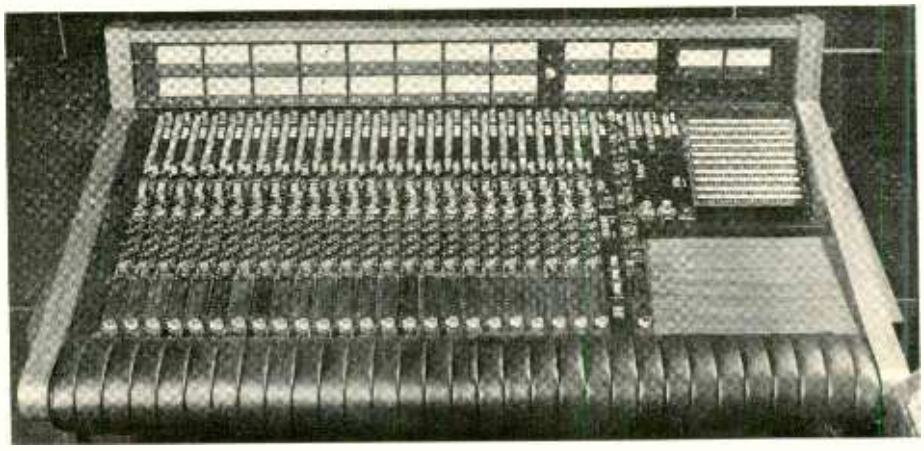

MCI JH-416

The *MCI JH-416 console* is in reality two totally separate consoles integrated into one housing for operational efficiency. The quad mixdown busses, outputs, master fader, echo send, quad panners, cue sends, etc., are entirely independent, and are not used in the process of recording original tracks. There is an entirely separate group of combining busses, output amps, sub masters, etc., which are used to route and mix microphone or other input signals to the multi-track machine.

What this means is that the *MCI JH-416 console* always has its quad mixdown circuits available intact to be used as a monitor mix console while recording and tracking. We believe that this is a far superior method of constructing high versatility consoles when you consider the alternative. That being to build into a console a separate monitor mix section which is not used for any true signal processing functions, lacking the versatility, and usually falling short of the traditional technical performance specifications you expect in the normal mixing circuits.

We believe that this ability to have the full facility of the regular quad, 2T, and mono mix-down circuits available so that you can accurately synthesize what a legitimate mix will sound like as you record, while musicians are still in the studio, and creative judgments can be made, is critical. In some consoles the subtle variations in combining characteristics and technical performance specifications in a monitor mix section when compared with the normal mixing circuits make all the difference in the world in what you heard when recording and what you hear when mixing down.

This is only one of the many features which makes the *MCI JH-416* possibly the most popular and widely accepted mixing console ever offered to the industry.

For further information contact Bill Dyer

MCI

Feldon Audio Limited
126 Great Portland Street
London W1N 5PH

Telephone 01-580 4314
Telex 28668

Survey: audio mixers

ALICE

Manufacturers: Alice (Stancoil) Ltd, 38 Alexandra Road, Windsor, Berkshire.
Phone: 95 51056.
Contact: Ted Fletcher.

AM series

Modular system to custom requirements.
Equalisation: ±15 dB bass and treble, ±15 dB between 300 and 6k Hz (variable frequency). (See photo.)
Typical price (32/24): £15,600.

AD62

Format: 6/2 portable mixer with bass and treble eq, pan, echo send, two limiters and group VU meters.
Price: £269. Case: £18.56.

AD52

Format: 5/2 battery portable mixer based on *AD62* but with improved specification.
Price: £190. Case: £15.

SM2

Format: 6/2, 10/4 or 16/2 with optical foldback, pfl, limiters talkback and ppms. VU meters standard.
Typical price (16/2): £1,400.

ALLEN & HEATH

Manufacturers: Allen & Heath Ltd, Pembroke House, Campsbourne Road, London N8.
Phone: 340 3291.
Contact: Andy Bereza.

Mini

Format: 6/2 miniature mixer with bass/mid/treble eq, echo, foldback, pan and group VU meters. Battery powered (21V 150 mA positive rail).
Dimensions: 236 x 299 x 300 mm.

Quasi

Format: 8/4 or 10/2 standard with 100, 700 and 10k Hz eq, echo, cue pan and group VU meters. Battery powered (21V 300 mA positive rail).
Dimensions: 18.75 x 14.5 x 1.5 in.

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ALTEC (USA)

European agents: Altec International, 17 Park Place, Stevenage, Hertfordshire SG1 1DU.
Phone: 0438 3241.
Telex: 825495.
UK distributors: Theatre Projects Sound Ltd, 10 Long Acre, London WCE2 9LN.

9300ACD

Based on 11 module options, to custom requirements.
Equalisation: ±12 dB bass and treble. Bass selector: 40 or 100 Hz Treble selector: 3k, 5k and 10k Hz.

1220AC

Format: 10/1 stage console with bass/treble eq, echo, peak limiting, input and master VU meters and compression meter.
Dimensions: 710 x 660 x 304 mm.

1214AX

Format: 7/1 stage mixer with choice of high-power amplifiers. Bass/treble eq and echo on each input.
Dimensions: 670 x 230 x 380 mm.

APOLLO

Manufacturers: Apollo Electronics, 96 Mill Lane, London NW6.
Phone: 794 8326.
Contact: C. Papazissimou.

Modular series

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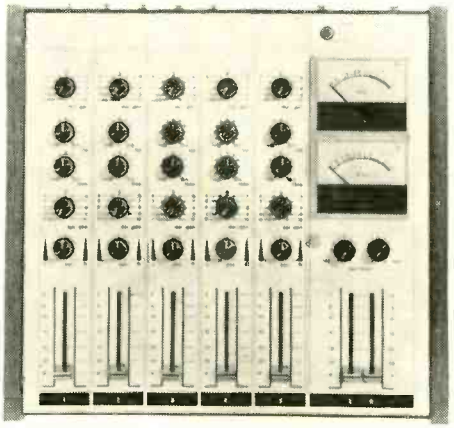
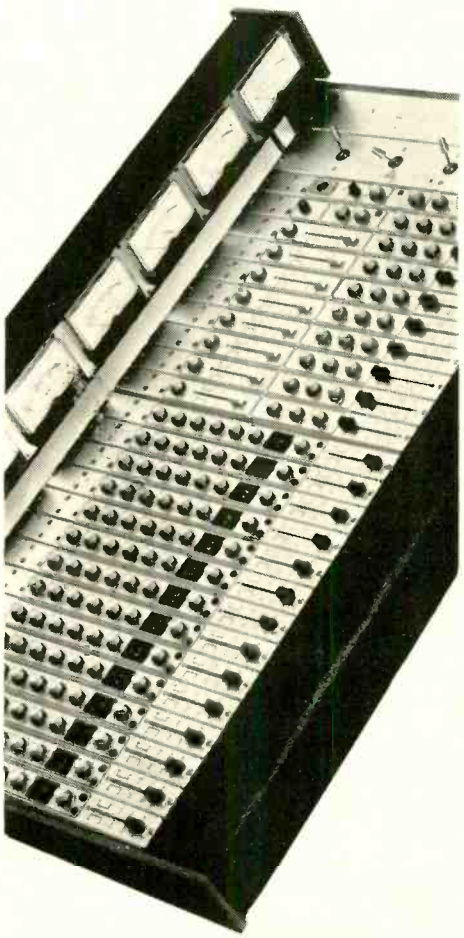
Equaliser: ±16 dB at 30 and 10k Hz. ±16 dB in presence range (350, 700, 1.2k, 2.5k, 4.5k or 6k Hz).

HM80 hybrid series

Range of 32 general audio, mixing and effects units based on a single control module.

78 ▶





Top: Alice *AD52*.

Right: Allen & Heath Modular.

Alice manufacturers of mixers, audio switching matrices and ancillary equipment for recording and broadcasting studios Worldwide.
Suppliers to British local radio stations existing and under construction. Comprehensive user advisory service for studio design and authority approval.

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Battery powered 5 channel 2 group. Balanced mic. inputs. top, bass, echo send, pan on each channel.

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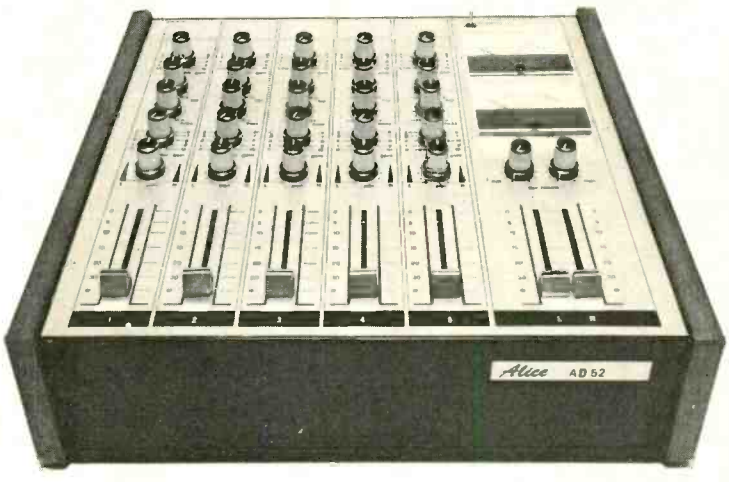

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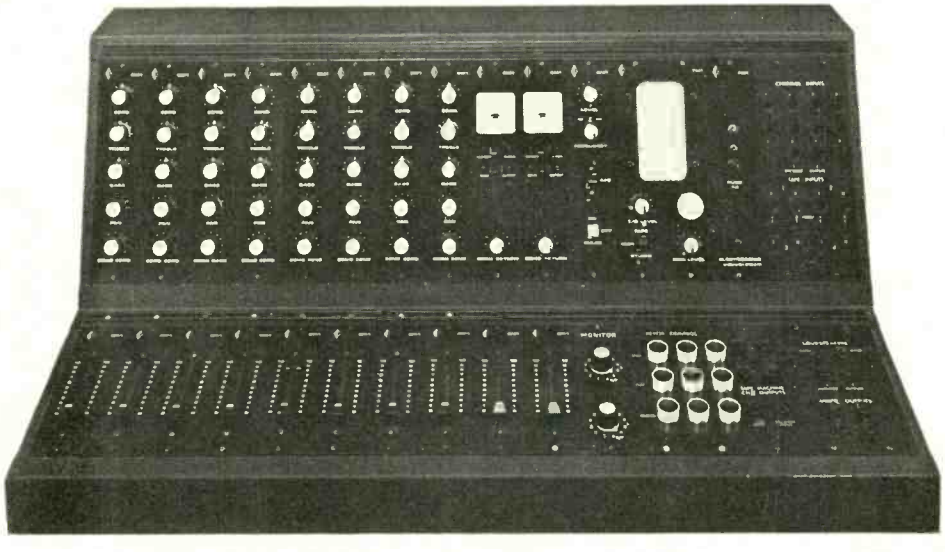
MODULAR STUDIO MIXER



