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studio sound
INCORPORATING TAPE RECORDER

NOVEMBER 1972 VOLUME 14 NUMBER 11

EDITOR DAVID KIRK

ASSISTANT EDITOR JOHN DWYER

CONSULTING EDITOR JOHN CRABBE

AUDIO GROUP ADVERTISEMENT MANAGER ROBIN WELLS

ADVERTISEMENT MANAGER TONY NEWMAN

AMERICAN REPRESENTATIVE STEPHEN H. LAMPEN

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

American Office: 2930 Jackson Street, San Francisco, California, 94115, U.S.A.

SOMEWHERE IN the nether regions of most recording studios you will find, often between the gents' and the tape store, a small cluttered room heavy with the smell of yesterday's solder. This, The Workshop, is where the equipment which publicity men insist on calling 'sophisticated' comes when it breaks down. Here recording machines and their guarantee cards are scrutinised for (to bend the Quad phrase) the easiest return to the original sound. At best, a telephone call will result in the immediate delivery of a replacement module. At worst, the studio's maintenance engineer may be destined for a week-long archaeological dig into the depths of unfamiliar apparatus.

From the operator's viewpoint, communications equipment is rapidly becoming easier to use. Automatic location finding, elaborate remote control systems and now automatic mixing (see pages 21 and 51) are obvious examples. Continuously variable tape speed, electronic delay lines and semi idiot-proof noise reduction systems are less obvious. Fine for the balance engineer but a future nightmare for maintenance staff. Digital systems in particular are making the ill-equipped service workshop entirely obsolete. Future maintenance problems are best avoided by purchasing equipment only from companies with an established reputation for follow-up servicing. Even then, difficulties may arise when today's equipment becomes tomorrow's second-hand stock.

The BBC in particular face a chaotic future unless their maintenance program is revised to take into account digitalisation, automation and miniaturisation. They have recognised the pitfalls of rapid technical evolution (page 39) and are considering a three line maintenance system modelled on that used in the armed services. In principle the latter appears logical and efficient, provided an information feedback loop is maintained between line three and what might be called 'line zero'—the designer. A danger exists, however, that third line engineers will lose contact with the staff who actually use the subject equipment. This aspect of the Services servicing should be studied very closely before the BBC commit themselves to a three line scheme.

FEATURES

COLUMNS

REVIEWS

COVER

Part of the Mini Moog Model D electronic music synthesiser. This unit is field tested on page 31.

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, engineering and music 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.

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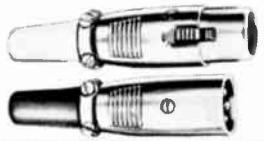

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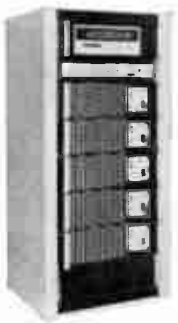

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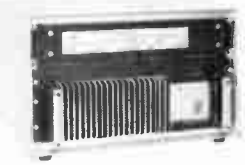

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News

Philips video disc

PHILIPS HAVE launched a colour video disc giving 45 minutes playing time a side. Unlike the Teldec, its only rival so far, the Philips disc, first shown at a press conference in Eindhoven on September 5, has no grooves or mechanical tracking apparatus. It is also claimed to be more resistant to damage than a conventional lp. It will cost about £6.

The disc, which spins at 25 revolutions per second—half the speed of the Teldec—can manage a total of more than 45,000 colour images and, with extra equipment, pictures can be stop-framed, played as a sequence of frames, played in slow motion or in reverse. It has been estimated that, if the disc were used for sound only, 16 hours of music could be accommodated on one side.

The VLP, as it is called, is 30 cm in diameter and has its surface covered in tiny pits, each of the same depth and width but varying in length and distance from one another. It is in these that the chrominance, luminance, sound and sync information is stored. The surface of the disc is coated in a thin metallic reflecting layer which, in turn, is covered with a protective plastic coating. The rotating disc modulates a laser beam from a cheap helium-neon cell. The beam scans the disc and the reflected beam reaches a photocell. The signal from the photocell is then processed to feed a domestic television receiver.

Reports of the Eindhoven demonstration indicate that the demonstration was good. It was particularly interesting that a video recording of journalists entering the conference was later shown to them—from a disc—an hour later. Philips have not yet made any plans for a British demonstration of the equipment.

Ampex recovery

IN THE LAST month Ampex have announced orders for their equipment worth nearly £1,700,000. Czech television have just taken delivery of their fifth mobile outside broadcast vehicle. The vehicles are built by Dell coach-builders of Southampton to customers' specifications. A spokesman for Ampex explained that, as long as there was an Ampex recorder in the unit, it would be equipped with whatever equipment a customer specified, regardless of manufacturer. This, said the spokesman, was probably the reason for the success of the units.

Belgian television has just ordered £1,250,000 of video recorders, for the new television centre in Brussels, and Harlech television and ATV, here in Britain, have each ordered two *ACR25* colour broadcast recorders. Each order is worth £200,000.

Ampex, who announced in April a loss for the fiscal year ending April 29, 1972, of around £36,000,000 on sales of £116,000,000, have just announced their figures for the first quarter of this year. The figures report sales of £28,000,000 for a loss of about £1,230,000. As he gave the figures, Mr Arthur Hausman, the Ampex president, said the loss was less than expected and that more orders had been written for professional video equipment in this first quarter than in any previous quarter in the company's history. The total backlog of orders for the beginning of the second quarter of this year was over £40,000,000, the highest yet.

'We still have much work to do,' he said, 'but the results of the first quarter are encouraging. I believe we are on our way to rebuilding Ampex on a sound financial basis.'

Ampex have just concluded loan agreements with their bankers and insurers which grant them £62,800,000 of credit, in the form of renewable 90-day notes, at an interest of two per cent above the prime rate. The agreement extends to July 31, 1974. To secure the loans, Ampex have mortgaged their domestic property holdings, which have a book value total of £13,000,000, and pledged their stock investments in various subsidiary companies to a value of £51,500,000.

The Beeb Saga

A SERIES OF talks to commemorate the BBC's 50th anniversary has been announced by Mullard. The 23 films and 33 lectures, which will be held at Mullard House from November 3 to December 21, will cover the technical developments that have taken place since the BBC made its first broadcasts in 1922. The talks will include: *Audio recording developments; Satellite tv broadcasts; Radio telephone module development; Post Office component development; Digital techniques in broadcasting; BBC sound archives; Television special effects; Running a local radio station; Sports coverage* and *Television news*. Films will be shown about the electron, colour tv, microcircuits, the Post Office tower, electromagnetic waves and *Match of the day*.

Macinnes appointment

MACINNES LABORATORIES have appointed Chris Flack, formerly of Fenland Dynamics, as their Technical Sales Engineer. Chris, who joined Macinnes on October 1, spent four years at Cambridge University doing research, after which he joined a group. He played professionally for two years and then became chief engineer at Fenland, where he designed sound systems for theatres, churches and pop groups. His recent work has included the pa system for the Cambridge folk festival. Chris is an engineering member of the APAE and has City and Guilds Certificates in Electrical and Mechanical Engineering.

CTH contract

THE SOUND distribution system for the Commonwealth Conference, which will be held in Blantyre, Malawi, between October 20 and 27, is being installed by Sound Light International of Leicester. The equipment, which was designed and built by CTH Electronics, was shipped 12 weeks after the order was received. It includes a 100 and a 50 channel mixer, power amplifiers, all the necessary wall boxes, junctions, ancillaries and connecting

continued 46

Below : CTH mixer installed for the Commonwealth Conference

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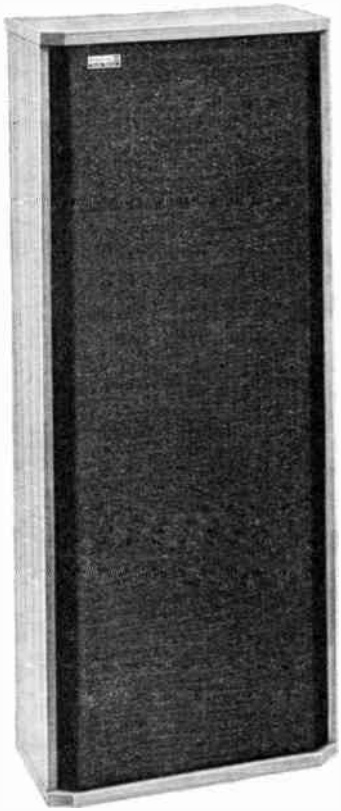

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Letters

Gain control

Dear Sir, I have just read Michael Skeet's article in the August 1972 issue of STUDIO SOUND entitled 'A Novel Quadrant Fader'. It was also my pleasure to have a look at Mr Skeet's nicely made mixer using these principles only a few weeks ago. He knows that, while impressed by the ingenuity of the ideas he exploits, it is my personal view that this is not the best way of carrying out voltage control of gain.

However, another possible fault with Mike's approach has been suggested to me by Peter Baxandall, who has been working with Cd cells as a control device in a very similar manner. This is the rather surprising discovery that Cd cells do not, in fact, behave as variable resistors but are distinctly nonlinear in action. This is contrary to what I (and I suspect, everyone else) believed. It has been clearly demonstrated to me that significant even order harmonic distortion is introduced when a Cd cell is used in this manner, ie as one arm of a potential divider in an audio attenuator. So it would be interesting if this factor could be checked by Michael and reported later in your magazine. It looks as if one well established preconceived idea is about to be thrown out of the window.

Yours faithfully, Reginald Williamson, Audio Engineering Consultant, Bay Cottage, 18 Unthank Road, Norwich NOR 28E.

Newsfilm sound

Dear Sir, Terence Bracey's September article on newsfilm sound was of great interest, although it was difficult to see why its scope was limited to that particular aspect of film sound which concerns so few. For example in all other types of filming Nagra recorders have reigned supreme for years as the source of double-system sound and of course the *SN* model has no equal in the news field.

However it was in the conclusive part of the article dealing with the future that I felt the article to be skimpy, perhaps because it was no longer possible to deal with newsfilm in isolation. Whatever techniques evolve will not be developed for news alone.

Earlier in his article Mr Bracey correctly blames current acetate film bases for many short-comings in commag sound. In this country and America this stock is almost exclusively supplied by Eastman Kodak, who must be pressed to introduce mylar based colour film without further delay. This material has been available with Japanese and German colour and monochrome emulsions for some years in 8 mm but Kodak continually make excuses for withholding it.

The introduction of such a stock would have many other advantages. It is normally about two-thirds the thickness of acetate, allowing for longer runs or less bulk and with the bonus of higher light transmission. Its much superior strength and keeping properties are of vital importance in all fields except perhaps newsfilm.

In this last connection I find an amusing paradox in the situation which presently obtains in the fight between film and portable vtr. Whereas the gramophone record is frequently held to ridicule by tape enthusiasts because the disc depends upon friction to produce its result, the same must be said of helical scan vtr—the only form in which viable portable vtr apparatus has appeared, and that only for monochrome. At present oxide wear in such systems allows of about the same number of playings as one can achieve with acetate film. But the balance would shift in favour of film on the mylar base, whose picture area is not even touched on projection.

Although Super 8 mm film has gained some acceptance for news applications in the USA, it is unlikely to do so here where standards are higher and truly local tv non-existent. The current rash of silent running 16 mm 60m run cameras also reduces significantly the burdens of operating the previous generation of blimp-free cameras. It should also be remembered that commercial rather than technological considerations were to the fore in the introduction of Super 8 mm stock, which actually has less width available for a sound stripe than the double-eight standard format which it sought to make obsolete.

Portable vtr achieves a lightweight camera by consigning the storage medium to a separate machine slung from the shoulder. The cine camera is therefore much more compact and only becomes weighty as the need arises to silence the contact of the intermittent mechanism with the film. The development of a Wankel alternative is surely an important future possibility and has already been achieved in certain high-speed applications for film.

In conclusion, it is perhaps a pity that the gauges of film could not have been standardised at an early stage as one-inch for theatrical use and half-inch for all other purposes, but perhaps that is heresy in a metric age.

Yours faithfully, Douglas Macintosh, Document Film Services Ltd, 8/12 Broadwick Street, London W1.

Local radio

Dear Sir, London has many local characteristics other than the dirt and tourists mentioned by John Dwyer in his survey of local radio in your September issue. Shared Local Government, shared entertainment, shared transport problems are among the more obvious, and in themselves they more than justify a radio station that serves the whole of the GLC area. No-one thinks it odd that two local daily papers should serve this area, large though it is. Why should it be strange for a radio station to do the same thing?

Incidentally, BBC local radio was not a belated reply to the commercial pirates as your article implies. The BBC first told the Government that it wished to promote local radio in 1959, and it made its first application for permission a year later in 1960. Nor, now that we have local radio, is playing part of a record help in solving our 'Needletime' problem. Every second counts—and it has to be registered against our allocation.

Yours faithfully, Peter Redhouse, Manager, BBC Radio London, Harewood House, Hanover Square, London W1R 0JD.

Imperial hams

Dear Sir, I was surprised to see in your September issue that an advertiser of loudspeakers has evolved his own unit of measurement, the Nothing. An example: 32 x 14 x 11. Eleven what? Other spec writers ignore the national adoption of metrication and plod on with their inches and their pounds, stooping occasionally to include a cm/sec, C/s, cm/SEC —or whatever takes their fancy. This is ham. Your editorial style is much more consistent (apart from the indecision between millimetres and centimetres for small dimensions) so why don't manufacturers follow suit?

Yours faithfully, C. E. Morton, 21 St Georges Drive, Westcliff, Essex.

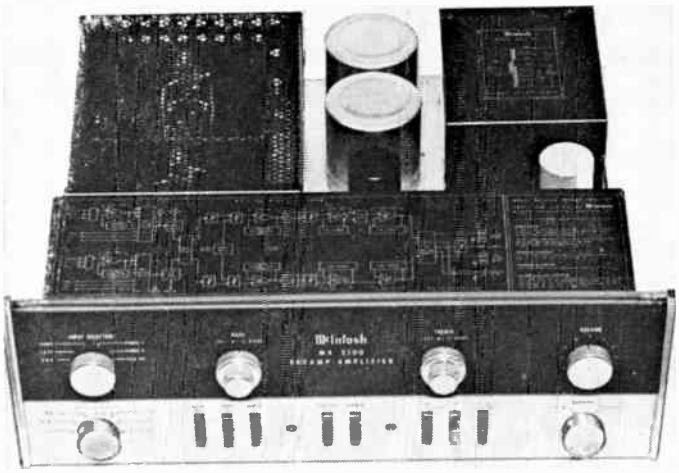
Bootstrapping

Dear Sir, I would like if I may to make a suggestion regarding the circuit design features you have in your magazine. It concerns the extensive use by some contributors of 'bootstrapping' the collector loads of amplifying transistors. I have rarely found that this type of circuit to perform satisfactorily over a long period of time; unwanted effects of rf pickup and squegging usually occur as the bootstrap capacitor ages (presumably due to inductance in the capacitor).

A far more satisfactory solution is to use a fet or bi-polar transistor to increase the dynamic collector load of the amplifying transistor. Previous limitations prevented this technique from being used (i.e. high current gain transistors h_{fe} 1,000 plus) for use as an emitter-follower stage to the amplifying stage, preventing loading on the amplifying transistor. These are now solved by the availability of low cost Darlington transistors and fets. Examples are *MPSA14* at 32p and *2N4302* fets at 30p.

Yours faithfully, W. H. Spencer, 31 Southwood Road, Liverpool 17.

McINTOSH IS HERE!



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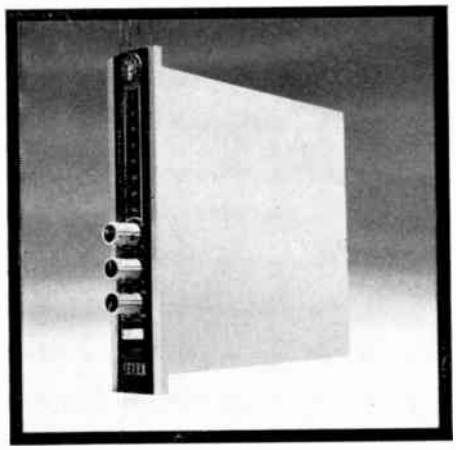

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The Sound of 'Superstar'

By David Collison (Theatre Projects)

UNLIKE most musicals which are conceived with a theatrical production in mind, *Jesus Christ Superstar* started life as a double lp. In a recording studio it is comparatively easy to achieve a balance between a 25-piece orchestra, a rock group, a solo voice and a chorus; but in a theatre with none of the ideal conditions built into studios this poses quite a problem.

The orchestra, which fills the pit at the Palace Theatre, consists of 15 strings, six brass, and four woodwind. There is a full orchestral percussion section, which because of space problems has to be on the side of the stage, including vibes, xylophone, glock, cymbals, bass drum, timps and triangle. Closed-circuit television from the conductor plus foldback monitor speakers from the orchestra keep him in tempo. Down stage left there is a section of rock group with full drum kit and three electric guitars—lead, rhythm and bass. On the other side of stage is the rest of the group with piano, electric piano, electric organ, and synthesiser.

In order to achieve a sound balance between all these musicians it was necessary to install a microphone for each instrument. This created a problem. As the microphones for the quieter instruments require to be used at a higher gain, they therefore pick up the sounds from the louder instruments. Similarly the rock group on stage tends to obliterate the actors' voices on the vocal microphones. A great deal of acoustic treatment including absorption and separation had to be done to minimise this spread of unwanted sound.

The director, Jim Sharman, wisely decided that a close-microphone technique was necessary for the singers. He also decided that it would be pointless trying to disguise the fact that microphones were being used. So for the main acting area we have three motorised riser microphones which can also be lifted off for hand use, plus six other hand-mics placed around the stage. There are three general pickup mics up-stage, two off-stage for chorus work, two 'specials' for the crucifixion scene, plus a total of 22 hand microphones for chorus use on the side stages.

In order to control and balance this very large installation, a special mixing desk had to be devised. It was obviously physically impossible to manipulate up to 80 separate channels at once so a certain amount of sub-grouping was incorporated. The desk was also split in half so that one operator could balance the orchestra and a second operator the voices.

24 days

A mere three and a half weeks before the required delivery date, Messrs Alice (Stancoil) Ltd received the verbal go ahead to start building a 100 input studio-quality stereo mixing desk, incorporating many non-standard frills; a task most manufacturers would take many months to achieve. It arrived on time—and working.

The loudspeakers used for the auditorium are all American Altec units with built-in amplifiers. Ten bass cabinets and ten high-frequency dispersal horns are installed. There is less than 1 kW of amplification but these particular loudspeakers are extremely efficient and do not require driving very hard.

The excellent microphones, of varying types and design, are all from AKG. These are mainly *C451* capacitors, D202, D190 and D160 for hand use. Keith Monks (Audio) Ltd provided some splendid microphone stands and brackets.

Theatre Projects were very fortunate to have available the services of a top class recording engineer for the initial orchestral balancing sessions. Michael Moor, who is manager of the Theatre Projects music recording studio, was able to obtain a sound on every instrument acceptable to musical director Anthony Bowles and a very exciting total blend. Michael Moor's biggest problem was adjusting to being able to hear the musicians via loudspeakers while hearing them 'live' at the same time. In New York, they apparently covered over the pit completely with glass and had the conductor standing in a perspex bubble. This did not work for many reasons, one of the main ones being that they lost the theatrical and exciting sound of a live orchestra.

Readers who may be worried that the result is what Anthony Bowles calls 'an aural assault course', as at a rock concert or some musicals heretofore, need have no fears. The whole object is to achieve as pleasant a sound as possible without ever approaching the threshold of pain. There are, indeed, long passages in the show where no microphones are used at all.

David Collison at the Alice desk

Around the Studios

BY ADRIAN HOPE

Electric Lady

THREE or four years ago, when Jimi Hendrix was at the peak of his career (he died soon afterwards), he and his manager Mike Jeffries hit on the idea of opening their own recording studio. Hendrix was at that time spending so much time recording in other people's studios that it looked like a sensible economy to put the money instead into a studio of his own. The location that Hendrix and Jeffries finally settled on was a disused nightclub in New York City's Greenwich Village—dangerously (from a commercial point of view) far away from the region of the city traditionally associated with recording studios. Hendrix originally intended that the studio should be half a nightclub and half recording studio but, fortunately for all concerned, Eddy Kramer (the engineer entrusted with the task of putting the whole thing together) soon knocked that idea firmly on the head.

A million dollars later . . .

Fourteen months and $1,000,000 later the Electric Lady Studios opened on West 8th Street, Greenwich Village, and Eddy Kramer recently showed me round what is now one of New York's most successful studios.

The ideas for layout were Kramer's but the architect who designed the studios was John Storyk. The basement (where the studios proper are) is built on New York bedrock. Even with the New York subway rumbling away beneath, and although Kramer admits to sensing its presence sometimes, there has never been any real problem over rumble filtering through on to a recording. Although there was no need to soundproof downwards, the soundproofing necessary in an upward and sideward direction was extensive. Most of this sideways soundproofing is concerned with acoustically isolating the two closely adjacent studios (A and B) and Bob Hanson was responsible for designing a floating three-wall system using sand-filled bricks. The basement ceiling needed proofing because immediately overhead there is a cinema (incidentally rather curious in that, when built in 1920, it was designed to look like the inside of a camera). Although there is not much risk of film noise coming down from the cinema into the studios, there is very real risk of rock group sounds blasting upwards to disturb the cinema audience. There is also a curiously noisy central heating system used in the cinema which might have caused trouble on cold days. All these problems have been avoided by the use of three separate ceilings, layered one over the other.

Because the studios are in a basement and New York becomes so abominably hot in the summer, a giant air conditioning unit maintains constant temperature and humidity all the year round, with separate zones under separate control.

To get into Electric Lady through the rather tiny front on West 8th Street, one must pass through a heavy oak door which is opened only after the caller has been scrutinised by closed circuit television. I asked Eddy Kramer about security. 'Out there on West 8th Street it's a jungle,' he said. And it is. One of the roughest, most ominous areas of New York which must itself be easily the roughest city in the world.

Barnes to New York

Kramer originally moved to New York from Olympic Studios in Barnes, initially to work for Record Plant and it was there that he met Hendrix. He now lives permanently in the States with occasional trips back to England. Among artists he has recently recorded are John Mayall for Polydor and Muddy Waters for Chess. The up and coming young engineer at Electric Lady is 21-year-old Dave Palmer, who has just finished producing and recording an album entitled *Godfrey Daniels* for Atlantic.

'There are going to be a lot of surprised faces when that album comes out,' said Kramer. 'Especially when they find out who the musicians on it actually are.' I couldn't get any more out of him but I believe that the surprises are in the area of multitracking by only a very few source musicians.

Other engineers who work regularly at Electric Lady Studios—but as independents—are Malcolm Cecil and Bob Margouleff. Cecil was known for years in England as a bass player before he took off to America and worked his way up to his present position as one half of the Cecil/Margouleff engineering team. They also specialise in electronic synthesis with an expanded Moog *Series 3*, both in the studio for records and now live for one or two concerts. Future plans are for 12 Moog banks in live performance.

While I was there, Cecil and Margouleff had just finished recording Stevie Wonder with some beautiful backings created only by Moog and drums. Late one night I found them mixing down live concert material with Ritchie Havens.

Combined abilities

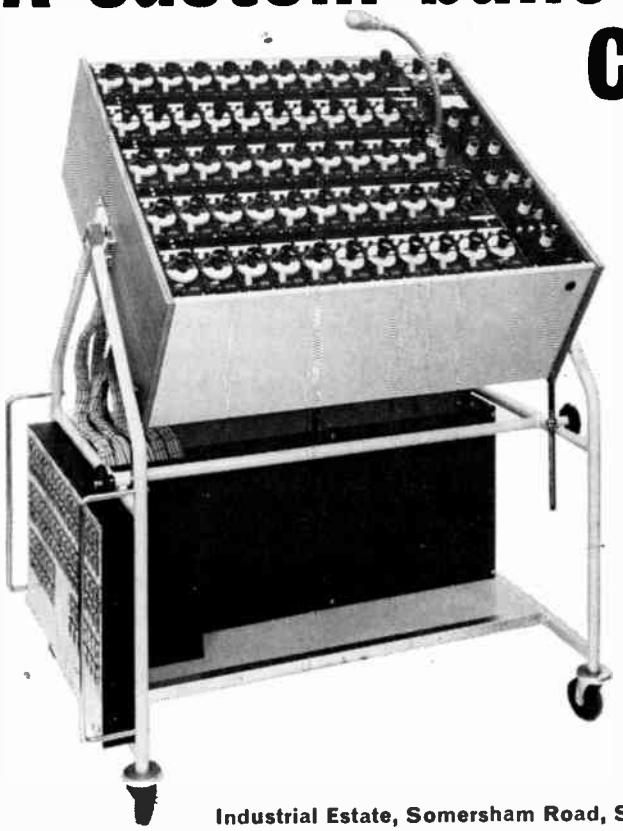
Malcolm Cecil was always well respected in England as a bass player but it is only now in New York that he has been able to combine his musical abilities with his electronic capabilities and become, with Margouleff, one of the hottest properties in the recording world.

All mixing at Electric Lady Studios is done (usually through the night) in the studio control rooms, there being no separate reduction rooms. There are, however, separate tape copying rooms, workshops, rest rooms and even a kitchen. The studio control rooms are

continued over

Electric Lady studio through control room

A custom-built mobile 50-way CTH Sound Mixer . . .



The photograph shows the 50-way trolley-mounted console of a complete sound distribution and mixing system recently completed to special order. Ideal for either studio or location work, it operates either from mains or 12 volt battery and incorporates a jack field and two integral 30 watt power amplifiers.

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continued

interesting in that in front of each console is an area of floor with scatter cushions so that friends and other spectators can watch a session without bothering the engineers. Both studio control rooms have 16 track Ampex machines and if necessary the use of two machines in sync can give 30 tracks (two tracks being used for sync pulses). In all there are 42 Dolbys available (apart from the copy room Dolby equipment) as well as DBX equipment. Studio time works out at around $150 per hour for 16 track facility, with a minimum of a three-hour booking for each session. Remix is at around $100 per hour although for quadraphonic remix there is an additional $25 per hour payable. At present there are plans to build a quad remix room upstairs with the offices.

Among the studio instruments available are guitar and bass amplifiers, two Ludwig drum kits, a Yamaha grand piano in studio A and Steinway in studio B, Yamaha organ, and two Hammond *B3* with three Leslie speakers. A Moog is also available. When the present president, Jim Marron, retires for a year's sabbatical to the Balearics (I wondered aloud whether Electric Lady were moving into Europe but was told that this isn't so), there are plans to extend the studio outwards and upwards into Marron's apartment. This lies conveniently through the wall to one side of the building. By knocking down this wall, it will be possible (to the tune of $250,000) for Electric Lady to build a permanent electronic music studio using Moog, ARP and Synthi equipment. This will be under the guidance of Cecil and Margouleff.

The studio total staff at present stands at 30, with six senior engineers and six junior. The rest are maintenance engineers, clerical staff and telephonists. With the Yamaha grand alone being tuned at least once a week, Kramer jokes about putting a tuner on the staff as well.

Groups can bring their own equipment down to the studios if they prefer it to using that already available and a massive pneumatic service lift connects street level with the below-street level studios. Of these, studio B is the smaller and has the deader acoustics. While I was there, the soundtrack for a documentary film was being recorded by a small group with no picture but an electronic metronome for timing. Where it is necessary for the group to view the film, Lady usually transfer the movie from film to videotape and then show the tape on closed circuit television.

Tight or lively

Studio A is large, is carpeted over half its area, and has oak wood over the remainder. This way there can be a tight sound for the rhythm section and a more lively sound for strings. There is low-key changeable coloured lighting throughout all the studios for creating whatever mood the group or producer require.

The desks are 36 channels in and 36 out and the monitors are JBL and Altec *45A* (four per studio). The studios each have conventional vocal booths and the large studio A can be divided by Rockwood partitions down the live/dead dividing line.

Upstairs, after looking at the studios themselves, I talked to Eddy Kramer in an office peppered with golden discs. I remarked about how the studio, although it had a relaxed atmosphere for those booking and using it, seemed in fact to be very tightly run. Anyone thinking of the fairly freaky Hendrix pop star image, and expecting to find his studio run along similar lines, would be in for a distinct surprise. Both Kramer and Jim Marron deplore any muddled outlook and realise that they are in a tough business up against heavy competition in the New York area. They are also obsessive about equipment maintenance—no liquids being allowed within metres of a console and the service room being very fully equipped.

