JULY 1971

15p

# STUDIO SOUND


## THE WONDERFUL SOUND OF RADIO £
## ABBEY ROAD · DESIGNING A SOUND MIXER
## MINIFLUX TEST METERS REVIEWED
## MUSIC OFF THE STREETS


# Drop in a top studio recorder

# London made

C.B.S. Records, Aylesbury, have chosen Leevers-Rich ¼ inch stereo, 1 inch 8-track tape machines and A501 graphic equalisers for the in-plant production of 1 inch masters. These are now tailor-made for use on their Gauss high speed tape duplicator. Both musicassettes and 8-track stereo cartridges are being produced at Aylesbury for world wide distribution on C.B.S labels.

**LEEVERS-RICH**

EQUIPMENT LIMITED

A Member of the MCP Group

**Nick Nichols** at our London Office knows the scene. Ring him at **01-874 9054**

Remember there are over 1200 Leevers-Rich professional ¼ inch recorders installed in London alone

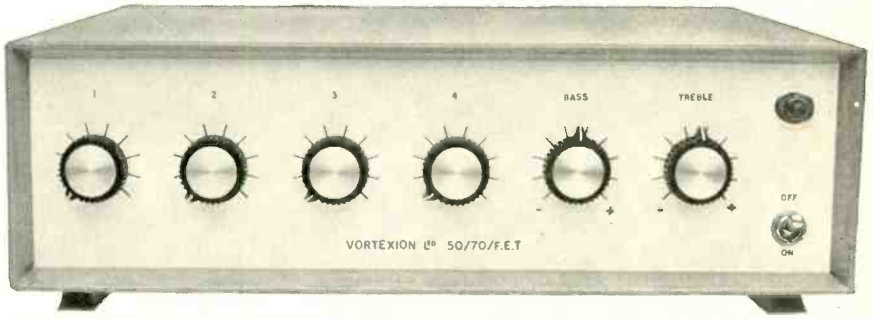
319 TRINITY ROAD · WANDSWORTH · LONDON SW18 · 01–874 9054 · CABLES LEEMAG LONDON SW18

# Vortexion

## THE VORTEXION 50/70 WATT ALL SILICON AMPLIFIER WITH BUILT-IN 4-WAY MIXER USING F.E.T's

This is a high fidelity amplifier (0.30% intermodulation distortion) using the circuit of our 100% reliable 100 Watt Amplifier with its elaborate protection against short and overload, etc. To this is allied our latest development of F.E.T. Mixer amplifier, again fully protected against overload and completely free from radio breakthrough.

The Mixer is arranged for 2-30/60Ω balanced line microphones, 1-HiZ gram input and 1-auxiliary input followed by bass and treble controls. 100 volt balanced line output or 5/15Ω and 100 volt line.




50/70 WATT ALL SILICON AMPLIFIER WITH BUILT-IN 5-WAY MIXER USING F.E.T's

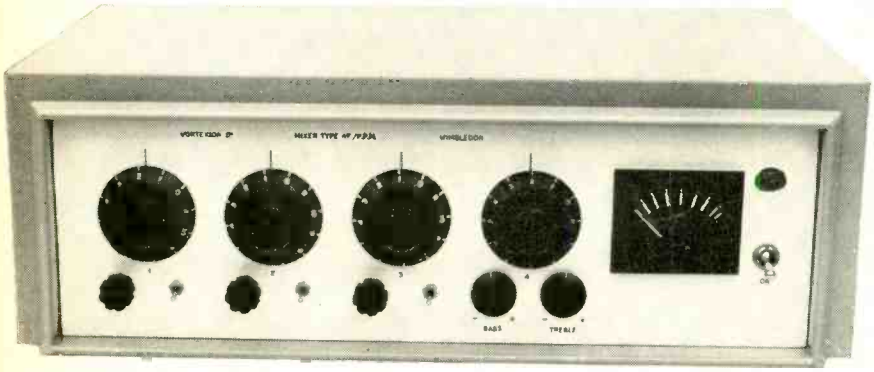
This is similar to the 4 way version but with 5 inputs and bass cut controls on each of the three low impedance balanced line microphone stages, and a high impedance (10 meg) gram stage with bass and treble controls plus the usual line or tape input. All the input stages are protected against overload by back to back low noise, low intermodulation distortion and freedom from radio breakthrough. A voltage stabilised supply is used for the pre-amplifiers making it independent of mains supply fluctuations and another stabilised supply for the driver stages is arranged to cut off when the output is overloaded or over temperature. The output is 75% efficient and 100 V balanced line or 8-16Ω output are selected by means of a rear panel switch which has a locking plate indicating the output impedance selected.

**100 WATT ALL SILICON AMPLIFIER.** A high quality amplifier with 8 ohms-15 ohms or 100 volt line output for A.C. mains. Protection is given for short and open circuit output over driving and over temperature. Input 0.4 V on 100K ohms.

**THE 100 WATT MIXER AMPLIFIER** with specification as above is here combined with a 4-channel F.E.T. mixer, 2-30/60Ω balanced microphone inputs, 1-HiZ gram output and 1-auxiliary input with tone controls and mounted in a standard robust stove-enamelled steel case. A stabilised voltage supply feeds the tone controls and pre amps, compensating for a mains voltage drop of over 25%, and the output transistor biasing compensates for a wide range of voltage and temperature. Also available in rack panel form.

**200 WATT AMPLIFIER.** Can deliver its full audio power at any frequency in the range of 30 c/s-20 Kc/s ±1 dB less than 0.2% distortion at 1 Kc/s. Can be used to drive mechanical devices for which power is over 120 watt on continuous sine wave. Input 1 mW 600 ohms. Output 100-120 V or 200-240 V. Additional matching transformers for other impedances are available.

**F.E.T. MIXERS and PPM's**



Since we have been supplying professional mixers for 25 years we have delayed the introduction of solid state units until they were at least as good as their valve counterparts. (Which will continue where required.)

The various sections of the F.E.T. mixers and BBC type PPM's have been performing successfully for several years in other equipments with complete reliability. The PPM also uses an F.E.T. in its time constant circuit so that polyester capacitors can be used. The response from the 600Ω output (25Ω source impedance) is level 20 Hz to over 30 kHz with very low intermodulation distortion to zero level + 12 dB. The input signal voltage range is over twice that of the valve unit and the noise at least halved.

**VORTEXION LIMITED, 257-263 The Broadway, Wimbledon, S.W.19**

**Telephone: 01-542 2814 and 01-542 6242/3/4** **Telegrams: "Vortexion London S.W.19"**

# MEET THE FAMILY.

We've been in the microphone business for over 40 years now.

And in all that time we've built up quite a family.

Ribbon mikes, moving coil mikes, headphones, stands, accessories, the lot.

Over 50 in fact.

All these products, made to the same high acoustic quality that has set standards all over the world.

All these products are shown and explained in detail in the Beyer Dynamic Catalogue.

Which, if you are at all interested in better equipment, is something you should send for.


BEYER DYNAMIC

To: Beyer Dynamic (GB) Ltd., 1 Clair Road, Haywards Heath, Sussex.
Telephone Haywards Heath 51003

Please send me full particulars and illustrated brochure of the Beyer Dynamic products.

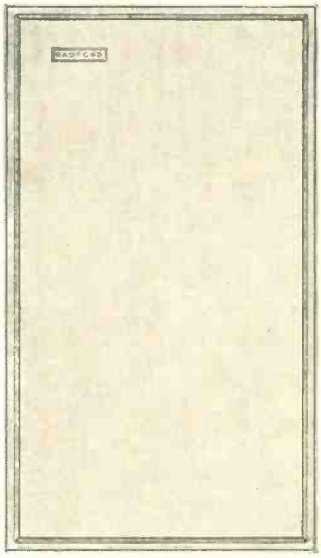
Name .....

Address .....

.....

# What is a reference standard ?

The development of loudspeakers would be very much simplified if a true reference standard of sound reproduction were available. Years ago the axial frequency response characteristic was used as a standard for comparison but this was found to have considerable pitfalls. It has been stated that a good loudspeaker has a sensibly flat frequency response characteristic but a loudspeaker with a flat frequency response is not necessarily a good loudspeaker. This is very true as the static frequency response can be considerably different from the dynamic response i.e. the response to transients. Transient distortion exists in all loudspeaker systems in varying degrees and it can be demonstrated that the lower the transient distortion the more lifelike the sound. During the last few years Radford have concentrated particularly on eliminating transient distortion from drive units and a realism of reproduction is obtained not previously possible. The two loudspeakers shown here can be considered as reference standards for their size. The TRI-STAR 50 is probably the smallest size wide range high power loudspeaker system available to-day. It uses a closed back type mid range unit as it operates in the same enclosure as the base driver. The MONITOR uses an open back type mid range unit and is therefore contained in a separate enclosure from the bass driver. Both loudspeakers have a frequency response $\pm 3\frac{1}{2}$ dB from 60 Hz to 20 kHz which is just about as flat as can be obtained from present techniques.



**TRI-STAR 50** A sealed enclosure for shelf mounting having three units. Mid range driver is a pressure type with enclosed back. Provides high performance with small size. Power handling capacity 50 watts. Matching impedance 8-16 ohms. *Size:* 21 x 12 x 9 in. (53 x 32 x 23 cm.) *Weight:* 35 lb. (16 Kg.) *Price:* **£42·50.**

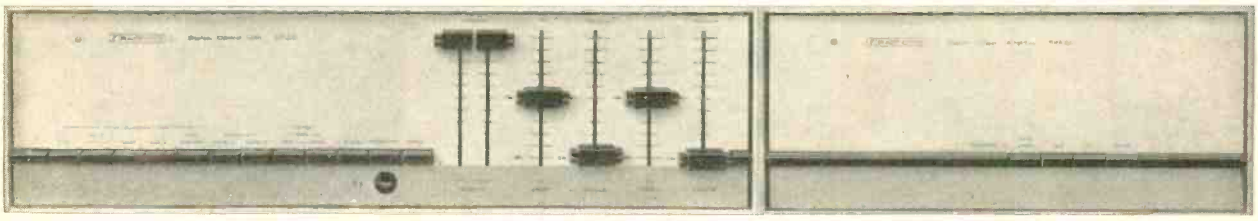
**MONITOR** For shelf and floor mounting on a suitable stand. Uses three drive units. Sealed enclosure for bass driver. Open back type mid range driver fitted in separate enclosure. Power handling capacity 50 watts. Matching impedance 8-16 ohms. *Size:* 30 x 12 x 10½ in. (76 x 30½ x 26½ cm.) *Weight:* 43 lb. (19½ Kg.) *Price:* **£60·00.**

Electronics is a more precise science than acoustics and standards can more readily be established from specific data. The performance standards of the SC.24 pre-amplifier and SPA.50 power amplifier are not equalled by any other amplifier system at the present time. However, many people with sensitive hearing believe that they can hear the difference between good quality amplifiers of different makes having a high specification. The SC.24, SPA.50 combination has been designed to provide a high standard of listening performance as well as a high specification. Among the subtle factors to achieve this are the elimination of cross-over distortion by complementary symmetry output and an extraordinary overload capacity of all the sections comprising the amplifier system with virtually zero hum and noise output.

Radford aim to make its products a reference standard for others. Write for a leaflet describing the above products or better still visit a franchised Radford dealer for a demonstration and study the quality of workmanship.

**PRE-AMPLIFIER CONTROL UNIT TYPE SC.24** A comprehensive stereo unit providing considerable facilities and flexibility. Output sufficient to drive any power amplifier. Mains operated. *Size:* 16½ x 4½ x 9¾in. (41½ x 11½ x 24 cm.) *Weight:* 17 lb. (7·7 Kg.) *Price:* **£80·00.**

**POWER AMPLIFIER TYPE SPA.50** A dual channel power amplifier with power output exceeding 50 watts r.m.s. continuous per channel. *Size:* 10¾ x 4½ x 13in. (27 x 11½ x 33 cm.) *Weight:* 22 lb. (9·9 Kg.) *Price:* **£85·00.**



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# glass & x'tal
## ferrite head
## and a matchless combination



GX-365D

SW-170A/AA-8500

The AKAI-developed **glass and x'tal (crystal) ferrite head** is the first of its kind in the world. We call it the GX Head. It's "dust free" and guaranteed for over 150,000 hours of service life! And it produces a "focused field" bias which completely eliminates distortion in recording/playback of high frequency signals. The **GX-365D Professional Stereo Tape Deck** incorporates this superb head. Together with the **AA-8500 Solid State AM/FM Multiplex Stereo Tuner Amplifier** and **SW-170 Hi-Fi Stereo Speaker System**, it makes a perfect combination for reproducing the ultimate in stereo sounds.