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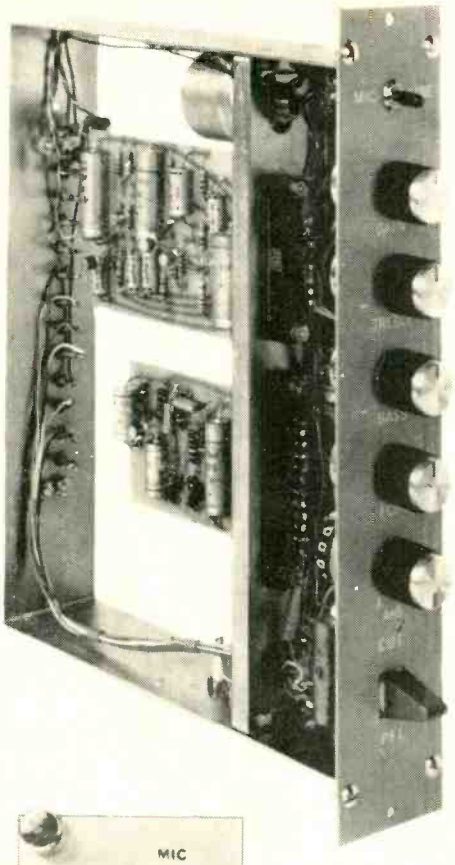
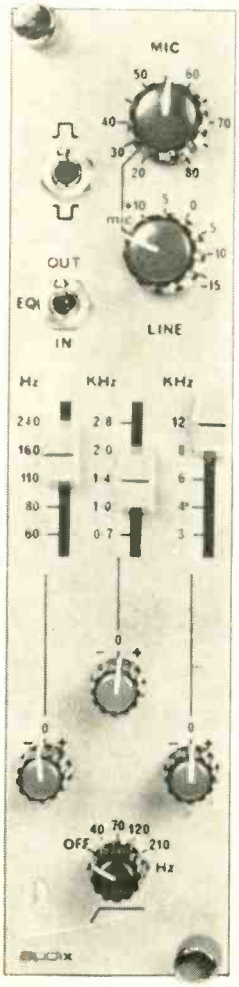
■ AUDIO MIXERS



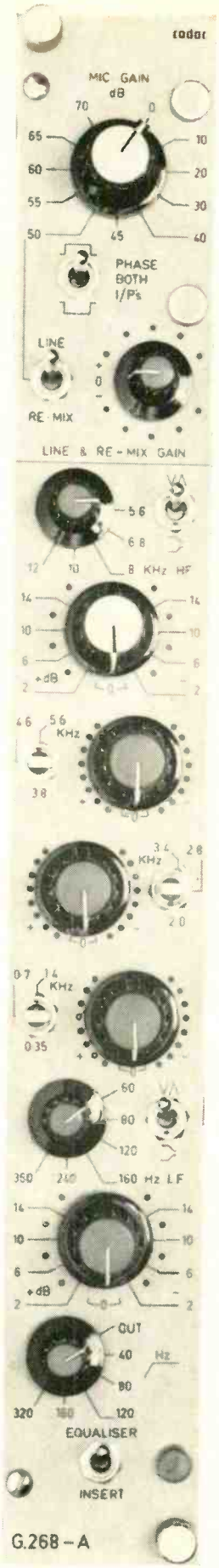


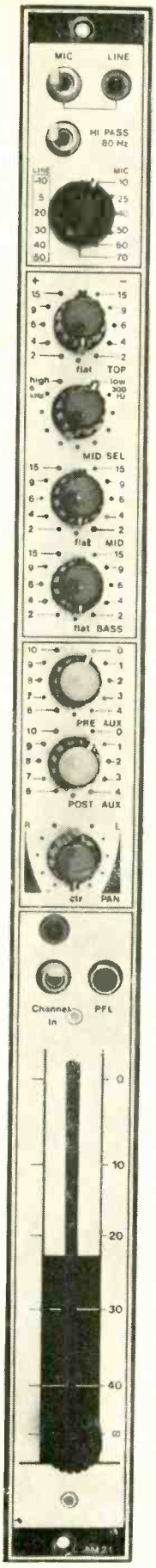
Top: Bias equaliser module from *206* series.

Left: Audix *B100* equaliser.

Right: Cadac *G268A* equaliser.

Far right: Alice *AM21* equaliser.





AUDIO DEVELOPMENTS

Manufacturers: Audio Developments, Hall Lane, Walsall Wood, Brownhills, Staffordshire.
Phone: 05433 5351
Contact: Peter Levesley

AD007

Format: 8/4 mixer with ±13 dB eq at 100 and 10k Hz, ±18 dB at 680, 1k, 1.6k, 2.4k, 3.6k, and 5.4k Hz. Two compressors, two ppms, and tone generator. Mains or battery powering.

AUDIX

Manufacturers: Audio Ltd, Stansted, Essex.
Phone: 0279 81312.
Contact: J. W. Boden.

MXT200

Based on 15 module options, to custom requirements.
Equaliser: ±7 dB at 40 Hz, ±8 dB at 8k Hz. Group output filters: ±12, —6 dB at 40 Hz, ±10 dB at 8k Hz.

MXT800/2

Based on 14 module options, to custom requirements.
Equaliser: Control One: 0 to +16 dB, resonant curves centred on 12k Hz. Control Two: 6 dB/octave slopes with turnover from 1k Hz upwards.

B100

Based on nine 117 x 40 mm module options, to custom requirements.
Equaliser: ±14 dB in each of three stages. Bass: 60, 80, 110, 160 and 240 Hz. Mid: 700, 1.4k, 2k and 2.8k Hz. Treble: 3k, 4k, 6k, 8k and 12k Hz. (See photo.)

BIAS

Manufacturers: Bias Electronics Ltd, Unit 8, Coombe Trading Estate, 112/120 Coombe Lane, London SW20 0BA.
Phone: 947 3131.
Contact: Tony Costello.

BE206

Format: 6/2 mixer with ppm, pfl and talkback.
Price: £294.

BE206TC

As *BE206* but with bass/treble eq and without talkback amplifier.
Price: £324.

BE104/6

Format: 4/1 or 6/1 mixer with VU meter.
Price: £68.25 or £89.25.

BE300

Based on 12 module options, to custom requirements.
Equaliser: Bass/treble (BE301a) or bass/mid/treble (BE301b). (See photo.)

CADAC

Manufacturers: Cadac, Lea Industrial Estate, Batford, Harpenden, Hertfordshire.
Phone: 05827 64698
Contact: Clive Green.

Modular series

Based on 50 module options, to custom requirements.

Equalisation: The six section equaliser (type *G268A*) uses passive networks of R, C and L through-

80 ▶

richardson

Mixer installed in the studios of Molinare Sound Services—10 Stratford Place, London, 01-629 0761

Richardson Electronics at A.P.R.S. 73

We announce a new economical range of tape electronics using chassis modules 19in (482.5mm) wide x 1.75in (44.5mm) high. The system uses our already well known plug-in amplifier cards with a mother board to provide interconnections within each chassis module. Each module comprises single channel playback, sel-sync, record circuits with 2 equalisations and using external power supply. Level, equalisation, and bias controls are accessible through the anodised aluminium front panel and Vu metering is provided on each module. A number of modules can be electronically coupled such that multi-track machines can be catered for in multiples of one. External connections are via Cannon XLR compatible and interconnections are via multi-way connectors.

■ Our well proved modular tape electronics system constructed on Vero series 1 rack frames each 19in (482.5mm) wide x 7in (177.8mm) high will be displayed. In standard form each rack comprises 4 replay, sel-sync, record, buffer oscillator units, thus the building of multitrack electronics is achieved in multiples of 4 together with external power supply and master sync oscillator. The complete system facilitates the electronic automation and remoting of many functions including muted drop-in and drop-out of record, meter monitoring on each channel for line in, line out, and bias, and switching between 4 equalisations.

Having built a number of modular mixers during the past 5 years for the entertainment and broadcast industries we are able to offer a compact system which provides flexibility, portability and serviceability within an economical price but without relatively non-essential 'features'.

An input module has been developed from customers' requirements and is now offered as a standard version together with custom-built output, routing and monitoring facilities. Normal routing is for 2 or 4 channel out although up to 8 could be accommodated.

REMEMBER

Richardson Electronics also offer a comprehensive range of plug-in amplifier modules to meet YOUR individual requirements. The range is being continually revised but, for example, comprises microphone (lo or hi level), gram (magnetic RIAA), hi-impedance, null point mixer, tone control, line out. 15W monitor, 30W and 100W driver, power supply, record and replay (DIN or NAB), tape oscillator, tone source, PPM driver. In addition a universal mother board to allow customers the freedom of building to their own system diagram but obviating connections directly to edge connectors and the running of bus-bars. Our own successful small mixer range including the 'DISCO' and '8 x 2 TRANSPORTABLE' uses the above system to great advantage.

To all those concerned with sound, come and have a chat with us about YOUR requirements.

J. RICHARDSON ELECTRONICS LIMITED

57 JAMESTOWN ROAD, LONDON N.W.1

01-267 0723/4874

■ AUDIO MIXERS

out in order that phase shifts produced when curve bending are precisely those associated with natural resonance. All inductors are generated electronically—there are no spurious resonances on transients and there is complete immunity to external fields. Symmetrical 'bell' and 'shelving' curves are provided within the same system, all with 16 dB lift or cut in 2 dB steps. At full lift or cut, the maximum rates of slope are typically 9 dB/octave for bell and 4 dB/octave for shelving. Carefully chosen frequencies cover the total sound spectrum.

Hf: Single section switched for bell or shelf. Centre frequencies (bell) are: 12k, 10k, 8k, 6.8k and 5.6k Hz.