Learning about quad

For anyone interested, Kramer confirms that nearly all the worthwhile Hendrix recordings have been mixed and released. He also told how the studios are now heavily involved in learning about quad mixing. At the time of writing there is still doubt over which disc encoding system will win out and the only quad issues are on four-track tape. Most studios of any repute are already heavily involved in finding the pitfalls of quad mixing. Kramer emphasises the very real problems that are going to be encountered once the initial enthusiasm for exhibitionist quad mix-downs has been got out of the way. One difficulty is that the mix is likely to sound very different at home in a domestic situation from what it sounded like in the studio. Kramer believes especially that great care will have to be taken where anything is put behind the listener because it would be psychologically disturbing.

'There is always the risk of making people want to turn round and look behind them. That is obviously going to be hopeless. We shall tend to put all the real information to the front of the centre with only a little echo at the rear. We have found that any voice support, from a guitar backing the voice for instance, will have to go exactly or very close to where the voice is. There is also the problem that, with the instruments spaced out, they sound very bare and it is possible to pick out every single detail of what is being played. So faults show up that could well be hidden in a stereo mix. All in all it is going to take us all a long time to get used to mixing sensibly for quad.'

America as a whole is by tradition often well ahead in trying out new ideas. Thus Kramer has already been involved in a simultaneous television and stereo radio 'simulcast' using WNEW radio station and channel 13 television.

'My feeling is that stereo is pretty much at the peak of perfection now.' [*Quote of the year*—Ed.] 'The public is generally round about five years behind the industry. I don't think they are really ready for quad yet because it is going to cost them a lot of money. By the time they have got the equipment, and the discs system battle is sorted out, we should be well on top of the question of putting out a psychologically acceptable quad mix.'

Electric Lady is clearly a commercially successful studio—despite at least one brief rumour to the contrary. When some passing New York junkie pulled the nameplate off the door on 8th Street, the word went round before it could be screwed back again that Lady Studios had gone out of business. New York is like that.

Multitrack Remixing-A Fresh Approach

By Clive Green [Cadac (London) Ltd.]

WITH the general use of 16 track audio recording, further expansion to 24 tracks already completed by some studios, and 32 tracks being discussed, the problems of leaving one man to operate a control console have become greatly increased.

The general procedure for multitrack recording may be summarised as follows:

(1) The 16 tracks of the audio recorder are fully modulated with information, not necessarily all at the same time but often by adding information at different recording sessions.

(2) Having finally recorded all the material, the engineer now has the problem of mixing the 16 tracks (possibly adding equalisation and reverberation at the same time) down to stereo or quadraphonic, for ultimate release by the record company to the entertainment market.

(3) On the mixing session, the engineer may have to control:

a) up to four master output faders, which are normally left in a fixed position except on a final fade-out.

b) two or more master faders controlling level to the reverberation plates and the individual echo send pots from the channels.

c) four faders controlling the 'stereo' reverb returns.

d) 16 faders controlling the information replayed from the multitrack recorder.

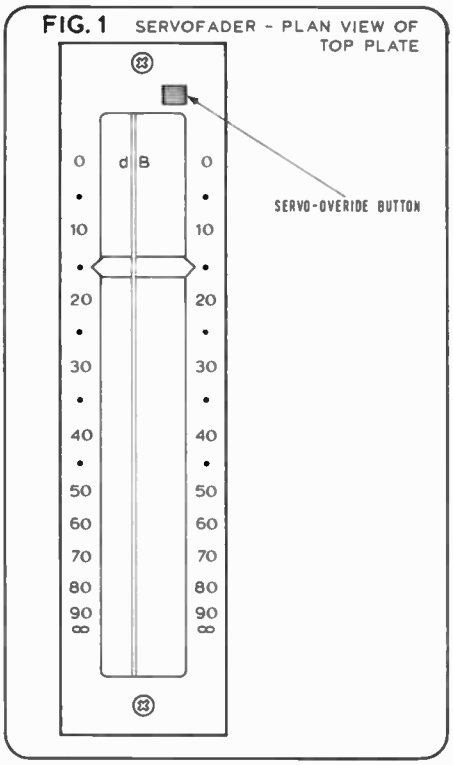
e) any equalisation adjustments which need to be made to each or all of the 16 tracks.

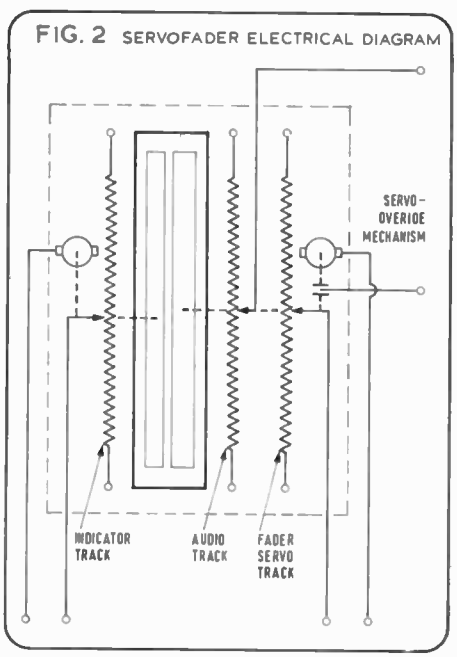
At the start of a mixing session, the 16 track tape is replayed through the console as though it comprised 16 different microphone sources. After several playback runs, the engineer will have a 'rough' balance. He will have the correct sound for each track, added reverberation if required, and obtained an 'internal' balance within each group of instruments plus an overall balance of the complete composition.

It is often necessary to adjust the balance continuously, bringing instruments or sections forward and taking them back, to assemble the sound picture required by the producer.

Any engineer who has worked on a complicated mixing session (where adjustments to faders, panning and equalisation are continuously being made) will appreciate that he really needs several pairs of hands and a perfect memory. If it were possible for initial adjustments made by the engineer to be memorised and repeated automatically at the next playback of the multitrack tape, he could then concentrate on one particular section at a time, continuously updating the memorised information in the knowledge that, when a section is correct, he will not have to repeat his movements while concentrating on another aspect of the mix.

For any such memory system to be practicable, it would be very useful to have a mechanical readout so that the engineer would be able to look at the controls and see what memorised adjustments were being, or had been, made. Most of the continuously varying adjustments during a mixing session are made to the faders. To enable an engineer to give more thought to the finer details of his balance, such as equalisation, panning and special effects, a system is required to assist him during the mixdown process by providing a positional memory of the complete fader score from the mixdown sequence.





Description

The system would consist of:

(1) A dual input/output servo driven fader (sdf) with:

a) one standard audio track coupled to a linear positional feedback track, both having the facility to disengage the servo drive mechanism easily.

b) one separate linear feedback track with a separate position indicator on the fader front panel.

(2) The conditioning electronics to:

a) translate the multi sdf inputs into digital signals and multiplex them into one or two tracks of the multitrack recorder.

b) translate the recorded information to analogue signals when replaying and drive the appropriate sdf.

Operation

The sdf would be used in the normal fader role, where the servo drive to the fader is disengaged, during the initial mixdown process. The indicating channel will be at 'off' during this process since it has no memory. During the operation all the fader positions and changes in positions will be recorded on both channels of the recording media.

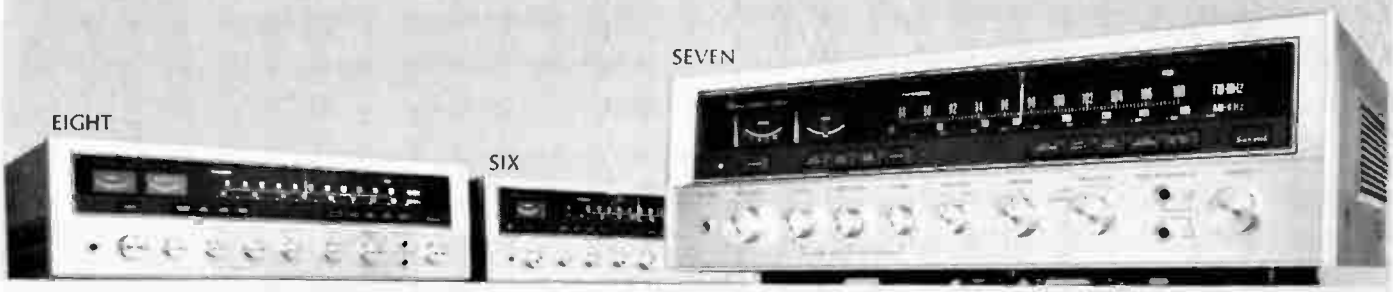
During the next mixdown process, each fader and its indicator will be servo driven by the recorded memory of the initial fader score. During this mixdown, modifications can be made to any fader channel by disengaging the servo drive. This simultaneously modifies the recorded fader position. The indicator now becomes a reference for the modified score. It can be used as a datum for the fader channel after the necessary adjustments to the sound balance have been made, and it assures the engineer that there are no positional (gain) discrepancies between the fader being modified and the level of the original recording, before allowing the fader to resume slaving to the previous recording.

The amended positional record will now serve as a master track if the modifications to the score are satisfactory.

The audio tape can be wound back to any

continued 35

They're all different, but it's not easy to tell the difference.



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The SEVEN, while delivering continuous RMS power of 47/47 watts per channel at 8 ohms, can also handle three sets of speakers, two turntables, two tape decks, a 4-channel adaptor and a noise reduction unit. At the same time, it limits total harmonic distortion and intermodulation distortion to less than 0.3%. And delivers FM sensitivity of 1.8μV.

If the sky is the limit, your customer will want to investigate the Sansui EIGHT. For here is a receiver with power to spare (60/60 watts RMS continuous at 8 ohms), FM sensitivity of 1.7μV, and preamplifier frequency response of 10 to 40,000Hz.

But if the EIGHT is just a bit too much, Sansui has created a suitable answer: the SIX. Hardly a budget receiver, the SIX delivers 39/39 watts of RMS continuous power at 8 ohms, features FM sensitivity of 2.0μV and handles three speaker systems, two tape decks, a noise reduction unit, two turntables and more.

The difference between a professional stereo receiver and a conventional receiver is often half-a-fortune.

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We make professional receivers for all tastes and price ranges.

We leave the conventional models for someone else to make.

It's still the big difference between us and them.

Sansui

Diary

BY JOHN DWYER

AIR studios, on the fourth floor of a building in Oxford Street, had a bomb scare this month. A phone call had been made to a Catholic-owned shop at street level and everybody in the rest of the building was ordered into the street. The building was, in theory, vacant for the second time when I arrived but, for an empty building, it had a lot of people in it.

For obvious reasons this kind of silliness disrupts recording even more effectively than it does other activities. So those at AIR had decided it was better to take the small risk that a bomb might explode than ruin sessions because of crank phone calls, especially in a studio as heavily booked as AIR is; at the end of the week they usually find that there are only two or three three-hour sessions left over.

This month, Peter Sullivan has produced a Casuals single at AIR which was engineered by Alan Harris. Osibisa were mixing an album and Congregation did some overdubbing and mixing. Roger Greenaway produced a single by White Plains and Roger Cook did likewise for Rick Woolf. Roger Cook also worked on his own album, which was produced by John Burgess and engineered by Bill Price. John Burgess was also the producer for a Christmas Carol by the Ippleden Children.

T. Rex made an appearance at AIR to overdub for a single, and a forthcoming Procol Harum lp was produced by Chris Thomas. Other faces seen at AIR during the month were Ralph McTell, Arwin Davidson, the Peddlars, Maciven Hine, Brenda Arnaud, Susan Shirley and Climax Chicago.

AIR are doing more film work; they were responsible for the dubbing of Roman Polanski's *Macbeth* and for that of the M. Caine film, *Pulp*. Air's recently enlarged dubbing theatre is now working fully, replete with Albrecht film machines.

AIR were very unfortunate to lose the opportunity of doing their first quadraphonic mix. The Album in question was a Frank Pourcel lp of western film themes, including the *Good, the Bad and the Ugly* and the *Magnificent Seven*. AIR wanted to borrow the necessary quadraphonic encoder since, very wisely, they had not (and still haven't) bought one of their own. But they were refused permission to hire or borrow the gear and so the Frank Pourcel lp found a corral elsewhere.

I chased madly by telephone round the company concerned, which, I discovered, was EMI. Eventually I phoned Abbey Road, who said that they would not have enough quad equipment to lend anybody, even were they sure they were allowed to. End of story.

While we're on EMI, they have recently had a game of boardroom musical chairs. The new managing director is Dutchman Gerry Oord, who replaces Philip Brodie. Mr Brodie will be music director for western Europe, replacing Oscar Hamilton, who now relinquishes some of his responsibilities to concentrate on those of EMI's European investment policy. Nearer home Len Wood, director of records, becomes chairman of EMI and MFP. Ron White relieves him of some of his tasks and becomes group co-ordinating director. Jonothan Lassman is now financial director of the sound and vision subsidiary

As background to this, EMI are now emerging from what one economics correspondent recently called a dismal year. The reasons for this are the decline in record sales—as STUDIO SOUND published in the April issue, total British sales fell from 72,000,000 in 1964 to under 47,000,000 in 1970, though export sales showed a steady, slight rise—and, more important, the disastrous performance of Capitol in the US—that company's share of the American market, the biggest in the world, dropped from 15 to eight per cent last year. The 1970-71 sales figures of Capitol, in which EMI have a 70 per cent share, showed a fall of around 20 per cent to £59,000,000, giving a pre-tax loss of £6,200,000. The result was that EMI's profits fell from 21 to £9,000,000 and Capitol was subjected to pretty ruthless economies.

Up to the end of 1971, EMI had made a slight improvement, partly the result of shedding Pickwick International, according to the company's report. Capitol made a profit of £84,400.

Command's studio manager, Mrs Hermi Wannell, tells me that the studio has been operating steadily throughout the holidays. Esther Ofarim has done an album produced by Bob Johnson and engineered by Bob Potter. Clive Westlake and Bob Fripp have also done lps and Command have had visits from John Jones and John Wilson. The cutting room, I am told, is working 24 hours a day on occasion.

Mayfair continues to be the recording haunt of Gary Glitter. who finished an album there at the beginning of August. Mike Leander produced the album and the engineering was by John Hudson. John also engineered a Juliet Lawson album produced by David Costa. The lp is a mixture of rock, reggae and acoustic numbers. Ex-Bolan associate Steve Took made a single with Tony Secunda Productions and Curved Air did one engineered by Trevor Vallis and produced by themselves. Lionel Bart came in to mix a show album.

At **Nova**, Mike Weighell engineered a Renaissance album, their second at Nova, produced by Miles Copeland for Sovereign records. Mike also engineered the first Fumble album, John Sherry producing. When I arrived, Paul Ryan was doing an lp and a single for Ryan Music produced by Phil Wayman. Paul has worked on the album for about two months, and I was told it might take until October. A Partridge Family type group, the Hillside Singers, recorded a jingle for American television under the supervision of David Katz. Mark Wesley, a Radio Luxembourg dj, made another single for RCA produced by David Paramor and engineered by Adrian Ibbetson. Adam Faith did a single produced by himself for himself. To the delight of his relatives and friends, Neil Reid has made yet another single. Mike Moran produced for Belgravia Productions while Richard Dodd engineered. Tony Hooper produced the Foggy Duo for York and Tony Macauley produced *Godspell* album titles and a single for Gem.

The music for a new Hywel Bennett movie was recorded at Nova for David Katch. Stanley Myers produced. The title of the film is *It's a Two Foot Six Inch World;* regular readers of this magazine will know, of course, that this should, in fact, be *It's a 76.2 mm World.*

James Royal has done an lp at IBC for Carnaby Records which was engineered by Andy Knight. A Fantastics single was engineered by Damon Lyon-Shaw for Gem music and an Andy Bown lp was engineered by Andy Knight for what is now Gaff Management, Robert Masters having departed. Mike Claydon engineered a Settlers single, produced by Jack Windsley for York Records. Status Quo were still working on an lp at the beginning of September. Again the lp is for Gaff and was engineered by Damon Lyon-Shaw, who also did a Ray Cameron lp. Parchment, a religious group, completed an lp for Key records under the production of John Pantry, an ex-IBC engineer. On this occasion the engineering was done by Andy Knight.

The New Seekers recently did a concert at the Albert Hall. They did the mobile recording work for this themselves, IBC tell me, then brought the tapes into that studio for dubbing. The work was done for Leon Henry Productions and engineered by Sandy Knight and Hugh Jones.

IBC say they are about three quarters booked. Like most of the studios I visited this month, they seem to be enjoying a busy period. The only other news from IBC is that they are in the process of installing some Neumann cutting equipment and a new desk. The desk has been built by Dennis King and three of his assistants and I hope to give more details about this in a subsequent column.

At **De Lane Lea's** Wembley Studio Selena Jones was produced by John Schroeder and engineered by Alan Florence. John Schofield produced sessions by East of Eden, for Damont records, which were engineered by Dave Hunt. Terry Johnson engineered Chris Andrews. Sammy were produced for Axle enterprises. Frank Barber produced a single by a new artist called Marion de Garriga and Noel Walker produced some dubbings of Blackfoot Sue which were engineered by Terry Johnson.

De Lane Lea seem to be in the middle of some reshuffling of their own, though they seem more shy about it than EMI. Two executives, one of them the studio manager, have left, for reasons unspecified. No new studio manager has yet been found but director Louis Elman has moved his traps over from

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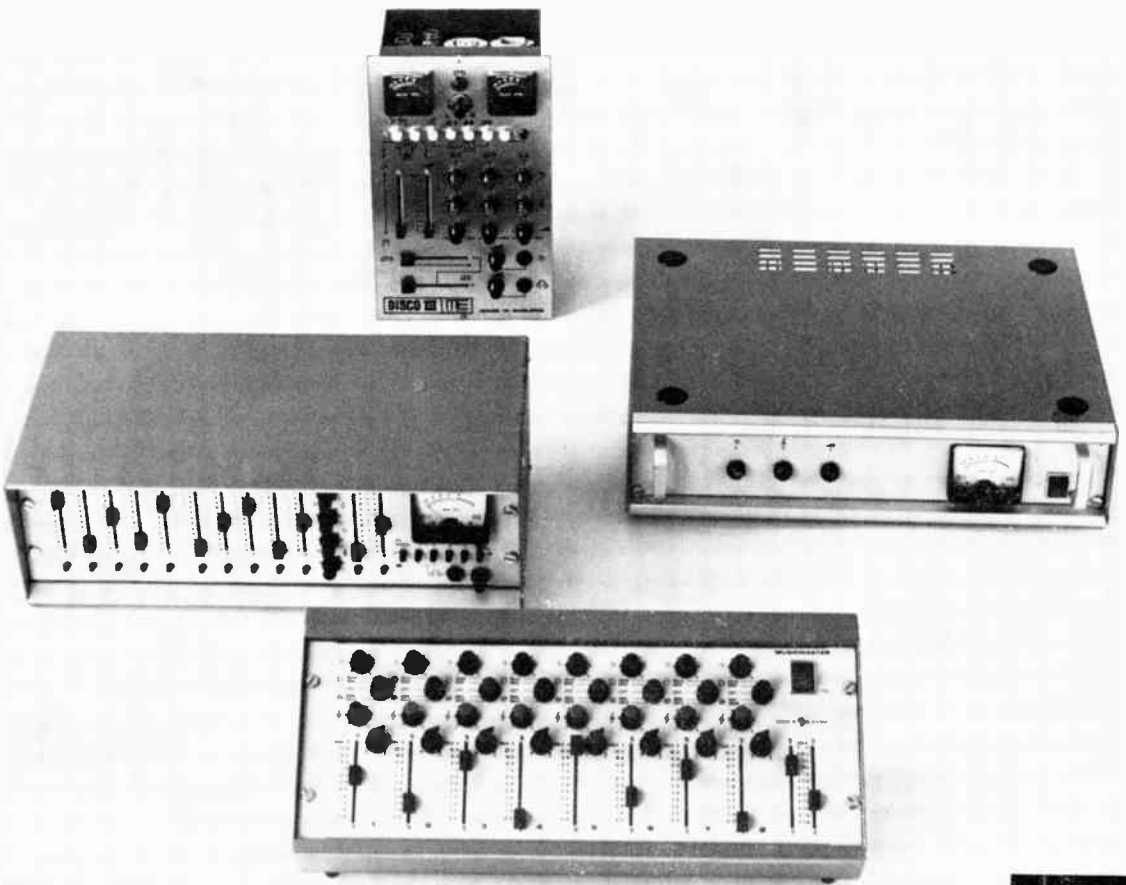

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ME MILLBANK

continued

Dean Street to see if he can sort things out.

Saturn Recordings is a relatively new studio which has opened in Worthing. At the moment it is a four track operation, with a desk built by Malcolm Toft, but Dave Ruffell, the studio manager, tells me that they will shortly be going 16 track and that Malcolm is building a new desk.

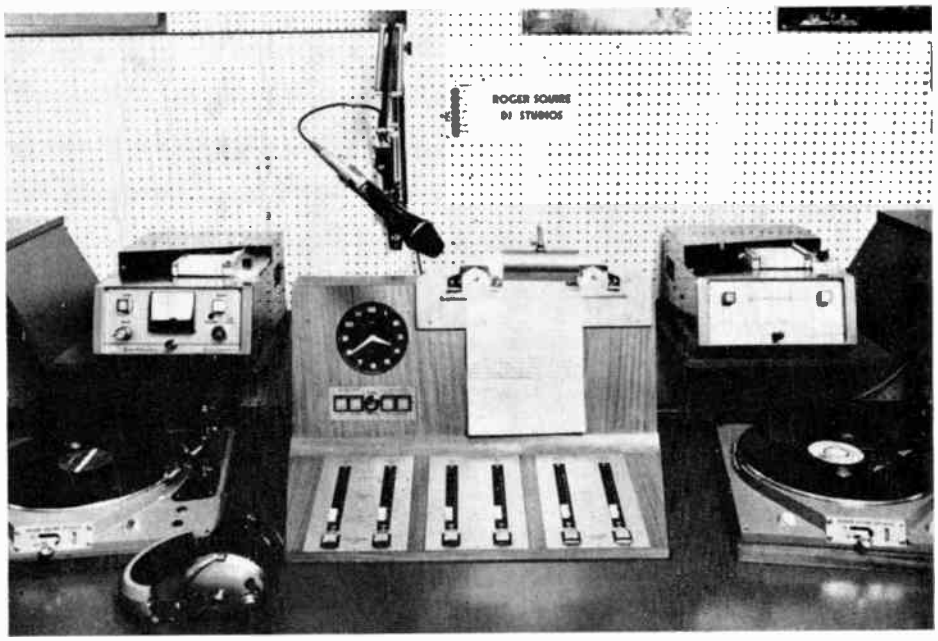
The studio, where the Steven Smith and Father single was recorded, has its own hotel above it at which visiting producers can stay free of charge. Business so far has been building up from demo work. Apart from the Steven Smith single, Jack Dorsey, a southern producer, has recorded a single with a group called Brownhill Stamp Duty, and Decca have used the studio for demo work.

Ex-Viking engineer Steve Vaughan is now working for a new television station in Toronto, Canada. The station is called **Channel 79**. Steve will be sending reports from the Toronto studios which will be published in STUDIO SOUND.

Sound and Recording Mobile (SARM) have been busier than ever. They have recorded two Irish groups, Sand and Planxty, under the production of Phil Coulter, and recorded an album of the English Production of Rupert with narration by Ed Stewart. SARM were responsible, by the way, for the sound effects for the Rupert Show at the Victoria Palace. At Pye, for Pye records, they recorded a Buddy Greco album and single, and elsewhere they did *Can't You Hear the Song*, by Butterscotch, and *Bright Shines the Light*, an Arnold, Martin and Morrow song recorded by Verity. They have also recorded the Swinging Blue Jeans, Johnny Hackett, Evie May, Carol Bell and Rasberry and cut singles by Gary Glitter, New Pearls, Bay City Rollers, Harlequin, Driftwood, David Cassidy and the Partridge Family. SARM must be one of the few recording and cutting operations of its size to have had five singles in the top 30 simultaneously. Currently they are producing, engineering and cutting another Rupert and a Noddy album.

At Pye studios, in Great Cumberland Place, Mungo Gerry tracks have been produced by Ray Dorset, Miki Dallon produced Mac and Katie Kassoon, Ray Davis did some four channel 'Button Down Brass' sessions, using the Sansui quadraphonic system, Des O'Connor was produced by Peter Huggett and Tony Hatch produced Desmier. Acker Bilk did an album produced by Terry Brown.

Last month's column had to be cut for lack of space. One of the items left out was a photo of the **Roger Squire** dj console and I have included it this month instead. To left and right of the fader panel are two of the three American-built, instant start turntables described by Keith Wicks in the June issue of this magazine. Above them are two Spotmaster jingle machines. The faders are Penny and Giles and the microphone is an AKG *D202*. The two outside faders control the two turntables shown and the cartridge machines are controlled by faders two and five. The fader third from right is for the mic and the other is an auxiliary channel—for a third turntable or a tape insert, for example. A light above the desk next to the name of the studio in the photo shows which mode has been selected. Each fader has a button below it which starts or stops its own machine. Half of the button lights when the machine rolls and the other half does so when the fader is opened.



Above: The Squire dj console

A remote control for the recording machine, an on/off for the extra mic and a headphone gain control are under the clock. The headphones will monitor the program unless one of the faders is pulled back slightly, operating a microswitch. The headphones then monitor the input to that fader. Thus, to cue records, the fader for the off-program turntable is pulled back. When the fader is released the headphones receive program again.

Not shown in the picture are an extra *D202* mic; another turntable; a Ferrograph *Series 7*, used for recorded inserts because of its fast take-up; two Revox *A77* machines: the engineer's mixer, which has full equalisation, limiting and so on; and a porthole, put there, I am told, to remind the more experienced djs of the good old days.

Recent work at Squire has included motor show demonstration tapes and promotional work for the American market. The Peugeot demonstration tapes, played inside the car at the motor show, was recorded at Squire. Brian Matthew, whose voice, after the Beatles Story broadcasts, is the delight of Little Miss Bouncers across America, recorded promotion tapes and jingles, as did John Peel. Duncan Edwards recorded his *Be My Guest* show for Medway at Squire, as did Jon Vine late last year. Bill Foster tells me that the studio has now had six BBC dj passes.

This month I also visited **Gooseberry**, Peter Houghton's new look Gerrard Street concern. Peter showed me the studio and played some of the tapes that have been made there. The studio seems to produce some good sounds. They have tried to make the best use of the space they have, which is by no means meagre, by using sliding doors fitted with double glazed windows. Peter Houghton tells me that the separation provided by the doors is really good. The rhythm section goes on one side and piano, brass and reeds on the other.

Gooseberry use the rock box idea to some extent. There are two guitar amp booths in the rhythm section which are acoustically sealed from each other and from the players. In each is a microphone connected to the control room. Bass guitar is fed to the control room directly. The walls of the studio are 30 cm thick and I couldn't hear any traffic noise.

Peter told me that it has become increasingly common for artists to do demos in the studios and then come back to do the masters. Currently Gooseberry are doing a lot of demo work for World-Wide artists, a film distribution company which is part of the Hemdale group. When that company came in with David Reid to record some acoustic numbers these were mixed straight down and a little echo was put on to the tracks with the studio's new AKG reverberation unit. I listened to some of the tracks and the echo was just perceptible and very effective. Mike Day seems to have resisted the temptation to get as much out of his new echo equipment as possible.

Other work at Gooseberry has included a jingle for ITN lunchtime news by Jeremy Rose for his Yer Actual Music Company and Frankie Reid, no relation to any of the previously mentioned Reids, has done some demos at Gooseberry and intends to make some masters there.

Gooseberry are now charging £7.50 an hour for four and £10.50 an hour for eight track. For a trial period there will be an opportunity to use the studio for £9 an hour if you only use six tracks.

Manfred Mann and Mike Hugg are frequent users of **Maximum Sound**; Mike's latest album, *Somewhere*, and single, were made there. Dick Heckstall Smith has done demos at the studio and a group called Dehems made an lp produced by Lee Shepherd. A Neil Innes lp was produced by Ian Whitcombe for United Artists.