**GX-365D Professional Stereo Tape Deck**
Features GX-Head, automatic continuous reverse, sensing tape reverse, automatic volume control, magnetic brake, 3 heads, 3 motors, automatic stop/shut off. Frequency response: 30 to 28,000 Hz (±3dB) at 7-1/2 ips.

**AA-8500 Solid State AM/FM Multiplex Stereo Tuner Amplifier**
Features 240W output power, new dial mechanism, FET and IC, FM/AM signal strength meters, AFC on/off switch. Use of multichannel amplifier possible.

**SW-170A Hi-Fi Stereo Speaker System**
Uniquely designed 80W, 5-way, 6-speaker system with frequency response of 20 to 23,000Hz.

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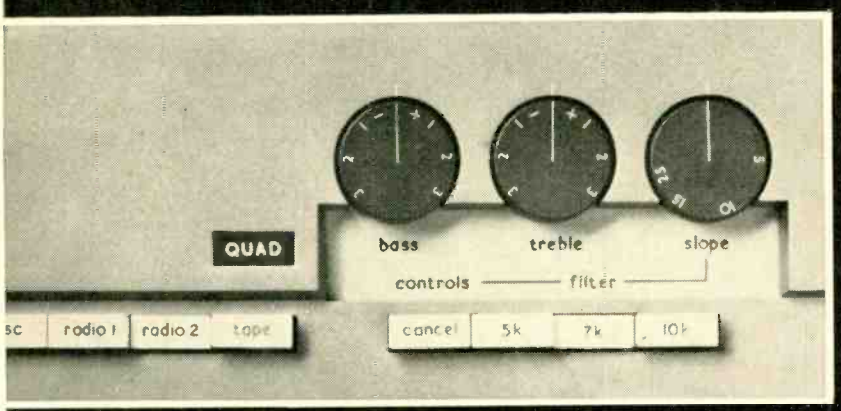


Even with a perfect pickup, the distortion from a gramophone record for sounds of equal level increases very rapidly at high frequencies, eventually doubling for every major third increase in pitch.

There comes a point when, to musical ears, the distortion is increasing faster than the musical quality. The QUAD filter system is designed to enable those with ears to hear to obtain more of the music and less of the distortion.

# QUAD

**for the closest approach to the original sound**

*Send postcard for illustrated leaflet to Dept.* S.S.T.R.
Acoustical Manufacturing Co. Ltd., Huntingdon, Tel: (0480) 2561. QUAD is a Registered Trade Mark.

# Studio Sound

JULY 1971 VOLUME 13 NUMBER 7

INCORPORATING
TAPE RECORDER

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**ADVERTISEMENT MANAGER**
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Editorial and Advertising Offices:
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**COVER PICTURE**

Automated advertising is the obvious application of the Ampex *ACR-25* video cassette system, handling up to 24 short inserts.

**SUBSCRIPTION RATES**

Annual UK subscription rate for *Studio Sound* is £1·80 (overseas £3, $7·20 or equivalent). Our associate publication *Hi-Fi News* costs £2.82 (overseas £3·36 $8 or equivalent). Six-month home subscriptions are 90p *(Studio Sound)* and £1·41 *(Hi-Fi News)*.

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

**BINDERS**

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

THE FIRST International Cartridge TV, Video Cassette and Video Record Conference was held in Cannes during the second half of April. Inevitably it was dominated by the low-speed chrome oxide helical-scan tape systems that have been developed for domestic applications by Ampex, Philips and Sony. There were surprises, however, notably in the shape of a video disc system now being evolved by Philips. Not to be confused with the electromechanical Teldec scheme, Philips are working with an opto-electronic medium, reproducing information by reflecting a light beam from the moulded disc surface. That Philips should feel the need to develop a system of this kind suggests a lack of confidence in videocassettes as a viable medium for commercial telerecords. This might in turn be attributed to the doubtful economics of real-time copying on the first videocassette duplicator to be offered to record manufacturers: the Sony *D100*.

It will be appreciated that high-speed video tape copying, in the conventional sense, would involve extremely high head-drum speeds. Multiply the basic drum rate by the eightfold speedup considered economic for audio and you have to contend with a 200 Hz drum speed; hardly practical. Two developments promise to alleviate this problem. Firstly, high-speed contact printers have been perfected for limited-scale quadruplex copying and are known to be currently under development for helical chrome. Secondly, chrome oxide tape may prove merely an addition to the list of shortlived inventions which barely left the ground. Its future is threatened by a higher storage density tape which, like chrome, is to be produced initially for the computer industry. Graham Magnetics Inc are the company behind this development. Situated in Texas, they are reported to be coating the tape with particles of *Cobaloy*, comprising cobalt and other compounds. This is apparently capable of a four-fold increase in storage capacity compared with 'existing', though not yet marketed, videocassettes. Like chrome, *Cobaloy* may well make itself felt in the audio field, perhaps as the true saviour of the Musicassette.

How do these events affect your shares in EVR? At Cannes, the EVR Partnership's managing director resorted to a defence of his claim that EVR is pirate-proof, where counterfeit releases in that medium are concerned. Nor, he stated, should EVR publishers fear the copying of an EVR film on to videotape. 'Should this be done with home-made equipment, the results will be inferior. Even if it is done by professionals, there will still be a dramatic loss in quality.' One wonders why.

RCA, meanwhile, are continuing the evolution of an inexpensive laser to form the heart of their SelectaVision holographic system. This is due to be marketed late in 1972, by which time the magnetic videocassette should be securely established.

When the 'B' studios were investigated for last month's Directory, we were distressed to find that many companies were either out of business or too small to merit serious consideration. Hence the temporary absence of that column. In the long term, the production of video records may prevent the rest of the alphabet from following the 'B's to extinction. In the short term, commercial radio will profit those studios prepared to study the intricacies of programme production. These mean more than the ability to link one gramophone record to another; the 'disc jockey' is in our view the most superfluous of the hangers-on surrounding the musical industries. His contribution to supermarket culture has ruined commercial radio broadcasting in the USA and threatens, sooner or later, to have the same effect on the UK.

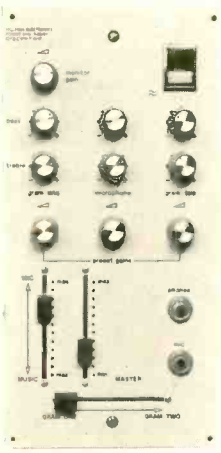
**CORRESPONDENCE AND ARTICLES**

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. Payment is negotiated on acceptance

# WE NEED TO MAKE EVEN MORE MIXERS

**MUSICMASTER**
8 CHANNEL MONO-STEREO WITH SWITCHED INPUT
TWIN 1v OUTPUTS



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CROSSFADE—
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MONITOR AMPLIFIER—
MAG-CERAMIC LOW OR HI Z MIC TO CHOICE.
MONO OR STEREO AVAILABLE.

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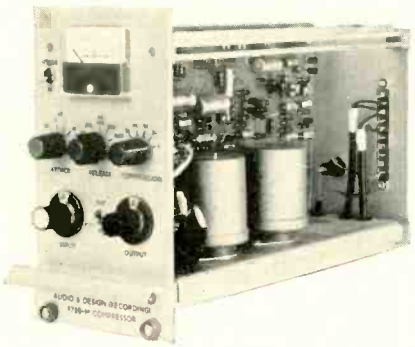
ME

# LEVEL CONTROL EQUIPMENT

**Superb Performance—moderate cost**

**7 700-M Compressor-Limiter**



The new F700 Compressor provides a range of compression slopes from less than 2:1 to greater than 25:1; switched attack control for special effects; switched release control from 25mS. The threshold level is switched with compression slope to provide a constant level of output for 17dB reduction. Normal output level (unattenuated) +8dBm. Noise better than –75dB below Limit level Distortion: 0.1% for 25dB reduction.

*also available*
F600 Limiter/Compressor and E800 Equaliser

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# Events

### FLEXIBLE LP DISCS

THE VIRTUAL elimination of surface noise, imperfect groove moulding and disc slippage is claimed by RCA Records for the newly developed Dynaflex gramophone record. Rex Isom, RCA's chief engineer, recalled that transcription discs used in broadcasting prior to the tape era 'were made as thin as possible to provide the best possible sound quality'. His own team's tests with thinner discs had reaffirmed the phenomenon. The thinner material suffers less warp, under rapid cooling, than is incurred by conventional thicknesses.

### COAXIAL CONNECTORS

SIXTEEN BASIC forms of plugs, sockets, adapters and links are now being manufactured to BBC and post office standards by NSF. Particularly low noise is claimed, nominal upper frequency limit being 200 MHz. Temperature limits are −40° to 110°C. Inner contacts are made from silver, the housings being finished in heavy silver plating. Further data: NSF Ltd, Ingrow Bridge, Keighley, Yorkshire.

### DESOLDERING AN IC

A ONE-PIECE head to suit the *HMS* miniature soldering iron has been developed by Solderstat to simplify the removal of 14-way and 16-way dual in line integrated circuits. The accessory is pushed on to the iron in place of the copper bit and is available from Solderstat Ltd., PO Box 10, Bush Fair, Harlow, Essex.

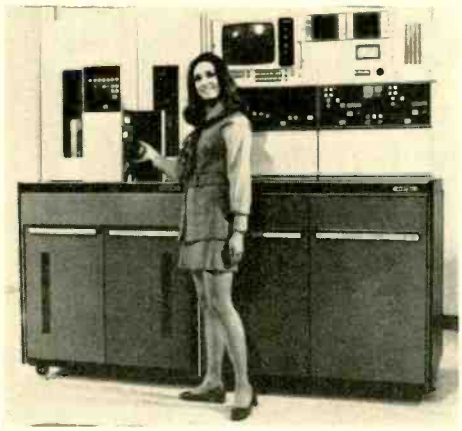
### VIDEOCASSETTES . . .

A PREPRODUCTION run of the Philips *N1500* videocassette recorder is about to start, anticipating deliveries towards the end of the year. The recorder is fully colour/monochrome compatible, making no reduction in playing time for colour, and will sell in the UK for between £280 and £290 including purchase tax. Blank cassettes with a 60 minute capacity will sell at about £12.

The recorder incorporates a time switch and UHF modulator, the latter permitting connection for playback through the aerial socket of any standard TV receiver. A built-in tuner allows viewers to watch one broadcast and simultaneously record another for later screening. AEG, Grundig, Loewe Opta, Studer/Revox and Thorn are among European companies who have adopted the Philips VCR system. The recorders will be produced in PAL and SECAM forms and will be compatible in the sense that PAL cassettes can be played in monochrome on SECAM equipment, and vice versa.

### . . . AND VIDEO CASSETTES

NOT TO BE confused with the above or with the Instavideo system, Ampex demonstrated a production model of the *ACR-25* video cassette



recorder at the National Association of Broadcasters Convention in Chicago (March 28 to 31). Up to 24 cassettes may be loaded into a storage carousel which delivers them in any selected order to one of two internal vacuum tape transports. The system is capable of playing segments as brief as 10 seconds without roll delay. Threading, cueing, playing and rewinding are automatic.

### MILLBANK MOVE SOUTH

THE FOREST Row address of Millbank Electronics changes as from July 1, becoming Bellbrook Estate, Uckfield, Sussex. Telephone number changes to 0825 4166.