Mf: Three sections each with a choice of three centre frequencies: 1) 5.6k, 4.6k and 3.8k Hz; 2) 3.4k, 2.8k and 2.0k Hz; 3) 1.4k, 0.7k and 0.35k Hz.

Lf: Single section switched for bell or shelf. Centre frequencies (bell) are: 350, 240, 160, 120, 80 and 60 Hz.

High Pass Filter: Standard 3 dB points are 320, 160, 120, 80 and 40 Hz. The rate of slope progressively increases from 12 dB/octave on 320 Hz to dB/octave on 40 Hz position.

Output level: +24.5 dBm maximum into 200Ω before clipping.

Overload Recovery: Within a half cycle for transients 20 dB above clipping.

Distortion (Either input over range 20 to 20k Hz): less than 0.08% at +24 dBm into 600Ω, less than 0.06% at +14 dBm into 600 Ω, less than 0.01 % at +8 dBm into 600Ω. At microphone gains exceeding 45 dB, thd is down in basic noise and not directly measurable.

Frequency Response (including the microphone transformer and with the equaliser sections set flat or cancelled): ±0.2 dB from 20 to 20k Hz. —3 dB points are 5 and 50k Hz.

Phase Shift: The microphone transformer contributes 2° lead at 20 and 10° lag at 10k Hz. Overall channel phase shift (with equaliser flat or cancelled) is less than 3° lead at 20 Hz and 11° lag at 10k Hz.

Transient Response: All amplifiers have an ample bandwidth before the application of negative feedback and transient handling is free from feedback stress. Simple square-wave tests yield completely clean waveforms right up to maximum levels.

Below: Cadac 28/24 quadraphonic desk supplied to Morgan Studios, Brussels.

Right: Cetec *2000*.

CALREC

Manufacturers: Calrec Audio Ltd, Hangingroyd Lane, Hebden Bridge, Yorkshire HX7 7DD.
Phone: 0422-84 2159.
Contact: Howard Smith.

Modular series
Based on 83 module options, to custom requirements.
Equaliser: Bass: ±15 dB at 60 or 160 Hz. Mid: ±15 dB at 700, 1.2k, 2.4k, 3.6k or 6.8k Hz. Treble: ±15 dB at 10k Hz. (See photo.)

CHADACRE

Manufacturers: Chadacre Electronics Ltd, 63 Stratford Broadway, London E15 4BQ.
Phone: 534 1207.
Contact: Gerald Chevin.

Portable mixers
Variety of modular and semi-modular units. Details on application.

CETEC (USA)

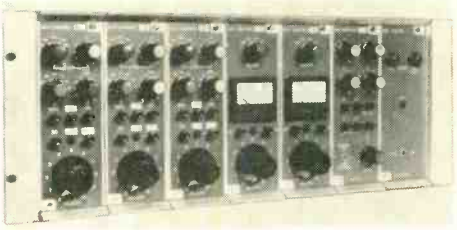
Agents: Cetec UK, Shaftesbury Street, High Wycombe, Buckinghamshire
Phone: 0494 37326
Telex: 837329

Electrodyne 2000
Format: 16/24 (standard) mixing console with graphic equalisation on four inputs. Four quad recording buses, three mono mixdown, four monitor output, four echo send, four echo return, and 21 tape playback monitor buses. 312 position patch bay.

Cetec 10
Format: 10/2 mixing desk with optional eq, two switchable VU meters, five-position monitor selector, digital time clock and 10W group monitor amplifiers.

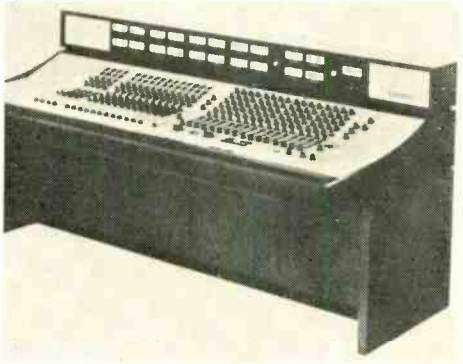
Langevin AM4A
Format: 12/4 with bass and treble eq and echo send on all inputs. Talkback/slating module available. Group VU meters. Rotary in place of straight faders available at extra cost.

82 ▶



Above: Audix *MXT 800/2*.

Top: Calrec *K Series* 12/4.



Problem created!

audix
SOUND SYSTEMS AND ELECTRONICS

ITN wanted to fit a high performance sound mixing desk into a small area located at the rear of a Range Rover.

Problem solved!

Audix designed and built a system conforming to their stringent specification using standard equipment, resulting in a professional economic unit, delivered to schedule.

Use our experience and capabilities to solve your audio problems.

The wide range of MXT 800 modules including mic amps, group combiners, monitors, talkback, limiters, oscillators, and power units were incorporated in this rugged mobile sound mixing desk for ITN's unique sound and vision recording facility.

audix

MANUFACTURERS OF SOUND SYSTEMS AND ELECTRONICS

AUDIX LIMITED · STANSTED · ESSEX CM24 8HS
TELEPHONE: BISHOP'S STORTFORD 813132
(4 lines) (STD 0279)

■ AUDIO MIXERS

CRYSLON
Manufacturers: Cryslon Electronics Ltd, The Firs, Rother Street, Stratford-on-Avon, Warwickshire.
Phone: 0789 4797.
Contact: D. G. Warby.

CE modular series
Portable and console mixers to custom requirements.
Standard equaliser module (*CE6115*): ±18 dB, bass, mid (1.4k, 2.8k, 4k or 5.6k Hz) and treble. (*CE6114*): ±18 dB bass/treble only.

ELECTROSONIC
Manufacturers: Electrosonic Ltd, 47 Old Woolwich Road, London SE10.
Phone: 858 4784.
Contact: Brian Pook.

MSM modular
Based on 10 module options, to customer requirements.
Equalisation: ±15 dB at 20 and 20k Hz.
Standard format: 8/2.

EMI
Manufacturers: EMI Sound & Vision Equipment Division, Hayes, Middlesex.
Phone: 573 3888, ext 2011.
Telex: London 22417.

8100 series
Based on 15 module options, to customer requirements.
Equalisation: Bass/treble.

HELIOS
Manufacturers: Helios Electronics Ltd, 161 High Street, Teddington, Middlesex
Phone: 977 7841 and 977 7877
Contact: Richard Swettenham

PS
Modular mixing systems designed for between eight track (PS1) and 16 track (PS2) working.
Equalisation: ±10 dB at 10k Hz. 14 dB peak or trough at any of one of eight mid frequencies. Broad peak bass boost at four frequencies and 15 dB maximum roll-off at 50 Hz.

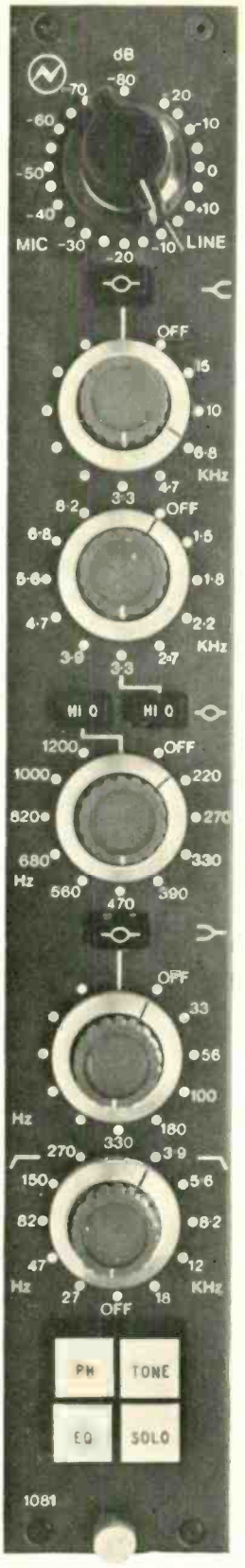
Type E
Modular mixing systems to individual requirements. Typical specifications on request.

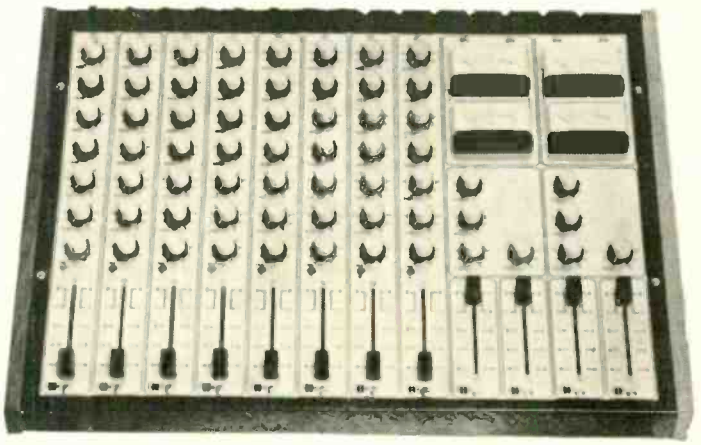
ICE
Manufacturers: Icelectrics Ltd, 15 Albert Road, Aldershot, Hampshire.
Phone: 0252 28513.
Contact: P. A. Woodhead.

MMP202
Format: 4/1 mixer with group bass/treble eq.

SMP101
Format: 6/2 mixer with 30, 100, 10k and 20k eq and group balance.
Dimensions: 19 x 4.5 x 3.5 in.
Price: £98.80.

84 ▶

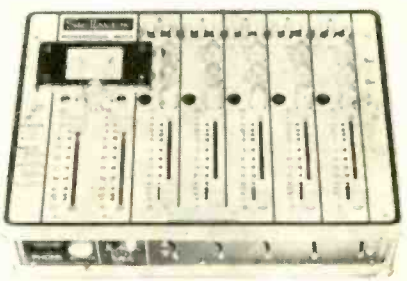




Above: Electrosonic 12/4 *MSM*.

Left: Calrec *PQ10S242* equaliser.

Below: Stellavox *AMI*.



Above: Neve equaliser module.

Top right: Alice *AM 16/8*.

Mid-right: Allen & Heath *Quasi*.

WHY CHILTON MIXERS?

We are manufacturers in the true sense of the word; producing Teak Cabinets, Sheet Metal Work, Tooling, Front Panel and Printed Circuit Artwork etc., our products are accurate with an attention to detail that is second nature to us.