Joe Cocker spent a good part of a week at **Orange** recently and other work at the studio has included film music for a sex movie called

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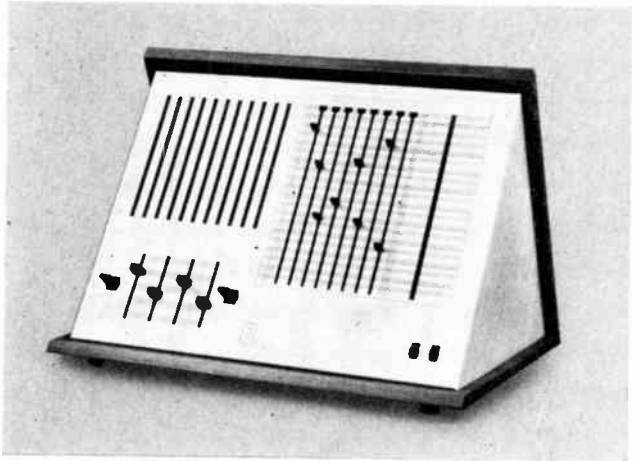

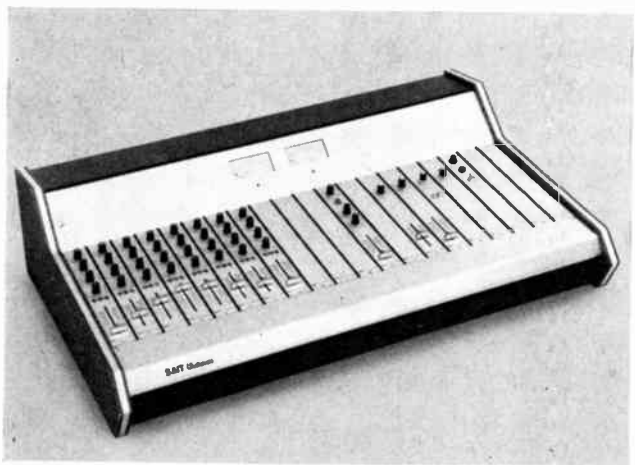

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Field Trials

Uher 124 Report

PERHAPS one day, if Ernie coughs up, I'll fulfil an ambition and climb up to the great Lamasary of Punakha in the Himalayan kingdom of Bhutan, or visit the great monastery at Lit'ang in Tibet and hear the beautifully timeless chanting, the evocative sound of the radong and the giyaleeng. Perhaps. If I do, I like to think I'll have a stereo Nagra with me, to capture these sounds. But if I have to slog in on foot I'll probably settle for something lighter, more compact, less expensive, and a bit easier to use one-handed halfway up a cliff . . .

All conjecture but not entirely irrelevant because I think there is something of this philosophy behind the Uher Compact Report Stereo *124*. One can't really compare it with the Nagra or for that matter with the Uher's reel-to-reel *4200* counterpart. Apparently Kudelski tried the Philips compact cassette system and abandoned it because of inherent difficulties in achieving Kudelski standards from the system. Uher, on the other hand, appear to have set out by accepting the limitations of the system and have aimed to exploit its virtues to the full. The result is a small, rugged and easily used piece of equipment.

I would join with a recent editorial in deploring the mastering of a gramophone record, albeit pop, on a cassette machine. On the other hand, can one deny the use of the cassette machine to the collector of oral history, to the interviewer, even to the radio reporter, in situations where extreme portability outweighs other considerations? A number of broadcast reporters *do* use very small cassette machines to collect their recordings (even if they are then dubbed carefully to 6.25 mm tape) and the fact that these prove acceptable under certain conditions established a precedent for considering a cassette machine, given a high standard of engineering, within these pages.

Anyone who uses the *4200* will find something familiar about the feel of the *124*: rugged but with small easily-damaged protrusions. It is finely engineered, without the final attention to detail that takes the Nagra's performance and price out of the Uher bracket; simple and easy to use, with some frills thrown in for good measure, that will trap the unwary. It is certainly compact and if you've ever sighed at the idea of prodding around inside the *4200*, you'll groan when you see the tightly packed guts of the *124*. It is not light, for all its compactness. This is due in no small part to the tough metal case, quite apart from the metalwork placed inside. In its leather carrying case, the *124* will take a fairly hard drop without protest—from waist height on to a corner against a hard floor. It survived some unusually rough treatment without any apparent deterioration in performance, apart from one glue joint giving way on the microphone case.

The *124* weighs 2 kg without batteries, mains unit or case, and its dimensions are 185 x 180 x 570 mm. All controls and the cassette pocket are on the front face, with connector sockets down one side. There are sockets at the rear for a mains unit and for connection to a car radio via a seven-pin DIN plug. There is another socket, on the side opposite the inputs and outputs, for batteries and dry accumulator or internal mains unit. The top face also carries a small monitor loudspeaker (one channel only) and the front panel a stereo microphone socket with locking facility.

The cassette is pushed sideways (tape to the left), into the pocket on the front of the machine; the bar marked Uher is pushed down, which pushes and locks the cassette in place and makes other controls available. The cassette is ejected by the unmarked button to the right of the tape position counter (a fairly rare item on cassette machines).

Top left of the front panel is the volume control, ganged to both channels. It appears to be a four element control, presumably altering feedback as well as attenuation in order to improve the overload performance of the input stages and possibly the ganging of the controls. To the right of this is a small grille; behind this we are told is an AKG capacitor microphone. Unfortunately there was something persistently amiss with this, which Bosch could not find, so I can't tell you how wonderful the built-in mic is. There is no sound access from the rear of its cubic plastic shell and it must be the only 'cardioid' going out under the AKG flag to rely apparently entirely on obstacle-effect to obtain its directivity. In fact I'm sure it is intended as an omni but the obstacle effect means that high frequencies arriving from the side or behind get attenuated. The internal microphone can only be used for mono recordings on *one* track. A cut-out button and stereo mic socket are provided, with remote control facility.

To the right of the microphone is a rotating-cylinder VU meter which also allows battery voltage to be checked in the replay condition. It is very sluggish and rather worse to use than most VUs. Since Uher are already using fets in the agc circuit, it seems a pity not to make the meter a proper peak-reading one.

To the right again is the off-run-pause control. With the cassette in the operational position, a touch to the right operates a solenoid that plays the tape to the right (direction one or A) as viewed on the little centre-zero direction indicator meter below and right—a cunning and necessary idea since the cassette window is right out of sight.

MANUFACTURER'S SPECIFICATION

Recording: 2 x ¼ track DIN 45516
Sound carrier: Compact cassette C60/90/120
Tape speed: 4.7 cm/s
Frequency range: 30 Hz to 12.5 kHz
S/N ratio (DIN): 48 dB
Wow and flutter (DIN): less than or equal to 0.2 per cent
Operating modes: mono and stereo, recording and playback
Inputs: mic: 0.2 mV, 500 ohm; radio 4.7 mV, 47 kΩ; phono: 200 mV, 750 kΩ
Outputs: radio/amp: at least 500 mV across 15 kΩ
Power supply: 6 mono cells 1.5V penlite special storage batteries, car batteries 12V power supply unit 100-130V, 200-240V ac, 50 and 60 Hz. The power supply unit acts simultaneously as an automatic charger for the storage batteries
Counter: three digit
Dimensions (WxHxD): 18.5 x 5.7 x 18 cm
Weight: about 2 kg
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Similarly, a touch down pauses the tape while a touch left changes the direction of play and enables replay of the bottom pair of tracks without turning the cassette over. The record/play head is four-track in-line and there are two contra rotating flywheels and capstans plus two solenoid-operated pinch wheels.

Pushing the red-centred record button at the same time as operating the play switch on the right permits recording on that pair of tracks. Doing the same to the left does not (to prevent accidental erasure) allow one to do more than replay the other pair of tracks. If the record button is forced in, nothing is recorded. As an additional safeguard, the usual breakable tabs on the back of cassettes prevent accidental erasure of a pre-recorded tape if they have been

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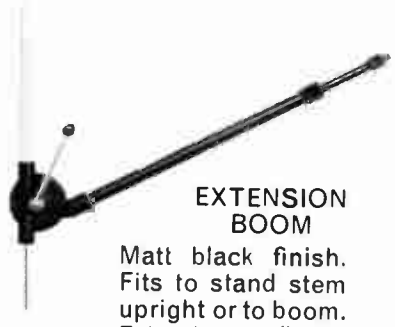

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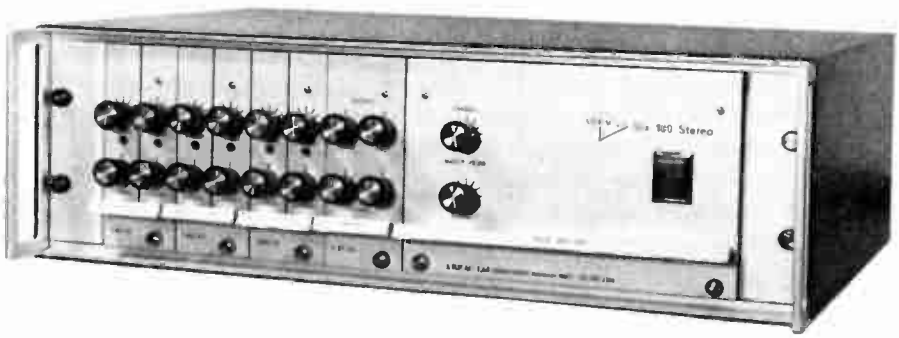

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continued

removed. (To record deliberately, one sticks Sellotape over the hole, to prevent the sensor entering.)

Below the play control is the fast wind/rewind selector which is inoperative unless the play control is in a central position. To the left of the record button is the agc control. For speech this is quite effective, holding the gain roughly at the right level with the volume control turned about half way up. The actual level varies a bit with setting of the volume control, and also with input level, but it is a useful way of keeping the volume right during an interview. On music the agc is less happy, as one might expect. You can get away with it on some things but my advice would be rely on proper setting of the gain control where possible, particularly with piano and voices. The agc elements (fet) of the two channels are fairly well ganged so that the stereo image varies little with level but there appeared on the review sample to be a difference in time constants. One channel reached its limited condition slightly ahead of the other. On speech it was not noticed; perhaps I am getting cloth-eared.

The internal monitor speaker can be muted by a front panel switch. The speaker can be used during both record and play. Its gain during record is controlled by a preset on the side.

Phones may be plugged into the speaker output socket (don't use low impedance phones if you value your ears) and, on replay, the output level at the speaker/phone outputs is determined by the main gain control setting. A nominal 1W per channel into 4 ohms is available from ic power amplifiers. Nominal output increases to 1.3W with the mains unit and distortion increases as the battery voltage drops.

One peculiarity I found was that, with low batteries and long speaker leads, a high gain setting started things oscillating at high frequencies. Given reasonably efficient speakers or decent headphones, the drive available is adequate for in-the-field monitoring but the internal amplifiers are clearly not intended for more than that. Results with a pair of 75 ohm *K50* phones were pleasant. The built-in monitoring facilities are worth keeping but I wish Uher would forget the built-in microphone (low voltage techniques, record-in-rainy-weather, or not) and cut the price. The machine is worthy of an AKG *D109* at least.

One of the features I have not mentioned is the automatic track change at the end of side, when playing (but not, as I said, when recording). Curious, this. I cannot really see a need for it but, with a solenoid mechanism, I suppose it was a temptation not to be resisted. Similarly, the machine shuts off after fast winding (though one has to centre the control). There are also pins on the output socket panel which, shorted to earth, change the direction of play (for lazy armchair listening) which seems yet another unnecessary concession to the domestic market. I suppose the idea is to kill two birds with one stone.

The Uher came complete with *M640* stereo microphone, *Z518* carrying case, dryfit storage battery and *Z131* mains unit charger. The *M640* is essentially two moving-coil pencil microphones hinged at the tail, with a stand adapter at the hinge. Foldout legs recessed into the microphone bodies make, with the stand adapter, a mini-tripod for the microphone when placed on a table. The microphones are allegedly directional and presumably there is some access to the rear of the diaphragm via the slot into which the spindly legs recess. There is a presence rise and lack of extreme bass but the microphones are not among the worst I have heard in that respect. However, the directivity does seem to be confined to hf.

Used for a stereo interview, about 600 mm from each speaker, with the microphone axes set at about 135° to one another, there was a noticeable stereo effect if the interviewer and interviewee were on the axes of their respective microphones. On music, however, with the performers set well back, there was precious little difference between stereo and double mono. I don't consider that particular setup to be intended as more than a convenient rig for interviews in stereo or mono.

In mono the two mics fold together to make a double-barrelled stick with legs tucked out of the way. The mics are locked together by a pip on the side of one; the result is of course a double-mono recording. One could parallel the channels in the subsequent amplifier stages to reduce noise slightly but this might reduce hf response fairly drastically with random phase differences as the tape moves unevenly across the head (this complaint was made by Kudelski). It is amazing how tolerant the ear seems to be of stereo phase.

Again, my feeling is that a pair of *D109* lavalier mics, one around the interviewer's neck and the other either hand-held or around the interviewee's neck, would be a better arrangement. I like the *D109* very much for interviews, particularly if fitted in a cleft aluminium tube (BBC fashion) to make it more easily handled.

The carrying case, which apparently is normally supplied with the compact, is in tough black leather with a carrying strap. It is rather a fight to remove and replace—necessary when one wishes to adjust the record monitor preset. Like all Uher cases, it is fairly tough but the review sample, which was some months old (like the machine), had already come adrift where the flap fastens over the front panel.

Accumulator and charger

I found the accumulator and charger essential though it only uses six *HP11* batteries at a shot, giving about 3½ hours mixed use, running costs on batteries alone would be rather high for my taste. The accumulator seemed to put up with about three hours use before recharging but, having seen them ruined through being run down on the *4000*, I didn't push my luck with the one in the review machine. The mains unit will recharge the accumulator when left plugged in. Floating it across the accumulator is the best way of making sure the machine is always ready for use outdoors when required. One needs to position the unit carefully (but not critically) to avoid inducing hum (mainly on playback). Sensibly, when the mains unit is slipped into the battery compartment in place of batteries, the positioning and shielding are such that induced hum is negligible. There is a guide inside the battery compartment to indicate how the cells are to be arranged, and the battery compartment is so shaped that the accumulator or mains unit will only fit in the right way round.

I wish Uher had stuck to their piano keys but perhaps that is because I am used to them. I like the idea of having the controls grouped closely enough for one-hand operation but found the record button excessively stiff to operate single handed at the same time as the play switch. Often the result was no recording. I think the button was excessively stiff in another sense. With the amount of force necessary to operate it, it is going to get damaged sooner or later. I found the mic-mute/speaker-mute switches the illogical way round and the agc switch all too easily depressed when one was fiddling with the record button. These are perhaps in part (stiffness anyway) teething troubles that may disappear.

I didn't like the sluggish and imprecise meter. There seems no reason why a small edgewise conventional meter should not have been used. The meter is not illuminated, which is a great pity. As the instructions warn you, cassettes sometimes fail to eject but repeated stabs at the button never fail to produce the cassette. I don't particularly like this system, for all the ease of one-handed insertion, because it is particularly difficult to clean the heads and virtually impossible to deflux them without taking the case apart. All right, there are head cleaning gadgets around in the shape of cleaning cassettes but I have nasty memories of the days of commercial head-cleaning tapes and solutions on reel-to-reel machines, with fluff and suds building up everywhere. I'm not sure what one does about defluxing, except getting into the guts if one is bold or plonking a bulk eraser on the top if one is stupid.

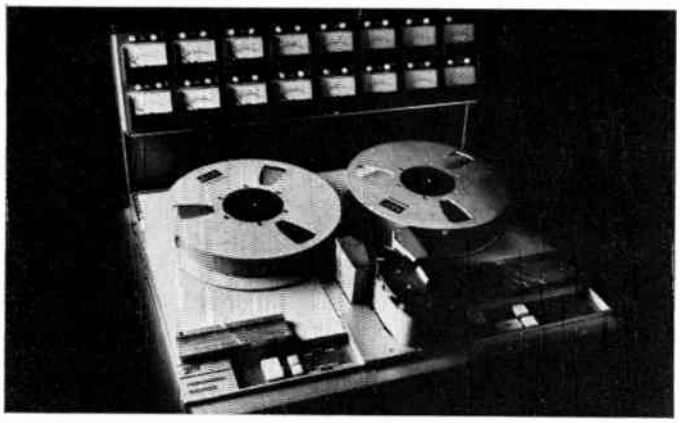
The stacked four track record/play head is a mixed blessing. It allows rapid search on both track pairs but the crosstalk is poor. Music and loud speech on one pair of tracks is clearly audible when reproducing quiet passages in the other.

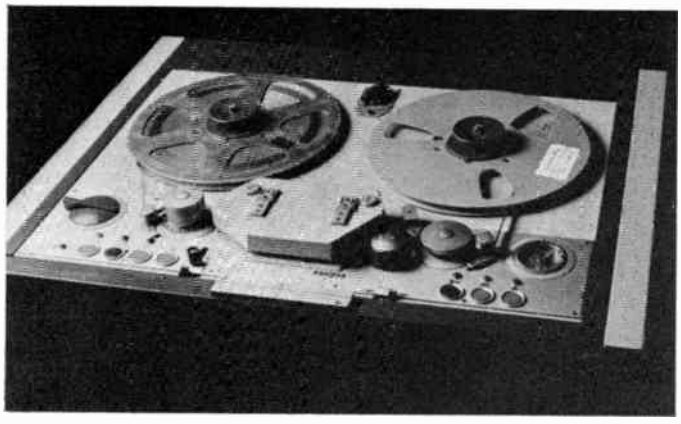
No noise reduction facility

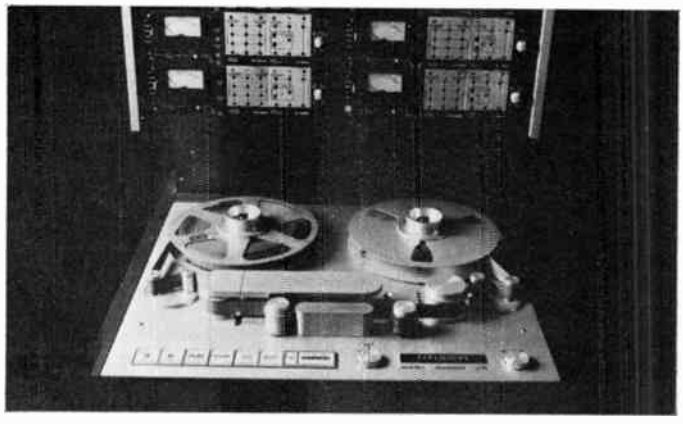
Used carefully, with low noise tapes, the recorder gave remarkably good results, though lacking in top and rather noisy. Indeed, one of the main criticisms of the machines must be that there is no noise-reduction facility available —and by that I mean Dolby *B* since the *A* system in its present form is too bulky for a portable machine of this kind. Uher (or, to be fair, their agents Bosch) argue that Dolby *B* is not universally accepted and that it is unnecessary with chrome cassettes. Curious because, to the best of my knowledge, chrome offers no more than about 6 dB maximum improvement in signal-to-noise ratio at high frequencies. Furthermore, chrome requires changes of equalisation and bias. Neither were apparently adjusted for chrome on the review machine, though it was down in the top. Uher say mysteriously that 'the erasure circuits and the signal-to-noise ratio of this recorder have been designed to take advantage of the benefits of chromium dioxide tape when it becomes generally available'. In fact, I suspect that they, like many other manufacturers, are awaiting the Dolby *B* ic. They would not be the first manufacturer to make nasty noises

continued 31

They're not much use without us.







There's nothing quite so frustrating in this world as a tape recorder without tape.

So BASF make a tape for every tape recorder manufactured anywhere in the world.

Everything from $\frac{1}{8}$" LH cassettes right through to 2" tapes for all major studios. More than 128 different types in all.

Which is not really surprising when you think that BASF were the first company in the world to make tape.

So if you've got a tape problem — we've got a tape answer — call us and see for yourself.

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London SW7 1SA
Telephone: 01-584 5080

continued

about Dolby right up to the moment the first machines incorporating Dolby *B* run out of the warehouse and the publicity boys start trumpeting the system's virtues. I don't see how anything bigger than the ic package could be fitted in, assuming it can be made to work off an 8V rail. I may have hit particularly bad samples of cassette but dropout is as much a function of tape tension and tape-channel design as of tape. Some recent Japanese machines in this price range have become very good in this respect so there is still room for improvement. The tapes I used were Scotch *Dynarange*, BASF *LH* and TDK. Scotch *C120* seemed to fare worst, despite the potentially good wrap due to its thinness, and TDK *SD C90* the best. Scotch *120* sounded decidedly woolly, despite the astonishing amount of pre-emphasis indicated by the record level meter when feeding in tone. I found it overloaded fairly easily too. BASF *LH C90*, which has long been recommended (and indeed with the similar Agfa is recommended by Uher for use with their machine) proved acceptable if a bit short on top when feeding in a wide range signal. With the mics provided it would just about do, though, and the dynamic range was slightly better. Ordinary TDK 'low noise' (Japanese) tape was not as good but the most spectacular improvement came with the sample of TDK *SD* tape which gave a marked improvement in top plus a slight but audibly worthwhile improvement in distortion even without adjusting the bias. If this sample is anything to go by, TDK *SD* cassettes are an improvement on other conventional iron oxide tapes currently available for cassette machines and seem to be the best for use with this machine. I understand that Uher themselves have shown some interest in the tape and I have heard it spoken highly of from other sources. The ordinary 'low noise' TDK seems to be no improvement on the competition.

To qualify what I have said about frequency response: I found it very difficult to get any reliable measurements. It was hard to get the meter needle steady even at 1 kHz and there were wild variations at high frequencies but the top was well down even with tests carried out at low levels. The heads were very carefully cleaned, despite the difficulties, without improvement and the variations are therefore puzzling. The head face looked rather flat but, having gone to the trouble of producing or obtaining four track heads, Uher would hardly have overlooked the effects of the head contour. Curious. Doubtless the hf response could be improved slightly by reducing the bias, at the expense of distortion; but neither the results obtained nor the information I had from Bosch indicated that the machine had been set up for chrome.

On the whole I had been very pleased with the machine's wow and flutter performance, even on piano. But it didn't seem to like pure tone at all, nor dubbed organ, which was therefore rather puzzling. The ordinary low noise TDK tape, with an apparent transverse engraving on the tape surface, came off worst. TDK *SD* proved the best, followed hotly by BASF *LH*. I had no problems of cassettes jamming or snapping, even on *C120*; I note that TDK are very cautious about the use of *C120* thickness. In short, if I were using this machine seriously, I would probably use TDK *SD C90* for most purposes. The tape handling of the machine seems excellent apart from reservations on head contact and flutter. I do wish the relays inside weren't open though; they seem an early target for dirt and troubles.

This is the only stereo cassette machine I know rugged enough to stand up to industrial usage. One wants to be able to forget that a machine is delicate and plastic cabinets would have been no help there. At the same price, the *124* doesn't compare in quality with its big brother the *4200*. But it *is* smaller and potentially easier to handle. Changing cassettes during an interview is so much easier than changing tapes—and the recorded material more compact. The *124* has much to recommend it.

John Fisher

Mini Moog Model D

THE Mini Moog *Model D* voltage controlled electronic synthesiser was designed, from start to finish, as a live-performance musical instrument. It comprises three vc oscillators, noise generator, vc filter and envelope shaper (two contour generators, one of which is permanently coupled to the filter). The signal routing is much simpler than in synthesisers I have so far examined. Instead of pin matrices, jack panels or multiple switch banks, the *Mini* generators and processors are prewired through 14 rocker switches. Prewiring is no new idea but has hitherto involved a complex pattern of route lines being printed on the face of the control panel. Moog have reduced such markings to a logical minimum, logical in the sense that signals are generated through controls on the left of the main panel, routed and mixed or blended in the panel centre, modified on the mid-right and extracted at the far right. Not literally, perhaps, but this is the way it is presented to the performer.

Like most vc synthesisers, the *Mini* is monophonic in that only one key of its 3½ octave (f to c) keyboard functions at any given instant. This takes care of your right hand, leaving your left free to alter the sound characteristics. For a skilled performer there need be no periods of silence while he changes his main signal connections. The sound structure may be completely altered through a series of smaller changes easily made during the course of playing a melody. Alternatively, the artist may switch off the feed to his external amplifier and listen to his own headphone monitor output while he adjusts the control settings. Yet another carrot for the 'conventional' musician, for whom the *Mini* was basically designed and who may look upon electronics the rest of us regard motor cars: with quiet suspicion, is an A (440 Hz) reference tone. Oscillator One (which, unlike Two and Three, has no independent fine tune control) may be tuned to this. Oscillator Two might then be tuned to Oscillator One, and Oscillator Three to Oscillator Two. If somebody wheels in a flat or sharp piano, all three oscillators may be retuned just over three semitones in either direction by turning a single control marked 'Tune'.

To begin, however, at the beginning. The *Mini* emerges from its packing case in the flat form of fig. 1. The power lead (3m on the model supplied) is connected to mains and standard jack (6.25 mm, unbalanced) sockets on the rear panel strip supply high or low level output to feed the high level or mic input of an external amplifier. One output might be connected to tape, the other to a monitor or public address amplifier.

The *Mini* is activated by pressing the mains on/off rocker switch at the extreme right of the front panel. Since the control labelling may be partially obscured when the panel is flat, the entire panel may be lifted to any of four raised positions about a hinge running almost the entire width of the instrument fig. 2. The locking device is simple and effective: a hinged aluminium flap which engages any of four

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MANUFACTURERS' SPECIFICATION

Transportable electronic music synthesiser designed for live performance.

Sound sources: Three oscillators, one noise source, one external input/microphone preamp.

Oscillator frequency: 0.1 Hz to 20 kHz in six overlapping ranges.

Short-term stability: ±1 per cent.

Waveform outputs: Triangular, sawtooth, triangular-sawtooth mix (osc one and two only), reverse sawtooth (osc three only), and three widths of rectangular.

Noise source outputs: White or pink random waveforms.

Price: £705.

Agent: Feldon Audio Ltd, 126 Great Portland Street, London W1N 5PH.

FIG. 2

This one you can take with you

The Neve BCM 10/2 is a fully transportable sound mixing console, with ten input channels with full equalization and two principal output groups, each controlled by precision horizontal faders. Designed and built by Neve for the professional who requires high quality sound control. Anywhere.

Neve

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Toronto,
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Canada.
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Berkshire Industrial Park,
Bethel,
Connecticut 06801,
U.S.A.
Telephone (203) 744 6230
Telex 969638

sleeved screw heads protruding from the base of the chassis housing the electronics.

Fig. 3a shows the farthest left of the six control groups on the hinged panel. Topmost is the main tuning potentiometer governing the keyboard pitch (of Oscillators One and, though they have their own presets, Two and Three). A performer using the *Mini* for multitrack composition would adjust this control against the highly stable internal 44 Hz to compensate for any drift occurring during the initial warm-up. Below this is the glide control which governs portamento speed when this facility is switched on the left hand controller beside the keyboard. At the zero glide calibration, the effect is that of a normal keyboard instrument. Advancing the control to its 10 maximum produces a slow glissando from one note to another, as achieved on a violin for example when a finger is slid up and down a bowed string. Slowest glissando across one octave is about one second. The third control in this section is labelled modulation mix and operates in conjunction with Oscillator Three and the random noise generator. A voltage can be routed to the pitch control circuitry through modulation switch (spanning the controllers group and the adjacent oscillator bank), governing all three oscillators. With the modulation mix control turned fully anticlockwise, the output of Oscillator Three is routed via the oscillator modulation switch to the pitch control input of Oscillators One and Two. A slow (5 Hz) triangular voltage waveform from Oscillator Three will produce a corresponding five-times-per-second pitch change in the tones produced by Oscillators One and Two, this particular effect resembling the vibrato of a divider organ. The modulation depth is controlled by the modulation wheel on the left hand controller. Altering the pitch control frequency, waveform, and modulation range, produces effects far removed from the aforementioned vibrato. For instance, a squarewave control voltage will produce a trill while a reversed sawtooth (vertical leading edge) imitates the rapid plucking employed on a balalaika or mandolin.

Twisting the modulation mix control towards (calibration 10) introduces progressively more random noise into the pitch control waveform, resulting in purely random pitch control at the fully clockwise setting—necessary when one wishes to create pitchless sounds (i.e., timpani or bass drum).

Moving now to **fig. 3b** we see, at the top, the frequency range and waveform controls governing Oscillator One. The six-position range switch raises or lowers the frequency in octave steps from the basic eight foot (middle C in the centre of the keyboard). The lowest setting (10) is not the 64 foot that might be expected but a much lower frequency pulse going to a minimum of about 0.7 Hz. The oscillators are still voltage controlled in the lo range—not a point which may be taken for granted. The Moog oscillators offer a wide choice of basic output waveforms. These comprise (going clockwise) triangular, sawtooth-triangular, sawtooth, square, wide rectangular and narrow rectangular. Identical facilities may be seen on Oscillators Two and Three but here we have fine pitch controls which are separate from the main tuning potentiometer governing Oscillator One. Oscillator Three has a slightly different configuration, the 'sawtooth triangular' waveform being substituted for a reversed sawtooth in order to give the rapid string pluck effect mentioned earlier.

Oscillator Three may be disconnected from the pitch control voltage produced by the keyboard, either to supply a fixed (though tuneable) vibrato frequency or to supply a drone signal. The *Mini* will create a very passable set of bagpipes if all three oscillators are set to rectangular waveforms, one oscillator providing a steady bass drone.