### DOLBY B BROADCASTING

THE APPLICATION of Dolby B noise reduction to FM broadcasting was demonstrated recently in Chicago to the National Association of FM Broadcasters. The system is claimed to give an improvement corresponding to between five and 20 times increase in transmitter power, depending on the signal strength at the listener's location. Dolby's chief engineer, David Robinson, claimed that the broadcasts would not sound unusual to listeners using ordinary reception equipment. This view was supported by Alfred Antlitz, chief engineer of Chicago's WFMT station, who collaborated in the tests. FM receivers incorporating Dolby B units will be marketed in the USA later this year.

### SCOTLAND'S FIRST FILM PREVIEW THEATRE

THE FIRST film preview theatre to be opened in Scotland is now established at 59 Berkeley Street, near Glasgow's Charing Cross. Seating for up to 30 people, 16 mm double-band recording and playback, 35 mm viewing and 16 mm editing facilities are offered for hire together with tape and disc production equipment. The company, City Films Ltd., are expanding their film and PA equipment hire service.

### NEW NAME FOR JONES

D. N. JONES Electronics Ltd have changed their name to Aston Electronic Developments Ltd, coming into line with the associated company manufacturing CCTV equipment: Aston Micro-Electronics Ltd. The address of both companies remains Vapery Lane, Pirbright, Woking, Surrey. Jones (as they were) are now producing complete jackfield assemblies for studio use. These are available in single, double or triple rows of 20 sockets. Delivery time for quantity orders is two to four months but much less for smaller orders.

### PORTABLE MIXER

A SIX-INPUT, two-output portable mixing unit has been introduced by Sonifex Sound Equipment, 93 Stanwell Way, Wellingborough, Northamptonshire. The unit is of modular construction and accepts 600 ohm line, 200 ohm microphone, or gram inputs. Each channel incorporates a slide fader, HF and LF equalisers, 0 to 70 dB gain control, prefade listen and echo send facilities. The 600 ohm balanced outputs are controlled by a master slide fader and 10 dB balance control. A

90 mm PPM or VU can be switched to monitor any input or output. Connectors are Cannon and the dimensions 430 x 380 x 100 mm.

### BBC ORDER EMS SYNTHESISER

A £6,500 electronic music synthesiser, the *Synthi 100*, has been ordered from Electronic Music Studios (London) Ltd for the Maida Vale Radiophonic Workshop. A second *Synthi 100* has been delivered to Radio Belgrade and a third ordered by the University of Cardiff.

### ZINC-AIR PRIMARY BATTERY

BETWEEN FIVE and eight times the performance of an equivalent Leclanche cell is claimed by Crompton Parkinson Ltd (a division of Hawker Siddeley) for their newly developed zinc-air primary dry battery. The first battery in production, the *2AS*, occupies the space of two AA penlight batteries and has a capacity of 2.5 Ampere-hours at a nominal 2.8V.

# It's back again!

## Beautiful Shamrock

FERRO-SHEEN
POLYESTER BASE
*recording tape*

Once again this top quality recording tape is coming in from the USA and is being made available at a price all can afford. Do not confuse SHAMROCK Ferro-Sheen with cheap tape, it is a quality product made by AMPEX, America's largest producer of high quality tapes for industrial, entertainment and domestic use.

Shamrock
*recording tape*

TOP QUALITY AT THE LOWEST PRICE

SHAMROCK Ferro-Sheen has always been difficult to get, over here, but with a special arrangement with AMPEX G.B., our continuity of supplies is assured. SHAMROCK Ferro-Sheen is a superior product.

THE GREATEST VALUE IN RECORDING TAPE

You get more good clean sound for your money with SHAMROCK Ferro-Sheen than with any other tape anywhere near the price... SHAMROCK Ferro-Sheen is extensively used by Educational Authorities, Universities, Language Laboratories and Tape Recording Clubs.

SHAMROCK Ferro-Sheen recording tape is available only on 7" reels. 1800ft L.P. 75p per reel, 3 for £2.50, 6 for £4.45, 12 for £7.75. 2400ft D.P. £1.15 per reel, 3 for £3.40, 6 for £6.85, 12 for £13.75. P & P is 5p PER REEL on all orders under £5.

**POST THIS COUPON TO DAY**

Music Tapes Mail Order,
36 High Street,
Salisbury, Wilts.

Please mail to me at the address below, the following reels of Shamrock Ferro-Sheen recording tape.

7" L.P..... @ £.....

7" D.P..... @ £.....

I enclose 5p per reel for P & P if my order totals less than £5.

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*Address* .....

.....

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# STUDIO DIARY

## BY KEITH WICKS

Information for inclusion in Studio Diary or Studio Directory should be sent direct to Keith Wicks, 98 Shakespeare Road, Acton, London, W.3

MAJESTIC Studios of Clapham High Street have been busy since their opening in January. Around that time, many established studios were having difficulty finding customers so in the circumstances Majestic have done well. Their success is probably due to the fact that, for only £14 per hour, they offer eight track facilities in conjunction with their 18 x 11m studio which accommodates up to 50 musicians. Four track costs £12 per hour and two track £10. The 16/8 desk and the monitoring system are by Cadac, and the recorders are by Ampex. Studio manager Alan Grandy explained that the reason the rates are so low is that they do not have the high overheads of West End studios. Anyone worried about venturing so far out into the sticks for a recording session is reminded that Clapham is only five minutes or so south of Chelsea Bridge.

Avenue Records have produced quite a lot of budget LPs at Majestic, mostly produced by Alan Caddy. The Johnny Howard band laid down tracks for an LP, and Rocking Horse have been in with producer Hal Carter. David Watkins, ex-resident harpist at Covent Garden, made a classical harp LP, and Al Saxon recorded an album of original songs with a 30 piece orchestra. Ex-Bonzo Dog, Roger Spear, made a maxi single for Liberty, which consisted of send-ups of popular songs such as *Release Me* and *Sugar Sugar*. During the riotous session, Roger was aided and abetted by Andy (Thunderclap) Newman, who brought along a truckload of gadgets. These included Queen Mary type hooters and a device for producing budgerigar noise (a budgerigar?). Also used on the session was a contra bass saxophone 2m long and weighing over 27 kg. I am told there are only five of these instruments in the world and that this is the only one in England. Other work at Majestic has included various pop sessions for producer Nat Kitner and musical director Gerry Shury. Studio owner Mike Morton has just finished a second LP with his group, the Mike Morton Congregation. One of Mike's albums is entitled *Non Stop Top Twenty*, and consists of cover versions of current hits. The other is a rock and roll LP with dubbed applause to simulate a live performance. These albums will be released shortly by EMI on the Plexium label.

At **De Lane Lea's** Dean Street Studios, the New World have been in for sessions with engineer Dave Stock and producer Mike Hurst. Dave also engineered sessions for Ashton Gardner and Dyke, Curtis Muldoon, and Buddy Bohn. Ian Kinnett produced another of Dave Stock's sessions, this one featuring Doris Troy.

At the Kingsway branch, Mike Blakeley produced a Tremelos single. This was engineered by Louie Austin who also did Peter Noone's new single *Pretty Thing*. Composer John Lord has been in to mix his *Gemini Suite* album which featured the London Philharmonic Orchestra conducted by Malcolm Arnold. Martin Birch was the engineer and, along with Louie Austin, was also responsible for a new Deep Purple album. Stackridge have been recording an album with Fritz Fryer and also made a single entitled *Dora the Female Explorer*. Derek Lawrence produced a Jodo album and Richard Kerr has been in for the Screen Gems production company.

**Sound Developments**, Roger Sinclair's new studio in NW1, has been occupied with Latin American sessions produced by Norman Newall. Besides being available for recording, Sound Developments also make tape-slide presentations for conferences and demonstrations. One such production shows the operation of their Osterley-based United Biscuits Network, mentioned last month in this column. The factory programme for Osterley is sent via a Post Office line to Roger's studio so anyone considering a similar set up in their own factory can go along and listen in.

At **Command Studios** in Piccadilly, Norrie Paramor has completed five albums in about as many weeks. The Regimental Band of the Irish Guards have been along with a platoon of soldiers drilling in Studio One, and a quadraphonic recording was produced for the US market by Command's technical director, John Mosely. This studio has been very heavily booked and the varied work has made it necessary to change the set-up very quickly between sessions. One morning, Ruggerio Ricci recorded unaccompanied Shostakovich, which was followed by a light orchestral recording in the afternoon. Then came a heavy group in the evening and through the night, followed by Mendelssohn Trios at 10 a.m., and string section overdubbing at 2 p.m. The tape of the Polydor Live Taste album, currently in the charts, was recorded on location at Montreaux by a Swiss radio engineer, then flown to London by the group's manager Eddie Kennedy and taken to Command.

**Advision,** as usual have had a fair share of pop performers at their studios this month, among them Shirley Bassey, Petula Clarke, T. Rex and Sacha Distel.

At **Wessex,** Vic Flick recorded a few titles with a single in mind, the session being co-produced by himself and Tommy Sanderson for Chapter One Records. Another Chapter One artist, Phillip Lea, has just finished an LP of classical flamenco style guitar, produced with the aid of Mike Thompson. For the same company wrestler Jackie Pallo recorded his first single. Robin Thompson was engineering and Les Reed producing. Studio manager Adrian Ibbertson says that this number, *Everyone Should Have What I've Got*, could be a hit as it is a very catchy composition. It contains various wrestling sound effects, and was fun to record because, as Adrian put it, 'Jackie is a bit of a character with a good sense of humour—it rather surprised me'. Tony Macauley has been in doing singles and LP material for the Fantastics and also for Sylvia McNeil. The Gerry Monroe single, *It's a Sin to Tell a Lie*, which is now in the top twenty, was engineered by Mike Thompson for Chapter One. Johnny Johnson and the Bandwagon have been doing a dozen religious albums for the American market.

The Flirtations have been in with producer Don Hunter to record a single, and the Westminster Symphony Orchestra have also recorded at the studio. Wessex now have a Yamaha organ in the studio. This is the latest £1,300 model with the advantage of being able to provide a number of weird effects such as whistling winds, steam trains, bass drum beats, snare drums, and flute and violin effects. These are all electronically produced and the organ is available for customers to hire.

At Gary Levy's **Mayfair Studios,** George Watkins produced an album for Avenue Recordings featuring Kenneth Connor. Engineer was John Hudson, and the line up included harpsichord, flute, and acoustic guitar. With engineer Dave Maynerd, Zack Lawrence produced Stack for Starlite Artists, and Pete Brown and Piblockto laid down more tracks for a film score.

Alan Bowley, studio manager at **Sound Incorporated Systems** studio in Northampton, reports that they are once again operational, after having been closed for a few weeks while the studio was being modified. Up to 10 musicians can be accommodated in this studio, which is used mainly for demo work, and the recording charges are £5 per hour for stereo. and £4 for mono. Reduction charges are £3 and £2 respectively.

From the States comes news that **Sumet Sound Studios,** started over seven years ago in an old warehouse in Dallas, Texas, have now moved to new premises in Twin Hills Avenue. They claim to have the most up to date recording facilities in the Southwest, and are proud of their 16 track Ampex recorder, the first in the area. Sumet have three studios, the largest measuring 15 x 19m, with a sloping ceiling which reaches 8m at the higher end. The next measures 6 x 9m and also has a sloping ceiling, the maximum height in this case being 5m. The third studio is smaller and used mainly for narration. Each studio has its own control room and the facilities include four natural echo chambers. Besides offering recording facilities, the new complex has offices for people in associated businesses, including song and jingle writers and producers, film producers, booking agents, music publishers, advertising men, concert managers and producers, and film animators. This means that Sumet can offer their clients a fully comprehensive service. Anyone wanting more information can call in to 7027 Twin Hills Avenue, where coffee and a guided tour may be had for the asking.

The **Jack Clement Studios** in Nashville, Tennessee, have been very busy with Tony Moon producing several numbers for Kavel Productions. These featured the Lynn Sisters, Heather, Southern Mother and Bill Davidson. Ray Frushay and Joe Stamply have both been in for Dot Records, and producer Michael Friedman recorded Jesse Frederick for Bearsville Records. Ray Stevens has just finished a self-produced album for Barnaby Records.