The popular M10/2 (10in 2out) portable mixer shown is supplied as a basic unit with 10 Line inputs inc PPM, Oscillator, LF/HF Equalisers, Cue Lights, 1 Aux and PFL. You choose the number of Microphone or Gram inputs, the channels to have Presence, Switchable HF/LF Filters or Ducking. In addition a 2nd Aux channel, Talk-Back, and/or Compressors can be fitted.

Ring or write for full information, if however our standard range is unsuitable it may be possible to modify one to suit your requirements.

M10/2 Mk 2 BASIC .....£275.00+VAT
16 input version.....£415.00+VAT
12 in 4 out.....£495.00+VAT

MAGNETIC TAPES Ltd., Chilton Works, Garden Rd., Richmond, Surrey, TW9 4NS

Telephone 01-876 7957

SONIFEX
SOUND EQUIPMENT

INTRODUCING THE CM2000 SERIES NAB CARTRIDGE REPRODUCER

The CM2000 series of cartridge reproducers are designed to accept NAB cartridges in A, B and C sizes.

The machines are specifically designed to meet the NAB criteria for broadcasting use, with the following features:

- ★ Electronic motor with precision speed control.
- ★ Remote and local solenoid actuated start and stop.
- ★ Simple cartridge insertion and release.
- ★ Record, playback, cue record, cue stop.
- ★ Rapid search forward wind with auto stop.

CM2000 THE ALTERNATIVE 'NAB' broadcast cartridge reproducer.

The B1000 six channel studio mixer, with improved technical specification, is available for early delivery.

For details of this equipment or quotations for special equipment contact:

SONIFEX

15 College Street, Irthlingborough, Wellingborough, Northants NN9 5TU

Tel. Wellingborough (0933) 650700

AUDIO MIXERS

LAMB
Distributors: Lamb Laboratories, Lamb House, Church Street, London W4 2PB.
Phone: 995 4551.
Telex: 934047.
Contact: J. E. Grose-Hodge.

PML420
Format: 4/2 portable mixer with bass, mid and treble eq, pan, echo send to group return, group limiters and group VU meters.
Dimensions: 419 x 368 x 178 mm.

MAGNETIC TAPES
Manufacturers: Magnetic Tapes Ltd, Chilton Works, Garden Road, Richmond, Surrey.
Phone: 876 7957.
Contact: T. Reps.

M10-2/2
Format: 10/2 mixer with bass, treble and optional presence eq, pfl, pan, echo send to group return, talkback, group ppms, line-up oscillator and cuelight switching. Other features to customer requirements.
Dimensions: 570 x 466 x 233 mm.
Price: £275 basic.

M16-2/2
Format: 16/2 version of M10-2/2.
Price: £415 basic.

M12-4
Format: 12/4 version of M10-2/2.
Price: £495 basic.

MILLBANK
Manufacturers: Millbank Electronics, Uckfield, Sussex TN22 1PS
Phone: 0825 4166

Disco 3
Format: 3/2 discotheque mixer/control unit. Bass and treble eq on all inputs.
Price: £140.

Musicmaster 2
Format: 8/2 compact mixer with bass and treble eq on all inputs.
Price £180.

MCC 3
Format. 10/2 compact mixer with bass and treble eq on each group. Group-switchable ppm, VU or peak VU.
Price. £189 (Cannon XLR connectors); £175.50 (DIN connectors).

MEX 6
Format. 6/1 compact mixer with output bass, mid and treble eq.
Price. £60.38.

MCI (USA)
Agents: Feldon Audio Ltd, 126 Great Portland Street, London W1N 5PH.
Phone: 580 4314.
Contact: Dag Felner.

JH416
Modular studio control console with exceptional monitoring facilities. Details on request.

NEVE
Manufacturers: Rupert Neve & Co Ltd, Cambridge House, Melbourn, Royston, Herts SG8 6AU
Phone: 0736 60776
Telex: 81381
Contact: Alan Foster

Modular series
Audio control desks to custom requirements.
Equalisation (channel amplifiers *1801* and *1802*):
High pass filter: Five switched frequencies with —3 dB points at 27, 47, 82, 150 and 270 Hz, sloping sloping 18 dB/octave.

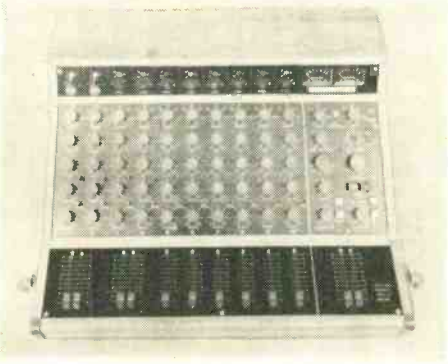
Low pass filter: Five switched frequencies with —3 dB points at 3.9k, 5.6k, 8.2k, 12k and 18k Hz, sloping 18 dB/octave. Lf: ±18 dB maximum, peaking at 33, 56, 100, 180 and 330 Hz. Pushbutton selection of shelf or peaking curve.

Presence: ±12 dB or ±18 dB (selectable on 'hi-Q' pushbutton switch), peaking at 220, 270, 330, 390, 470, 560, 680, 820, 1k, 1.2k, 1.5k, 1.8k, 2.2, 2.7, 3.3, 3.9, 4.7, 5.6, 6.8 and 8.2k Hz. Separate hi-Q switch ranges above and below 1.35k Hz.

Hf: ±18 dB maximum, peaking at 3.3k, 4.7k, 6.8k, 10k and 15k Hz.

S16/4
Format. 16/4 console with input eq, 4-3-2-1 grouping, four pairable complimiters, two echo groups, two foldback groups, pfl, pan, line-up oscillator, talkback and monitor echo.
Dimensions: 1,956 x 927 x 572 mm (1,003 mm including base).

S24/8
Format: 24/8 console with input eq, four pairable complimiters, four echo groups, four foldback groups, pfl, pan, line-up and slate oscillators, talkback and stereo echo monitoring.



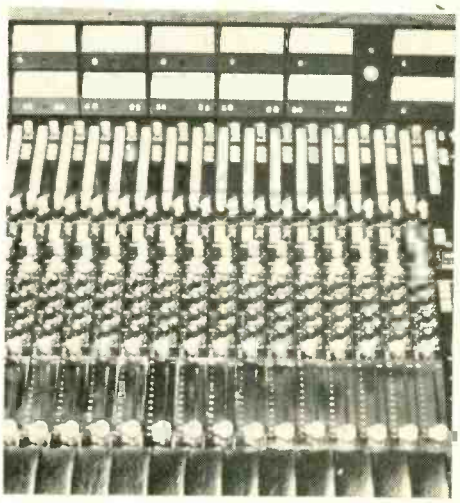
PARTRIDGE
Manufacturers: Partridge Electronics Ltd, 23-25 Hart Road, Benfleet, Essex SS7 3PB.
Phone: 03745 3256.
Contact: A. C Partridge.

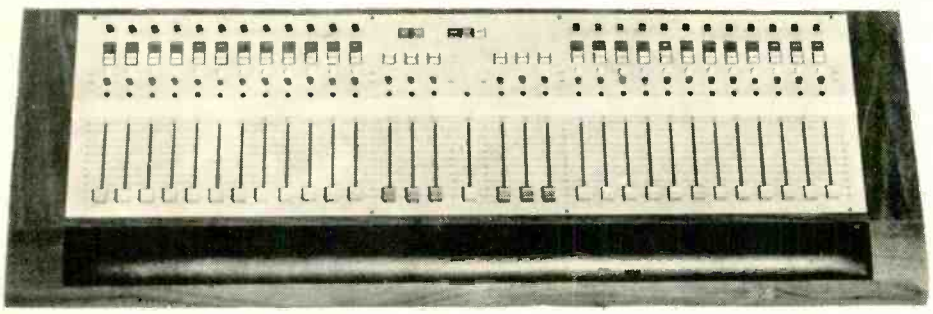
Modular series
Based on 9 module options, to custom requirements.
Equalisation: —22 to +19.5 bB at 30 Hz, —19 to +19.5 dB at 20k Hz.

QUAD-EIGHT (USA)
Agents: Feldon Audio Ltd, 126 Great Portland Street, London W1N 5PH.
Phone: 580 4314.
Contact: Dag Felner.

Compumix automatic
Format: 24 channel automatic remixer with auxiliary 54 switch function memory. Coding: SMPTE compatible.

Modular series
Modular range of desks to custom requirements.





Left: Quad Eight *Compumix*

High left: Chilton *M10-2/2*

Above: Section of MCI *JH416.*

Top: Neve 16/4 desk.

This Philips idea makes any cassette recorder sound better

Even the most inexpensive cassette recorder sounds better when you use the new kind of Philips cassette tape coated with chromium dioxide.

Philips chromium dioxide compact cassettes are designed to give you:

1. Excellent reproduction of high frequencies.
2. Practically no background noise.
3. Crisp and brilliant sound character.

The results are especially noticeable on a cassette recorder adjusted for the use of this tape–such as Philips N2510 Hi-Fi cassette stereo recording deck or Philips N2407 cassette stereo recording system. The cassettes have special lugs that operate the deck's sensing device adapting it automatically to the correct equalisation.

Philips chromium dioxide Compact Cassettes come in two sizes:

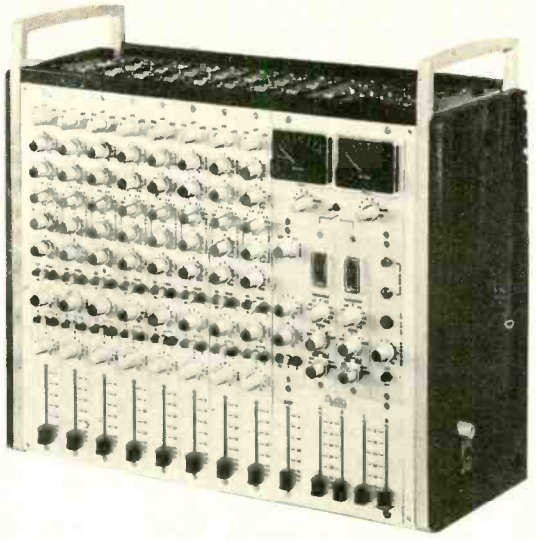
C60 (2 x 30mins) C90 (2 x 45 mins)

Get them from your Philips dealer. And for a free booklet on all Philips audio and recording accessories, write now to

Philips Electrical Ltd.,
Dept. SP. Century House,
Shaftesbury Avenue,
London WC2H 8AS.