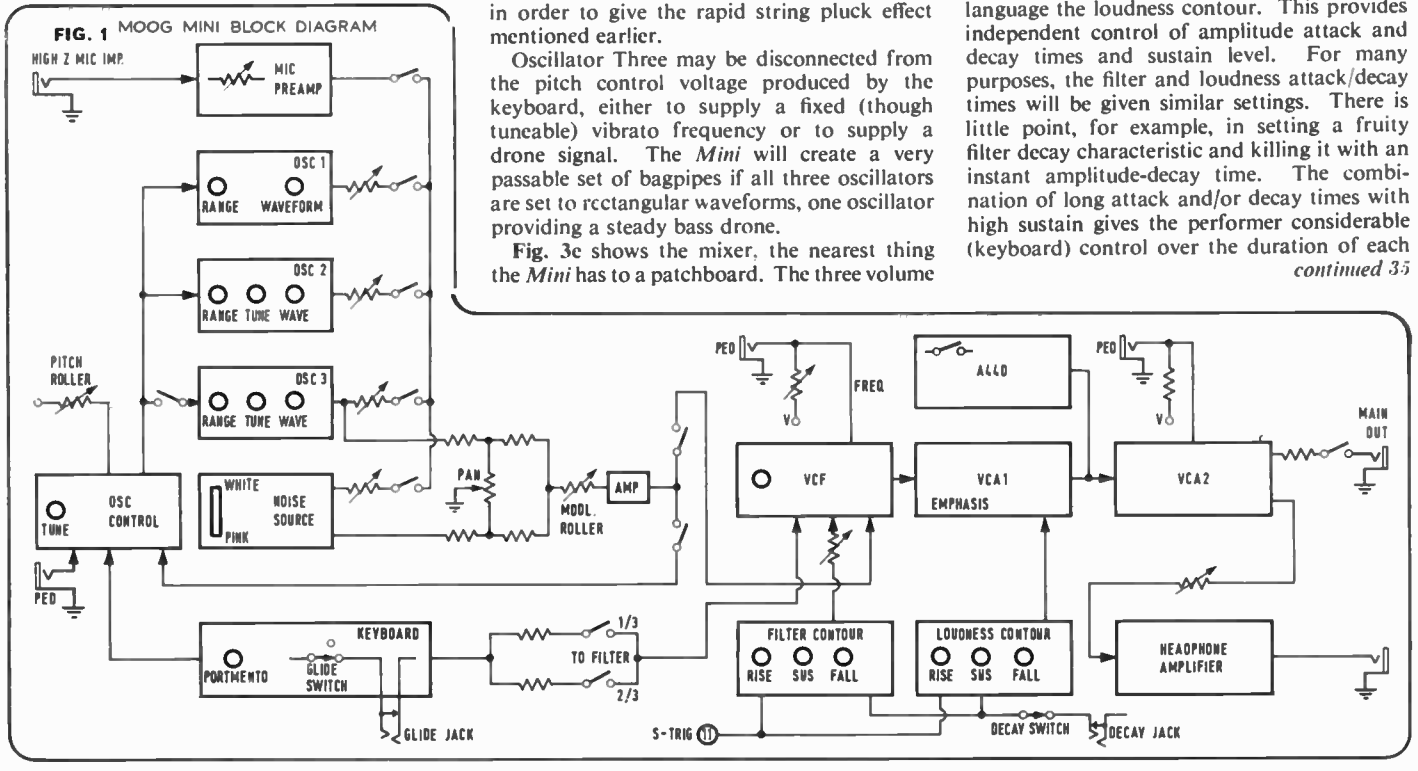
Fig. 3c shows the mixer, the nearest thing the *Mini* has to a patchboard. The three volume controls relate to the adjacent oscillators. From the volume control, each oscillator feeds through an on/off rocker switch to the mixing amplifier in the chain, the filter and envelope shaper. This takes care of three switches in the bank of five; the other two select an externally originated signal (microphone, guitar pickup or what-have-you) and internally generated noise. The respective level controls may be seen to the right of the switch bank. A white/pink switch determines the initial noise characteristic; this switch also affects the type of noise fed to the modulation mixer in **fig. 3a**. External signals pass through an input mic amplifier with its level control and overload warning lamp.

Any or all the signals switched into the mixer appear at the input filter (upper section, **fig. 3d**). This is a low-pass network, the initial cutoff frequency being set by the top-left rotary control. A resonance peak may be introduced at the cutoff frequency, dependent in sharpness on the position of the emphasis control (top centre). The contour control determines the frequency to which the cutoff point will rise when a key is pressed. With the filter attack time (middle left control) at calibration 1, the cutoff frequency will rise in the space of 1s to the point set by the contour control. If the key is released, the cutoff frequency will immediately return to its preset value while the key is held down—returning to this point at a speed governed by the setting of the decay time control. By means of the sustain control, the filter can be held at its uppermost cutoff frequency (adjusted on the 'amount of contour' knob) for any predetermined length, variable between 1 ms and one minute. Here again the key hold-down time, or the shortest of the two durations, will have an over-riding function.

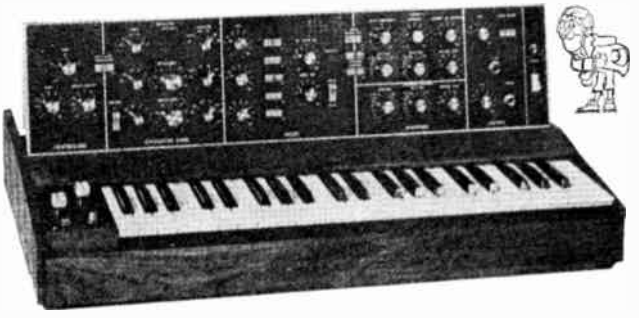
We should not really discuss the filter without reference to the envelope shaper—in Moog language the loudness contour. This provides independent control of amplitude attack and decay times and sustain level. For many purposes, the filter and loudness attack/decay times will be given similar settings. There is little point, for example, in setting a fruity filter decay characteristic and killing it with an instant amplitude-decay time. The combination of long attack and/or decay times with high sustain gives the performer considerable (keyboard) control over the duration of each

continued 35

FIG. 1 MOOG MINI BLOCK DIAGRAM



FOR THE PERFORMER



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moog

The MINIMOOG is a well-bred performer, precisely engineered yet sensitive and responsive, in the hands of a musician.

It looks good . . . It feels good . . . and, above all it makes musical sense ; after all, it is supposed to be a MUSICAL instrument for the modern musician, not a box of electronic gadgetry for an engineer.

More top groups than we care to mention use it; more and more hit records have been made with MOOG synthesisers than any other synthesiser.

That is a fact (and it speaks for itself !).

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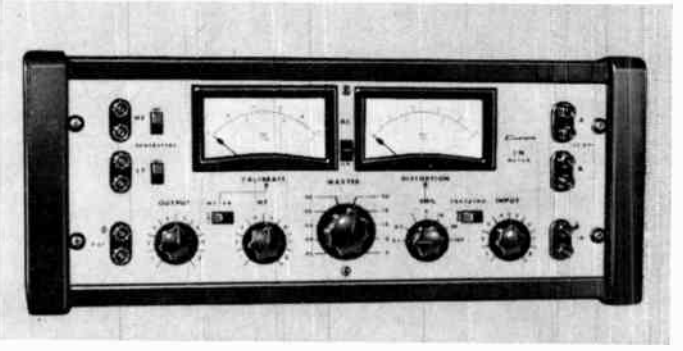
equipment to meet the demands of the world's most exacting users



Model IMA £395
Intermodulation Distortion Analyser

A dual-meter instrument providing facilities for measuring to exceptional degrees of precision on both L.F. and H.F. ranges (10-150 Hz and 2.5 KHz to 20 KHz). Tests over a wide range of varying amplitudes can be made quickly and accurately. FET circuitry assure measurements approaching a typical residual of 0.005% and within 5% of full scale. Many original features are incorporated in this instrument whereby generator interaction is eliminated, as are microphonics through the use of FET controlled AGC. Full details appear on the leaflet which we will gladly forward on request.

Model DC 300 £360
Two channel p.a. power amplifier

This superbly engineered Crown International power amplifier combines the qualities of a precision laboratory instrument with built-in ruggedness for a hard, long working life. It will deliver a total of 800 watts RMS into two 4 Ω loads, or 420 watts RMS into 8 Ω loads. Frequency response from 0 to 20 KHz into 8 Ω is within ±0.1 dB, up to 100 KHz, it is within ±0.6 dB. There is all-over protection against overload and misuse. Signal to noise ratio is 100 dB below 150 watts RMS output (unweighted, typically 110 dB). There is minimal programme delay on switching on. For standard rack mounting if required. May we send details of this outstandingly fine unit?

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Telephone Stonham 486

MINI MOOG FIELD TRIAL

continued

note, without having to endure the instant now-you-hear-it, now-you-don't characteristic of electronic organs. In this respect, as with any other synthesiser, it is important to lift your fingers completely clear of the keyboard in order to produce a new trigger pulse for the envelope generators between notes. Pressing b while c is still down or partially down can result in the smallest tail of a b or no b at all. Raising the sustain control (middle right) brings the touch and sound of the *Mini* closer to that of an organ.

Raising the filter emphasis control to maximum sets the filter into oscillation and thus provides a further voltage controlled sinewave source. Between the mixer and filter panels are a filter modulation switch and two keyboard control switches. The filter modulation selector routes a signal from the modulation mix control to the filter cutoff frequency control input. Switching in the keyboard control selectors produces a rise and fall in cutoff frequency—corresponding to the rise and fall in keyboard control voltage. This is important as it maintains a constant ratio between fundamental and harmonics. Without this switched into circuit, the filter would resemble a fixed low-pass equaliser. Notes would then sound duller as we proceeded up the keyboard until the fundamental itself disappeared. With both switches on, an octave rise across the keyboard produces a corresponding octave rise in cutoff frequency. One or other switch alone produces a smaller rise of half an octave per keyboard octave.

Fig. 3e illustrates the output section comprising main output volume control (top left) and mute switch. Below these is the 440 Hz injection switch, incidentally useful for preliminary level adjustments. Further down are the headphone output socket and level control.

Left of the keyboard are two Perspex slide controls and two switches. We have already covered the modulation control. To the left of this is a pitch control giving some seven semitones rise or fall and offering the facility provided by the guitar 'tremolo' arm, i.e. 'bending' notes might be compared with the sustain pedal on a piano, gives decay control a second function: how long the note takes to die *after* the key has been released. Obviously this only works if a certain amount of sustain is preset. The first decay control function is the time taken to decay to the sustain level. The second function is the time taken from sustain level down to zero.

The *Mini* is very well executed, its control knobs being nearer the diameter of an old penny than the ½p diminutive so common on modern equipment. It is light enough to carry short distances though might be the better for a handle. A means of locking the hinged panel down would also be worthwhile. Faults: two superficial points which may have arisen from a sideways knock in transit from the USA. (1) A small end-grain crack in the oiled-wood cabinet to the left of the keyboard, urgently in need of resin glue. (2) Reduced clearance between the lowest (f) key and the aluminium side of the left hand controller. At best the key squeaked; at worst it failed to spring back. Both points would clearly have been attended to under the Moog warranty.

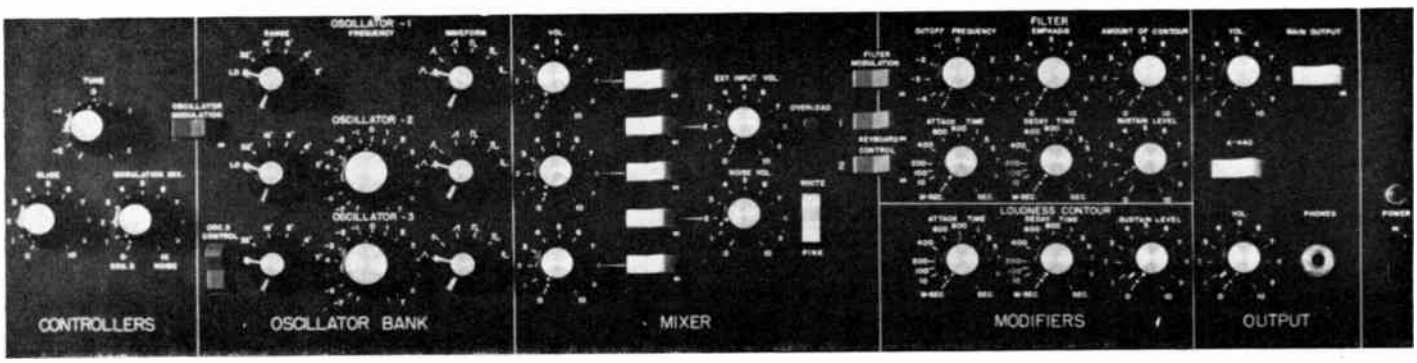
As for the price, £705 makes the *Mini* a good investment, particularly if you require its unequalled on-stage convenience. More versatile devices are available at lower cost but their greater flexibility can involve time-consuming setting up, in particular 'octave width' adjustments which—if set slightly out of tune through carelessness or fatigue—can ruin an entire session. I recommend the *Model D* without reservation.

David Kirk

Distributor's comment

Mini that David Kirk picked up was one of four which are constantly out on hire. These instruments do suffer hardships and I am sorry there was not time to check it over. However, a new instrument would never exhibit the faults described. The warranty, by the way, has no time limit in this country; instruments are repaired or replaced free of charge, providing nothing stupid has been done to them. If you spill minestrone soup down the keyboard, however, it will cost you. That sometimes does happen.

FIG. 3A B C D E



MULTI-TRACK REMIXING

continued

position in the score for closer examination. The faders will pick up their position from the master record and the indicators from the previous record, for comparisons. This procedure is repeated for the subsequent mixdown, updating either or both channels during the operation.

The advantages of the servo fader memory system are numerous. The faders show exactly which gain settings the memory is replaying. Most consoles could be converted to servo fader operation by replacing the existing faders with sdf units. It is not necessary to modify the audio circuits of a console to accept servo faders. The faders could be used perfectly conventionally when the memory system is not in use. The digital information of the memory is electrically isolated from the audio track of the fader. A servo fader memory system could be purchased with only a few sdf units and enlarged at a later date. The mental strain on a balance engineer can be enormously reduced by employing an sdf memory system. The time taken, per item, for mixing down can be greatly reduced, thus saving record producers' money and increasing studio availability to other clients.

Outline specification

The sdf unit is illustrated in **fig. 1** and its wiring in **fig. 2.** Servotrack faders should be available in three basic sizes: 40 x 190 mm, 45 x 174 mm and 38 x 105 mm.

Channel One: servo driven fader. Semi-logarithmic, 600 ohms, 5 kΩ or 10 kΩ.

Channel Two: servo driven fader indicator. Linear 5 kΩ indicator positional feedback track.

The repeatability of each channel should be ±0.25 dB within the range 0 to −30 dB and ±1 dB from −30 to −50 dB attenuation. The response of each channel should be in the order of 1s for full scale deflection.

The resolution of recording (multiplex) must not be greater than 250 ms between input/output signals; i.e. multiplexing speed should be 120 channels per second for 30 sdf units.

Up to 36 servo driven faders could be locked to one memory system.

Introducing Memorex tapes: reproduction so true it can shatter glass.

Before launching our range of tapes in this country we put them through a great many tests. This was one of them.

We took a singer and a glass and we amplified the singer's voice.

When the singer reached the precise pitch the glass shattered.

We recorded that note on Memorex tape.

Then we played back the tape, and when the note came up again a similar glass shattered.

As you can imagine, it takes precise reproduction to get the exact pitch to shatter the glass.

Which is all very impressive. But what difference will this make to your own recordings?

Less background noise.

Memorex Particles, Magnification 25,000X.

Competitor's Particles, Magnification 25,000X.

Well, it means you'll be hearing your recordings more like they really are.

Less background noise, less distortion at high volumes.

This is because Memorex tape is more sensitive than the tape you're probably using now.

The diagram here will help you understand why. It shows the coating of tapes magnified 25,000 times.

Those funny shaped fragments are particles of iron oxide. And it's these that pick up the sound.

The smaller and more numerous they are, the clearer the reproduction.

Trouble is, the smaller a manufacturer makes his particles, the more difficult it is to coat them evenly and smoothly over the tape.

But by spending time and money, Memorex found a way of doing it. So you get a better sound.

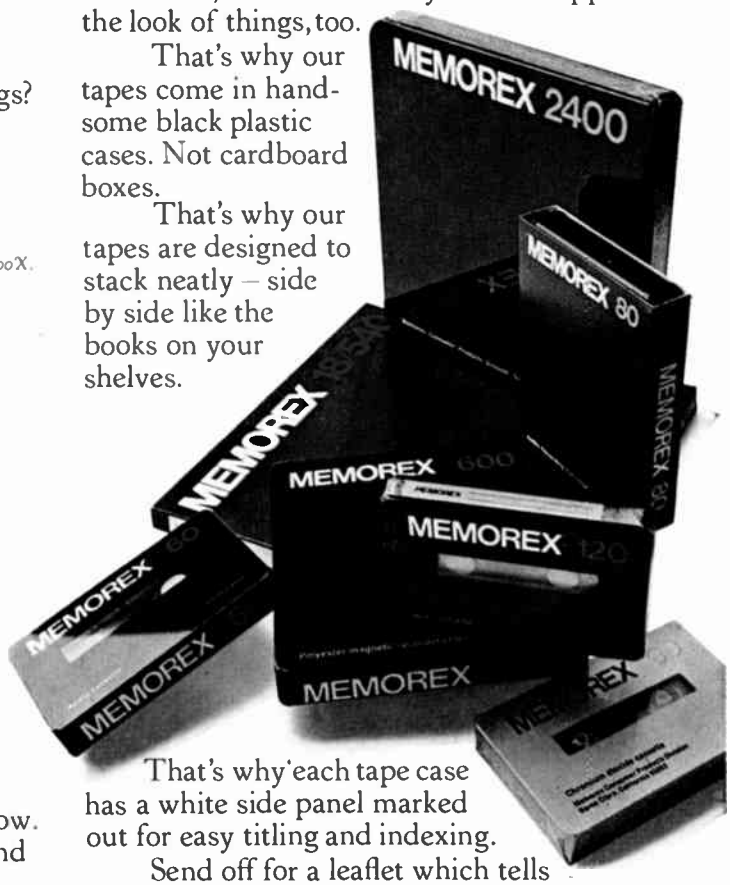
Not that sound is the only thing we've taken trouble over. We've worked hard on looks too.

The first handsome tape.

We believe that, just because you're an audio enthusiast, it doesn't mean you don't appreciate the look of things, too.

That's why our tapes come in handsome black plastic cases. Not cardboard boxes.

That's why our tapes are designed to stack neatly – side by side like the books on your shelves.



That's why each tape case has a white side panel marked out for easy titling and indexing.

Send off for a leaflet which tells you more about the Memorex range, plus a list of stockists.

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IBC '72 In Retrospect

THE 1972 International Broadcasting Convention was opened with a speech by Lord Hill, Chairman of the BBC, on Monday September 4. While the IBC is in the main sponsored by the television industry, several exhibitors were clearly preparing for the eventual introduction of commercial radio. Lord Hill had his own thoughts on this.

'At present, all public radio broadcasting in the United Kingdom is by the BBC. That is shortly going to be changed, although there is not going to be a national commercial network. The Minister of Posts and Telecommunications has sanctioned the opening of 60 commercial local radio stations in addition to the 20 BBC local stations which have been in operation for some time in the vhf band. Now, it seems, all 80 of them are to appear on the medium waves as well. May the Lord have mercy upon you after dark!'

Altogether 61 exhibitors booked space on the ground or balcony levels of Grosvenor House. Countries represented included Australia, Belgium, Canada, China, Denmark, Eire, West Germany, Finland, France, Ghana, Holland, Hong Kong, Hungary, Israel, Italy, Lebanon, Liechtenstein, New Zealand, Norway, Poland, Rumania, South Africa, Spain, Sweden, Switzerland, Turkey, UK, Uruguay, USA and Yugoslavia.

Forty-four papers were read in the course of five sessions covering Management and Engineering Training; Origination and Recording; Distribution and Satellites, Sound Broadcasting and Transmitters, Educational Broadcasting, Propagation and Receivers.

J. Redmond (BBC) contributed *The management of broadcast engineering in the BBC*. Six thousand of the Corporation's 24,000 staff are engaged in engineering, 76 engineers and scientists (with a support staff of 170) being employed in the Research Department whose function is to advise Engineering Management in the formulation of BBC technical policies. Nearly one per cent of the BBC's annual income (£900,000 out of £110,000,000) is allocated to research. One third of the Research Department's activities are involved in the selection of transmission frequencies, transmitter siting, transmission power and aerial patterns.

Another contribution came from H. Henderson (head of the BBC Engineering Training Centre, Evesham): *The problems of maintaining the complex yet reliable equipment found in broadcasting engineering*.

'In the BBC we recruit most of our technical maintenance staff at about the age of 18. By a combination of formal basic training courses at the Training Centre and supervised work on-station, we obtain qualified BBC engineers after about four or five years.

'Apart from basic training, the Training Centre provides special (usually one week duration) courses on various topics to meet particular training needs. In 1963, ten such courses were provided whereas in 1970/71 there were 45 and in 1971/72 there were 99! These included courses on Line Store Conversion, UHF Techniques, Stereo, Colour Television Mixers, Lighting Control and Digital Techniques.

'With . . . new devices came new techniques, digital techniques, and a new language—counters, registers, clock pulses, readout, bits and words. Familiar perhaps to the computer engineers but new to broadcasting. This increased complexity, which often leads to equipment very simple to operate yet with a sophisticated function, is achieved only because of the high reliability of its components. This . . . is moving the whole concept of maintenance into a new dimension.

'As things are dealt with at the moment, a man must learn more and more as complexity grows, without being able to give much up. There are still valves about. There must be a limit to this process if engineering staff are not to become permanent residents of the Training Department. It should be recognised that system complexity is even now akin to circuit complexity of years ago.'

Having outlined the difficulties, Mr Henderson proceeded to suggest solutions. Firstly, equipment designers must understand the increasing problems of maintenance and should provide more accessible monitoring points chosen for their significance in a logical fault-finding routine. Close collaboration between designers and technical authors should begin at a very early stage in the design. Maintenance should be dealt with in three phases, as it has been for some time by the armed services. In essence, this comprises 'first line' maintenance, carried out by the equipment operator working under program conditions whose role is to bypass that fault with minimum disturbance to the program, subsequently reporting it to the 'second line'. At this next stage, faulty cards are identified and faulty connections repaired. Cards are replaced by a spare, where necessary, the faulty item being dispatched to a central maintenance area—the 'third line'. Here the fault is investigated and, if economic, repaired. Either way, the fault is reported to the equipment designer when it appears possible to prevent repetition of such defects.

B. R. Webster (Head of the Electrical and Electronic Engineering Department, Plymouth Polytechnic) touched on similar ground in his paper *The education and training of radio and television engineers*.

'All those attending this Convention are involved in the communications industry—which at the lowest assessment is a high growth rate industry but, if one accepts some of the current prophesies, it may prove to be one of the essential keys to mankind's survival. Our stock of knowledge of communication science doubles every decade or, in more pertinent terms, the knowledge stock will be increased 16 times during a normal professional life span (say 20 to 60 at present). To the educationalist this has two important implications. First, if we could produce a genius who literally "knew it all" when he left college and did no further study he would be short of some $\frac{15}{16}$ths of current knowledge when he approached retirement. Secondly, as we plan now for the needs of young engineers, we must accept that the odds are 15:1 that the subject matter we cover will be of no use to them by the time that they become experienced senior engineers.

Mr Webster described the courses offered by his department and gave examples of fourth-year student projects.

The future of sound broadcasting in Europe was the subject covered by Dr H. Rindfleisch (Norddeutscher Rundfunk, Hamburg). He advocated an increase in the vhf broadcasting band since the present 87.5 to 100 MHz range permits little more than four full-coverage channels and, under certain conditions, a few low-power local stations.

'For the time being in several countries, three to four programs on vhf seem to be sufficient. However, when taking into account the future of broadcasting, a limitation to three or four programs is rather annoying. For example the distribution of programs that are addressed to qualified minorities would not be possible in many cases. It should therefore urgently be claimed that this frequency range, so perfectly suitable for sound broadcasting, be extended at least up to 104 MHz, if possible to 108 MHz. Dr Rindfleisch instanced motorists as a 'minority' in need of a specialised vhf service 'with as full a coverage as possible, reaching them even before they start their journeys. In the FDR, not only home receivers but also all modern car receivers are equipped for vhf, thus supplying the basis for such a service.

'It appears that vhf broadcasting has met with widespread response of listeners in countries where attractive new programs were broadcast exclusively on vhf. On the other hand, the spread of vhf receivers was not successful in those countries where the same programs are radiated on both mf and vhf. Obviously the better quality of vhf reception is not alone sufficiently interesting for the majority of listeners.'

Discussing the problems of lf and mf broadcasting, Dr Rindfleisch suggested that better

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FIG. 1 PROPOSED STATION LAYOUT ASSUMING NOISE IS PREVENTED FROM ENTERING THE STUDIO AREA

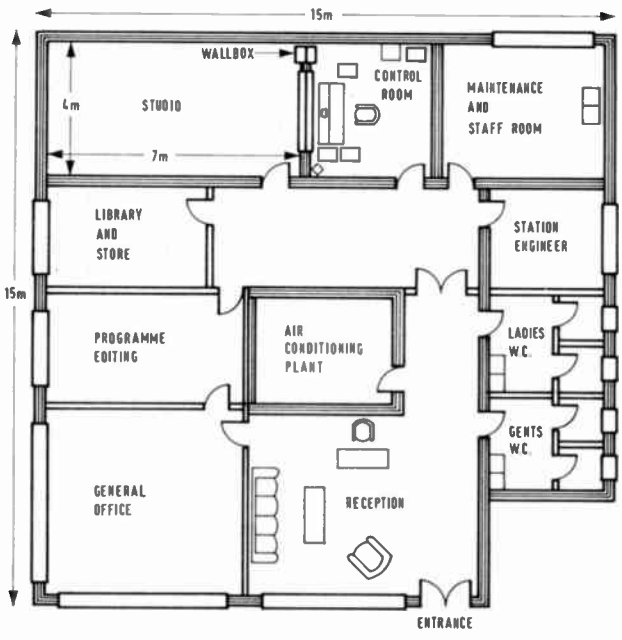
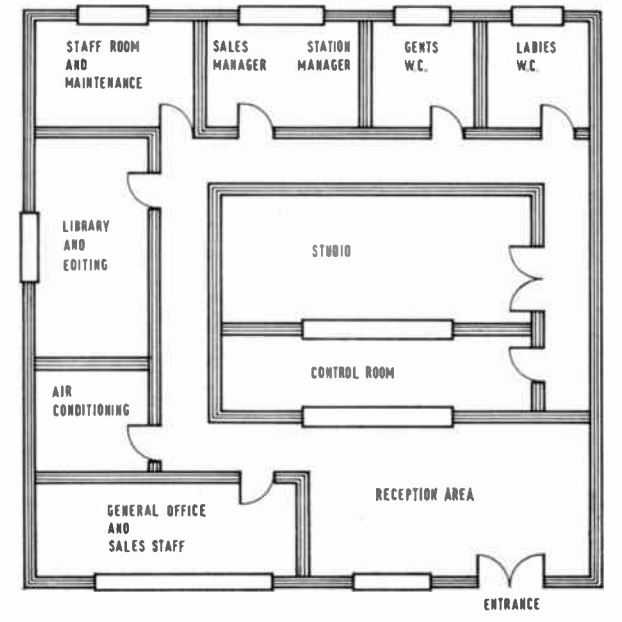


FIG. 2 ARRANGEMENT EMPLOYING A CENTRALLY PLACED STUDIO TO MAXIMISE ISOLATION FROM EXTERNAL INTERFERENCE



coverage of densely-populated areas could be achieved by using directional aerials, small transmitters for big city areas, or synchronised transmitter networks.

'However, none of these would permit full ground-wave coverage at night. A particularly interesting solution has been practised by the Beromünster transmitter (1,562 kHz) for some time. At darkness, horizontally polarised waves are radiated in a vertical direction and reflected by the ionosphere. In this way, a limited area of about 500 to 600 km diameter is covered. There is very little radiation at greater distances so that the interference with co-channel transmitters in Portugal and Sweden is negligible. However, it is uncertain to what extent this method could be applied in an overall plan.'

G. D. Cook and C. R. Longman presented a paper which raised the question *Television origination: film or electronic?*

'The use of small mobile electronic recording units has previously been impractical due to the size, weight and cost of the electronic colour cameras and video tape recorders. During the past few years, smaller colour cameras have been used for broadcast purposes and, more recently, broadcast colour (helical scan) video tape recorders are becoming available whose cost and size make them suitable for mobile use. Although the cost of a one or two camera mobile unit will be higher when compared with a film unit, in a total costing activity the possible increases in productivity could offset these additional capital costs. Improved picture quality could also be achieved and this is especially important on studio insert material.'

Excluding news film, about 15 per cent of the BBC program output originates on film. Despite the high capital costs of an 'electronic' studio (some £650,000), such a studio can average 30 minutes output per day.