# Profile

## PETER BASTIN DESCRIBES THE PRODUCTION OF A 10-MINUTE DOCUMENTARY

THE Man from the Theatre was a nice chap. He smelled faintly of a decent after-shave and wore a director's suit. His hair didn't cascade over his shoulders like brown ale out of a bottle and he didn't wear a pink shirt and a pink tie. He wanted something, that was clear. And that was a fact.

Actually, he said, the BBC want a little thing on our theatre company. A profile, he thought they called it. A sort of mini documentary; about ten minutes. Ten minutes in which to cram the history of the theatre, interviews with actors, technicians, producers, extracts and the rest? Ten minutes, he said. We made some notes. A lot of notes, all about how plays hatch from the written word to the final polished production. All about the backstage boys, the committees, rehearsals and hard cash. I learned a lot about a theatre company in those few minutes.

The notes slowly transformed themselves into a rough working script which worked its way via a quick description of the theatre to an extract from the current play in rehearsal. I lined up (on paper) those people I wanted to talk on the tape—the secretary, an actor, actress, designer, production manager, and a producer knocking hell out of his sweating cast. I drafted a couple of questions for each of them and sent them to the Man from the Theatre, asking him to work on the answers, keep them brief and stand by for recording. There were no questions about the questions, which helped. Came the day of the recordings. We met at the actors' dawn of 10 a.m. At least, two of us did. The other five were late but not very late. We sat in the modern luxurious lounge bar of the theatre and idly watched bearded artists and cleaners shuffle about their business. There was a chap counting empty bottles and two well-fed ladies arguing about a piece of paper. It was very cold.

In time, everyone who was supposed to be there was. I explained, in my simple fashion, what it was all about and how we would proceed. I was a little astonished to find that half of them had no idea at all what it was all about. So I explained it in theatrical terms and told them that the whole thing would depend very much upon their prepared answers to my interview questions. What questions, what answers? So off we went again with the explanations. In time, they got the idea.

We then had a dry run, all sitting round in a circle. This went fairly well, apart from the two lady members of the circle. One was a producer and it took me half an hour to get her thinking on the right lines. All I wanted to know were her duties and responsibilities as a producer, and how she went about mounting a production? She talked about everything except these two points and, in the end, the rest of the gang had to help her to write the answers down on the back of an envelope, which she later lost. The other lady was a designer, young and verbose but frightfully nervous. She said far too much and bumbled every sixth word.

We retired to a dressing-room for the recording. I was using a battery portable machine with a good dynamic microphone and everything seemed to be in order. I explained that I would sit still and each, in turn, would come and sit next to me for their interview. I realised later that it would have been very much better to have used a stand-mounted microphone; poor relative levels and cable clonk sabotaged several of the lead-in questions.

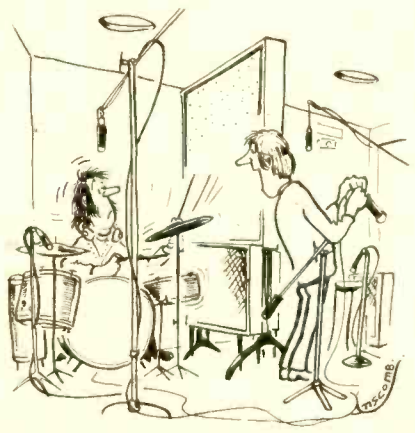
We started. The first question was answered excellently, although the first word of the reply came out overloud, due no doubt to a minor nervous reaction by the interviewee. The second hero to be interviewed was our dear lady producer. This was disastrous and I lost count of the number of takes we had before we got it right; the two-second pause I had requested was completely forgotten and in a number of cases we had to repeat the interview because the interviewee started talking while the microphone was in transit, resulting in an up-fade start to the reply. Voice projection, very often a problem when interviewing undertakers, caused no trouble. All those interviewed were, or had been, actors or actresses, and they spoke up splendidly. The young lady designer was nervous and tripped over herself until, after several takes, she became familiar enough with her material to answer spontaneously. When everyone had spoken their piece, I played the tape back. We altered one or two interviews and everyone professed themselves satisfied. Unfortunately, a number of my questions were pretty duff, due to unforeseen discrepancies in level. Interviewing requires a uniform voice level but, when one interviews actors and actresses, it is difficult to predict just how loud the interviewee's voice will be. The production manager, for example, had a very low, soft voice, and his particular track was backed by a very unpleasant hiss.

I returned to my small studio and transferred the whole tape to another machine. Most of the interviews were too long and severe surgery was necessary to reduce their length and to remove nasty pauses, glurks, ers and sniffs. The interviews were reduced to specific time limits and bad questions re-recorded. The interviews were spliced together with about two seconds between each—just enough time to avoid the tape becoming one long gabble. With only 10 minutes at my disposal and a lot of material to get across, timing was extremely critical.

I wanted an extract from a production or rehearsal as the penultimate item on the tape and found that I had just about two minutes to spare, allowing for main introduction (already recorded) and wind-up. The rehearsal was in a pavilion on a racecourse. The pavilion was smack in the centre of the course and it was a pitch black night. But I did get there. The acoustics were as sympathetic as the local baths. I asked the producer (not the lady this time) to bully people a bit and get stroppy. Right, he said, and off we went. Rather funny really, with me dodging round following the actors, sticking a microphone under their noses. The producer was a very gentlemanly sort of chap and his bullying didn't really come off as such. Nevertheless, it was all right in that it demonstrated what he was supposed to be doing. This tape joined the rest of the glued-up master. The main introduction, with guitar music, was spliced on and the wind-up was recorded and stuck on the end of the tape. I timed it. Twelve minutes. Razor blade and out with two minutes.

The tape sounded rather dead in parts and there were interviews with a little too much background hiss. So, on the second track of the master, I added background. Some bar-room murmur, some music. In the two-second pauses, I lead in with music, all related to the introductory and wind-up music.

It was really quite an enjoyable experience. Theatrical folk are easy to get on with because they understand what you are trying to do and, in general, they are lucid in speech and quick to grasp a point. What does surprise me is the fact that all my characters admitted to being nervous in front of a microphone. As they explained, they can perform to a theatre full of people, but a disembodied microphone puts them right off their stroke. Give them their head; keep on repeating the interview, and their training and experience will eventually create its own environment and off they go. But one very important tip. Always get the coffee laid on before you start the real work of recording. Ours turned up in tin pots just before we all broke up for lunch. Very depressing.



'Your lot have gone'

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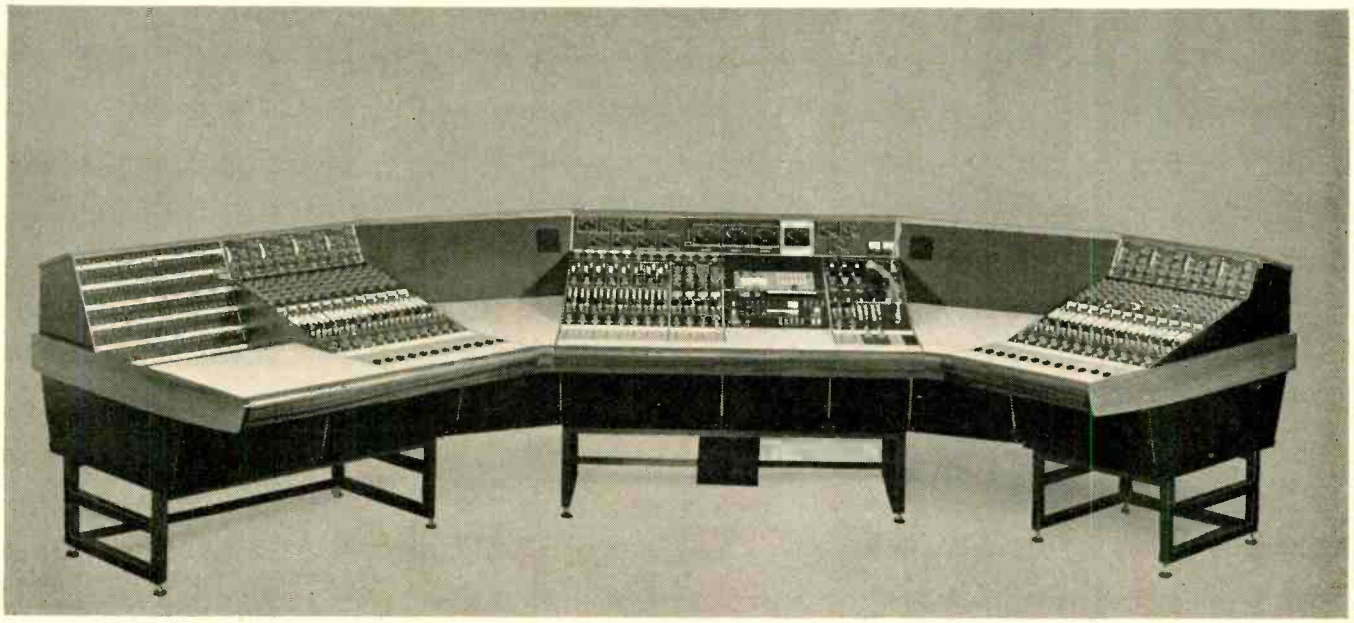

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# RECORDING STUDIO TECHNIQUES

## PART 19—TEST EQUIPMENT *by Angus McKenzie*

MANY studios today are having to spend more and more time setting up and servicing increasingly complex equipment. In addition to general purpose multimeters such as the Avo *Model 9*, one ideally requires a good quality double-beam scope, an audio oscillator with not more than 0.1 per cent distortion at audio frequencies, an AC millivolt meter capable of reading down to –80 dBm (such as those made by Levell), a wow and flutter meter (I prefer the kind working to the DIN peak-weighted spec), a resistance, capacitance and inductance measuring set, and finally, most important of all, a well trained pair of ears.

Where time is at a premium, I would strongly recommend the B & K *2112* spectrometer, or an equivalent, for reasons I will explain later. An accurate frequency counter capable of measuring up to 250 kHz or so is useful, as is a wave analyser.

For testing microphone circuits, a transistor battery powered oscillator is essential since mains oscillators can contribute hum. Since the output impedance of many oscillators is about 600 ohms, this must be padded down to a source impedance equivalent to that of the microphones normally used, usually about 200 ohms. A simple way of matching is to use a microphone transformer stepping down instead of up, which therefore provides a very low source impedance. A series resistor is then connected in the secondary to give the required source impedance. Alternatively, by using an H resistive pad, an unbalanced oscillator can approximate a balanced output. The parallel resistor must be of significantly lower value than any of the others to provide a constant voltage at the output at all frequencies. The voltage should only change if the input impedance of the microphone preamplifier changes with frequency. Whereas some oscillators are calibrated for an assumed high load impedance, others need to be terminated by precisely 600 ohms for the output voltage to correspond to that shown on the instrument. An example of the latter is the latest Levell oscillator which gives approximately 6 dB more output into an open circuit than that shown on the instrument meter, calibrated for 600 ohms loading. In view of this, I recommend a battery transistor millivoltmeter which actually reads the voltage present on the connections to the microphone lines. An input clipping point of –20 dBm can be considered satisfactory. Any levels higher than this resulting from close miking on pop sessions can be accommodated by attenuator pads before the preamp. Don't forget that a 600 ohm source impedance oscillator will drop approximately 0.5 dB when connected to a bridging impedance of 10 K. Various points on the mixing desk should be progressively checked from the source to ascertain that the second harmonic distortion is below 0.1 per cent, even as high as a decibel or two below clipping points. One well known design of microphone preamplifier recently examined still gave 0.5 per cent distortion at 6 dB below clipping point. This will usually be due to incorrect transistor biasing and a 10 to 20 per cent change of bias resistor can virtually remove even harmonic distortion.