PHILIPS

Simply years ahead



AD 007 PORTABLE MIXER

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

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

Modules such as the input channels and compressors can be purchased as separate units and enclosed in a 19" racking system if required.

It has customer appeal. For example London Broadcasting, the first commercial Radio Station on the air, use one for all their outside broadcasts.

Audio Developments

Hall Lane
Walsall Wood
Brownhills
Staffs

Tel. Brownhills 5351

■ AUDIO MIXERS

RAINDIRK
Manufacturers: Raindirk, 33A Bridge Street, Downham Market, Norfolk
Phone: 03663 2165
Contact: Ron Pender, Cyril Jones

KR series
Format: 30/16 mixer based on a design produced for Kingsway Recorders. High and low pass filters, bass, two-mid and treble eq, phase switching, pan, tape monitoring, talkback, slate and internal remix.

RICHARDSON
Manufacturers: J. Richardson Electronics Ltd, 57 Jamestown Road, London NW1.
Phone: 267 0723 or 794 2268.
Contact: J. Richardson.

Modular series
Modular mixing system based on units of approximately £40 each. Supporting range of plug-in cards.
Equaliser: 40 and 60 Hz high pass, three frequency mid-lift, Baxandall bass and treble.

SONIFEX
Manufacturers: Sonifex Sound Equipment, 15 College Street, Irthlingborough, Wellingborough, Northamptonshire NN9 5TU.
Phone: 0933 650700.
Contact: Paul Brooke.

B1000
Format: 6/1 compact mixer with optional ppm or VU meter, Cannon or DIN connectors. ±15 dB eq at 100 and 10k Hz. Pfl.

SOUND TECHNIQUES
Manufacturers: Sound Techniques Ltd, Industrial Estate, Mildenhall, Suffolk IP28 7AS.
Phone: 713631.
Telex: 81509.
Contact: Ian Levene.

ASDEV
Format: 12/2 console with pfl, pan, echo send/return, talkback, cue switching, line-up oscillator, led level indicators and VU or ppm group metering.
Equalisation: High pass: 12 dB/octave, —3 dB at 40 or 80 Hz. Bass: ±14 dB at 60, 125 or 250 Hz. **Presence:** ±14 dB at 700, 1.4k, 2.8k, 4.5k and 7.5k Hz with broad or narrow band selector. Treble: ±14 dB at 6k, 9k or 12k Hz. Low pass: 12 dB/octave, —3 dB at 8.5k or 12k Hz.

SYSTEM 12
Format: 18/8 console with pan, echo send/return, talkback, cue, foldback, line-up oscillator and slate, group ppm or VU meters and 180 way jackfield.
Equalisation: High pass: 6 dB/octave, —3 dB at 80 Hz Bass: ±14 dB at 80 or 150 Hz. Presence: +14 dB at 3k or 5k Hz. Treble: ±14 dB at 8k or 10k Hz.

SYSTEM 24
Format: 18/8 console with quad pan, pre/post fade echo, pfl, foldback, pan, cueing, line-up oscillator and slate, 16 ppm or VU meters and 180 way jackfield.
Equalisation: High pass: 6 dB/octave, —3 dB at 80 Hz. Bass: ±14 dB at 80 or 150 Hz. Presence: ±14 dB at 700, 1.4k, 2.8k, 4.5k or 7.5k Hz. Treble: ±14 dB at 8k or 10k Hz.

STELLAVOX (Switzerland)
Agents: A.V. Distributors, London Ltd, 26 Park Road, Baker Street, London NW1 4SH.
Phone: 935 8161.
Contact: Bob Woolford.

AMI.1
Format: 5/2 miniature mixer with optional compressor on inputs Four and Five and optional balanced output. Battery powered with +12V phantom mic supply. Group ppms.
Equalisation: ±20 dB at 30 and 20k Hz. Presence: +7 dB at 5k Hz.
Dimensions: 80 x 215 x 270 mm.
Price: £792.

AMI.48
Format: As *AMI.1* plus 48V phantom, pfl, individual channel outputs and improved performance.
Price: £946.

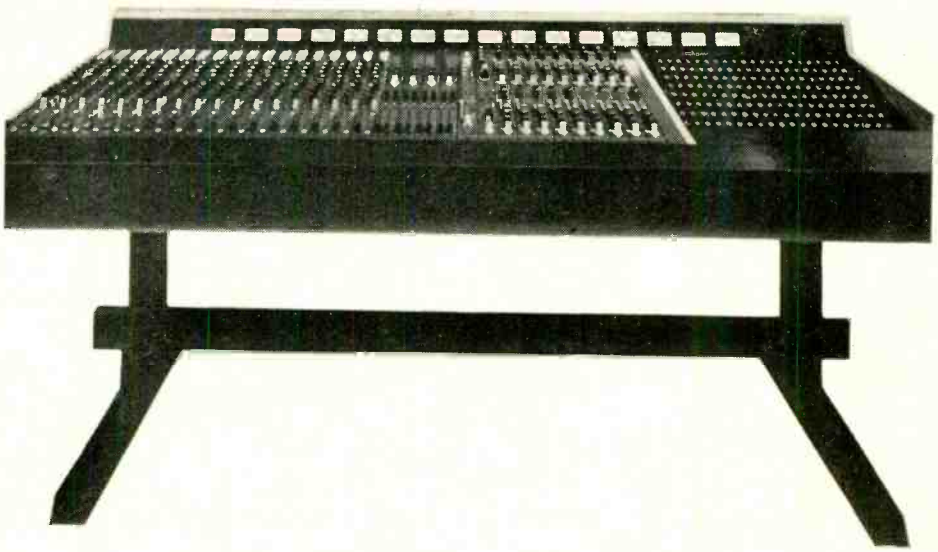
AMI.48SIL
Format: As *AMI.48* plus limiter led indication on all inputs and outputs.
Price: £1,255. Mains unit: £47.

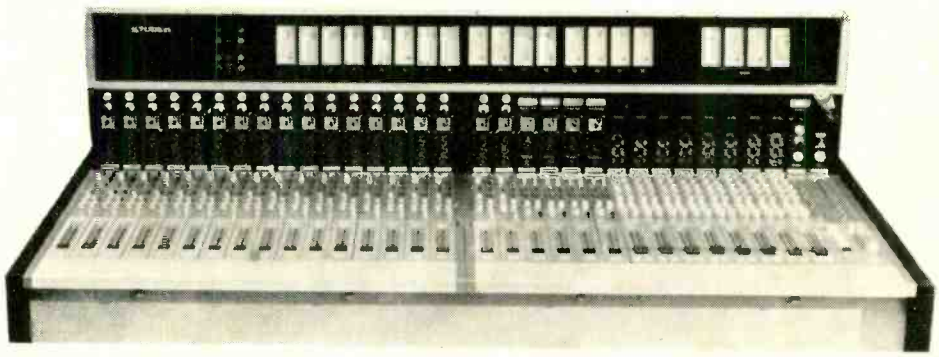
STUDER (Switzerland)
Agents: F. W. O. Bauch Ltd, 49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ
Phone: 01 953 0091
Telex: 27502

189 Quadro
Format: 16/8 or 16/16 with optional ppm or VU meters on all input and output channels. Joystick quadpot on each input, monitor mixer on each group and four reverberation channels. Bass, mid, treble, lowpass and highpass eq.

TRIAD
Manufacturers: Trident Audio Developments Ltd, 4-10 North Road, London N7 9HG
Phone: 609 0087
Telex: 27782
Contact: Barry Porter

Series A
Range of modular audio mixing consoles. Details on request.





Above right: Sound Techniques *System 24.*

Right: Studer *189* quadraphonic.

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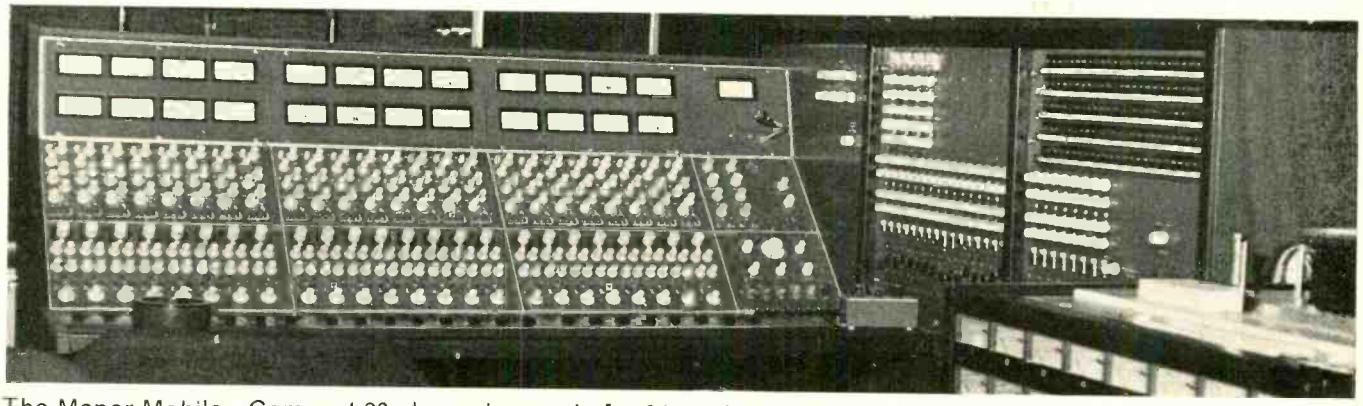

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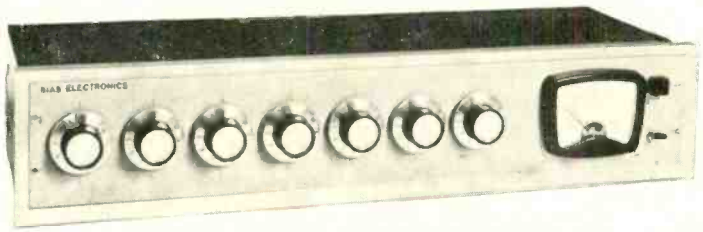
BIAS ELECTRONICS BE106 MIXER

By Hugh Ford



MANUFACTURERS' SPECIFICATION
Power requirements: 200 to 240V, 50 Hz.
Frequency response: —2 dB, 20 Hz to 20k Hz. —1 dB, 40 Hz to 15 kHz.
Signal to noise ratio: —120 dBm referred to input.
Distortion: less than 0.1% at +8 dBm.
Gain: 80 dB nominal.
Inputs: Balanced, switchable microphone or line. Suitable microphones 50 to 600 ohms.
Output: low impedance balanced output 0 dBm into 600 ohms. Maximum level +8 dBm. Clipping level +12 dBm.
Meter: VU.
Dimensions: 441 x 153 x 83 mm.
Weight: 4.08 kg.
PRICE: £89.25 + VAT.
Manufacturers: Bias Electronics Ltd, Unit 8, Coombe Trading Estate, 112-120 Coombe Lane, London SW20.