'A 16 mm sound film unit costs approximately £10,000. With an 8:1 shooting ratio (the average for Drama productions), a single film camera can supply 2.5 to four minutes a day of program material.

'Early television productions were . . . mounted in real time and when recording methods first became available they were used essentially to store material for subsequent transmission. Eventually, to allow greater production sophistication, producers began to edit their recordings. In the BBC today it is exceptional for a studio production to have a shooting ratio exceeding 1.5:1 and the majority have a shooting ratio very close to unity.'

Example costs were quoted for a 15-minute item shot in a picture gallery during an eight-hour working day. Total cost of a video tape production would be £733 against the £767 film equivalent. The former figure was derived from £250 (camera, one day), £180 (crew, one day), £120 (vtr, record), £144 (vtr editing, three hours), plus £39 (production staff). This compares with £390 (16 mm film costs), £19 (camera, one day), £128 (crew, one day), £100 (film editing, four days) and £130 (production staff). Cost comparison was also made between electronic and film production of a 30 Minute Theatre program. The electronic production came to £8,563 (studio) and £7,815 (ob) against £11,879 (stage) and £12,847 (location) for film.

B. Sandford (senior systems planning engineer, Television Equipment Division, EMI Electronics) contributed *Considerations in the*

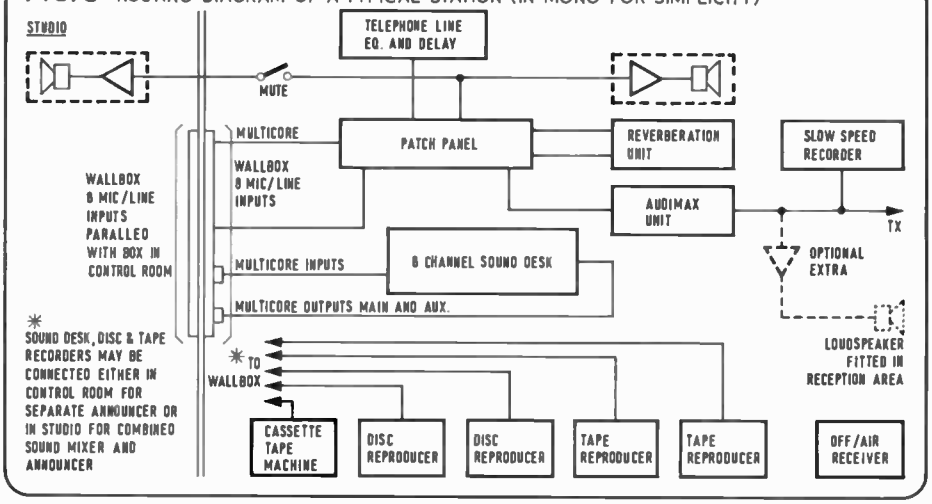
planning and equipping of a local radio broadcast station. Dealing with economic considerations, he quoted the suggested program content put forward by the Local Radio Association. This comprised (in minutes per hour): 39 (music), five (news bulletins), ten (speech other than news), and six (advertising). On this basic assumption, he advised a site allowing a minimum 225 m² floor area in an accessible part of the host town. It would be important to choose a location relatively free of noise or very expensive sound proofing might be necessary. Two proposed site layouts were given for small broadcasting stations. That reproduced in **fig. 1** offers optimum use of space, assuming noise is prevented from filtering into the studio area. The **fig. 2** arrangement provides maximum isolation from external noise by virtue of its centrally placed studio; space utilisation is, however, less efficient than in the previous example. Mr Sandford outlined a schedule of equipment essential to a manual station, assuming stereo operation. He proposed one 6/2 sound control desk; two 19 cm/s 27 cm capacity stereo-optimised studio recorders, four 27 or 18 cm capacity 19 cm/s semi-professional machines; four studio monitor loudspeakers; four 15 to 20W power amplifiers, four gram units, a reverberation unit (springs were considered acceptable in view of the high cost of plates); a telephone line equaliser and delay unit (the latter to permit pretransmission editing); one cartridge recorder/player (for identification inserts and advertising); an off-air receiver; a slow-speed recorder holding all transmitted material for evidence purposes; one master and two slave clocks; an internal communication system; four microphones ('two-way, cardioid'); three table stands; three floor stands; two boom arms; and three door status lamps. A volume limiter was also required, fitted either at the transmitter end of the studio or just before the studio line amplifier. In the latter position, less expensive limiters with outputs not truly balanced to earth could be used. A comprehensive patch panel located in the control room and other key areas would be essential, a typical routing system being shown in **fig. 3.**

Mr Sandford progressed to the subject of station automation.

'A radio station that is "on air" for 18 hours a day, seven days a week, will probably require for each program operation a staff of four persons on a shift basis. This allows for an actual 20-hour day to cover testing and routing maintenance plus "slack" for illness and holidays. If only one operation can be dispensed with, the saving obtained may be sufficient say over a three-year period to make . . . automation equipment . . . worthwhile.'

A typical program schedule was given to illustrate the degree of control available. After discussing basic studio and ob requirements, Mr Sandford concluded 'Recent articles in the UK national press (*Daily Telegraph* 1972 January 21 and *Sunday Times* February 13) have expressed the view that prospective local radio operators will have great difficulty in making the operation a profitable one. Obviously the key to success will lie in capturing a large listening audience which to some degree will depend upon the program content and its coverage, but at the same time it is necessary to limit the capital outlay and to minimise running costs.'

FIG. 3 ROUTING DIAGRAM OF A TYPICAL STATION (IN MONO FOR SIMPLICITY)



Above

Scanimate computer developed and manufactured by Computer Image Corporation. The system offers instant tv animation, controlled and viewed while the action actually takes place.

Further data: Computer Image Corporation, Denver, USA.

Right

Ampex exhibited the new *MM-1100*, a compact multitrack audio recorder costing £8,200 in its standard 16 track form. Facilities include servo capstan drive, 21 cm spool capacity (permitting more than two hours recording at 38 cm/s), rapid conversion from 25 to 50 mm tape width, and improved Sel-Sync performance. Eight and 24 track versions are available, occupying the same floor space.

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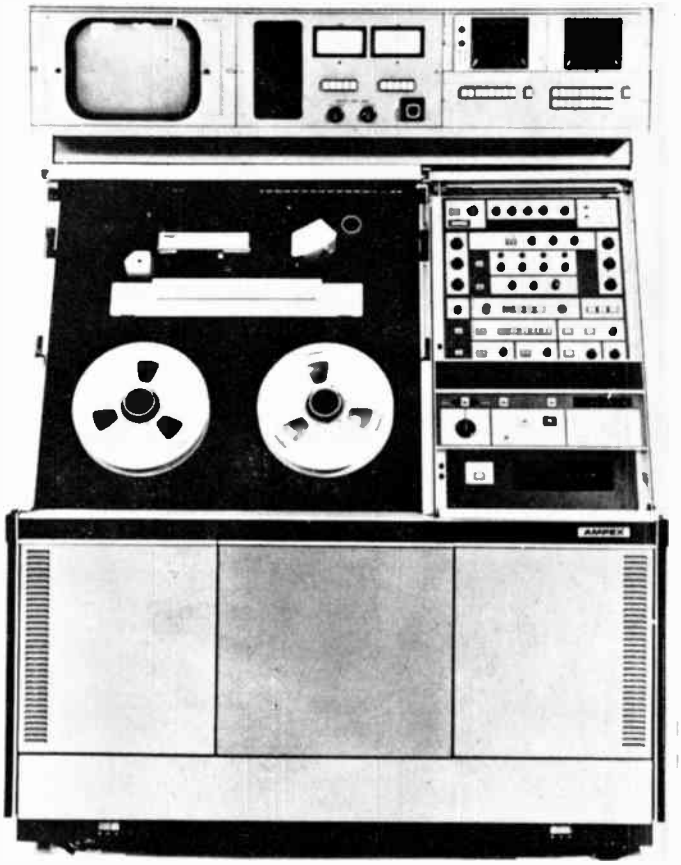
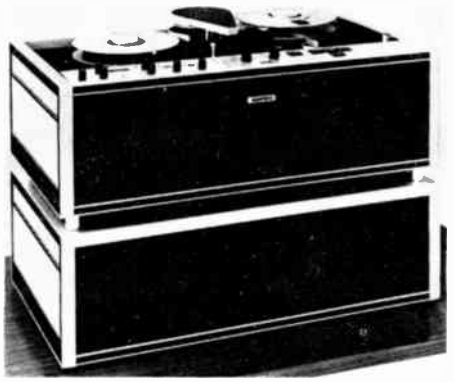
Also on the Ampex platform, a third generation version of the *AVR-1* colour vtr (right). During the IBC period, 42 of these were in use at the unhappily soured Munich Olympic Games.

Helical scan vtr operation is becoming increasingly respectable in the broadcasting world, having previously been largely confined to less demanding markets. The Ampex *VPR-7903* features improved stability and high band PAL/SECAM colour or monochrome record/playback capability.

Further data: Ampex International, 72 Berkeley Avenue, Reading, Berkshire.

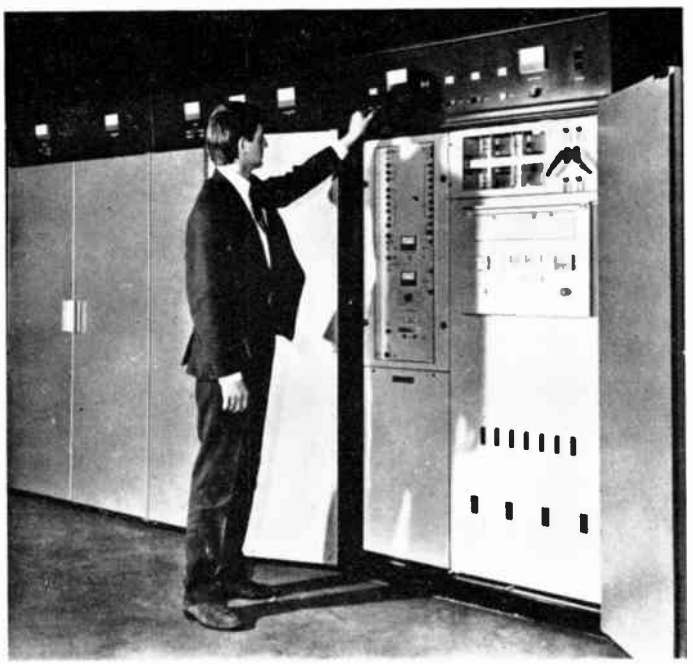


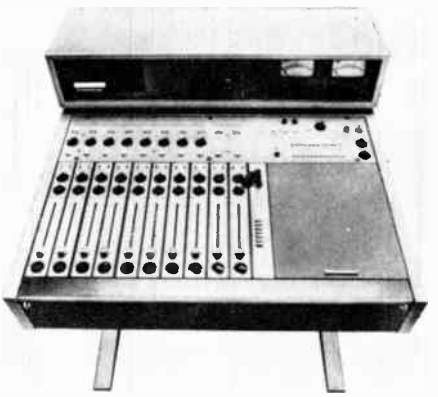


Below

Marconi's new *B7320* 10 kW uhf tv transmitter. This uses two high-gain four-cavity klystrons, separate vision and audio outputs being combined in an external unit. The IF modulation drive unit is visible on the right of the photo.

Further data: Marconi Communications Systems Ltd, Broadcasting Division, Chelmsford, Essex.





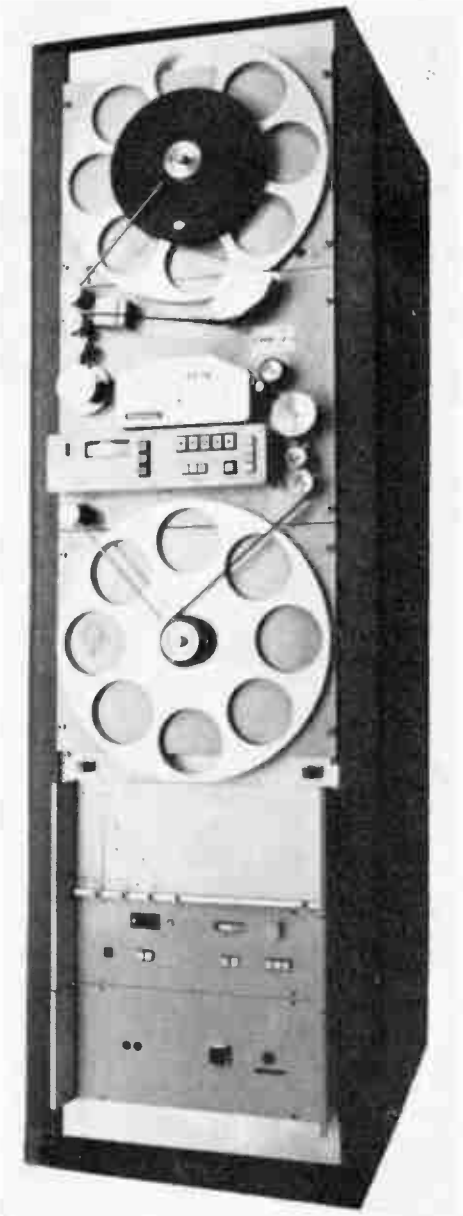
Above and right

Schlumberger, a name relatively new in the UK, displayed their *DS160* multitrack magnetic film recorder for which they claim rapid loading, low wear of film and heads, start times and wow/flutter figures comparable with non-sprocket tape recorders, and low working cost. The *DS160* also lends itself to automated operation. Modular construction permits a wide range of options from simple synchronous recording to slaving with an automatic editing system. Other Schlumberger exhibits, illustrated here were an *F200* series tape recorder and *UPS2082* sound control desk (above).

Further data: Schlumberger Instruments and Systems, Centre de Rueil, 296 Av. N. Bonaparte, 92503 Rueil Malmaison, France.

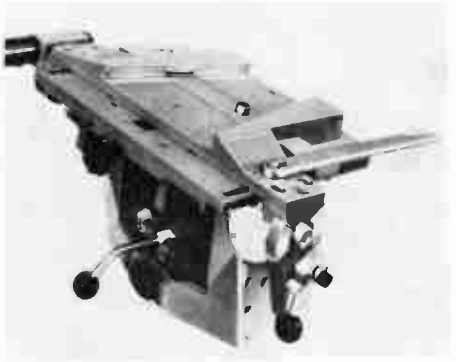
Schlumberger F20D

Schlumberger DS160



Below

Robert Bosch displayed their *KCR40* hand-held colour camera for the first time in Britain at IBC '72. Total weight, including viewfinder and lens, is approximately 7 kg. The *KCR40* is divided into a camera head and backpack, leading via a 13 mm diameter cable to a standard *KCU* control unit. A coaxial cable link between camera and control unit will shortly be available. The equipment is offered as a supplement to ob vans but also has applications in studio productions.
Further data: Bosch Ltd, Rhodes Way, Watford.



Above

Vinten *Mark Five* pan and tilt head with up to 60° tilt each way from horizontal. The unit weighs under 11 kg yet has an 81 kg capacity. Designed for compact broadcast cameras, it incorporates separate braking and friction controls.
Further data: W. Vinten Ltd, Western Way, Bury St Edmunds, Suffolk.

Centre left

Pye TVT demonstrated the new Philips LDK5 colour camera, seen here with a Rank Taylor-Hobson Varotal *30* lens system. Triaxial cable contributes to greater mobility, being more reliable, lighter, thinner and less expensive than multicore cable. More than 3 km can be used with any one camera, making the *LDK5* ideal for ob applications.
Further data: Pye TVT Ltd, Coldhams Lane, Cambridge.

Below

Link Electronics introduced their *Camera Tube Test Channel*, thought to be unique. It allows accurate measurements to be made of colour and monochrome tube performance, then compared with the tube specifications.
Further data: Link Electronics Ltd, Walworth Industrial Estate, Andover, Hampshire.

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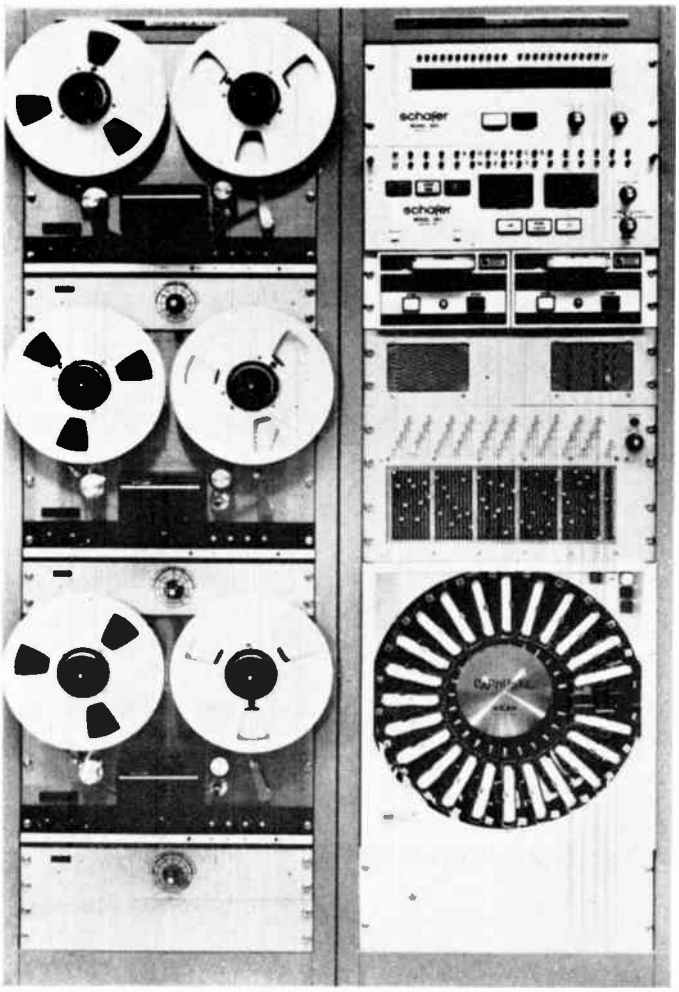
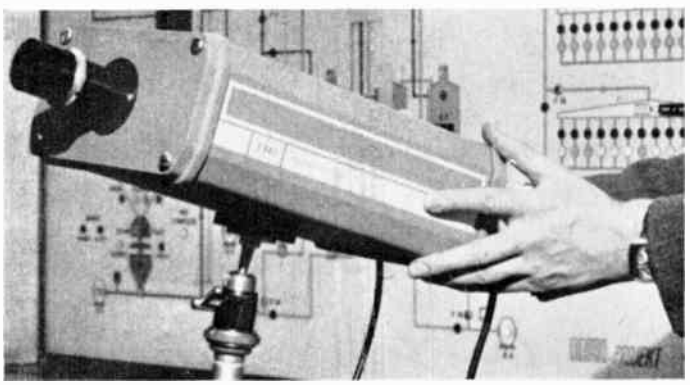


Above

EMI are the exclusive international agents (outside North America and Mexico) for the Schafer *900* series of modular broadcasting systems. Comprising reel-to-reel and cartridge reproducers, the installation is controlled by programming events into an internal memory. **Further data:** EMI Electronics, Hayes, Middlesex.



Right: EMI Surveyor monochrome cctv camera

Above

Model *2005*, the latest three-tube colour tv camera from EMI, was demonstrated in conjunction with an EMI five-camera colour ob van outside Grosvenor House. Five *2005* cameras will shortly be supplied to Granada Television under a £200,000 contract to equip a new colour studio at the Manchester TV Centre.
Further data: EMI Electronics, Hayes, Middlesex.

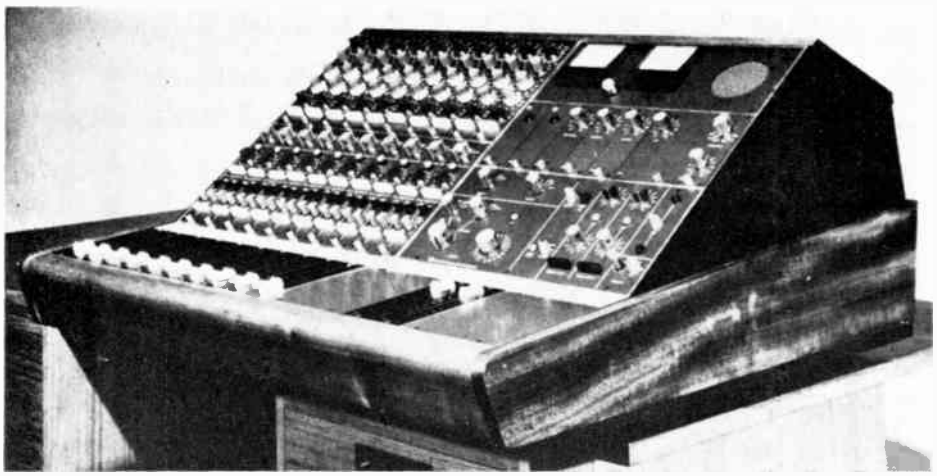
Above

The Allison Research *VCA-1* voltage controlled amplifier module was among the newest items being handled by F. W. O. Bauch. Applying a zero to 1V dc control voltage provides a wide

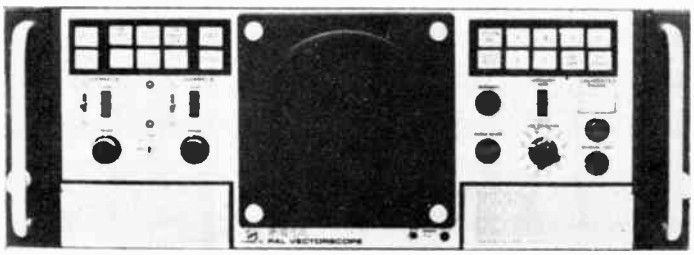
range of linear gain control, padding facilities for higher control voltages being available in the *VCA-IPC*. Any number of *VCA-1* units may be fed from one control voltage source, tracking each other within ±1 dB over a range of at least 60 dB.
Further data: F. W. O. Bauch Ltd, 49 Theobald Street, Boreham Wood, Hertfordshire WD6 4RZ.

Below

Tektronix *521A* vectorscope. This is designed for use on 625 line 50 field PAL colour and is calibrated to monitor video signals with 0 set-up level in both vectorial and linear-sweep presentations. Features include a differential phase and gain graticule for easy direct reading of large differential phase distortion.
Further data: Tektronix UK Ltd, Beaverton House, PO Box 69, Harpenden, Hertfordshire.



Above: Neve BCM10 sound control desk

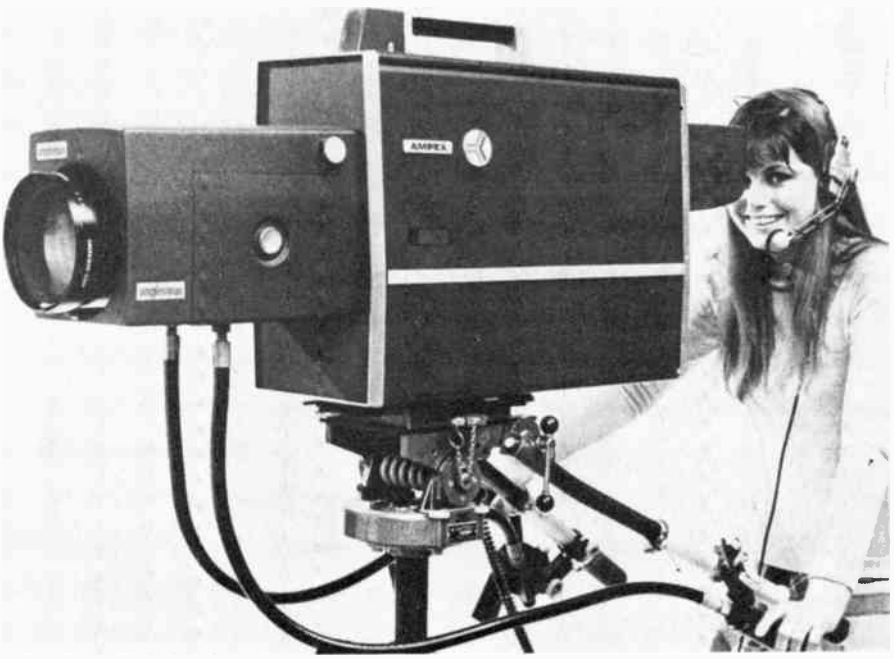


Above

Decca *EP731GB* television field strength meter, operating from mains or a 12V battery. The receiver functions on 625 line bands one, three and four to five (47 to 64 MHz, 160 to 230 MHz and 470 to 770 MHz respectively). Sensitivity is 10 μV, weight is 11 kg, and whd dimensions are 350 x 200 x 270 mm.
Further data: Decca Radio & TV, Ingate Place, Queenstown Road, London SW8.

Above right

Feldon Audio displayed two items new to the UK market, the Eventide Clockworks (New York) *1745* digital audio delay line (illustrated) and *PS101* electronic phaser. The basic *1745* unit has a 200 ms capacity rising to 800 ms when optional *1745DL* modules are added. Module *1745OP* increases the basic two switchable outputs to an unlimited number of outputs. The specification quotes a 20 Hz to 15 kHz ±1 dB bandwidth, better than 66 dB signal-to-noise ratio and less than one per cent 1 kHz distortion. Price has yet to be finalised but will be in the £1,500 region. The *PS101* phaser offers over 1,200° of phase shift and will function automatically from an internal envelope follower, thus ensuring repeatable treatment. Price of this unit is £250.
Further data: Feldon Audio, 126 Great Portland Street, London W1N 5PH.



Right: Ampex BC-230 colour camera

continued

cables and 150 unidirectional microphones mounted on CTH designed stands.

The 100-way console is installed in a separate control room and linked to the main conference room. The 50 input unit is mounted on a trolley to enable it to be used in a sub-committee room or, after the conference, for other purposes. Both units can be used to record the proceedings as well as for public address, broadcasting and monitoring. Each microphone user can signal the control console and a lamp on the console indicates that the microphone is live. A three-position muting switch on the console, when in the centre position, only partially switches off the mic. In this way the whole conference will be recorded even should a speaker from one mic be interrupted by one from another.

The chairman is provided with a master switch which enables him to override the console operator. As well as having talk back facilities the chairman has independent control of his own mic. Each microphone stand has been designed to be stable whether it is used from a standing or sitting position.

Comment on the Stellavox AMI review

THE FOLLOWING comment has been received from Mr R. J. Woolford on behalf of A.V. Distributors (London) Ltd in response to points raised in Hugh Ford's October review of the Stellavox *AMI* portable mixer:

'Firstly we must apologise again about the missing fuse (it was 'borrowed' during the APRS exhibition), having already done so to Mr Ford during the course of his reviewing.

'The exploding neon in the *APS* was one of a batch in which the current limiting resistor was fitted externally, and its insulating sleeve was too short; these are being replaced as necessary. It is possible to earth the *APS* without introducing hum loops, as the dc output can be left floating.

On seeing Mr Ford's distortion figures, we rechecked the review unit with Angus McKenzie who has been preparing a field trial. With 100 mV at the line input, the distortion was 0.4 per cent for +6 dBm out; with 0.775V it was 0.1 per cent, and with 1.55V it was 0.21 per cent. Signal-to-noise ratio was 57 dB ref 100 mV input. On the mic input it was found that at signal levels above –48 dBm the channel fader had to be brought down (increasing feedback) to avoid input distortion, and full output was no longer available.

'A modified unit (referred to at the end of the review) was then tried, with the following results:

'Line in. 1.55V input 0.1 per cent distortion for +6 dBm out.

'10V input 0.23 per cent distortion for +6 dBm out.

'Mic in. –30 dBm input 0.14 per cent distortion for +6 dBm out.

'Distortion was measured on channel four in the automatic mode as 0.6 per cent at 30 dB compression. During automatic operation the gain controls act as threshold controls, adjusting for differing mics and noise levels.

'The modified mixer is undergoing further treatment as a result of suggestions from Mr McKenzie, and will be returned to him for field trials.

'Mr Ford measured the mic input impedance as 205 ohms; this is in fact due to the feed resistors for capacitor mics. AB fed mics (Schoeps, Sennheiser, Neumann *70*) see it as their emitter resistors and an input impedance of greater than 2 kΩ. As the same resistors provide the phantom power, the impedance is too low in this mode and we are investigating switch modifications to overcome this.

'Mr Ford also appears to have missed the part of the instruction book where it is shown that input sensitivities are measured with master faders at +15, and channel faders at 0 dB. The reason for the lower sensitivity on channels four and five is that there are stand-off resistors on the faders to permit the automatic operation.'

continued

The Other Woman, produced by Dave Humphries and Pat Ryan, and some commercials. Brian Hatt has now left the Orange operation though he still works in association with them.

Indigo, in Manchester, have arranged a distribution deal for the Indigo record label. Bob Auger tells me that Decca will distribute the new label in the north of England; negotiations will begin for distribution in the south when the label's northern success can be estimated.

Indigo recently recorded a live album of Johnny Recourt's act at his haunt in Palma, Majorca. He it was whose *Leyenka* single chalked up about 1,250,000 European sales, though it did little here.