A spectrometer has the provision of octave and third-octave filters which allows the engineer to measure a waveform a portion at a time and usually incorporates weighting networks. A spectrometer has numerous uses and I will outline a few that will show how they can speed up service work. Since a good spectrometer has a rejection of at least 50 dB one octave away from the centre frequency, it can be used to determine quickly the hum level on a piece of equipment and the individual proportions of hum at 50, 100 and 150 Hz. Quite often, a high pitched hum can measure less than a lower pitched one but will sound louder. Measuring which third octave the main readings are in, one can ascertain whether the hum is due to a fault in the power supply (usually causing a 100 Hz hum) or mains inductance (usually 50 Hz from mains wiring or 50 and 150 Hz from mains transformers, 150 Hz being present particularly when the transformer is being worked near to the saturation point of the core in which case other odd harmonics may also be noted). Adjustments can be made while watching the individual components of hum and it is also useful to connect the output of the spectrometer to a monitoring circuit so that one can hear any changes.

### Tape evaluation

For a quick evaluation of tape, the spectrometer can measure the point of three per cent third-harmonic distortion generated by the tape since such distortion is at least 20 dB higher than the breakthrough fundamental in the third harmonic band segment. Even if wow and flutter would normally affect some wave analysers for this measurement, they would have no effect on a third-octave filter method. The same instrument can also be used for examining the noise in tape playback amplifiers and will show immediately if too much equalisation is being used at very high frequencies in order to get a flat response. Engineers will often screw up replay equalisers as a head is wearing, not realising that the replay hiss level at very high frequencies will be seriously deteriorating.

Since often two or more recorders may be in use for a session, I find a frequency counter useful to display the frequency of the 1 kHz peak level to be found at the beginning of most test tapes. I recently measured a BASF 38 cm/s test tape and found the frequency on a very reliable machine to be extremely good; I understand that this accuracy is guaranteed to $\pm 0.2$ per cent. Good machines will replay the test tape producing a frequency somewhere between 995 Hz and 1.005 kHz and frequently considerably better than this, although I have known professional machines to be as far out as two per cent using this technique. The long-term speed stability can also be noted, and this can be surprisingly inaccurate on battery powered portable machines.

A frequency counter is also useful in lining up the frequency of a bias oscillator. It is then possible to construct bias traps using an audio oscillator set accurately to the bias frequency to give the maximum attenuation at the required frequency without having the bias oscillator in operation. I have often found bias traps incapable of resonating, without modification, at the bias frequency in use. The frequency counter will immediately show accurately the exact resonant frequency. The value of capacitance necessary to make the circuit resonant can be easily determined.

In looking for hum on an amplifier, it may be better to measure ripple voltages on HT lines than to place various values of electrolytic capacitor across these lines to attempt to lower 100 Hz hum. Well-stabilised power supplies should give HT voltages better than 0.01 per cent of nominal DC although this figure is often considerably improved upon, particularly for earlier stages. If the ripple is considerably worse than this, it is possible that a fault is present. A faulty zener diode can cause high ripple rather than smoothing, if not drawing enough current to stabilise. One recently tested piece of equipment with such a design fault had a 20 dB improvement in ripple voltage when the applied mains voltage was increased by only five per cent. A variac can be extremely useful here.

Finally, a personal experience that may interest some readers. I have received a number of comments that low frequency mush has been audible on some types of tape, particularly when recorded on TRD and Revox machines. Normal head demagnetisation did not improve matters. At the time I was stumped, but Barry Lambden of Revox gave the answer which I found rather surprising. He recommended that a bulk eraser such as the Leeraser be switched on upside down and the entire tape transport demagnetised with its very strong AC field. I actually used an old EMI bulk eraser for the purpose and this, to my astonishment, completely removed all signs of the trouble. It appeared that the gap at the *back* of the record head cannot have been completely demagnetised by the normal procedure.

# ABBEY ROAD

## Keith Wicks visits EMI studios

IN 1930, His Masters Voice, known then as the Gramophone Company, merged with the British-owned Columbia Gramophone Company to form Electric and Musical Industries. As a result of this merger, a change was made to the Abbey Road Studios which had only just been completed. Originally they intended to use Western Electric equipment but this was taken out and replaced by the Columbia Moving Coil system which had been devised by Blumlein.

Today the premises contain three studios and control rooms, four editing rooms, six disc cutting channels, three tape-to-tape rooms, a disc-to-tape room, three quality control rooms, two remix rooms, a tape store, offices, canteen, and various test rooms and laboratories. The staff total 85 and, as studio manager Gus Cook understated, 'It is a rather larger operation than most'.

To me, the place is rather reminiscent of an old BBC building, with long corridors and numerous rooms, many of them containing rather ancient equipment, such as the famous *BTR2* mono recorder. Anyone who has not operated one of these machines might be put off by their size but the fact is that a lot of people (including myself) consider that, for many purposes, the *BTR2* was the best recorder ever made. The BBC have been unable to find a comparable modern machine and have transistorised many of their own *BTR2*s.

EMI's equally bulky stereo *BTR3*s were built especially for their own studios and 25 of them were brought into service about nine years ago. These are now gradually being replaced by Studer *A80* two track machines. Modernisation and refurbishing is a slow continuous process at Abbey Road because of the size of the place. For example, the newly equipped Control Room Three has the latest EMI *Mk 4* console and a Studer 16 track recorder, the first one in this country. Gus Cook's assistant, Ken Townsend, was my guide for the day and he explained the rather unusual desk design:

KT: Basically it's a 44 input 16 track desk although in the future the number of tracks could be increased quite simply to a total of 40. Modular construction is used but each unit is larger than you find on most other desks, and contains two individual channels complete with faders.

KW: I notice that you use quadrant faders instead of the more usual slide faders. Any particular reason?

KT: Lots of people like these. The stud quadrant faders are more expensive than the slide ones, but we've made some of the quadrants continuously variable by fitting carbon tracks produced by our research department. One of the reasons we had the stud pots was for consistency. We do many jobs which we want to repeat later with the same settings. On stud pots you can go back to the same point every time, but you can run into trouble when fading and the individual steps are sometimes noticeable, particularly on bass guitar. We may eventually change right over to carbon tracks as they are much better than they used to be.

KW: I believe your mixers are also different to conventional units in that the modules all have their own built-in power supply.

KT: Each of the modules, or cassettes as we have always called them, contains a power supply which requires an input of 50V AC. The advantage of these large cassettes is that, if there is a fault on any channel, you can change the cassette and be sure of solving the problem. The reason we use twin casettes is that, when we started this system, people were thinking of stereo in terms of two inputs, and we often used to use stereo pairs.

KW: What are the functions of the various cassettes used in this desk?

KT: On the extreme outside of the console are the two track monitor cassettes for monitoring the 16 tracks. Each of the tracks has a level control, and each track can be pan-potted to any stereo position you like. Echo can be sent from, and returned to, any tracks purely for monitoring and you can also send to either of the two cue circuits from these cassettes. Then there is an echo cassette on either side of the mixer. The one on the left sends and returns echo one and two, and the one on the right sends and returns echo three and four. Besides six stereo plates, we also have three echo chambers available, so the echo cassettes are designed to handle either high level or microphone level. This means that they can be used as additional microphone channels if required. Extensive tone controls are provided and there are built-in limiter/compressors.

Next come the microphone cassettes, six on the left, six on the right. That's 24 channels, and provision is made inside these cassettes for phantom powering capacitor microphones. On each channel, coarse and fine attenuators are provided for setting the level. The tone controls consist of bass and treble controls giving $\pm 10$ dB and a multifrequency presence filter. The input can be selected to microphone, to a test/line-up oscillator, or to a re-record position. This allows you to re-record the output of a tape track. There is also a built-in limiter/compressor, and cue and echo send controls. The output selector switch allows each channel to be routed to any of 16 tracks, either directly, which is a secondary function, or via one of the central main cassettes, which is a primary function. Altogether there are 16 positions for primary functions, 16 for secondary, and also four 'gimmick' positions. These route the channel to inject points enabling you to connect a gimmick box, or perhaps a special limiter, or other external circuitry.

Although it's basically a 24 input desk, if the microphone channels are not selected to the main cassettes, the latter can be used for 16 additional microphone inputs. These main cassettes, which are almost identical to the microphone cassettes, have an input switch. This enables you to select them directly to microphones or to the sync or line outputs of the tape machine.

On the left of this central bank of main cassettes is the control room monitor cassette. This permits selection of the tape line in or line out. Here at Abbey Road we usually monitor on line out unless, for instance, we want to bring in a signal at a precise moment. A lot of studios listen on line in but that way you never know whether you have a satisfactory recording. Also on the control room monitor cassette is the main level control. You can control the overall level to the two loudspeakers and also select the output to left, right, parallel, or stereo. You can also reverse one side to check for out of phase signals.

On the right of the main group is the studio playback cassette. This feeds all the studio facilities such as cue circuits, playback, and signalling. Pushing a button sounds a buzzer which warns people that we're going to start, and we put a red light on when we're actually recording. The talkback microphone on the console is a noise cancellation *D58*, which plugs into the back of this cassette. We can announce on the tracks by pressing the multitrack announce button and we can also put tone on the tracks for lining up.

KW: Do you ever use an LF tone to mark the end of a track? Some people do this so that when you spool through, you hear a bleep, and get a rough idea of where you are.

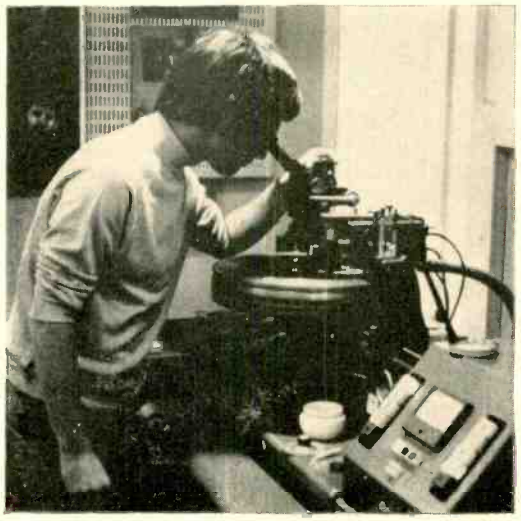
KT: We *have* done this, but it's not our normal practice. Some people put 30 Hz on. We have fitted position indicating clocks to all our machines, and these allow us to spool back to any particular spot very accurately.

KW: You have quite a lot of meters on this desk. What do they all do?

KT: We have a 'noise meter' on every channel so that you can see what the input level is. We can also use it to check the noise figure of the channel; when a limiter/compressor is in circuit, it shows the degree of compression. There is also a correlator which checks the phase between the two channels of

**Left:** Outside of premises.

**Lower Left:** Peter Vince at Control Room Three mixer.



**Upper right:** Peter Brown at Control Room Two Mixer.

**Immediate right:** Chris Blair cutting a single on the latest Neumann cutter with *SX68* head.

each cassette. A centre zero meter indicates *in phase* on one side, and *out of phase* on the other. Finally, there are the 16 main VU meters.

KW: What are all the controls on the upper part of the desk?

KT: In the middle are the facilities for checking signals at various points, and for testing the meters. Either side are the sync mixing panels, eight on the left and eight on the right. These enable you to do a sync mix for the artists in the studio. For example you could send a singer all the previously recorded tracks from a tape machine, plus his own voice. There are two groups of eight controls on each side, one for cue one, and one for cue two.

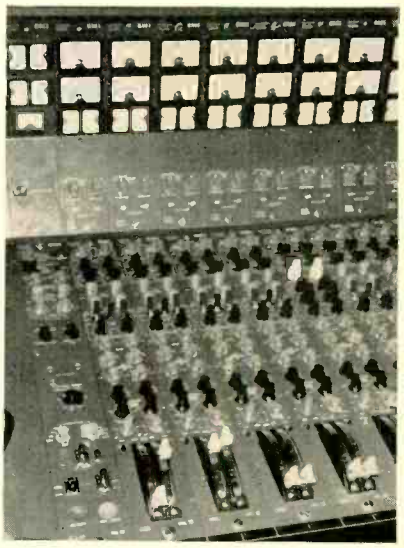
After watching engineer Peter Vince operate the desk while in the 12 x 10m studio, ex-Shadows Bruce Welch and Brian Bennett helped put down some backing tracks for Olivier Newton John, I continued my tour of the building. One of the tape-to-tape rooms, lined with *BTR*s, is used mainly for producing pseudo stereo records from mono meters. But that's all I was told, the actual techniques used being one of EMI's secrets. On the other hand there's no secret about their method of checking a disc cutting stylus. Every day a test cutting is made and some molten wax is dropped on the grooves. When the wax has hardened, it is removed from the disc and observed under the microscope. Any imperfections in the cut are apparently very easy to detect by this method. The cutting lathes used are Neumann and include the latest model fitted with the *SX68* head. In one cutting room I saw, the master tape was being played on a *BTR2* fitted with an advance head assembly while, in another, a stereo *C37* Studer was in use.