BIAS ELECTRONICS are as yet a relatively little-known firm in the field of audio equipment and started life with a limited range of products, including a studio tape recorder and two mixers: the *104* four channel and the *106* six channel which is the subject of this review. All three products have good practical specifications and sell at a very reasonable price having regard to the specified performance.

The *104* and *106* mixers have identical electrical specifications and it would be anticipated that the pros and cons found in this review apply to both models. The units are supplied complete with rack mounting brackets for 483 mm racks, a set of locking DIN type input plugs, and a three pole (ring, tip and sleeve) jack plug for the mixer output.

All inputs and outputs are located on the back panel of the mixer, together with a miniature toggle switch adjacent to each input socket for selecting high or low input sensitivity, a clearly labelled mains fuse and the fixed mains power supply lead. From left to right, the front panel is occupied by the six input faders, a master fader, a VU meter and the mains input switch with its associated pilot light.

All seven faders are rotary potentiometers fitted with knobs which are calibrated from zero to nine and can be easily read in conjunction with an engraved line above each knob. However, the channel identification is under the knobs and not always easy to read. It might be some advantage if the master fader were fitted with a different coloured knob to the channel faders.

Mechanically, the unit is of extremely sound construction and pleasing appearance with simple access to the interior should this be necessary for repairs. All the electronic components are mounted on a single high quality printed circuit board which includes the six active input stages and the output stage. It may be thought surprising that the input stages are not mounted on individual plug-in boards but this would naturally add considerably to the cost of the mixer and provide little advantage because of the excellent accessibility of the interior of the unit for servicing.

The mixer inputs are all balanced floating inputs with an input impedance at 1.592 kHz of 675 ohms with the input sensitivity switch set for high level inputs or 420 ohms with the input sensitivity switch set for low level inputs such as microphones. When the input sensitivity is set too high, the maximum mixer gain is 78 dB with an input clipping point of 25 mV so this input setting is suitable for low impedance dynamic microphones of impedances less than around 100 ohms. I do not consider this input suitable for 600 ohm microphones as suggested in the manufacturers' specification for the mixer.

The low input sensitivity setting is intended for line inputs and is associated with a maximum mixer gain of 26.5 dB and an overload point of 5.4V (+17 dBm) which is more than adequate from all points of view.

Like the mixer inputs, the output is also a floating balanced line with a source impedance at 1.592k Hz of 54 ohms and having the VU meter connected across the output lines. This meter is a genuine VU with the correct sensitivity, calibration and ballistics; not one of the half wave rectifier instruments of extraordinary ballistics which are calibrated in VUs and fitted to many not so cheap systems.

Having a genuine VU meter, a mixer output of +4 dBm corresponds to a steady state meter reading of 0 VU which, as a result of the accepted performance of a VU meter indicating between 8 dB or 10 dB below programme peaks, leads to anticipated output peaks of between +12 dBm and +14 dBm. It is here that the first snags appeared with the mixer, for the output clipping point was +13 dBm with 240V mains inputs, or +11.5 dBm with the minimum specified 200V mains input, the mixer gain remaining constant over this mains voltage range. In fact the measured third harmonic distortion with full mains input and +10 VU output was 1.4 per cent at 1k Hz and virtually constant over the audio frequency spectrum. This means that the mixer distortion is marginal on programme peaks but, at output levels of +12 dBm and below the mixer distortion was excellent at well below 0.1 per cent third harmonic and intermodulation distortion to the SMPTE method below 0.12 per cent with the output terminated in 600 ohms.

Mixer noise over the 20 Hz to 20k Hz bandwidth at maximum mixer gain measured at −118.5 dBm referred to the mixer input with one channel open, or −126 dBm (A weighted). However, increasing the measurement bandwidth up to 200k Hz demonstrated a significant amount of high frequency noise in the output, which could be troublesome in some circumstances.

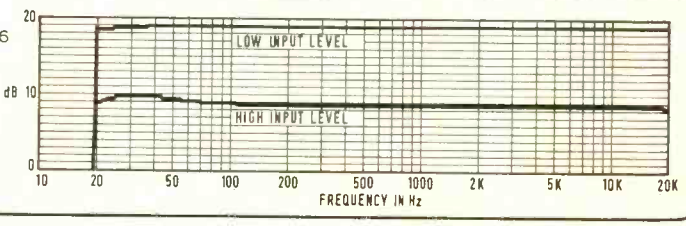
While the overall mixer noise is to a high standard, the mains hum situation could do with some improvement, particularly on channel six which is nearest to the power supplies, as can be seen from the following:

50 Hz hum (all potentiometers closed): —78 dBm at output.
50 Hz hum (only master gain open): —51.5 dBm at output.
50 Hz hum (channel six open): —44 dBm at output.

It is only channel Six that made any significant change on the hum level of −51.5 dBm but this figure itself could well be improved. Fortunately, the level of mains frequency harmonics was well below the level of the 50 Hz fundamental.

Fig. 1 shows that the frequency response of the mixer was virtually flat over the entire ▶

FIG. 1
BIAS ELECTRONICS 106
FREQUENCY RESPONSE INTO 600 OHMS
PEN: 100mm/S
PAPER: 3mm/S



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4″ 300′	20p	50p	4″ 450′	25p	70p	4″ 600′	34p	97½p	4″ 8p
5″ 600′	30p	87½p	5″ 900′	40p	£1·17½	5″ 1200′	62½p	£1·85	5″ 9p
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audio spectrum, at both the high and low input settings, and no interaction between controls was observed during the frequency response measurements or at any other time. However, crosstalk between open and shut channels could be a problem in certain limited circumstances. **Fig. 2** shows the worst case in this respect, where a 1V signal was fed into channel two set to the low sensitivity setting and with its fader shut. Channels One and Three were then fully opened with the maximum sensitivity setting, the inputs being open circuit. While one is very unlikely to operate the mixer in practice with a shut but live line input adjacent to two wide open microphone inputs, the crosstalk performance certainly leaves something to be desired.

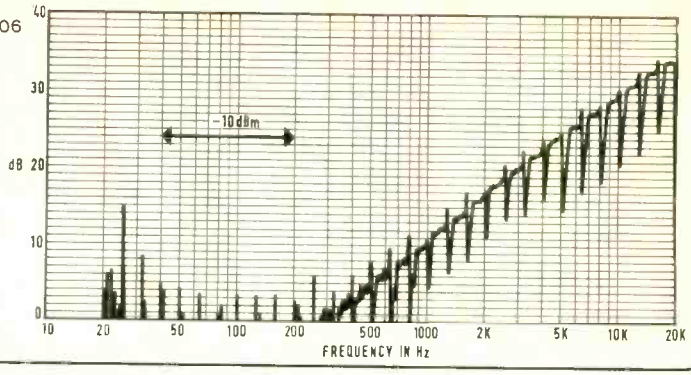
Finally, some consideration was given to the mains input. The power consumption of the mixer is only 6.7 VA, which makes it eminently suitable for operation from battery/mains inverters on location. The general electrical safety was satisfactory with one exception: this is that the mains lead must be properly secured within the mixer so that it cannot be pushed into, or twisted within, the unit.

In conclusion, the mechanical design of the Bias Electronics *106* mixer is to a high standard and, at a price of £89.25 for a six channel active mixer with floating balanced inputs and output, it is not reasonable to expect perfection.

FIG. 2
BIAS ELECTRONICS 106

THIRD-OCTAVE FILTERED BREAKTHROUGH. 1V INTO CHANNEL 2 (CLOSED ON HIGH INPUT) CHANNELS 1 & 3 OPEN ON LOW.

PEN: 16 mm/S
PAPER: 1mm/S



On the credit side, the mixer has a good frequency response, sensible input and output impedances and levels, reasonable noise performance, and a genuine standard level meter. The distortion performance is also extremely good up to +12 dBm output but an extra 2 dB before the distortion performance deteriorates would be highly desirable.

The other matters which are on the debit side are the poor hum levels associated with channel six and the possibility of severe breakthrough from closed channels under certain circumstances.

If Bias Electronics sort out these problems, their mixer will be outstanding value for money.

MANUFACTURERS' COMMENT:

Congratulations to Hugh Ford on his painstaking and 'unbiased' (if you will pardon the expression) review. Since his examination of the BE106 we have incorporated modifications to improve the performance of the mixer in the following respects:

1. We are now fitting the output stage which is used in all our other mixers; this has better noise performance and the clipping level is +20 dBm.
2. We are modifying the printed circuit boards to improve the breakthrough.

We would point out, however, that we consider the conditions under which the crosstalk figures were obtained rather extreme and it is unlikely that these would occur in practice. The hum figures obtained with the main fader open and channel 6 fader open were given as –44 dBm. In these conditions, the gain of the mixer is 78 dBm. The resultant hum figure referred to input would therefore be –122 dBm. This is below the normal noise level of the mixer at maximum gain. The normal operating setting of the controls to give 60 dB of gain are at approximately position 7 on both the channel fader and the master fader. This setting gives a noise figure of –62 dB.

CROWN IMA DISTORTION ANALYSER

By Hugh Ford

MANUFACTURERS' SPECIFICATION

Im ranges: 01., 0.3, 1, 3, 10, 30, 100% full scale on separate im meter

Residual im: Less than 0.005% with internal generators. (Typically less than 0.003%.)

Accuracy of im scales: 5% of full scale (±.005% on 0.1 full scale range).

Range of tracking: 45 dB in 5 dB (±1%) increments.

Input impedance: 100 KΩ (maximum) and 45 kΩ (minimum) depending on setting of input level control.

Necessary hf input: 17 mV minimum.

Lf/hf voltage ratio: Internal generators continuously variable from ∞:1 to 1:1 by hf level on front panel. Ratio is read by reading voltage on CALIBRATE meter.