In the studio, or more accurately in the car park next to it, Indigo recorded an album of music played on a Wurlitzer *Orbit three*. The instrument, a combined organ and synthesiser, was too large to go into the studio so it was played outside. The musician concerned listened to the output of the other instruments, the players of which were in the studio, through headphones. Production was by Peter Sullivan.

Indigo also recorded a Vivaldi Mass performed by the British Youth Choir in Sheffield Cathedral. The tapes were sent to Trident for cutting, and Bob Auger tells me that Trident were impressed with them.

Strawberry, also in Manchester, recorded a Mixtures single which the group produced themselves. The engineer was studio manager Peter Tattersall. Much of the studios recent recording time has been booked by Barclay James Harvest, who did an album which they produced themselves and which Peter also engineered. Among other work that has been going on at the studio, the Hermits reduced a single and Penny Farthing produced singles by Manchester United and Liverpool football teams.

Strawberry will be closing down for three weeks beginning in the middle of next January so that the studio can be redecorated, modified and, most important of all, so that a new Helios 16 track desk can be installed. New machines will also be brought in but which these will be has not yet been decided. STUDIO SOUND will publish a full report when the alterations have been made.

Editing on the Revox 77

TO the right of the headblock of the Revox *A77* is an anonymous grey button in a quadrant slot, identified in the handbook as the 'edit' lever. This article describes a simple modification to extend the usefulness of the edit lever and, at the same time, to clear away some of the hazards that exist for the absent-minded when editing on this machine. The modification does not change the appearance or normal operation of the machine in any way and can be removed without trace in less than ten minutes should the recorder be passed to a buyer not sympathetic to deviations from the norm.

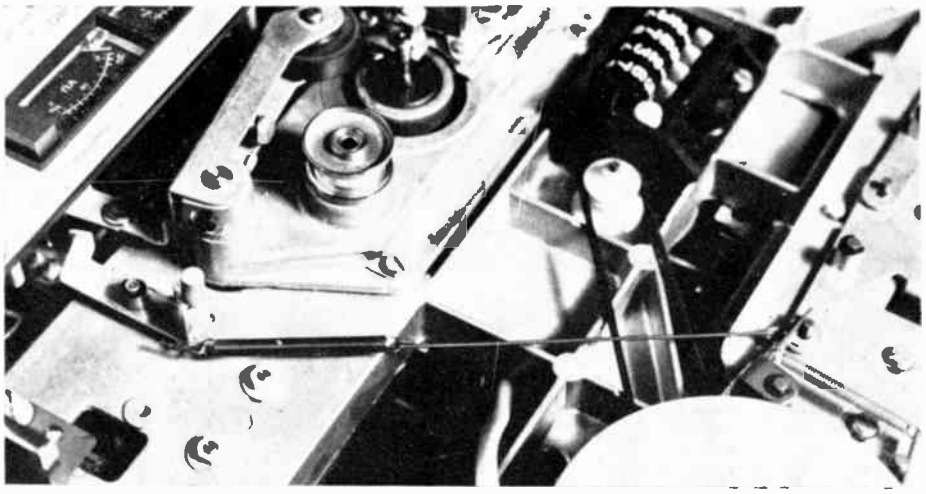
Since not all *A77* owners fully understand the function and correct use of the edit lever, it seems appropriate to begin by following through a typical editing operation as it is done on this machine:

1. Play the tape, pressing the stop button as soon as the desired cutting point is heard.
2. Move the edit lever clockwise in its slot until it clicks and latches into position.

This operation causes (a) the pinch wheel to move towards the capstan, carrying the tape to the playing position against the heads, (b) the hum screening flap on the replay head to close, and (c) the replay amplifier muting switch to open (unmute). The lever should latch into position with a firm click just before the tape comes into contact with the capstan.

3. Press down the spooling power cutout.
4. Select fast forward to release the brakes.
5. Search the tape for the exact cutting point by rocking it backwards and forwards, rotating the spools by hand. Bring this point exactly against the replay gap.
6. Press the stop button to apply the brakes again.
7. Switch on the spooling power button to enable the spooling motors to resume their normal operation. If you forget, there will be a nasty spill of tape next time you switch to play, with tape being fed out by the capstan on to a stationary take-up spool.
8. Pull down the hum screening flap against its spring, and mark the back of the tape in the centre of the replay head (or use whatever trick you have evolved for marking a point a known distance away).
9. Release the edit lever by pressing the pinch wheel towards the capstan just enough to move it against its return spring, and letting it spring back.
10. Splice the tape.

It is readily apparent that steps 3 and 4, and the inverse steps 6 and 7, are merely a rather roundabout way of releasing and applying the brakes and could with advantage be combined into a single operation. It is less obvious, but rapidly brought home once one begins to edit in this way, that these steps are traps for the abstracted operator, whose mind may be totally occupied with the problem of identifying the exact point to cut from take X to take Y. Suppose, for example, that one has marked take X and laid it in the splicing block. On the machine is take Y, with the identical point identified and brought over the replay gap. One heaves a sigh of relief, and presses the reel motors deactivation button—by mistake *before* the stop button. Instantly the tape sets off at the usual brisk Revox fast forward pace, playing as it goes. The result is a paralysing avalanche of sound which does nothing to help the concentration required for finding the place again.



A few experiences of this kind led me to consider ways of eliminating steps 3, 4, 6 and 7 altogether. The logic required is trivial; merely that operation of the edit lever should release the brakes and releasing of the lever should re-apply them. Better still, operation of the lever should merely slacken the brakes so that the spools could be turned easily by hand in either direction but would not tend to 'lose the place' when left alone. Plans involving microswitches were drawn up and discarded. Eventually the present simple mechanical linkage was tried out, using string and an elastic band. This system has proved very successful and well repays the small amount of effort required to fit it and adjust it to work correctly.

The photograph shows the modification in a more respectable form, using more durable and stable materials. Ordinary copper wire, about 18 swg, is suitable for the hook attached to the edit lever, and the rigid part of the link. It should be work-hardened and straightened by standing on the reel, gripping the end with pliers, and stretching it about ten per cent. This makes it surprisingly stiff and springy. The attachment to the brake mechanism is a 2BA solder tag, thin enough not to interfere with the normal operation of the brake. There is of course no need to follow every detail of the construction shown if alternative means to the same end are easily to hand. The strength of the tension spring is the most critical feature, and should be between 150 and 200 g/cm. If a suitable one cannot be found, choose one that is too weak and increase its spring rate by cutting pieces off until it is right.

To gain access to the appropriate part of the deck, retract the hinged fascia panel and pull off the headblock cover. Remove the two screws holding down the deck cover; these are the one immediately to the left of the speaker cutout button on the left-hand side, and the one immediately to the right of the edit lever button on the right-hand side. Don't undo any other screws. The deck cover plate is then held only by three strong spring 'poppers' along the back edge of the case, and should be prised off.

The first step after this is to fit the wire hook on to the edit lever and secure it with a blob of epoxy adhesive. If you are impatient this can be cured in about ten minutes by applying a hot soldering iron for a few seconds at a time to the other side of the metal but first remove the plastic knob from the lever by prising it off.

The correct length for the straight wire part of the link is best found by experiment, using a few turns of strong thread in place of the wire and adjusting the length of the loop by trial and error. When it is right there is no interference with the normal operation of the brakes with the edit lever released but fairly free movement of the spools with the lever in the edit position. Then make the link the same length as the loop of thread, install it, and put the covers back on.

QS SYSTEM

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(4) The QS system offers complete compatibility with existing stereo equipment. The QS-encoded 4-channel records, when played back on such equipment, actually offer greater depth and dimension than conventional 2-channel sound. There's no need to keep double inventories of separate 4- and 2-channel recordings.

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Sansui

Recording Studio Techniques

BY ANGUS MCKENZIE

Further thoughts on stereo microphone placement

IN the past I may have given the impression that I nearly always prefer to use a stereo coincidental microphone pair to record classical music. I would like to take this opportunity of showing that this is not necessarily so, and to give the reasons why other microphone techniques are to be preferred under certain circumstances.

For recording simple chamber groups and small choirs a coincidental pair will probably be hard to better if, and this is of the utmost importance, the microphone is placed correctly. Furthermore it is almost essential, when using a coincidental pair, to have on the control desk a width control capable of decreasing or increasing the difference channel by up to 6 dB or so.

However, a single stereo pair on larger forces is only likely to be effective in locations that have superb acoustics, examples of such halls being the Royal Albert Hall and, with reservations, the Royal Festival Hall. In many locations, such as town halls that were not originally designed for good acoustics, it is necessary to employ additional microphones to achieve a good balance without introducing too much poor quality ambience: this is usually too much ambience of too short a reverberation time and sometimes, in addition, with bad flutter echo, as in Leicester's de Montfort Hall.

I therefore do not disagree with a multimic technique when used properly but I do disagree with a technique where single microphones are panpotted across the sound stage with little regard for the phasing of low frequencies and where the engineer does not use a number of stereo pairs in order to achieve a spread of each section of the sound source. It has been said by engineers who I respect highly, but with whom I do not necessarily agree, that under session conditions there is insufficient time to attempt a main balance on a stereo pair and to add small proportions of spot mics after the main pair has been balanced. Many record companies tend to get the sound to their liking on each individual microphone then balance these as a whole, finally bringing up atmosphere with either a stereo pair or spaced reverberation mics or both.

It is unfortunate that almost no commercial desks exist with widening available, although narrowing can be achieved by panning the outputs of the stereo pair to wherever they are desired. The ability to widen a stereo pair allows the engineer to retain a 90° angle between the capsules, merely altering polar diagrams on the microphone and adjusting the width to give the same effect as of physically widening the capsule angle.

An example of the use of this technique may be helpful. On one recent occasion I had suspended a Neumann fet *SM69* in front of and above a choir. An almost ideal balance was achieved, but too much reverberation came in from the back of the microphone when the polar diagram was set at crossed figure-of-eight. On altering the polar diagram to cardioid the sound became a little too dead and hence too close. In addition, as would be expected, the stereo image was too narrow. A small increase of difference channel on the widening control not only had the effect of widening the sound stage to exactly the desired width but also increased the pickup of reverberation marginally so that the sound was regarded as ideal. The resulting equivalent polar diagram was approximately that which would be given by 120° hypercardioid but it was noted that the high frequency response in the centre of the sound stage was slightly better than that which would have been obtained if the capsule angle had been physically widened.

Although this technique can only be recommended for use with coincidental, or very nearly coincidental, capsules, it will be seen that it can save a considerable amount of the engineer's time in re-adjusting microphones, and I therefore cannot understand why so very few engineers use it. Much praise then to the BBC for having widening facilities available on almost all their stereo control desks.

If a multi-mic technique is to be used, I feel that the sound produced should be as similar as possible to that which would be produced under better acoustic conditions. Great care should be taken not to give the impression that microphones are used to bring soloists any more forward than they would be heard under good listening conditions. Not many engineers hold this opinion and it is possible that in this area of discussion there is greater disagreement than in any other.

I should like to repeat the comments of a very famous counter-tenor who I was recently privileged to record, but first I will describe the microphone technique I employed when balancing his voice against organ accompaniment. A stereo mic 2.5m above floor level was placed 2.5m away from the soloist, a hypercardioid polar diagram being chosen. Another stereo mic was raised approximately 14m away from him. On hearing the playback the soloist remarked that although he had at first thought the microphone seemed a little too distant, in fact the recorded balance was exactly what he wanted. He also mentioned that in no way had he modified his performance for the recording; he had used his full dynamic range, which is amazingly wide. He told us that earlier that day, when making a recording for a large commercial company, the presence of a microphone only 1m from him caused him instinctively to restrict his power, which tended to alter his interpretation. Perhaps this may strengthen the argument that microphones placed too close to musicians may well have bad psychological effects on those musicians, no matter how professional they are.

I wonder also if some of the unpleasant edginess that I notice on some close miked recordings of singers is due to capacitor microphones receiving such a high sound pressure level that their inbuilt amplifiers are being driven to non-linearity on peaks, causing both harmonic and intermodulation distortion in their outputs. I proved last year that this effect was present in one fairly commonly-used make of cardioid capacitor microphone, although most others seemed to be clear of severe distortion. It is very difficult, however, to achieve a pure sine wave source of an intensity high enough to test the distortion level of microphones adequately at sound pressure levels of above 110 dB, which are frequently encountered with close miking.

I recently recorded two symphonies by Havergall Brian in the De Montfort Hall, Leicester. It was fairly obvious from the beginning that a simple stereo pair would be unsuitable because of the hall's extremely bad flutter echo between the domed roof and the floor, and also because of the rather poor reverberation characteristic when the hall is empty. I therefore decided that in addition to a main stereo pair I would use coincidental pairs over the violins, low strings and woodwind. A *C24* was used above the violins and angled to pick up both harp and french horns. The microphone's output was panned between left and centre, and a small amount of top cut was added to offset the slight treble peak in the microphone at 10 kHz. Two *C12A* were slung above the violas, cellos and basses, and panned centre and right, the vertical angle of the microphones also being chosen to pick up trumpets, trombones and tubas. Two Beyer *M160* cardioids were placed as a pair above and looking down on the woodwind section, and angled at about 90°. The vertical angle was fairly critical, as the microphones were also used to pick up some percussion. Additional mics were used on solo violin, percussion and off-stage trumpet.

continued December

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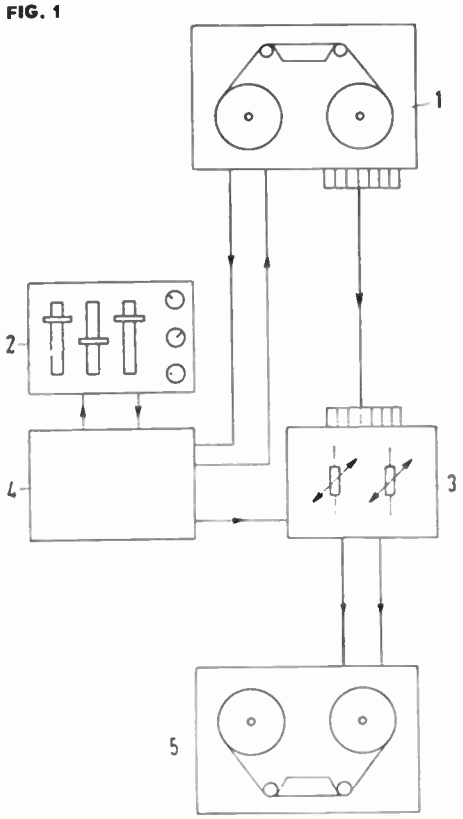
Patents

Automated remixing

'IMPROVEMENTS IN OR relating to methods of an apparatus for magnetic recording' is the title of BP 1279952 filed by Deutsche Grammophon GmbH. Aware that elaborate sound control equipment can overtax the mixing engineer, DGG propose deriving analogue (and thence digital) control signals from the mixer which indicate changes in relative channel level.

In **fig. 1**, recorder 1 represents the primary recording medium with perhaps eight tracks. One or more tracks are reserved for recording the control positions determined during the mixing operation while the remaining tracks

FIG. 1



record the individual acoustic events. The seven audio tracks on machine 1 are subsequently copied on to machine 5 through servo elements 3. Electronic or electromechanical elements may be employed, following the control settings determined during the original mix. If amendments are required at this stage, the control track read/write head is switched to write again and the mixer 2 adjusted to produce new control signals for the servo elements.

Conveying sound direct to the brain

WITH BIO feedback and the control of sounds by alpha waves direct from the brain now gaining public interest, BP 1284158 from the ZCM Corporation of California, USA, is particularly topical. For the ZCM system is directed towards introducing sound information to the brain without the intermediary of the ear. If the system works, it could of course be of immense value to the deaf. Rather less significant, it could be useful for telecommunication such as where audible noises must be kept to a minimum (camera control in tv studios).

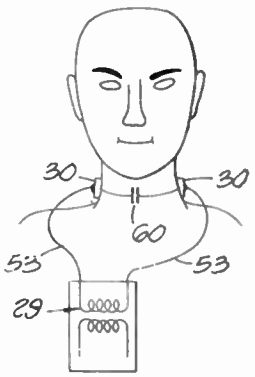
ZCM regard the ear cochlea as the electronic generator of the auditory system and suggests that, with normal hearing, mechanical sound signals which reach the cochlea cause oscillation of the cells attached to the tectorial membrane. Conversion from mechanical to 'nervous' energy produces electronic signals which are conveyed to the brain where the sensation of hearing is produced.

What ZCM propose is a microphone to pick up conventional audio signals which are then amplified in each of three buffer amplifier stages (**fig. 3**). Each amplifier has its output feeding a pulse generator of Schmidt trigger type, the arrangement being such that the output pulses from the three triggers are non-coincident. This is achieved by conventional delay techniques.

The pulse generator outputs are added and shaped prior to application to a modulator, which on-off keys the output of a radio frequency generator. So a pulsed rf output appears across the primary of an output transformer, the secondary of which feeds a pair of electrodes attached to the subject's head or neck (**fig. 2**). The crucial point about the electrodes is that, although they contain metal, an insulating material ensures that there is no metal in direct contact with the subject's skin. Thus there is only capacitive coupling.

Operation may be at microwave frequency and it is claimed that the modulated rf pulses

FIG. 2



act as nerve-cell trigger pulses which are transmitted to the brain. To excite the relevant part of the brain they must be above a predetermined threshold intensity. The theory is that, once a pulse has exceeded this predetermined threshold intensity, its pulse width and rate of occurrence can be used to create the sensations of frequency and loudness respectively. Thus the longer the pulse the lower the frequency 'heard'. For pulses appearing at a rate of 1 kHz, loudness sensation may be increased by raising the pulse repetition rate.

Some pulse diagrams would have helped to clarify this concept but they are absent. It would be very interesting to know whether the inventor (Henry Zink) has made the system work or whether it is still only theory.

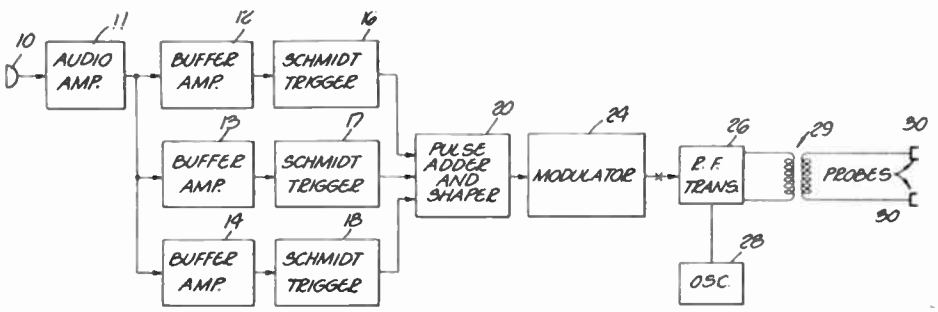
Stringed instruments

IN BP 1285542, Goronwy Davies of Swansea suggests a radical rethink in the construction of stringed instruments.

Most stringed instruments are conventionally made of wood and the skill involved in their construction is indisputable. Thus cheap

continued 53

FIG. 3



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continued

instruments sound cheap. Davies proposes a new approach whereby a stringed instrument (e.g. of cello size) is formed from an outer metal frame which is in the form of an elongated closed loop—imagine a hoop-like loop squashed semi-flat. [*Come again*?—Ed.] Within the semi-squashed loop, a hollow sound box is mounted with the loop expanded somewhat in that area to house it. Thus in side view the instrument has thin flattened loop ends and a bulbous middle containing a soundbox.

The soundbox is made of moulded plastics and is provided internally with a sound post and a base (sic) bar for strengthening (**fig. 4**). The instrument has a bridge on the sound box cover and this supports strings stretched between tensioning devices at remote ends of the loop. A conventional finger board is mounted underneath the strings at one end.

The frame would be made of aluminium and in the suggested instrument the strings are tuned to E, A, D and G, an octave below the violin.

Even if the instrument sounds bad when played acoustically, it is conceivable that Davies has a useful new approach to instruments intended specifically for amplification. There is after all no point in a pop group amplifying a Stradivarius and sousing it in beer twice-nightly.

FIG. 4

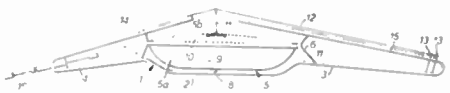
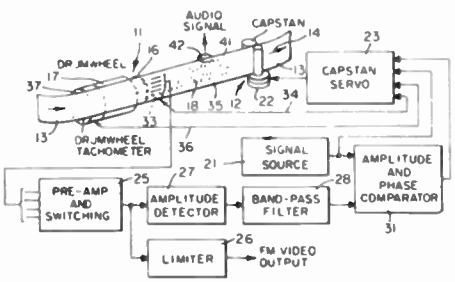


FIG. 5



Automatic videotape tracking

IN BP 1285308 THE Ampex Corporation detail the problems of automatically controlling the registration of a rotary magnetic head with the oblique tracks which it must read from tape. The theory of rotary head videotape machines is well known and in all machines of this type, during playback, the head must retrace the prerecorded tracks very accurately if maximum signal strength is to be derived. Ideally of course the rotary head should travel along an imaginary centre line of each oblique track section

Conventional systems rely on a longitudinal control track which controls the speed and angle of rotation of the rotary head wheel and capstan drive. But problems arise if the tape stretches; for example, phase discrepancies crop up and the video information is attenuated.

What Ampex propose is a fairly complicated system (**fig. 5**) whereby the speed of the capstan 12 is varied according to a periodically varying electric signal. There is thus applied to the signal derived from the rotating heads 11 a amplitude modulation which is detected and compared with the original varying electric signal to provide an error signal which will correct the speed and phase of the capstan so that the rotating heads are exactly centred on the oblique tracks 18.

To this end, the capstan motor 22 is controlled by a servo system 23 which governs the speed and phase of the capstan 12. This depends upon the outputs of a tachometer 37 coupled to the rotating head and to an auxiliary head 33 which reads a synchronising signal provided on the tape.

The output of a signal source 21 is also supplied to the servo system to cause the periodic variation of the capstan speed. This signal has a frequency below the audio spectrum so that there is no serious effect on the sound signal read by head 42.

The video signal is derived from the rotating heads by a switching circuit 25, and includes a frequency modulated carrier. The signal is applied to a limiter 26 to remove the am modulation before video processing in the usual way; it is also fed to an amplitude detector 27, of which the output is fed to a band pass filter 28 which is tuned to reject all but the frequency of the signal source 21.

When the heads are centred, the frequency of the modulation is twice the frequency of the source 21; when the heads are displaced to the edge of the tracks 18, the modulation frequency is equal to that of the source 21. In this way the level of the fundamental frequency passing through the filter 28 represents the phase error and its phase in relation to the source 21 represents the sign of the error. The derived error signal is then used to servo-modify the phase of the signal produced by tachometer 37 or of the signal from the synchronising head 33.

Although the system is obviously complicated Ampex claim that by this technique of sensing low frequency and low amplitude periodic variations in the tape longitudinal speed, the resultant tracking error signal can adjust the tape speed to achieve optimum tracking registration. And they maintain it is in practice possible to disturb the tape speed at a frequency just below the lower frequency limit of the audio band and so not adversely affect the audio signal. Reproduction of the transverse video tracks will of course be affected even less by such disturbances.

THE FOLLOWING list of complete Specifications Accepted is quoted from the August issues of the Official Journal (Patents). Copies of specifications may be purchased at 25p each from The Patent Office, Orpington, Kent BR5 3RD.

1972, August 2

1288470
Sony Corporation
Mechanism for protecting magnetic tape in a cassette
1288524
Bosch Elektronik Und Photokino GmbH
Robert
Cinematograph cameras
1288659
International Business Machines Corporation
Magnetic tape information retrieval system
1288769
Nippon Victor KK
Video signal magnetic reproducing arrangements
1288770
Nippon Victor KK
Signal address system for use in magnetically recording and reproducing a video signal using a rotary member
1288959
Miller, F A and Key B O
Electronic audio frequency modulation system and method
1288964
Singer Co
Motion picture projector
1288970
Xerox Corporation
Frequency modulated signal generator
1288978
Telefunken Patentverwertungs GmbH
Solid damping media
1288990
Philips Electronic & Associated Industries Ltd
Circuit arrangement for the phase adjustment of a PAL switch
1289005
Motorola Inc
Gamma control circuit
1289015
British Broadcasting Corporation
Digital information transmission
1289028
Sakai, T
Tone oscillator for an electronic musical instrument
1289051
Siemens AG
Circuit arrangements for time-division multiplex exchange systems
1289055
AKG Akustische U Kino-Gerate GmbH
Electro-mechanical apparatus for producing artificial reverberation
1289082
Fernseh GmbH
Colour television arrangement
1289084
Koenig, W.
Stroboscopic display
1289104
EMI Ltd
Charge storage pickup tubes
1289129
National Research Development Corporation
Apparatus for producing images
1289142
Planned Equipment Ltd
Magnetic tape apparatus
1289148
Telefunken Patenverwertungs GmbH
Device for transmitting coded items of information which can be read back from a store
1289153
Sony Corporation
Tape cartridge

1972, August 9

1289404
International Business Machines Corporation
Display device
1289474/5/6
International Harvester Co of Great Britain Ltd
Vehicle guidance systems
1289501
Simms Group Research & Development Ltd
Ultrasonic devices
1289507
American Optical Corporation

continued over

continued

Acoustical imaging arrangement and transducer therefor
1289589
Zuckermann, W J and Way D J
Harpsichords
1289697
International Business Machines Corporation
Video display system
1289705
Philips Electronic & Associated Industries Ltd
Controllable amplifier
1289710
General Electric Co
Colour television demodulation circuit
1289761/2
Bunker-Ramo Corporation
Data storage and display systems
1289770
Texaco Development Corporation
Amplifier system
1289774
Dixie, F H
Polyphonic electronic keyboard musical instrument
1289779
Columbia Broadcasting System Inc
Video record media and apparatus responsive thereto
1289785
Siemens AG
Time division multiplex exchange systems
1289855
Xerox Corporation
Data transmission system interruption monitor
1289858
Bertagni, J J
Diaphragm of planar form for electro-acoustic transducers and methods for manufacturing same
1289875
Hughes Aircraft Co
Helmet mounted display unit with fastener device
1289904
Cailliot, S
Magnetic tape and magazine assembly
1289947
Tektronix Inc
Cathode ray tube display system
1289955
Vincent-Carrefour, J Merlin J-C and Pitard P
Cathode-ray tube displays
1289963
EMI Ltd
Oscilloscopes
1289979
Rank Organisation Ltd
Telecine equipment
1289993
Cosmocord Ltd
Ear defenders
1289994
Iwasaki Tsushinki KK
Apparatus for displaying representative axes with abscissa and ordinate information
1290010
Matsushita Electric Industrial Co Ltd
Colour pickup device
1290033
Motorola Inc
Track indicator for a tape player
1290044
Sony Corporation
Magnetic recording and/or reproducing apparatus
1290097
Unisearch Ltd
Electronic surveillance system
1290098
PHI Magnetronics Ltd
Magnetic tape recording/playback heads
1290102
Licentia Patent-Verwaltungs GmbH
Device for reading magnetic information
1290152
Chevron Research Co
Continuous automatic migration of seismic reflection data with waveform preservation
1290224
Thomson-CSF
Trichromatic optical separating system
1290229
Standard Telephones & Cables Ltd
Speech immunity circuit
1290236
Nauchno-Issledovatelsky Institut 'Gidropribor'
Resonant piezoelectric transducer
1290245
International Business Machines Corporation
Delta coder with a plurality of quantization step sizes

1972, August 16

1290306
Mullard Ltd
Magnetic memory stores
1290329
Colour Film Services Ltd and Venis, R J
Television image recording systems and apparatus therefor
1290358
Thomson-CSF
Antennas
1290414
Bendix Corporation
System for displaying a synthetic runway image in an aircraft
1290520
Kudelski S
Automatic gain control circuits
1290567
Licentia Patent-ver Waltungs GmbH
Radio link systems
1290597
Sony Corporation
Transistor circuits
1290698
Olympus Kogaku Kogyo KK
Optically interlaced scanning and reproducing apparatus
1290719
Thomson-CSF
Circuits having a non-linear amplitude transfer function
1290720
Thomson-CSF
Monitoring systems for colour television equipments
1290852
EMI Ltd
Instruments for reproducing information from magnetic tapes
1290869
Western Electric Co Inc
Telephone set amplifiers
1291078
Rupert, R E
System for producing musical tones

1972, August 23

1291171
Mohawk Data Sciences Corporation
Tape handling apparatus
1291181
Nusonics Inc
Sound velocimeters
1291213
Bell & Howell Co
Film cartridge attaching apparatus
1291225
Imperial Chemical Industries Ltd
Treatment of textile materials
1291275
Carter, D L
Log-periodic antenna array having closely spaced linear elements
1291326
Rabodzei, N V Ljubimov E M Nadobnikoz M N and Krokhin A A
X-ray television device
1291443
Gentex Corporation
Resilient seal
1291444
Tokyo Shibaura Electric Co Ltd
Frequency modulation communication system
1291465
General Electric Co
Magnetic system components having a protective film thereon
1291474
Tokyo Shibaura Electric Co Ltd
Foreground object locating device
1291498
Eidophor AG
Television signal conversion apparatus
1291501
Matsushita Electric Industrial Co Ltd
Thin-window image pickup and recording tube
1291516
International Standard Electric Corporation
Frequency-selective signal receiver
1291530
Marconi Co Ltd
Microwave horn aerials
1291585
Eastman Kodak Co
Film cartridges
1291601
British Broadcasting Corporation
Colour television cameras
1291615
International Computers Ltd
Magnetic recording apparatus
1291668
Ricoh, KK
Web feeding device
1291692
Mullard Ltd
Light modulator
1291703
Bendix Corporation
Single channel duplex space linked pulse communications system
1291801
Fernseh GmbH
Circuits for producing a contour enchantment signal for television image transmitters
1291875
Sydenham E ST B
Hearing aid systems
1291906
Fernseh GmbH
Colour television apparatus
1291967
Fernseh GmbH
Television cameras systems
1291981
Philips Electronic & Associated Industries Ltd
Circuit arrangement for providing a focusing voltage for display tubes

1972, August 31

1292035
Marconi Co Ltd
Colour television system transcoders
1292062
RCA Corporation
Shadowing system for colour encoding camera
1292063
RCA Corporation
Lens array imaging system for a colour encoding camera
1292067
Fernseh GmbH
Television apparatus
1292093
International Business Machines Corporation
Transport mechanism
1292116
Plessey Co Ltd
Pickup arm actuating mechanism for automatic record changers
1292117
Arseneault J P
Foot operated musical instruments
1292205
Philips Electronic & Associated Industries Ltd
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Servicing

BY H.W.HELLYER

Printed Circuits

MOST tape recorders nowadays are blessed (cursed?) with printed circuits. Some of these boards are marvels of modern ingenuity. Others appear to have been dreamed up by a spiteful spider with a penchant for firework displays. All of them, according to the makers of the assembled equipment, are designed for maximum efficiency in the smallest space. Most of them show some evidence of afterthoughts; wired links, bridges, cut foil and odd components strung up to handy mounting points. Servicing them needs a special approach. If you were brought up on open-plan layout (what one tv manufacturer proudly called 'a hand-wired chassis') the transition to pc boards can be painful.