We moved on to Studio Two. While a hot-panted Kathy Kirby danced around to the number she had just recorded, Ken Townsend gave me an outline of the facilities.

KT: The studio measures 18 x 11m and holds up to 50 musicians. The control room has an EMI *Mk 2* desk which is similar to the *Mk 4* except that it is basically a 24 input, eight output device. As in the other Abbey Road studios, a pair of J. B. Lansing *S8* are used for monitoring, fed from Quad *50E* amplifiers. I know some studios use four speakers but we use two because we prefer to monitor the sound in the same way as the final customers. For

(*continued overleaf*)


Session musicians in Studio Three



Close-up of Control Room Three mixer

studio talkback, the producer can use either the desk-mounted microphone or a hand microphone. This allows him to move over to the viewing window so that he can look down into the studio and still be able to speak to the musicians.

After Studio Two, we visited a room where Margaret Norrington was editing stereo classical tapes on a *BTR3*. Having myself edited a lot of material on the similar *BTR2*, I am convinced that this kind of machine is the best available for editing.

After leaving the editing room, we passed by the echo chambers. Ken Townsend described what they looked like inside.

KT: The main thing is that no two sides are parallel. This reduces the problem of standing waves and in two of these chambers we have stood a lot of drainpipes which also help in this respect by dispersing the sound. The walls are tiled, rather like a bathroom, so that the sound is reflected and a long reverberation time obtained. The signal is fed to a loudspeaker and a pair of *KM53* omnidirectional microphones spaced about 1.5m apart pick up the reverberations. The lines from all the echo chambers and plates come up in a linking room, where they can be plugged to the studios as required.

The next stop was at one of the quality check rooms. Here, Dave Reckless was checking what EMI call 'white label' pressings.

KT: When we have cut the lacquer discs, we send them to the factory for processing. The white label pressings are the first ones that some back from the factory and, in quality control, the engineer's job is to check them against the original tape to make sure there has been no loss of quality during the disc process.

KW: When you say 'checked against the tape', presumably you mean that you run both of them simultaneously and compare the quality.

KT: Yes. A key allows you to monitor either. The levels are matched up at the beginning so the two should sound identical. If they don't, the discs are rejected and remade.

KW: About what percentage have to be rejected at this stage?

KT: Probably around 20 per cent. On the classical side, the rejection rate is higher, and for pop records it is lower. On classical music, you often have very quiet passages during which you can hear any slight noise on the disc. On a typical pop record, it is obviously not so easy to hear the imperfections.

Finally, my excellent guide showed me the recently redesigned Studio One. Measuring 28 x 17m and accommodating up to 100 musicians, this is the second largest studio in Europe (the largest being the RCA studio in Rome).

KT: When we rebuilt this studio, we increased the reverberation time from 2.2 to 3.1 seconds.

KW: Are those the times with it empty?

KT: Yes. The problem before was that, if we had a large orchestra in there, the reverberation time dropped considerably, particularly at the top end. We had a lot of acoustic material in there which tended to absorb these frequencies so we stripped it all down and set out to make the walls more reflective. Peter Dix, one of our research engineers at Hayes, did a lot of the calculations for the new acoustics. The bottom 1.5m of the walls were unchanged but above this, up to about 3.5m, we used plywood boards with an ash veneer. Above that we used Plimberdeck covered with formica on each side. The panels were spaced a certain distance from the walls in order to absorb the lower end of the spectrum. On one wall, the panels have been placed at angles, so that they are not parallel to the opposite walls, thus reducing room resonances. Another thing we did was to increase the thickness of glass in the window between the studio and control room. It's now 19 mm one side and 16 mm the other. They are different thicknesses so that they don't both go off at the same frequency. Otherwise, the insulation would be greatly reduced at the common resonant frequency.

KW: I see this is a *Mk 2* desk as in Studio Two. Do you intend to replace this with a *Mk 4* as well?

KT: Not at the moment. Since this studio is basically for classical music, we don't often need more than an eight track desk. Even for big orchestral works, eight track is enough. Sixteen track tends to be more for pop recording.

KW: Do you invariably use Dolbys for multitrack recording?

KT: We use them on sessions when requested but haven't really found them necessary. You see, we put 4 dB more on our tapes than most people and so don't have much problem as far as noise is concerned.

KW: Are *you* happy with Dolbys?

KT: Well they are good in that you get a 10 dB better signal to noise ratio, and I don't think they have any bad effects. We've got 54 *361* Dolbys and about four of the older *A301*.

Having covered most of the activities at Abbey Road, Ken told me about EMI's outside recording activities.

KT: We record orchestral and choral works all over the country. At the moment, we're recording the Birmingham Symphony Orchestra at Birmingham University, and a Welsh choir at Port Talbot. We're going to record Ernest Broadbent at the Blackpool Tower, where we've recorded Reginald Dixon for years. In the summer, our recording locations will include Liverpool Cathedral, Kings College Cambridge, and Watford Town Hall.

KW: What equipment would you take on a typical outside recording?

KT: Similar equipment to that in Studio One. We have two 24 input eight track mixers available for outside work, one 20 input four track, and one 12 input four track. We frequently use a four track *J37* Studer on the classical jobs, although we sometimes record direct on to two track using an *A62* Studer.

The hourly charges for some of EMI's comprehensive services are as follows:

| | | |
|---|---|---|
| Studio One | Eight track | £36 |
| | Four track | £32 |
| | Two track | £28 |
| Studio Two | 16 track | £38 |
| | Eight track | £33 |
| | Four track | £28 |
| | Two track | £25 |
| Studio Three | 16 track | £35 |
| | Eight track | £30 |
| | Four track | £25 |
| | Two track | £22 |

Copying costs £20 per hour for multitrack tapes and £10 for mono or stereo. Editing is £9 per hour, and disc cutting rates (per side) range from £1.25 for a 178 mm mono acetate, to £12 for a 305 mm stereo master.

# SOUND MINUS SYNC

by Edward Tatnall Canby

THE introduction of Super-8 film and the near total automation of film transport and exposure setting have brought equipment buyers to a state of some dissatisfaction concerning the wealth of equipment now available in two major areas, sound recording and colour cine—yet never the twain shall meet. It would be desirable if these two could be brought together for the avocational user. (Avocational, you will note, includes professionals in their leisure hours as often as it does the rank amateur.)

Whereas in the professional field, sound applied to 16 mm or 35 mm film is virtually taken for granted, whether it is recorded on the spot, recorded later, or both, sound and sight together are extremely rare in Super-8.

Numerous synchronising devices have appeared in attempts to bring the two elements into a practical relationship. In America two recent systems, in fact, have been much publicised. Both the Bell & Howell *Filmosound* and the Synchronex *Sound on Film* camera (a misnomer) make use of synchronised cassette recorders in separate cabinets. In the past, the Fairchild sound system made an appeal to some users of home-type film. But none of these is cheap and all are variably clumsy in operation when used by a single individual.

And so most of us who interest ourselves in sound *and* sight simply resign ourselves to the utterly silent cinema (not counting projector noise) and the totally sightless tape recording. We shouldn't. There is much that can be done if we are curious enough to indulge in a bit of experimenting. There are large areas of useful overlap—*if* we are willing to put aside the on-the-spot synchronised recording feature and trust to cruder but potentially effective methods. Indeed, I suggest that the direct synchronised sound-and-picture camera system is actually more limited in important ways than a less precise (and less expensive) arrangement that gives each medium its own best freedom without too literal a relationship in the mechanical sense. My own experiments in this fashion with Super-8 sound are the substance of this series.

First—why do I suggest that lip-sync Super-8 sound recording is inherently limited? There are two major factors that count heavily against it, putting aside the extra expense. First, the mechanical and electronic difficulties in achieving a smooth match between the miniature Super-8 film and good sound, accurately synchronized, are considerable. (A *slightly* out-of-sync talking picture is like a *slightly* mistuned violin!) Even with the much more expensive 16 mm film, sound quality has long been notoriously poor and it is only in recent years, with lavish magnetic recording, that we have achieved really high quality sound with professional 35 mm film and its larger specialised cousins—70 mm, *Cinerama* and the rest. At best, down at the Super-8 economy level, the sound-and-sight combination is likely to be less than ideal. There are almost insuperable external problems, such as editing, which is difficult or impossible.

A microphone held by or near the cameraman—even with perfect sync and excellent sound quality—will record the average indoor or outdoor silent film scene with nothing better than a garbled hash of 'off-mike' sound, mostly unintelligible and rife with unwanted background noise. At best, one may achieve a sort of news-broadcast quality, and that only via close-up. The two media have different requirements right down the line, and most notably in the matter of distance from the subject. Where the camera is best backed off, the microphone does its best job close in.

In effect, the home sound/sight recording is limited to a single type of scene, the static 'talk' picture, with the camera at close-up or, if at a distance, disassociated from its microphone, which must always remain close to the sound-source, visibly or no. Normal action-filled pictures, the best kind for home filming, are largely impracticable. Sound at a scenic distance is impossible. In this literal synchronisation, the media are both severely inhibited, neither at its best nor easiest, and thus over-all versatility is seriously reduced. Is it worth it?

If you wish to experiment in a less literal sound/sight relationship, give up all thought of direct, on-the-scenes sound, recorded simultaneously with the film. You will *add* sound via your tape recorder, after the fact. Not literal sound but suggestive, interpretive, to reinforce the sight by every means that sound can manage, including music, meaningful noise, spoken (but non-synchronous) speech, dual sound channels and a stereo spread. Perhaps even four-way sound, surrounding the viewers. (Can you do *that* with ordinary sync?) If you are as persistent as I was, over some five years, you may reap astonishing benefits in dual-medium entertainment, and put all your equipment to its best use, each medium in its own most suitable fashion.

The principle is not new, not even new in the modest-cost home entertainment field, for we have had film striping for many years, by which sound may be added to previously exposed film. But now you are out for bigger game, on a more professional scale. Your tape recorder can reproduce far better sound quality than most film-stripe arrangements. You can put the full range of your audio system to work. More important, you have more than one channel available if you have gone stereo. *Two* channels of information, for a more versatile array of sound, And the stereo spread of both channels together, whenever you need it.

On this basis, I have completed to date the sound portion of four Super-8 film shows, ranging in length from 10 to well over 30 minutes, all with multichannel sound via stereo equipment—and all without direct synchronisation. In fact there is no physical connection whatsoever between the taped recording and the filmed pictures. There were problems but they were solved, in one way or another, most particularly via the flexible use of sound itself. Occasionally, the total impact has been that of a sort of 'happening'—no matter. Our accidents have often turned out to be better than the sound we intended. The last, and most successful, of these ventures sallied forth into ambitious territory, with the benefit of hindsight and experience. Presentation Number Four, *Henry*, still employing plain Super-8 colour film and standard stereo tape, not only added two simultaneous sets of still pictures, flashed on a huge wide screen (home made) on either side of the film, but employed two tape recorders and four simultaneous channels of sound, emanating from the four corners of the room, two speakers in front and two behind and above the audience. The effect, to put it mildly, was overwhelming, and the more so thanks to a pair of fat power amplifiers and speakers to match—all borrowed straight from the living room.

Not professional. The equipment was all consumer type. We simply took advantage of the vast discrepancy in quality between the usual sound equipment available for (portable) audio film and these state-of-the-art audio products. Even the most moderately priced audio system sounds gloriously alive in such a comparison! All you must do is to adapt

(*continued on page 345*)

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your sound material to the *degree* of sync you can actually achieve, between tape recorder and film projector, each operating independently. Hopefully, you will be able to override the projector's built-in inaccuracy via a variable speed control. That can do wonders to restore a proper relationship. You will flounder at first, as we did on our first sound film.