Low: 60 Hz low distortion oscillator. (Less than 0.1% thd) synchronised with ac line, External oscillator input (10 to 150 Hz) provided (one terminal grounded, 5.6 KΩ internal impedance)

High: 7 kHz ±1% low distorton oscillator.

Outputs 10 kΩ output impedance SCOPE A and SCOPE B showing hf envelope and demodulated im signal

Output impedance: 600Ω for all settings of OUTPUT level control and MASTER attenuator.

Output level: 25V peak (maximum) for either internal generator or any generator combination—internal or external. Level is adjustable by a 40 dB attenuator (in 10 dB steps) concentric with a 15 dB variable (fine) control.

Slide switches: EXT-INT hf generator. EXT-INT lf generator, CAL-OUT meter, ac power, MAN-TRK TRACKING allows meter input and output controls to remain set when testing over a range of levels using the master attenuator (automatically tracking the two adjustments, input and output level, in 5 dB increments).

Rotary controls: output level controls. Hf level control, master attenuator switch, im range, input level control (continuously adjustable pot).

Semiconductor complement: 53 transistors, 12 diodes, 2 fets and one zener diode. Size: 19" (rack-mtg) width (48.3 cm), 7" (17.8 cm) height and 7½" (19.1 cm) depth from mtg surface).

Dimensions (rack mounting): 483 x 178 x 191 whd.

Manufacturers: Crown International, Box 1000, Elkhart, Indiana, U.S.A.

Agents: Macinnes Laboratories Ltd, Carlton Park Industrial Estate, Saxmundham, Suffolk, IP17 2NL.

Price: £395.

THE MEASUREMENT of intermodulation distortion is an extremely tiresome operation without equipment specifically designed for the purpose and, because very few such instruments are available, im distortion is all too commonly ignored and consequently little understood by many engineers.

Therefore, before proceeding with the review of the *IMA* analyser, it is I hope of interest to describe briefly the two commonly accepted methods of measuring im distortion. These are known as the SMPTE (Society of Motion Picture & Television Engineers) method and the CCIF (International Telephonics Consultative Committee) method. Both methods are similar to the extent that they both feed two tones of different frequency to the equipment under investigation and measure distortion in terms of the ratio between the original signal (or signals) and the difference tones generated within the equipment under investigation. But this is where the similarity ends.

With the CCIF method, the two input tones are closely spaced high frequencies of equal amplitudes; if non-linearity is present in the unit under test, a further frequency which is the difference between the input frequencies will be generated. The percentage im distortion is calculated from the ratio of the total input signal components to the difference frequency component which can easily be separated by a low pass filter.

In the SMPTE method the two input signals are of widely differing frequency, commonly 50 Hz and 7 kHz, with the high frequency amplitude usually 25 per cent of the low frequency amplitude. In this case the difference frequencies which result from non linearity will be centered around the high frequency. The high frequency and difference frequencies are separated from the low frequency component by a high pass filter which eliminates the low

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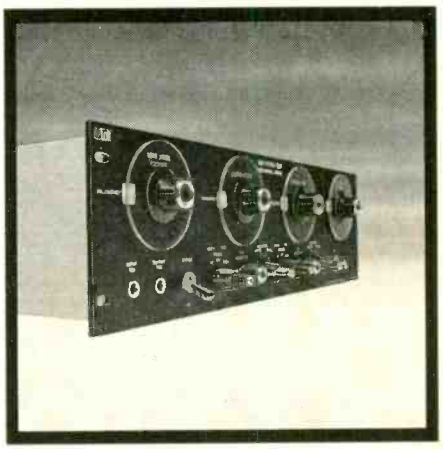

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frequency component and outputs an amplitude modulated version of the high frequency if distortion is present. This amplitude modulated waveform is then rectified (detected) and fed to a low pass filter to eliminate any remaining high frequency and to provide a clean version of the intermodulation components for measurement.

The percentage of im distortion is determined from the average value of the amplitude modulated waveform at the output of the high pass filter and the rms value of the intermodulation components at the output of the low pass filter (**fig. 1.**)

It is sometimes claimed that there is a direct relation between im distortion and harmonic distortion; figures have in fact been published for this relation between methods. However, this relation is only true if the frequency response of the unit being considered is flat throughout and no pre-emphasis or de-emphasis is included. It is quite possible to contrive a system with zero harmonic distortion and very high im distortion. Furthermore, harmonic distortion measurements at high frequencies may be meaningless if the harmonics are beyond the high frequency cut-off of the unit being tested and I have all too often seen such absurd figures quoted.

From the point of view of the ear itself, intermodulation distortion is far more objectionable because not only is it non-harmonically related to the original frequencies but it is not found to any great extent in natural sounds.

A further advantage of im measurement is that system noise does not interfere with measurements to nearly such an extent as it does with total harmonic measurement, which provides an immediate advantage that im distortion can be determined at very low power levels, such as when investigating crossover distortion in power amplifiers.

So much for a very abbreviated description of im distortion measurements, what about the Crown *IMA*? While the instrument is basically designed for 483 mm rack mounting, the review sample was mounted in the normally supplied standard 'walnut finished furniture piece with decorative protective black vinyl end trim' which together with a scratched aluminium finish front panel and black knobs would adequately adorn the bookshelves of any lounge.

This 'furniture piece' has very adequate stowage for the fixed mains lead and mains plug (including enough space for a 13A plug) at the back, but lacks any front feet for tipping the instrument backwards which can make reading the meters a little awkward when the instrument is on the bench.

The rear panel of the instrument includes two fuses together with a spare. All the operational controls are mounted on the front panel, which includes two illuminated meters with the mains on/off switch located at the centre between the meters. The layout is logical with all input controls to the right of centre and all output controls left of centre, a master gain control which effects input and output being centrally located.

Starting at the left of the instrument, there are two pairs of standard terminals/sockets on 19 mm centres for applying external signals, together with ext/int slide switches, and a further pair of terminals/sockets for the output from the instrument. Proceeding towards the centre of the instrument, there are then a pair of concentric attenuators (which control the output by means of a 40 dB attenuator in 10 dB steps) and also a continuous attenuator with a nominal 15 dB range which between them provide peak outputs between 26 mV and 23 V. The final output controls are a high frequency level control which permits the hf level to be adjusted from zero to 100 per cent of the low frequency level by means of the left hand meter which can be switched by a slide switch to either read high frequency level as a percentage of low frequency level, or to read input to the analyser.

The design of the output section is such that it includes 7 kHz and 50 Hz (60 Hz in the USA version) oscillators for SMPTE im distortion measurements but the internal mixer is such that any combination of audio frequency signals may be mixed so that, with one or two external signal sources, a CCIF im signal may be obtained.

On the other hand, the input section is confined to SMPTE im measurements (with the possibility of using LeBel's oscillographic method which I have not described). Proceeding from the centre of the instrument there is a seven position rotary switch for selecting the percentage distortion ranges in a 1:3 sequence from 100 fsd per cent down to 0.1 per fsd cent on the right hand meter which is directly calibrated in percentage im distortion. There follows a manual tracking switch, about which more will be said, and an input level potentiometer for setting the input level on the left hand meter with a minimum high frequency input requirement of 16 mV.

Finally, there are three pairs of standard 19 mm spacing terminals/sockets, one pair for the instrument's input and two pairs for feeding an oscilloscope from either the output of the high pass filter (which is the high frequency envelope) or from the low pass filter output (the distortion components).

The remaining control, which is located at the centre of the front panel, is identified as 'master' and takes the form of two ganged 45 dB attenuators which are switched in 5 dB steps. When the manual tracking switch is set to tracking, this attenuator is arranged to decrease the output from the instrument simultaneously in 5 dB steps and increase the sensitivity of the input in 5 dB steps: thus, once the analyser has been set-up in the track mode, it can be switched to read im distortion directly at 5 dB intervals in level by rotating the master switch and without any further adjustments to the controls. This facility, albeit simple, does save an enormous amount of time in making measurements.

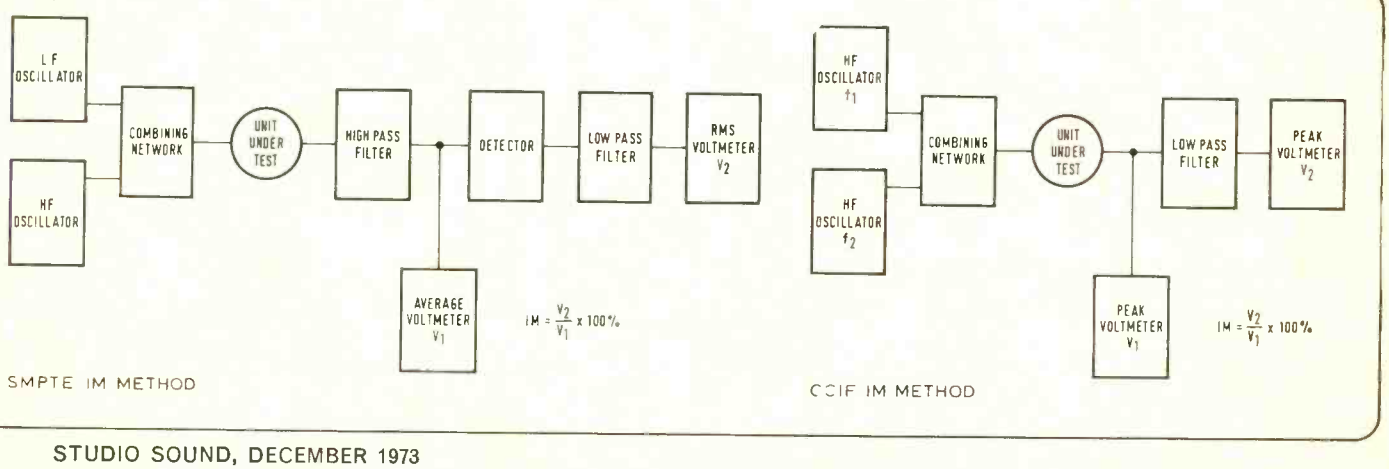
However, in order to use the full facilities of the track device, a minimum hf input of 2.8 V rms is required, the maximum permitted input being several hundred volts.