I have been asked to devote one article to the subject of servicing printed circuit boards and for the purpose of this chat will assume the reader is tackling them for the first—well, maybe the second—time.

The easiest way to do a job is not always the most obvious; neither is the shortest route always the quickest. Such trite observations do not seem so badly out of place when we take a closer look at printed circuits.

These aids to production can make servicing even more difficult than direct wiring, and may themselves pose new problems. In particular, they demand a different approach. It is no longer feasible to disconnect a component or its connecting wire to make a quick test. One must learn to test circuitry without being able to apply the 'brute force' method. Interpretation of meter readings and other test gear measurements becomes more exacting. The physical dimensions of components and their mounting make greater care a necessity. Replacement of parts is more often impossible unless an exact substitute is available. In short, a new servicing technique is required when tackling printed circuits, and it helps if we begin with some idea of how and why these wired boards are made.

Perhaps the first approximation to a printed circuit was the old instructional 'breadboard' on which we practised at technical college. Various mounting devices for valves and main components, and sockets for the connection of test equipment, were permanently wired to the board so that the wiring formed a harness or matrix. From this initial step it is a short hop to the laminated board of insulating material with the wiring permanently laid out and fixed to it. If the wiring is now made from foil and literally 'printed' on to the board so that it is virtually part of it, we have a rugged piece of hardware that positively defies us to make wiring mistakes.

In theory, that is. More often, in practice, we find the great amount of trouble taken in the prime design has been obviated by 'modifications', wiring links, connections to and from the board to link it to other sections of the apparatus, switches, controls and the mounting of the components themselves. Each item can give us some trouble, so let's begin with a look at the board itself.

The basic laminate is usually of phenolic or other similar insulating material, and may be thin enough to be translucent (which can be an aid to servicing), or as stiff and thick as a book cover. Much depends on its function; some boards have to withstand a deal of rough treatment. On this board is bonded a thin foil of copper. The bonding method varies between makers and is often a jealously guarded industrial secret.

Master drawing

After the preparation of the board with its bonded foil, the next step is the drawing of the master circuit. This can be a complicated business, and development costs are a large factor in the design of new equipment. Much ingenuity has to be exercised in laying out components and routing the interconnections, as an inspection of any printed circuit will show. It is an interesting exercise to plan and make one's own printed circuits for small pieces of equipment.

Once the master drawing has been made, this is photographed and transferred to a printing plate. The reproduction is then printed on to the copper foil and the surplus copper removed to leave the 'print' formed in conducting copper as a copy of the master. There are several ways of doing this.

One method is to use a 'resist', a special printing ink impervious to acid. The board itself is, of course, impervious to acid as well. This leaves the board and the printed lines of the pattern protected, but the sections of the foil not printed with the resist can be attacked and eaten away by dipping the whole board in an acid bath. Before this is done, the surface is dusted with bituminous powder and heated to fuse it and 'fix' the resist. After the unprotected areas of copper are etched away by the acid, the board is washed and dried, removing all unwanted material, including the resist, which has now done its job. This washing process may be carried out in several stages, depending on the nature of the work. Often, the dissolving of the resist is a separate process.

Holes are punched or drilled at the predetermined places to take the components or lead wires. Shaped slots or other apertures for fixing clips and switches are made at this stage. Then the board is treated with a solder resist. This covers the section of the foil where no solder is required, although in some designs the whole of the remaining foil is allowed a coat of solder. The board is then treated with solder flux on the connection side after the components have been mounted.

Soldering the lead-out wires of the components is again done by different methods. One popular way is to dip-solder, the whole board being quickly dipped so that the connection side contacts the surface of a bath of molten solder. The surplus solder is shaken off while still molten, and the components should remain firmly fixed in place. The timing of such an operation is important to ensure that dry joints are not caused and that surplus solder does not bridge the thin lines of foil.

Another method widely used is 'wave-soldering', where the board is passed along the top of a bath of molten solder which is agitated to form a 'wave', the crest of which touches the board's connecting surface. With this method, there is less heat transferred to the board as a whole, and careful regulation of production conditions can effect a better job. After the soldering process, the flux is cleaned away and the board again washed and dried. Finally, a protective coating of lacquer may be applied to the whole surface. It is important to remember this as the lacquer has to be scraped away or treated with some solvent before service work on some boards can be commenced.

Plating

More elaborate printed circuit boards may be plated rather than printed—a quite different and more expensive process. Other methods entail the printing or plating of both sides of a board with interconnecting links inserted through holes in the board to form a complicated matrix, which is often quite difficult to trace when the components are mounted. A layout diagram with interconnections shown is a great aid in servicing. Not all manufacturers are kind enough to supply them.

As may be judged from the foregoing brief notes, trouble-shooting on printed circuits can have its interesting moments. Principal faults directly deriving from the manufacturing process are (1) dry joints, (2) hairline cracks in the foil, (3) raised foil, and (4) leaks or short-circuits between adjacent lines of print.

In addition, faults can be caused by damage to components by overheating—a very real trouble when replacing small parts in a congested section of printed circuit. Lead-out wires may be cut very short, especially with vertically mounted components. This can cause dry joints by attempts to solder quickly without

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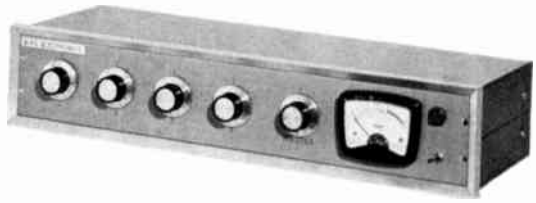

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continued

the aid of heat shunts to avoid damage to components. Larger components such as switches, variable controls and lugged capacitors may be mounted directly on the board. Constant action can cause the breaking of foil at the entry point of tags and lugs, and small cracks should be looked for at these points, especially if there is any looseness of the main component.

One of the most difficult pc faults to trace is the intermittent open-circuit caused by a hairline crack in the foil. Flexing the board slightly may cause the fault, but the naked eye is defeated and special test methods are needed to trace the break. In these circumstances it is often an advantage to bring on the fault by flexing the board slightly, holding it in the fault position, then making tests to prove the 'break'. Careful flexing will usually localise the area of the break and then jumper contacts can be made from joint to joint, by-passing sections of print.

Signal tracing

It should be stressed that a far better method of investigation is to test by signal tracing or injection, or a combination of these. For example: let us suppose the break occurs at one of the 'popular' places, such as at the tag connection of a volume control. No break can be seen but, if we touch with a screwdriver on the input to the succeeding stage, a disturbance signal should be heard.

Servicing is sometimes aided by the manufacturer having marked the board with code numbers that tie up with the circuit, and also, in exceptional cases, by dotted lines that indicate interconnections. But even without these aids it is possible to make servicing easier by mounting a fairly bright lamp on one side of the board and looking through the translucent board, when the foil strips show up as dark lines and the components as well-defined shadows. It is advisable, if possible, to make this test with the lamp on the obverse side of the board to avoid damaging components by heat.

Although, when talking of printed circuits, we tend to think of transistor equipment, it must not be forgotten that many valved circuits are based on print and the problem of heat is a very real one. In particular, we must look for raised foil after a fault that has caused a component to overheat. The construction of some tape recorders leaves much to be desired and the region around valve-bases can get very hot. Cleaning off the inevitable dirt may reveal discoloration. Look for bad connections at the bent-over valve lugs, and especially where the solder runs around the punched hole in the board. Again, the signal injection/tracing tests are very useful for proving bad connections, where physical movement may be inconclusive.

A break in a strip of foil should be repaired by a jumper wire rather than by merely running solder across the break—which will probably result in fresh weaknesses at either side of the solder 'bridge'. Remember that the coating of lacquer will have to be removed before making new connections, and that scraping to do this —apart from the unsightly mess it makes—can cause new faults. Acetone is the usual solvent, but if this is not available, always join at a solder point, where the coating can be scraped away with less danger of damage.

Component replacement can present a problem, especially where the exact substitute is not to hand. Removing a component whose lead wire has been cut very short, or bent over and soldered close to the entry hole, may result in damage to the component. In any case, the necessary heat to remove such a part as a small capacitor may well change its value. For this reason, if no other, work on printed circuits demands logical testing, not hit-or-miss methods. When disconnection of a component may lead to its destruction it is better to make sure the disconnection is absolutely necessary before attacking the job.

If a component has to be replaced, consider whether it is better to snip the mounting wires near the component rather than near the board, leaving a tail to which the new part can be soldered with the least disturbance to the print. If care is taken with this operation, there should not be any loosening of the tail end from its original mounting. To make sure of this, of course, a heat shunt between the soldering iron and the board can be used. This can be quite a simple device, a crocodile clip, or, for close work, a pin clip, or even, for really close work, a twist of wire around the tail. Use enamelled or cotton-coated wire for this or you will end up with more tail end than you need!

If the component and its lead is to be removed, leaving a clean hole for soldering, it is often easier to snip the lead above the board and then heat the solder joint and withdraw the tail from beneath. This saves that twisting and pulling which so often puts more faults on the set than changing the component may cure.

Multi-tagged components

The same stricture applies when removing multi-tagged components, such as switches, controls and valve bases. Unless it is necessary to 'save' the removed part, it is better to cut off the tags, leaving tail ends soldered in place, each of which can be unsoldered individually. The alternative method of removing multi-tagged components requires a shaped bit or a piece of heavy-gauge wire attached to the soldering iron bit, plus some gentle leverage and sometimes a lot of luck! The added heat imposed by such a venture is often a real hazard. When parts are relatively cheap, it is better to destroy and substitute.

After the tail ends are removed, there remains the problem of remounting. This requires that the entry hole shall be clean. When a hot iron is applied to the hole on a printed board, the tendency of the solder is to 'bubble' over the hole. Trying to clear away the surplus and perhaps shake it free can cause even more damage. If an adroit use of the ordinary pastry-brush or cheap 'camel-hair' type purloined from Junior's toy box is made, solder can be brushed away and will harden before it can attach to other parts of the circuit. It can then be removed in streaks or blobs—but care must be taken to ensure *complete* removal. Careless work at this stage can cause obscure faults later.

Clearing out the hole is quite easily done by sharpening the end of a match or orange-stick, heating the position and inserting the stick, withdrawing the iron and letting the joint ring cool. The stick is then taken out, leaving a nice, clean aperture for wire, lug or tag.

Whenever possible, use the right size iron for the job. The smallest bit and the shortest time of application is the aim. But care must be taken to make a good joint. Dry joints are the greatest bugbear of the electronics business. Using old solder is another mistake that can lead to poor joints. The resin-cored variety is by far the best for our purpose, and by no means expensive. Acid-based fluxes must be avoided like the plague. Old solder tends to 'dry up' and may carry impurities on its outer skin. Dampness, too, can cause minute bubbles in the joint, leading to later trouble.

Special tools have been developed for removal of surplus solder. These are very useful where a large amount of soldering work has to be done, and some versions of them are quite cheap enough for the small-time engineer or home constructor to consider.

Heat shunts are often discussed and as often misunderstood. There is no mystery about them, neither do they have to be specially shaped or made of special material—though it is obvious that a material with a higher heat conductivity than the material being soldered makes for greater efficiency. All that is needed is an alternative path for the heat that would otherwise 'flow' where it is not wanted. As, for example, the simple trick of a crocodile clip put on the lead-out wire of a transistor, between the capsule and the solder point, to divert the heat from the transistor when the soldering iron is applied.

A solder joint which has dissimilar metals under the solder coat and which passes current may have an electrolysis action working upon it. In time, this may cause the solder to crystallise. Look for joints with this tendency and resolder with good new solder. Similarly, chemical action can take place around battery terminals—especially if the cells have been neglected, allowed to run down and leak. Always clean the old electrolyte away before attempting to make new joints. Suspect wire ends which may oxidise and give high resistance connections just inside the insulation—especially when this is taken right to the solder of the joint itself.

Remember, when soldering a transistor circuit, the leakage current due to a mains-operated iron can cause damage to transistors —even when the set is switched off! The same stricture applies to test instruments. It is often advisable to use a low-voltage soldering iron, fed by an isolating transformer. Where this is not possible, disconnect the supply to the receiver before soldering—disconnect, not just switch off, and use the iron without an earth return. The usual precautions as to personal safety must be observed, of course, and in many instances it is advisable to work from an individual bench supply fed from a good isolating transformer.

One final word of warning: if you do use an isolating transformer for bench supplies, always make a second 'final' test of the repaired equipment on the supply with which it is to be used. Having been caught a few times with equipment wrongly wired but capable of operating on the 'floating' bench rig, the author is rather fussy about final testing.

New Equipment

Quadpot

A CONTINUOUSLY VARIABLE joystick action quadraphonic pan control has been added to the Spectra Sonics line of industrial audio equipment. Model *904P* permits variable panning of one audio source to four channels and is available on 38 mm centres for installation into any audio system. Price is £66.70.
Manufacturer: Spectra Sonics, 770 Wall Avenue, Ogden, Utah 84404, USA. Tel. 801 392 7531.

Dolby 16-in-one

SIXTEEN A-TYPE noise reduction systems in one chassis comprise the new Dolby *M16*, designed specifically for multitrack applications. Each channel contains a *Cat 22* noise reduction module and *Cat 44* interface, transferring automatically from record (encode) to playback (decode). The additional cost of *XLR* connectors is avoided by employing standard screw-type terminal blocks though *XLR* are available to special order. Features include electronic mode switching with a 200 μS changeover time, led status lamps, compactness (493 x 267 x 305 mm hwd) and comparatively light weight (20.5 kg). Claimed specification (overall encode-decode) states less than 5° phase error (20 Hz to 20 kHz), 30 μS signal delay (constant with frequency), ±1 dB matching between units at any level and frequency (30 Hz to 20 kHz between channels and to other Dolby A units), −75 dB noise (ref Dolby level, 30 Hz to 20 kHz unweighted) and less than 0.2 per cent distortion at +8 dBm from 40 Hz to 20 kHz. Versions are also available for eight track and 24 track working (*M8* and *M24* respectively), basic prices being as follows: £1,800 (*M8*), £3,200 (*M16*), £4,800 (*M24*).
Manufacturer: Dolby Laboratories Inc, 346 Clapham Road, London SW9.

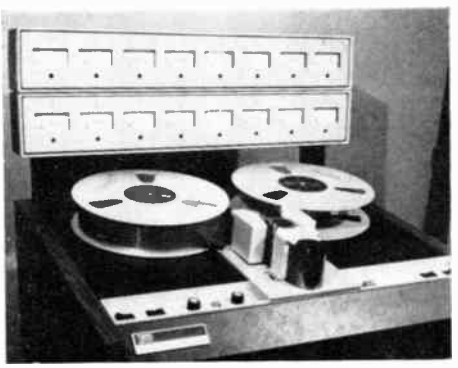
Tektronix oscilloscope

A NEW ADDITION to the *7700* range of oscilloscopes has been announced by Tektronix. A choice of 200 MHz with optimised transient response or 250 MHz with optimised bandwidth is offered by the *7704A*. Like other units in the *7700* series, the *7704A* uses plug-in amplifiers to obtain a wide choice of bandwidths and rise times. An 80 x 100 mm crt is available as standard with the option of a 40 x 50 mm reduced-scan tube for fast writing speed applications. Writing speed of the standard tube is 70 mm/ns without, and 140 mm/ns with, the Tektronix writing speed enhancer. Accessories are available to increase the writing speed to at least 200 mm/ns. Dimensions of the *7704A* are 345 x 306 x 557 mm (hwd), weight 13.6 kg. Basic price is listed as £1,095. Nine options are available, varying in price from £913 (without character generator circuits) to £1,255 (maximum brightness crt; 40 x 50 mm graticule with variable illumination; very high writing speed).
Agent: Tektronix UK Ltd, PO Box 69, Beaverton House, Harpenden, Hertfordshire.

3M series 79

FIRST SHOWN AT the APRS '72 Exhibition, the 3M *Series 79* is now being offered at £14,500 in 24 track form, 16 track (£10,500) and eight track. A conversion kit raising the 16 track to 24 track operation is also available at £5,500 and the eight track model may be similarly extended. The 3M *Isoloop* drive system is retained but among several new features are a dc servo capstan, zero to 114 cm/s variable recording speed, a choice of three tape reversal accelerations, a spooling speed approaching 7 m/s, remote lifter override and cue muting. Electronic switching is employed to eliminate transient interference and a detachable control panel makes the *79* easy to adapt from local to remote operation. Frontal circuit access permits easy maintenance, still leaving room for a full complement of noise reduction units if required.

As an accessory to the *79* and its predecessors, 3M also offer the *Selectake* four-tube readout tape position indicator and automatic finder. This will locate a preselected position within ±2 counts of the readout.
Agent: 3M UK Ltd, 3M House, Wigmore Street, London W1A 1ET



'Isodynamic' headphones

A NEW APPROACH to transducer construction is being employed in the *Isodynamic* moving-coil headphones now available from Rank Wharfedale. A 4 μm thick copper conductor is bonded to a thin plastic base to form a diaphragm with a total dynamic mass of 100 mg. This, in combination with a newly developed 'ceramic rubber' magnet system, is said to minimise diaphragm breakup, resulting in less than 0.1 per cent third harmonic distortion at +104 dB, 200 Hz. Good bass response is claimed, down to 35 Hz, without the necessity of a high side force. Weight is 360g.
Manufacturer: Rank Wharfedale Ltd, Bradford Road, Idle, Bradford BD10 8SQ, Yorkshire.

Left: Tektronix *7704A*

Right: Dolby *M16*

Equipment Reviews

Allison Kepex 500

MANUFACTURERS' SPECIFICATION

Attack time: Less than 20 μs.
Release time: Variable from 50 ms to 6s.
Active expansion range: Greater than 60 dB.
Expansion ratio: 2:1 from 0 dB to 30 dB expansion, gradually increasing to 4:1 at 60 dB expansion.
Signal-to-noise ratio: Minimum 85 dB below rated output.
Distortion: Less than 0.5% total harmonic distortion under normal operating conditions.
Insertion loss: 0 dB, internal adjustment provides up to 20 dB gain.
Frequency response: ±1 dB, 20 Hz to 40 kHz.
Threshold of expansion: Variable from —35 dBm to +20 dBm.
Output: ±18 dBm into 600 ohms,
Meter range: 0 dB to —30 dB (display); 0 dB, —3 dB, —6 dB, —9 dB, —12 dB, —18 dB, —24 dB & —30 dB.
Meter accuracy: Instantaneous gain ±1.5 dB.
Meter speed: 100% response to gain change in less than 25 μs.
Power requirements: +24V dc at 125 mA negative ground. +100V dc at 3 mA, negative ground.
Dimensions: (Standard mounting case type *501*) height 178 mm, width 38 mm, depth including connector lugs 183 mm.
Price: £165.
Manufacturers: Allison Research Inc, 7120 Sunset Boulevard, Hollywood, California 90046, USA.
Agent: F. W. O. Bauch Ltd, 49 Theobald Street, Boreham Wood, Herts.

THE Allison *KEPEX 500* is a keyable expander which forms a companion to the Allison *Gain Brain* which was reviewed in the May STUDIO SOUND. It is identical in size to the *Gain Brain* and has similar styling, the front panel being provided with an eight segment lamp display which indicates gain reduction, under which is mounted a set of three potentiometer controls and two pushbutton switches.

The upper potentiometer affects the expansion range as shown in fig. 1. Unfortunately the knob of this control, and that of the threshold control, lacks any sensible form of pointer and is only associated with four calibration points—it is therefore quite impossible to position these controls at any predetermined setting with any accuracy.

While the centre potentiometer control has a similar knob and only four calibration points determining the release times of the expander (5s, 1s, 0.2s and 0.05s) it is not felt that such difficulty would be experienced with the calibration of this control.

The third, and lower, potentiometers control setting adjusts the threshold of the onset of the expansion function between infinity and −35 dBm and, as explained above, lacks any sensible calibration points.

Below this control are two small pushbutton switches, the upper of which disconnects the internal expansion control and permits the control of the expansion characteristic from an external source, a function which can be highly effective in the production of electronic music. The second pushbutton switch simply allows the expander to be disconnected and the input connected straight through to the output terminal.

The complete electronics are very neatly laid-out on a high quality printed board incorporating a printed plug. The moulded front panel is attached to the printed board and the complete unit is designed to slip into a well constructed metal case which is provided with the printed circuit connector. All the components, which include some 47 transistors most of which are used in the metering circuit, are clearly identified by component reference numbers, and the four pre-set controls are sensibly labelled with their function. It follows that the unit should be easy to service, provided that adequate technical handbooks are available.

Operation of the unit

The basic function of the expander is demonstrated by figs. 1 and 2 which show that the onset of the expansion characteristic occurs at the input level set by the threshold control and that the input range over which expansion occurs is controlled by the setting of the range control. Fig. 2 demonstrates that the effect of the threshold control is simultaneously to alter the expansion onset and cessation points without making any alteration to the range over which expansion occurs.

Investigation into the characteristics of the review sample confirmed that its performance was virtually identical with the published curves. It should however be noted that the curves below about −70 dBm output are rather meaningless because the output at such levels is below the noise output of the unit.

The attack time of the system (that is the time required for the gain to increase when the input is reduced) was certainly extremely small, and there is no reason to believe that it is not the specified 20 μs. There is no adjustment of this time. On the other hand, the release time is controlled by the front panel potentiometer, the four calibration points of 0.05s, 0.2s, 1s and 5s. Investigation of the actual release times for each calibration point revealed the following performance.

Release time setting (seconds)	Actual release time (seconds)
0.05	0.06
0.2	0.3
1	1
5	6.5

While this performance may at first sight appear to be doubtful, the errors are in fact of little practical significance and it is interesting to note that the specification indicates a maximum release time of 6s which disagrees with the maximum front panel calibration of 5s associated with an actual release time of 6.5s.

At first sight it may appear that the facility

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FIG. 1 EFFECT OF dB RANGE CONTROL ON EXPANSION CHARACTERISTICS

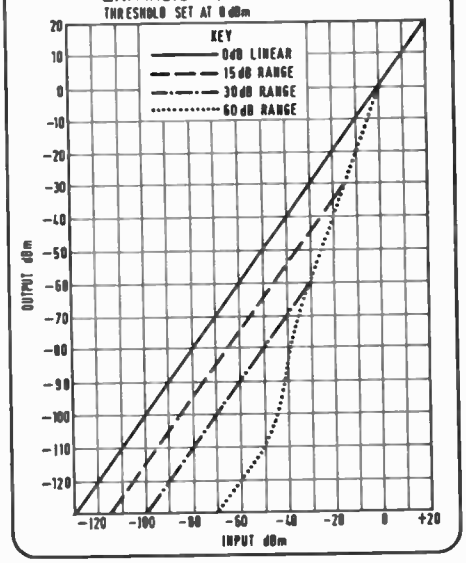
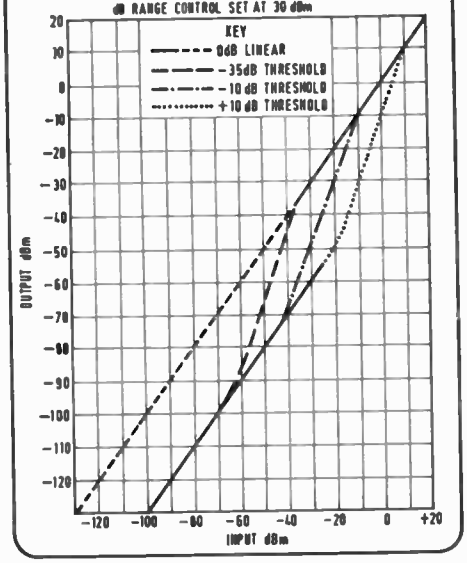


FIG. 2 EFFECT OF THRESHOLD CONTROL ON EXPANSION CHARACTERISTICS



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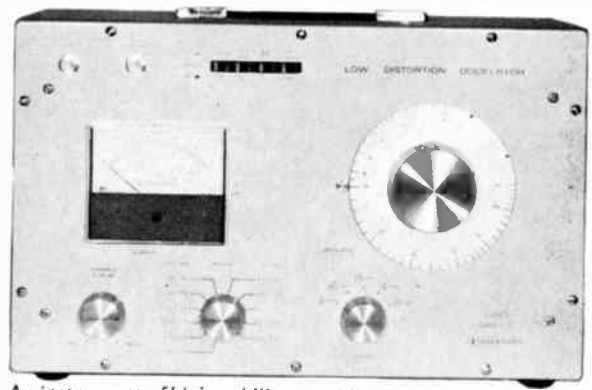

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Specification

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Output Voltage:	10 Volts r.m.s. max.
Output Attenuation:	0-110 dB continuously variable.
Sine Wave Distortion:	0.005% from 200 Hz to 20 kHz increasing to 0.015% at 10 Hz and 100 kHz.
Square Wave Rise Time:	Less than 0.1 microseconds.
Monitor Output Meter:	Scaled 0-3, 0-10 and dBm
Mains Input:	100 V.-250 V. 50/50 Hz
Size:	17½ x 11 x 8in.
Weight:	25lb.
Price:	£150.

DISTORTION MEASURING SET

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Specification:

Frequency Range:	20 Hz-20 kHz (6 ranges).
Distortion Range:	0.01%-100% f.s.d. (9 ranges).
Sensitivity:	100 Mv.-100 V, (3 ranges).
Meter:	Square law r.m.s. reading.
Input Resistance:	100 kOhms.
High Pass Filter:	3 dB down at 350 Hz. 30 dB down at 45 Hz.
Frequency Response:	±1 dB from second harmonic of rejection frequency to 250 kHz.
Power Requirements:	Included battery.
Size:	17½ x 11 x 8in.
Weight:	15lb.
Price:	£120.

Descriptive technical leaflets are available on request.

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for controlling the expansion characteristic from an external signal source will result in straightforward amplitude modulation of the signal being processed, but this is not the case. In practice the differing attack and release times lead to a complicated form of amplitude modulation, demonstrated by **fig. 3** which shows the effect of applying a 50 Hz sinewave to the external 'keying' input with a high frequency signal being 'modulated'.

This modulation facility can be used to produce some really terrible 'headshrinking' noises and no doubt will find many interesting applications in recording Pop and electronic music.

The metering system

As has already been mentioned, the *Kepex 500* is provided with an eight segment display which indicates the effective expansion at any instant but for some reason is labelled 'gain reduction' on the front panel!

The design of the metering is such that virtually instantaneous gain is indicated and the display is held so that the effect of short term gain changes can easily be read. Even under fairly bright lighting conditions there was no problem in reading the indication.