Let me take you back a few years. A friend of mine, wife of a busy travelling college professor, had discovered after a considerable career as an artist (while producing five children) that she had talent for photography, both still and moving. She is one of those rare women (rare in the public estimation!) who have both an aesthetic and a mechanical sense. She found she could take pictures galore while her husband was busy in the field—India, Peru, Africa, Ethiopia or at home in Massachusetts. The intricacies of photographic equipment and still picture projectors did not bother her at all, nor the chores of editing, splicing, cataloguing, continuity. At home, this lady turned out her own dramatic films, put together imaginatively from the product of her many trips as well as her films made on the home scene.

But there was a major problem—sound. There is nothing more deadly for a film audience than the naked whir and buzz of projection machinery, unaccompanied. Not even a 'live' narrator's voice is sufficient to distract the listener from its numbing effects. A sound track of some sort is virtually obligatory for a good film presentation other than the home-travelogue-and-Sunday-outing sort. It is interesting that this lady did not even investigate the possibility of *sound pictures*, directly synchronised at the taking. She understood intuitively that neither she nor her very uninhibited students could limit themselves to the techniques required by the direct medium. Instead, she turned to *applied* sound, the sound track added after the fact. The children were given a tape recorder and told to forage for themselves.

I heard the results, which were amusing. A confused, distorted melange of wobbly pop music and electronic sound, totally minus tape editing (nobody knew how), the music cut off in the middle of a note (lifting the gramophone pickup from the disc!) at approximately the right moment, the next selection starting with a squawk and a scratch (same technique). But the principle was a good one and the children thought it all very wonderful. At this point I was called in, to fabricate a better grade of added sound for the lady's own adult films. That was a different matter altogether.

Our first joint venture was a humorous home-based farce called *The Beast of Yelping Hill*, in which a mysterious giant abominable snowman (made visible by huge white footprints cut out of paper) haunted a very ordinary and respectable community of summer householders.

How to put sound to the sequence of hysterical chase scenes involving all our neighbours and their children? It was most definitely a 'home' moving picture! My immediate stipulation was that our sound *must* be via two channels and of good quality—or else. One speaker to each side of the screen. And since there was narration, scene by scene, I set up one channel for that purpose. The other, during the film itself, was for the rest of the sound, mostly music. No mixing.

To add impressiveness, set the mood, and allow audience eyes to adjust to total darkness (always a requisite for a good film show) I taped a prelude. And at the end, there was a 'postlude', closing music, suddenly in full stereo—since the narration track was by then free. It made a grand finale, while the film credits unrolled, rather shakily, including a brief picture of myself as sound man. Roars of approval. Even louder roars for the camera lady and her camera-assistant son, aged 13. The photo-sonic combination definitely pleased!

But the audience hardly knew what trials we had gone through. My stereo tape recorder had a fixed speed within reasonably narrow limits. There might be a few seconds difference in timing over ten or fifteen minutes, depending on mains voltage, room temperature, and the number of hours the equipment had been running.

Not so the film! We were incredibly lucky, even so, as I found later to my cost. Our Super-8 projector was a modest machine with no speed control. At a given temperature, in a given location, and at a particular time of day, this projector did in fact repeat the film with fairly good timing accuracy. We did all our work in one small studio, where the wiring was adequate and the voltage strong. I laid out the music, sequence by sequence, recorded it on tape as the film was projected and spliced the whole together. Then, starting at a signal, we could play the music and project the picture with a certain degree of synchroneity. Indeed, and this was almost five years ago, I remember no serious problems in that respect during the work of assembling tape and sound, though I had picked appropriate selections, for suspense, the chase, exaggerated terror or casual good humour, to fit the various successive episodes, each tailored to fit the proper length.

The matron who in the end proved to be our 'master' made frequent cryptic clue appearances in her coloured shawl, smiling benignly on the frantic proceedings; for her to take an example, I chose a sudden brief passage of Indian *raga* music. If it came a mite too soon, or began late in the midst of her picture, no harm was done; the *leitmotif* established itself very easily. The same was true of the narration, on one sound track, which could be a bit early or a few seconds late without harm to the presentation. (It was recorded on one track as the picture was projected before the narrator.) Leeway was the important factor. Anything was OK, provided *exact* timing was not necessary. I used all sorts of music, from a work by Darius Milhaud (*Le boeuf sur le toit*) to a snatch of Chopin played on the harpsichord. Smooth editing made the joints acceptable and the vital timing leeway meant that variations in projection speed from one showing to the next could be accommodated without wrecking the continuity of the whole. . . . Or so we thought.

#### Sizeable playroom

The Big Show was to be given before an audience in a sizeable playroom situated in a country barn. A day before, we moved from our studio to the Final Location for dress rehearsals. Horrors! Within minutes, film and projector were hopelessly out of synchronisation. The narration came at the wrong time, creating chaos, the music was completely crazy. We were a half minute apart in no time at all! Take warning. The playroom's electric mains came from another line which ran 70 m underground after leaving the transformer. At our already low US voltage (one half the British norm) this was fatal. The voltage reading in the playroom, it turned out, was permanently down. Moreover, at the early evening hour—the same as for the coming performance—a heavy local household use of electricity had pulled it even farther downward to about 102 V!

The tape recorder played on imperturbably at its normal speed, voltage loss or no. Tape recorders, even the cheaper models, are built with just this sort of variation in mind, Film projector manufacturers, alas, have very much lower standards, perhaps with some reason; for the eye in this respect is less sensitive than the ear. It's a matter of taste, they would say. And so, like the early 78 acoustic records—which were recorded at anywhere from 75 to 85 rpm and reproduced at wildly differing speeds on the old mechanical gramophones—most present day projectors run at whatever speed seems pleasing to the individual operator. Variations in line voltage are consequently not too important. The strict standard speed, in fact, is seldom reliably available, as we discovered.

The upshot was that, after frantic attempts to edit our tape to match the sudden change in film speed, we borrowed a large variac, or voltage regulator, one of those variable affairs with a large circular handle on top like something out of a power station. With this formidable machine installed ahead of our fractious projector and a cautious hand on it to advance or retard, we were able to put on our first sound-and-film show with the aforementioned success, and not a soul knew our problems. Indeed, we did it three times in a row, just to prove our point. But we decided that for the next film we would have a projector with a speed control—definitely. (We did—and ran into even worse problems.)

A year later, my friend came up with a very different film, offering a whole new set of aesthetic and technical problems for the non-synched added sound. That one ran for more than a half hour, was *very* serious, and featured long, quiet sequences of nature photography in which a mood of oriental mystery was to be induced solely by the musical accompaniment. That was a challenge, and in solving it I found myself turning to electronic music, which somehow seems to blend more easily into the pictorial material than "concert" music. Probably a matter of one contemporary medium complementing another. This film's demands led me into more elaborate mixing techniques for my two stereo channels. Instead of feeding the narrator into one channel and the music into the other I superimposed the speaking voice in mono on a spread-out background of music. (The voice was fed equally and in phase into both channels.) Though the loudspeakers were to each side, the voice appeared to come straight from the screen—no hole in the middle! That procedure worked so well that it suggested a more ambitious technique for our third film, a documentary on life in Ethiopia which for the first time had no narration at all; the whole story was in the pictures—and the sound.

by Peter Levesley*

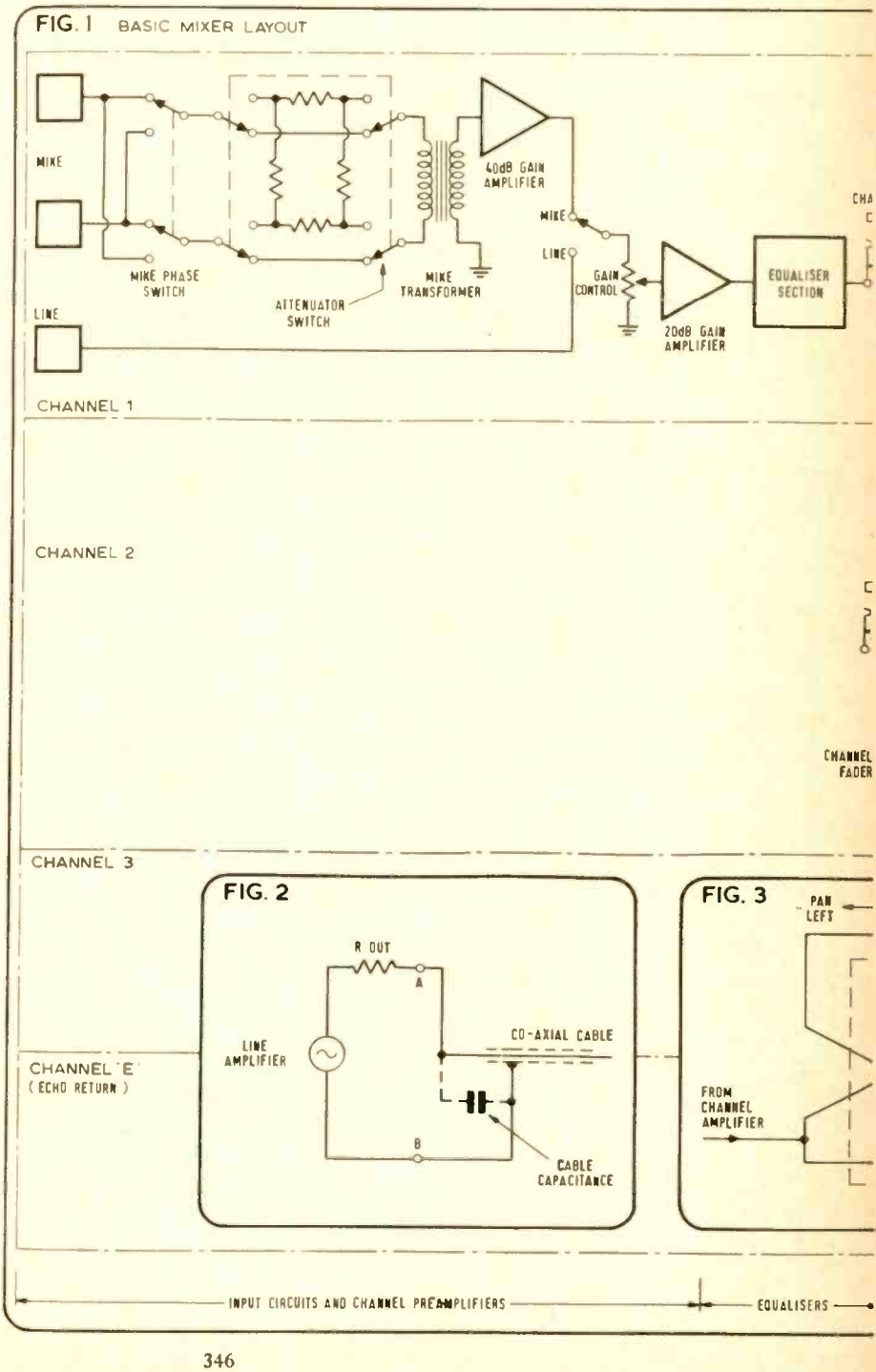
# design studio part one: sys

THE way I have decided to present this material is to consider a specimen mixer incorporating the main features commonly found in studio equipment. This will enable us to get an overall picture of what each part does and its relationship to the rest of the system. This basic scheme is a real system and could be used exactly as it stands. Other people may wish to add to it or miss off features not required.

I originally considered the 'plug-in' type module to be the best approach. It has become clear that this is not so since the sockets and edge connectors give more trouble than the components. For all our professional systems, we now wire permanently as much as possible. The modules under discussion will therefore be the 'wire-in' type. Where amplifiers must be easily replaced, we recommend that the system be split into sub-systems which can largely be permanently wired. Where required, more reliable connectors may be used to couple the sub-systems together. One such sub-system would possibly be a microphone amplifier chain from the attenuator switch right through to the output and main fader. It is wise to have all controls relating to one premixing channel in a clearly defined pattern so that the hand instinctively goes to the right control, even in the heat of a recording session. Colour coding of the knobs can be most helpful and this is another way that balance engineers ease their burdens.