A further facility offered by the master control is that it remains connected to the output section only when the manual tracking switch is in the manual position: therefore, provided that the tracking facility is not required, the minimum output of 26 mV peak in the tracking mode may be further reduced by 45 dB which ends up around the 100 μV mark.

Operation

Before dealing with practical knob twiddling it should be mentioned that the instrument is provided with a most comprehensive instruction manual, which not only includes operating instructions, but also a full description of the functions of the instrument, calibration instructions, the circuits and components lists and comments upon the practical use of the

FIG. 1



instrument including novel applications.

Once the function of the controls has been understood, practical operation is very simple. First the relation between the amplitudes of the hf and lf signals is established by removing the lf signal (disconnecting any external lf and switching to external), switching the left hand meter to output and adjusting the hf level control for the desired percentage reading on the meter. The lf signal is then restored and the output voltage set to the desired value by means of the concentric attenuator controls.

Next the manual or tracking mode is selected as desired and the input attenuator set for fsd on the left hand meter. Im distortion may then be read directly from the right hand meter by operating the im per cent range control.

If required, the actual intermodulation envelope may be examined by attaching an oscilloscope to the scope A output, ot the completely de-modulated waveform may be examined at the scope B output.

The signal generation section

The internal oscillators comprise a 50 Hz oscillator which is locked to the mains frequency and acts as a low distortion high stability mains buffer. Distortion of this oscillator was measured as 0.14 per cent total harmonic against the specified 0.1 per cent but the measurement is open to suspicion as the result of possible introduced mains hum. The second high frequency oscillator operates at a nominal 7 kHz ±1 per cent and was found to be at 7 kHz within 0.11 per cent from switch on and over a wide mains input tolerance. Distortion of the hf oscillator was measured as 0.034 per cent.

While the oscillator distortion is not particularly critical for the measurements of im distortion, and both oscillators have more than adequate performance, the output level constancy of the oscillators is of prime importance. Here both oscillators demonstrated extremely good performance, with variations of output less than 0.02 dB even when the nominal mains input of 240V was reduced to 210V.

Accuracy of both the switched output attenautor and the master attenuator were better than 0.05 dB at both the high and low frequencies and the variable output attenuator gave a maximum attenuation of 18.9 dB which is advantageously larger than specification. The output impedance of a nominal 600Ω ±1 per cent varied from 605.4Ω to 597Ω according to attenuator settings, which is within specification.

When using external signal sources a minimum of 4V rms is required to produce 100 per cent output level for both the hf and lf signals. The load impedance is 5.58kΩ for the lf input, and varies between 2.604 and 4.864 kΩ for the hf input, according to the hf level setting.

While the specification quotes frequency limits for the hf and lf inputs, these limits really arrive from the performance of the analyser section filters. In fact the frequency response of the signal generation section is extremely flat for both inputs over the audio range and can therefore be used for other signal mixing purposes, such as signal generation for im distortion measurements to the CCIF method.

A final matter of interest in this section is the metering accuracy when setting the ratio between hf and lf signals—in the worst case at any setting between 20 per cent and 100 per cent the error including readability was less than 1 per cent which is quite adequate.

The analyser section

The minimum hf level input requirement was approximately 16 mV rms in the manual mode, or 2.8V rms in the tracking mode, with a maximum capability of several hundred volts. Input impedance varying between 67.3 kΩ and 96.6 kΩ according to the input attenuator setting, unaffected by the master tracking control which was itself accurate to better than 0.05 dB.

As has already been said, the acceptable hf and lf frequency ranges are determined by the analyser section; the principle is that at least the first order sum and difference frequencies of the hf and lf shall be within the pass band of the high pass filter, and also that the lf and preferably its harmonics shall be within the pass band of the low pass filter.

Examination of fig 2 (ignoring the boost around 2.5 kHz which resulted from the test method) shows that the high pass characteristic is effectively flat from 2 kHz to above the audio range and that the low pass characteristic is effectively flat below 500 Hz, the practical

96 ▶

FIG. 2
CROWN IMA
FILTER RESPONSE

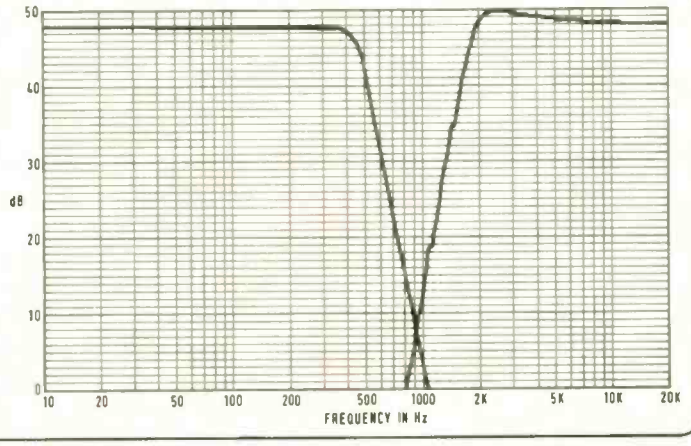
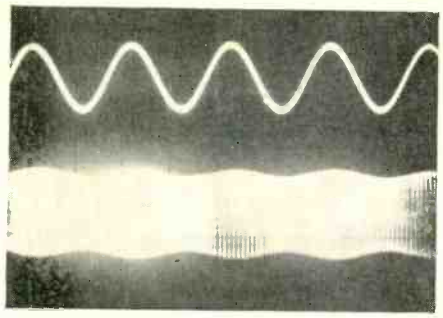


FIG. 3



lower limit being about 10 Hz where the instruments meter damping is insufficient to make accurate readings possible.

It follows that the specified limits for the lf (10 to 150 Hz) and the hf (2.5 to 20 kHz) are really pessimistic, and that frequencies outside the specified ranges can be used with caution.

The accuracy of the im calibration was checked at fsd and 30 per cent fsd on all ranges and found to be within the specification but, as the best digital voltmeter was away being recalibrated, it was not possible to make more precise measurements. Residual im indication using the internal oscillators was always less than 0.003 per cent which is exceptionally good. Fig 3 shows the nature of the A and B oscilloscope monitoring points, which gave fsd outputs of 1.52V rms and 1.1V rms respectively from internal impedances of 10.54 and 10.48 ohms respectively. A is shown uppermost.

Summary

The Crown *IMA* intermodulation distortion analyser is without doubt a first class instrument and comes into my 'if it does what you want and you can afford it, buy it' category of equipment. The published specification is met by a large margin and furthermore it is a very tight specification to meet.

What more can be said?

H. D. Ford

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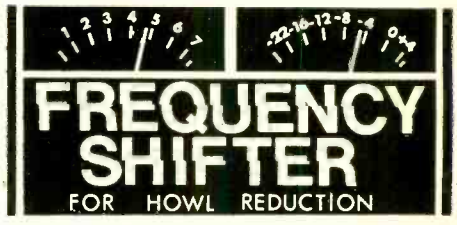

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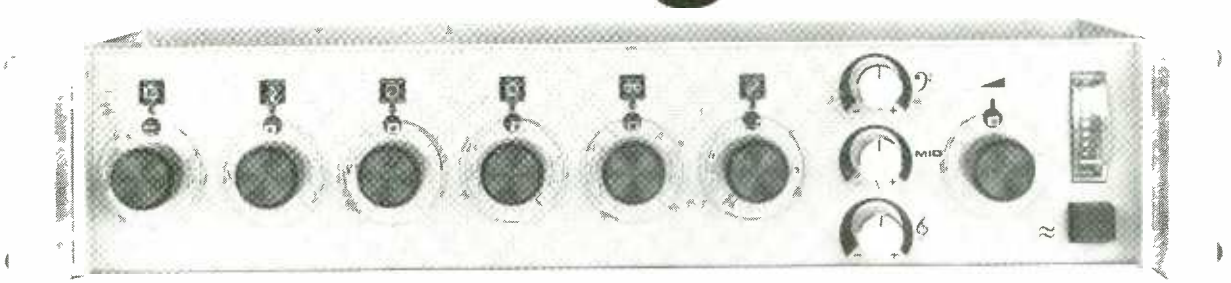

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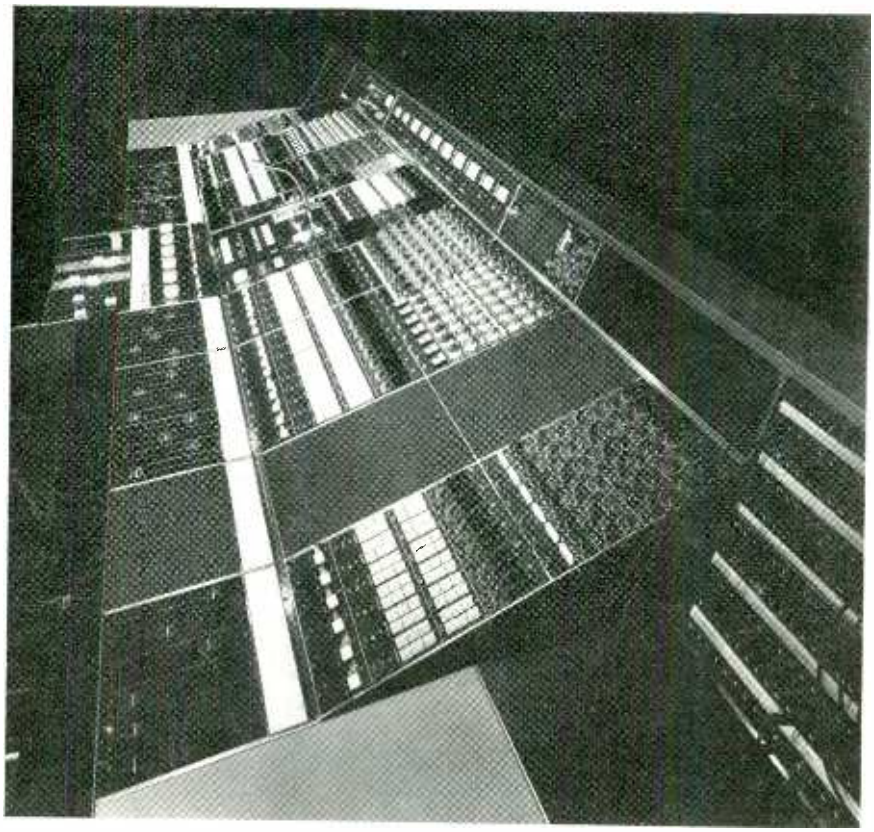

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