Metering accuracy is specified as +1.5 dB but, as will be seen from the following figures, a more realistic specification would be ±2 dB.

Meter indication	Actual gain difference
3 dB	3 dB
6 dB	7.5 dB
9 dB	10.5 dB
12 dB	14 dB
18 dB	18 dB
24 dB	24 dB
30 dB	28.5 dB

Frequency response, distortion and noise

Initial frequency response measurements into a high impedance load showed that the response between 1 kHz and 20 kHz was within ±0.1 dB but that a slight bass loss of 1.4 dB at 20 Hz made one suspicious of the published specification of ±1 dB from 20 Hz to 40 kHz. Further investigation with the unit operating into a 600 ohm resistive load produced the very poor bass response shown in **fig. 4.**

Inspection of the unit revealed that the likely cause of this extreme loss of bass was that the output terminal is in series with a 5 µF capacitor, which has sufficient reactance at low frequencies to account for the 6 dB bass loss at 50 Hz when the unit is loaded with 600 ohms.

Measurement of total harmonic distortion at various output levels with the unit loaded by a 600 ohm resistive load provided the following figures:

Output (dBm)	Distortion
+18	6.0%
+15	4.0%
+12	0.4%
+10	0.21%
0	0.12%

These figures are clearly unsatisfactory when viewed against a rated output of +18 dBm and a specified distortion of less than 0.5 per cent 'under normal operating conditions' bearing in mind that the distortion measurements were made with the threshold and expansion range controls set to 0 dBm so that no expansion should have been in action during the measurements.

The noise output from the unit was also measured with the threshold and expansion range controls set to 0 dBm and was found to be –69 dB unweighted or –83 dBA with respect to 0 dBm. These figures are clearly better than the specified 85 dB below rated output and are generally satisfactory.

Inputs and outputs

While the input sensitivity is suitable for operation with 600 ohm lines and the unit has a spare 20 dB of internal gain, the input impedance was found to vary between 2.6 and 2.9 kΩ according to the setting of the threshold control and is definitely too low for direct bridging across conventional 600Ω lines.

Naturally this snag can be overcome by inserting a resistor in series with the input and winding up the internal gain but such fiddles are bad practice and always degrade the available signal-to-noise ratio.

The output impedance as measured by a bridge at 1,592 Hz was found to be 3.1Ω in series with 5.8 µF. While the resistive component is satisfactory, comment has already been made upon the disastrous effect that the series capacitor has upon the bass response when the unit is used to feed into a conventional 600Ω line or any other sensibly low impedance.

Finally, the dc power requirements were checked against the published specification. The +100V requirement was found to be 2.8 mA and is not critical because the 100V line is only used to drive the neon indicator lamps in the metering circuits. Turning to the +24V line, it was found that the unit only required 84 mA, against the specified 125 mA.

Here again, a second sample could have been different, and I suspect that the review sample may have been faulty in the output stages. This would account for the excessive distortion at high output levels and for the low power consumption.

Summary

Potentially the *Kepex 500* is a useful little expander which includes a number of good ideas. However, the review sample clearly failed to meet the manufacturers' specification and obviously was unsuitable for use with 600 ohm lines as a result of its low input impedance and very poor bass response when it was loaded into 600 ohms.

While the mechanical construction of the unit is to a high standard and the printed board quality and layout good, I did not like the fiddly little knobs on the potentiometer controls and the lack of any sensible calibration on these controls. **Hugh Ford**

Postscript

Just over three weeks after asking the agents for a second sample of the *Kepex 500* for further investigation it arrived through the post.

The second sample showed precisely the same poor low frequency response when it was loaded into 600 ohms, and it was confirmed that this defect is due to too low a series capacitor in the output stage.

Distortion at the rated output of +18 dBm was measured at 16.3 per cent total harmonic, with waveform clipping commencing at an output of +16 dBm into a resistive load of 600 ohms. Distortion at lower outputs was as follows at 1 kHz.

Output	Total Harmonic Distortion
+18 dBm	16.3%
+15 dBm	0.25%
+12 dBm	0.14%
+10 dBm	0.125%
+0 dBm	0.11%

The current drawn from the +24v line was again found to be 84 mA against the specified current of 125 mA **H.F.**

FIG. 3

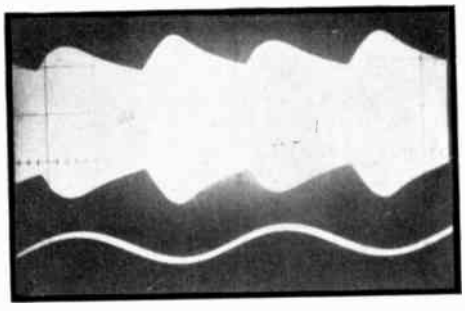
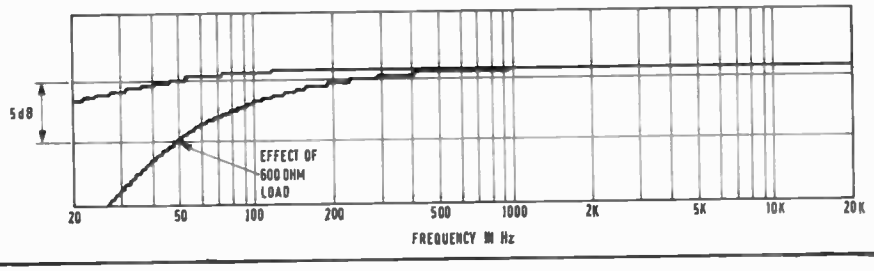


FIG. 4 KEPEX 500 FREQUENCY RESPONSE



An example of the Midas modular system mixers.

Medium scale chassis, with space for sixteen inputs. The input modules shown include, sensitivity control and fader, pan and output group switch, fold back with pre-fade/post-fade switch, bass, treble, presence equalisation and reverb/ echo mix.

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Specifications

Inputs 0.2 mV into 200 ohms, 10 mV into 50K ohms.
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Levell TM3B microvoltmeter

MANUFACTURER'S SPECIFICATION

Voltmeter ranges: 15 μV, 50 μV, 150 μV, 500V fsd. Linear 127 mm black meter scales.

Accuracy: ±1% of reading ±1% of fsd ±1 μV at 1 kHz

Decibel ranges: −100 to +50 dB in 10 dB steps. Red scale −20 to +6 dB relative to 1 mW into 600 Ohms.

Frequency response: On 'mV' and 'V': ±3 dB from 1 Hz to 3 MHz, ±0.3 dB from 4 Hz to 1MHz. On 500 μV: ±3 dB from 2 Hz to 2MHz. On 150 μV: ±3 dB from 4 Hz to 1 MHz. On 50 μV: ±3 dB from 7 Hz to 500 kHz. On 15 μV: ±3db from 20 Hz to 200 kHz. The bandwidth switch introduces a bandpass filter with bottom cut −3 dB at 10 Hz and top cut −3 dB at 10 kHz or 100 kHz.

Input imp: Above 50 mV: 4.3 MΩ minimum in parallel with 20 pF maximum from 1 Hz to 3 MHz. On 50 μV to 50 mV: 5 MΩ in parallel with 50 pF from 200 Hz to 200 kHz. On 15 μV: 2 MΩ in parallel with 50 pF from 200 Hz to 20 kHz.

Input noise level: 5 μV rms maximum on 15 μV range with input shorted; 2.4 μV maximum on bandwidth. 10 Hz to 10 kHz. 20 μV rms on 50 μV range with 100kΩ source; 10 μV on 10 Hz to 10 kHz.

Amplifier output: The output is a phase-inverted undistorted replica of the input with the meter indicating the output voltage at a fixed sensitivity of 150 mV fsd. Gain is 80 dB on the 15 μV range. A load of 200kΩ and 50 pF may be connected with negligible loss of accuracy or frequency response.

Maximum safe input voltages: On 15 μV to 50 mV ranges: 250V DC, 100V AC up to 20 kHz, 30V AC above 20 kHz. On 150 mV to 500V ranges: 750V AC peak plus DC.

Temperature: The above characteristics are at 25°C but only minor divergencies exist from −10 C to +45°C.

Connections: The input accepts Belling Lee *L734* plugs but type *BNC* can be fitted to special order. The input test lead is 90 cm long, capacity 35 pF, and terminated by crocodile clips. The output sockets accept two 4 mm banana plugs at 20 mm spacing.

Power supply: One type *PP9* battery, life 1,000 hours; or, AC mains when Levell Power Unit is fitted.

Size and weight: 180 x 260 x 140 mm, 3.6 kg.

Leather cases: Cases are available as optional extras. They are stiffened with board and felt lined. Shoulder straps are detachable and it is possible to use an Instrument whilst in a case.

Price: £63 with batteries. delivered UK.

SUCH a comprehensive specification as this is usually attached to an instrument costing well over the £100 mark. Let us first congratulate Levell on their efforts to tell the user precisely what the instrument is intended to do. Furthermore, with a few exceptions, they have succeeded in describing the precise performance of the instrument.

The instrument is housed in a sturdy metal case, complete with insulated feet and a hinged leg which provides a convenient tilt for viewing the instrument on the bench, plus a really strong carrying handle. The design of the case is such that the face of the 127 mm scale meter and the knobs cannot be damaged if the unit is laid on its face on a flat surface. The general appearance of the instrument is rather old fashioned, but the controls are very clearly marked and the 127 mm meter with its mirrored scale is exceptionally easy to read.

As stated in the specification, the instrument is powered by a single type *PP9* battery with an anticipated life of 1,000 hours, but the operation of changing the battery is rather tiresome because it is necessary to undo four Philips head screws to obtain access to the battery compartment; captive slotted head fasteners would be an improvement here. Another improvement that would save a lot of oaths in the laboratory is knobs that do not fall off the rotary switches, and furthermore cannot be screwed on again without removing the front panel or finding one of that useful collection of bent screwdrivers!

Now to the electrical aspects of the Levell *TM3B*. The input is a standard Belling Lee coaxial socket (with the option of a BNC socket) which feeds a high input impedance preamplifier, the gain of which is variable in 10 dB steps up to a maximum of 80 dB. The output of this preamp is connected to a pair of front panel sockets, and to a second amplifier which drives the meter rectifiers. It is provided with negative feedback from the meter circuit in order to compensate for non-linearity of the meter rectifiers.

A bandwidth switch is inserted at the point where the two amplifier sections join and provides the following nominal 3 dB points by inserting a series capacitor between the amplifiers, and/or inserting a feedback capacitor around the input amplifier:

1 Hz to 3 MHz
10Hz to 100 kHz
10Hz to 10 kHz.

Not only is this facility useful for reducing the inherent noise during low level measurements, but it can be used for rejecting tape recorder bias or tracking down spurious HF oscillations in amplifiers.

It is also possible to modify the bandwidth of the instrument by shunting the output sockets from the input amplifier with reactive components, but a more likely use for this output facility is to feed an oscilloscope or distortion meter. Then the *TM3B* can act as a low distortion and high gain preamp for investigating low level signals, providing a gain up to 80 dB with a good noise factor. One of the great things about this is, because the instrument is battery operated, that no hum is introduced.

The calibration accuracy was checked at 1 kHz against a digital voltmeter of +0.25 per cent accuracy and found to be well within the claimed specifications of +1 per cent fsd +1 per cent reading on all ranges above the 15 mV range, on the more sensitive ranges, comparison was made with a Bruel & Kjaer *2606* measuring amplifier and the accuracy was within the combined specifications of the instruments. Linearity of the meter was found to be within +1 −0 per cent above 30 per cent fsd which is a completely satisfactory standard of performance.

Next the frequency response was investigated at maximum gain (15 μV fsd) in the audio range, and provided the following performance relative to 1 kHz: 22 Hz −1.5 dB, 29 Hz −1 dB, 45 Hz −0.5 dB, 1 kHz 0 dB, 20 kHz +0.25 dB. This, of course, is well within specification and perfectly adequate for most purposes. Furthermore, the frequency response between 20 Hz and 20 kHz was found to be absolutely flat above the 50 μV range. The function of the bandwidth switch was found to be substantially as specified in the 'restricted' positions, providing an approximate 3 dB/octave attenuation at either end of the passband. However, in the wide band position the frequency response was found to be −0.75 dB at 3 MHz, −2.5 dB at 4 MHz and −5.5 dB at 5 MHz with 100 mV input. Rather better performance than would be anticipated.

Investigation into the input impedance and noise performance revealed that all the specified figures are adequately pessimistic, so there was no doubt that this instrument was well within the published specification.

Well, not everything can be perfection for £63 and from the audio engineer's point of view there are one or two snags and omissions. Firstly, it is clearly stated on the instrument, but not in the specification, that the meter is mean reading calibrated rms. This is fine when we measure sinewaves but, if we attempt to measure noise, it is most likely that the instrument will under-read to a certain extent, depending upon the effective crest factor of the noise. Such rectifier characteristics are common in the cheaper types of voltmeter and should be expected to lead to errors of at least −1 dB when measuring random noise.

A second but not normally important snag is that, while the frequency response is specified down to 1 Hz, the meter is quite unusable below 3 Hz because the meter damping is such that the needle swings back and forth in sympathy with the input waveform.

A further point that should be mentioned is that, while the first amplifier output is specified as 150 mV for fsd of the meter, this is only true at the full scale indication of 15 on every other range, and occurs at an indication 47.5 on the intermediate ranges. This fact in no way detracts from the usefulness of the input amplifier, which has negligible distortion, but could lead to confusion.

From an audio engineer's point of view it would be nice to see an 'A' weighting network included in this instrument, but it must be remembered that this would essentially increase the price of the instrument.

Summing up, the Levell *TM3B* is an excellent instrument for measuring sinewaves from 3 Hz up into the MHz regions and its extreme

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Inside Action Video

DESPITE the increased use of closed circuit television over the last few years, and the obvious huge potential of videotape as a medium, it is surprising how few companies have realised its implications. There are, of course, plenty of places to buy the necessary hardware, but when it comes to offering the type of services and facilities which are taken for granted in the fields of film and audio recording, the companies concerned can practically be counted on the fingers of two hands.

Among this small band, and perhaps the people with the most unconventional and flexible approach to the video challenge, are Action Video Limited. From their Soho headquarters in Great Marlborough Street, AV provide an across-the-board service which takes in equipment sales and hire, studio and location production and playback facilities, telecine and tape to film transfer, and a service and maintenance section which they claim is unrivalled in London.

'Video, at least as far as the private user is concerned, is still a young medium,' said managing director Brian Speck, 'so there are no hard and fast rules about how to do things. A lot of our work involves finding answers to problems that have never been met before so an unconventional attitude based on sound professional expertise is a great asset in this business.'

Action Video started life as an answer to a problem—the problem of how a market research company (Action Research) could get a reliable closed circuit television recording and playback service for use in conducting surveys and interviews. The answer was to set up a cctv unit and it was from these small beginnings that AV evolved until today they are bigger than the research company, and still growing. Action Video's early involvement in market research continued and grew to encompass the related field of producing test commercials for advertising agencies. Many agencies now use AV's studios as a creative workshop, to develop visually their thoughts for a new campaign or client presentation.

One rather surprising feature of this side of the company's operations is the number of advertising agencies with their own cctv equipment using AV's facilities. Speck feels this is because they bought hardware virtually on impulse without any thought as to the equipment's ease of use or compatibility. He blames these expensive mistakes not on the purchasers but on the majority of equipment suppliers who are eager only to make a sale without any regard to the user's real requirements. His attitude is reflected throughout AV. A client who has come in to buy a cctv studio set-up is often persuaded that he really only needs to hire the equipment when required, or that he will be better off letting AV take care of all his production problems.

Action Video claim that their studios are capable of producing results indistinguishable in quality from broadcast pictures. The main studio gives over 50 m^2 of unobstructed floor space and is fully equipped for up to six channel operation. Shibaden monochrome orthicon cameras are used. AV find that black and white pictures are normally adequate for most requirements but colour cameras are available if required. This is in fact the only area of modern cctv systems where colour is significantly more expensive than monochrome—a reliable, low cost colour camera for nonbroadcast use has yet to be manufactured. The control room houses a full effects bank, together with comprehensive mixing and editing facilities. Studio productions are normally recorded on 25 mm IVC videotape recorders, although other machines will be supplied if a client specifically requests it.

The main studio, used for larger productions and those requiring set building or special lighting, connects with a smaller studio which can be used to record discussions, interviews or casting sessions, and can also be used as a comfortable viewing room. As an extension of these studio facilities, AV also maintain an outside broadcast unit housed in a converted Bedford *Duple* coach. The equipment carried by the ob unit varies depending on individual circumstances but normally two or three cameras are used, together with full mixing facilities and 25 mm video tape recorders. The unit is capable of operating on up to six channels with a corresponding number of cameras.

For live closed circuit work—typically conferences or exhibitions—the ob unit can be used as a mobile control room relaying pictures to normal monitors or to a large projection screen. AV believe this projection system to be the only one of its type in the country. It produces results comparable to the more familiar eidophor screen but at much lower cost, and without requiring an experienced operator. The ob unit can also be tied to a landline system for simultaneous playback or live transmission to selected locations throughout the UK.

Besides these functions, the outside broadcast van also doubles as a mobile viewing room and demonstration unit. It is in this guise that it recently completed a tour of British universities, demonstrating some of the latest cctv equipment. One of the busiest sections at Action Video is the telecine unit. This reflects a growing awareness that both film and videotape have their own separate advantages, and that it is increasingly easy to combine them to produce a cheaper yet superior end product. Videotape has the advantages of economy, portability and ease of presentation. It is also the ideal medium for non-destructive editing and experimenting with optical effects. 'Recent technical developments have meant a vast improvement in quality,' Speck commented 'so more and more people now shoot their basic material on film, to which most production companies are still geared, then transfer this to video tape for editing into the desired form. This can then be back to film if required.'

continued over

Right: Mobile demonstration vehicle

INSIDE ACTION VIDEO

continued

Both 16 and 35 mm film in monochrome or colour can be transferred to video tape giving results which match up to broadcast quality. Rank Cintel flying spot twin lens equipment is used for 35 mm colour work and the results are normally recorded on 25 mm IVC videotape recorders, so that the tapes are compatible with those recorded in the studio or outside broadcast unit.

Videotape to film transfer is normally used when a print is required as the final presentation medium but where shooting and editing are carried out on videotape for reasons of cost and speed. Savings in time and money possible by this method are impressive—AV claim that a ten minute monochrome film, including location shooting, opticals and titles can be completed in only three days for around £700. Quality remains consistent whether 12.5 or 25 mm video tape, and 16 or 35 mm film are used.

Advertising agencies again make up the bulk of AV's customers for these transfer services. The speed and ease of videotape makes it ideal for making a pilot commercial either from existing film or experimental material. Agencies are also increasingly using videotape as the medium for client presentations of new TV campaigns. 'All TV commercials are ultimately seen on the small screen,' said Speck, 'so it makes sense for an agency to show them to their clients like that. It's also a lot easier and cheaper to hire or buy a videotape recorder and monitor than to maintain the unnecessarily elaborate presentation theatres which all the big agencies used to consider a must, even though they were probably used for only a few hours a month. With videotape, all you need is a power socket and every office or boardroom can double as a presentation suite.'

The sales division of Action Video is headed by Dave Annett who sees this side of the business as complementary to the production facility. 'We actually use the equipment we sell and can advise a customer exactly how it operates in a true user environment. We hold no brief for any one manufacturer so can give unbiased advice based on practical experience. We also back up the sales side with a service section which I consider is the best in London.'

While working with Philips as manager of their Professional Recording Department, Annett was responsible for the British marketing introduction of the first videotape recorder to sell for less than £1,000. This was a breakthrough in bringing cctv within the reach of the average non-broadcast user, but in recent months there has been a development which Annett considers to be of even greater significance in the spread of video. This is the introduction of the EIAJ 1 standard for 12.5 mm videotape recorders. 'The Electronic Industries Association of Japan have been working for many years to introduce a standard among video tape recorders similar to that which is taken for granted in the audio world. Until the introduction of this standard there has been a confusion of systems, with every manufacturer offering his own interpretation. Now tapes recorded on one EIAJ 1 machine are fully compatible with all other machines manufactured to the standard.'

Action Video believe their range of EIAJ 1 machines to be the largest in the UK. All cost under £1,000, in fact most are below £400, and between them offer every technical facility likely to be needed by the average user, including colour, slow motion, battery portable record/replay, remote control and electronic editing. The next stage will be the introduction of cassette machines to the EIAJ 1 standard which will firmly establish this long awaited 'revolution'.

'Our greatest asset is the expertise of the people working here,' Speck concluded. 'Because we are using video equipment every day and have seen it develop, we can appreciate the difficulties confronting someone unfamiliar with the possibilities of the medium. Our clients know that we won't ask them to pay for anything they don't need. I think this mixture of trust and professionalism, which you don't get from a dealer, is the secret of AV's success.'

Right: Telecine room

LEVELL TM3B REVIEW

continued

sensitivity makes it useful for directly measuring microphone input sensitivities etcetera, as well as being extremely useful as a general purpose measuring pre-amplifier.

It is not ideal for measuring signal-to-noise ratios because of its rectifier characteristic, which is common among instruments in its class, but it does have the advantage of variable bandwidth.

However, the facility of being able to use the low distortion (this was not accurately measured, but must be in the order of 0.01 per cent) preamplifier to feed other instruments is a valuable asset. **Hugh Ford**

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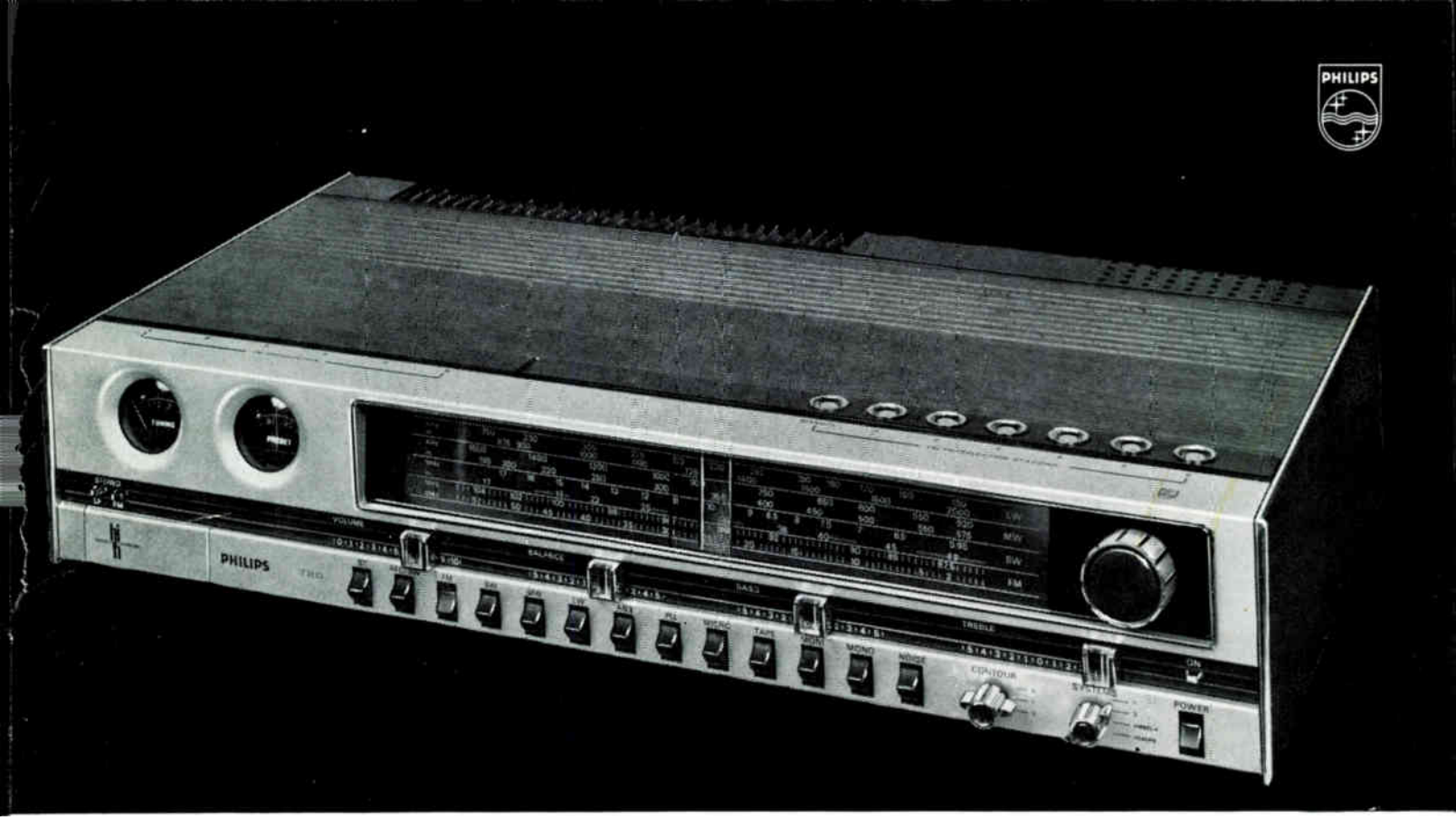

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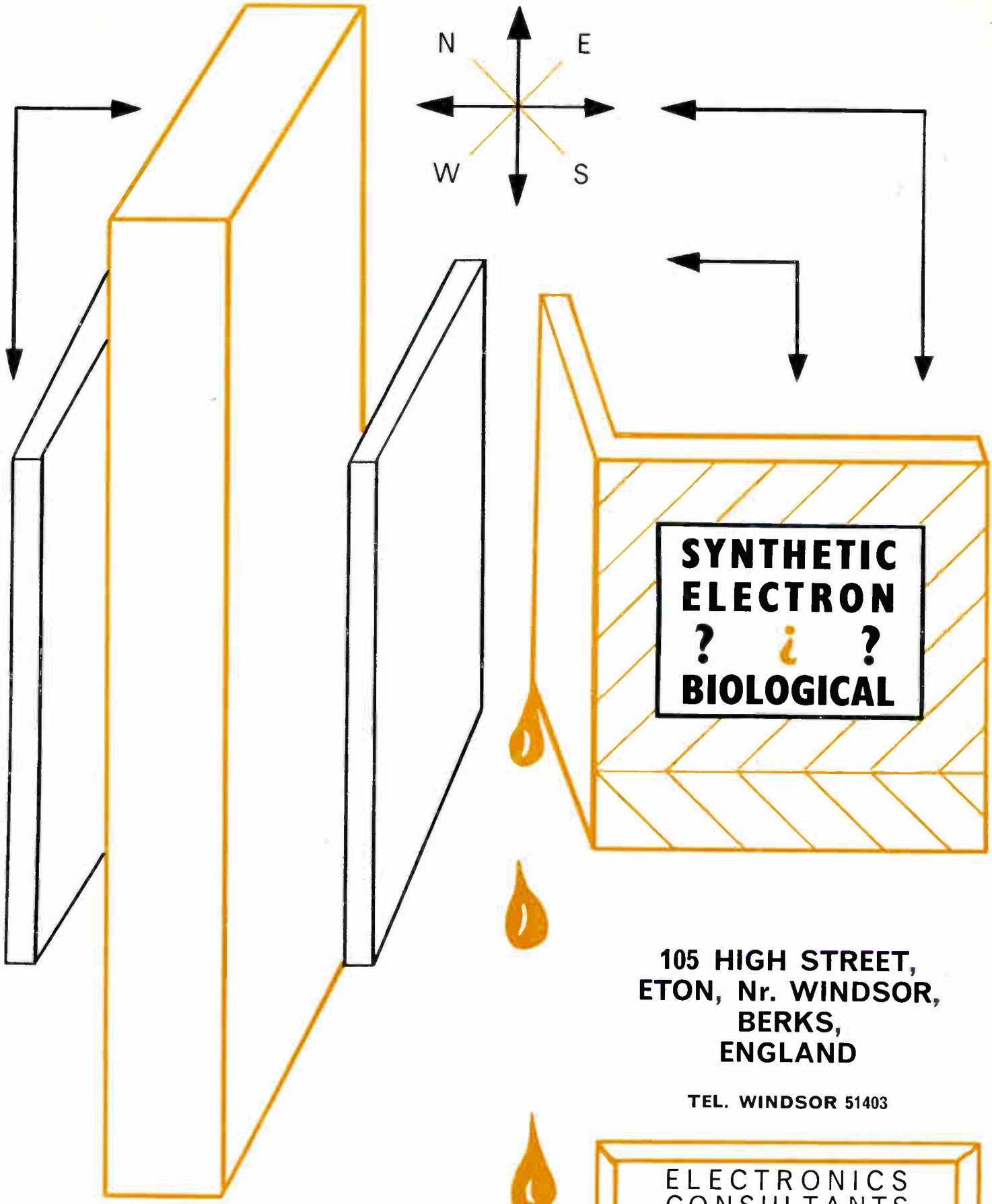

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