In the first part of the series, let us consider in some detail the job that mixers have to do and how the various functions are fulfilled. The purpose of a mixer is to accept a variety of input signals and to group them together to form one or more composite outputs. If you say it quickly, it doesn't sound very much, but what does it mean in practice? We may be asked by a choral society to record, in stereo, their latest production. This may require three or four microphones, each perhaps of a different make. We only have two tracks on the tape recorder and some means must be used to produce suitable signals for the tape recorder using the outputs of four microphones. This is the job of a mixer. Each microphone signal must be amplified and equalised. It must then be combined with its neighbours' signals to produce the twin signals required by the tape recorder. **Fig. 1** shows the block layout of a system that could be used to do the job outlined above. Other functions have been added and the purpose of these will be discussed later. There are three main sections to our mixer. In the middle are the mixer amplifiers and, to their left, the premixing functions. On the right of the drawing we find all the amplifiers concerned with passing the signals on to following equipment. I think it will be best if we think first of all about the needs of the following equipment and then work back through the system, seeing as we go how suitable signals are formed.

I have suggested that the following equipment might be a tape recorder but this is not inevitable. In other applications, we might be feeding amplifiers for sound effects in a theatrical production. The cables connecting the mixer to the following equipment could be some 3m if the recorder was nearby, or several hundred metres if the output was being fed halfway round a theatre. This means that we must take care, in designing the output amplifiers, to consider the most unfavourable circumstances in which they may be called upon to operate. If they perform well there, then they will be working well within their capability when demands are less severe. In order to minimise the effect of the parallel capacitance




* *Walsall Timing Developments*

# ing a mixer em planning

of long cables, it is necessary to make the output impedance of the line amplifiers, as they are known, very low.

In fig. 2 we see a line amplifier represented by an AC generator in series with a resistor. The resistor is labelled $R_{out}$ and is called the output resistance of the amplifier. The total capacitance of the cable is represented by the dotted capacitor. If we disconnect the cable and measure the output between A and B with an AC voltmeter we shall find, when varying the frequency of the generator, that the reading on the meter is substantially constant. When the cable is connected, it will be observed that, as the generator frequency is increased, the voltmeter reading falls because the reactance of the capacitance in parallel with the voltmeter reduces as frequency increases. A point will be reached where the reading is 3 dB below the LF reading. At this point, the reactance of the cable capacitance is equal to the output resistance of the line amplifier. Let us consider a practical example. The type of screened cable commonly used for microphones has a capacitance of about 100 pF per metre. Let us suppose that we have a cable 100 m long. This will have a capacitance of 10 kpF. Let us further suppose that we have an amplifier with an output resistance of 10 K and we wish to know at what frequency the output will have fallen by 3 dB. (This figure of 3 dB is customarily taken as the frequency limit of system though other limits are sometimes specified.) Now we must involve ourselves in some simple mathematics. The reactance of a capacitor is given by

$$Xc = \frac{1}{2\pi f c}$$

where $Xc$ = capacitive reactance in ohms
$f$ = frequency in Hz
$c$ = capacitance in farads

When output has fallen by 3 dB, we have said that the capacitive reactance is equal to the output resistance or

$$Xc = R_{out}$$

$$R_{out} = \frac{1}{2\pi f c}$$

$$\text{transposing } f = \frac{1}{2\pi C R_{out}}$$

$$\text{transposing } f = \frac{1}{2\pi C R_{out}}$$

$$\text{Substituting our known values} = \frac{1}{2\pi 10^8 \times 1)}$$

$$= \frac{10^4}{2\pi}$$

$$= 1.6 \text{ kHz}$$

As you can see, this would give us a very poor result, worse even than is considered necessary for telephone transmission. This is why it is customary to use amplifiers with output impedances of 600 ohms or less. If we use 600 ohms output resistance instead of 10K, we find our –3 dB point will be 26.7 kHz which is quite acceptable. (It should be clear why microphones are made with low output impedance since they are more likely to have to work into long, highly capacitive lines.)

The second point that must be considered is the voltage output capability of the amplifier.

(*continued on page 349*)

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# designing a studio mixer

## part one: system planning

Since we do not know exactly what the drive requirements of the following equipment will be, we must make the amplifier tolerant of varying loads and able to deliver a satisfactory voltage to them. It is very unusual to come across a tape recorder or amplifier which requires more than 1V rms to drive it, so this is the normal level around which to work. More will be said about this later.

Referring now to the specimen mixer diagram, let us consider the outputs provided and see how they are derived.

The principal outputs, those going on to the following equipment, are the group A and group B outputs. It is interesting to think for a moment why we do not label them as left and right. This might be thought the best thing to do as they will presumably finish up as the left and right hand channels fed to loudspeakers. In practice, however, a twin channel recorder is not always used for normal stereo recording. This is even more the case as the number of tracks multiplies. Recorders are now being made with 24 input channels and there is talk of 32 before long. In the case of a twin track recorder, a group of musicians may record on one track while a vocalist uses the other track. This would be done to allow the recording engineer to achieve a satisfactory balance between the two after the musicians have departed. In this case, it would be quite wrong to speak of left and right. These labels may be added temporarily if the occasion requires it.

Since the recorder may be some distance away from the mixing desk, so far in fact that the recording engineer cannot easily see the recording level indicators, it is necessary to provide meters on the mixing desk which read the level being sent to the recorder. It will normally be pre-arranged that the peak level indicated on the desk will coincide with the peak recording level on the tape machine.

When making a recording, the engineer will normally be acoustically isolated from the performers and it is necessary for him to be able to hear the results of his mixing. Associated with each group output we have therefore provided a monitor output. Notice that this is taken off before the group fader so that the programme quality can be checked before the signals are passed on to the following equipment. Hence, this facility may be used as a pre-fade listen output. The line amplifiers used for these outputs could be fed direct to headphones or used to drive amplifier/loudspeaker combinations in the control room.

The echo output is used, as its name implies to generate artificial reverberation which is fed back into the input of the mixer via the echo return channel. The output amplifier here is used to drive one of several types of reverberation units.

Finally, the foldback output is used to enable performers to hear selected outputs from the mixer, which can assist them. The name derives from the fact that these signals will generally originate from a fellow performer and they are 'folded back' into the studio from the control room.

From time to time it is necessary to introduce into the signal circuits ancillary equipment such as extra equalisers or compressors. For this reason break-in points have been included in the groups and individual channels. These usually consist of a pair of jack sockets with switches fitted. When the jacks are in use, the signals are diverted via the ancillary equipment and return, suitably modified, to the mixer. Working our way back through the system we next come to the mixers. These are of virtual-earth summing amplifier type and they accept the inputs from the various channel faders. There are separate mixers for foldback and echo as well as those for the groups. All are arranged to have sufficiently low output impedance to drive the various arrangements of faders encountered.

### Distribution wiring

The dotted box shown as distribution wiring is intended to represent the wiring harness, possibly made of screened cable, which connects the various channels to the output sections. It is shown this way for clarity. It can be seen that each connection from the channels has a letter and number identification. For example, 'F/B 1' refers to the foldback output of channel one and this is taken to foldback mixer input one. Similarly. 'F/B E' refers to foldback of the echo return channel. There is, of course, no echo output of the echo return channel, since a positive feedback howl would almost certainly result. The other connections should be self-explanatory.

The output from the channel amplifier can be distributed in several ways and on the specimen mixer drawing we have shown two ways in frequent use. The more traditional system is shown on the end of channel one. Here, as on channel two the foldback level control is in parallel with the channel fader. This output is always independent of the channel fader setting whereas the echo level control can be switched to come before or after the channel fader. Since the echo and foldback systems are identical except for this feature, there is no reason why they should not be temporarily interchanged in function if post-fader foldback was occasionally required.

The difference between the two channels lies in the way the group outputs are handled. In channel one, the channel fader output is taken to a switch. This can be either a simple single-pole rotary switch or, with more complex systems, a pushbutton assembly. The pushbutton system would obviously be more appropriate where many output groups were needed. In the simple case shown here, a three position switch is all that is needed. By its use, the signal can be routed to group A mixer, group B mixer, or both at the same time.

The alternative system is shown in channel two. This makes use of a technique known as panning and the control used is called a pan pot. When a camera is swung horizontally on its mounting to cover a scene, this is called panning. In a similar way, by use of this mixer control, a sound image can be swung smoothly between the right and left extreme of the apparent sound scene. This effect is achieved by feeding a portion of the channel output to each of the group mixers.

The pan pot is a ganged control, one section being normal 10 per cent log and the other anti-log. The 10 per cent means that, at the mechanical centre of the rotation, the output is 10 per cent of the input (or 20 dB loss occurs). In **fig. 3** we see the basic pan pot diagram. When the control is at the mechanical centre, each group receives the same signal. As the control is swung to the right of centre, group A output increases while group B output reduces. Due to the logarithmic action of these controls, the reduction in B occurs more acutely than the increase in A. This has been found to give the right 'feel' to the control, otherwise it tends to cramp the movement excessively towards the centre of the ends of the travel. Panning to the left is simply the opposite of panning right. Systems of balance control as found on some control units are not suitable in this application as the range of adjustment is insufficient.

We now come to the channel amplifier proper. This divides into three sections. The third is the equaliser department, used to alter the frequency balance of the signal. Several options are possible here but most commonly required are bass and treble lift/cut, together with some form of selective boost facility. The output impedance of the equaliser is made sufficiently low to deliver adequate signal to the various possible combination of faders and level controls. The second section is a 20 dB amplifier which follows the preset gain control. It is sometimes possible to combine the equaliser and 20 dB gain amplifier but this can lead to complications.

The preset gain control is fed from a switch which can select either the input from an unbalanced line at a level of about 20 dBm, or the output of the first section which is the special microphone amplifier. This consists of a 40 dB gain amplifier and a transformer. Preceding the transformer is an attenuator and switch arrangement which enables a larger level of signal to be handled than otherwise. These and other topics will be discussed in the second article in this series, which will concentrate on microphone amplifiers.

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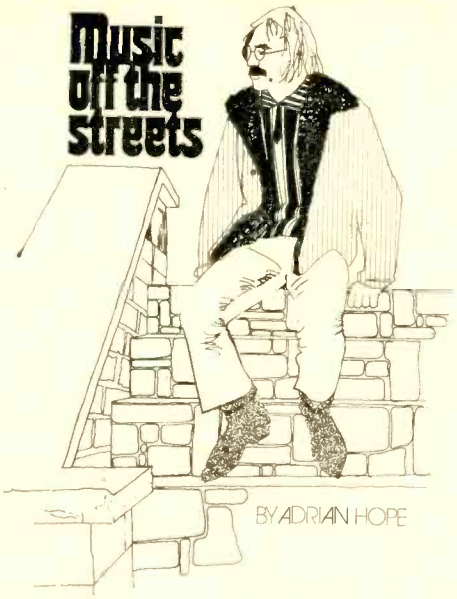
# Music off the streets




THREE names: John Peel, Dandelion Records and Loll Coxhill. John Peel you may have heard of. He's one of the few Radio One disc jockeys eschewing the hit parade and playing his own choice of un-hit music. It's mostly of British origin, some of it fresh, some of it boring, some of it exciting, and some of it pretentious. The common factor is that it's the kind of music Peel and his producer have interest and faith in. And Peel is no fool. On one of his programmes, he spoke of groups of his choice that had turned up and played 'lazy and inconsequential sets'.

Dandelion Records: a small record label run by Peel and distributed by Warner Brothers. Peel is prepared to put his money where his mouth is and issue on disc, more or less at his own risk, the kind of material that he reproduces on the radio.

Loll Coxhill: a name few readers will have heard of but someone they'll possibly have seen. Although he's now not often to be seen playing his sax on London's streets, he was for a while the only avant garde street busker in the world.

If you have read so far you'll be wondering what on earth Peel, Dandelion and Coxhill have to offer here. They have been working on something for the last six months and, irrespective of whether the music involved excites, bores or annoys you, I hope that the transcription of a meeting I had with Coxhill will be of interest to anyone involved either in location tape work or the frustration of having their taped gems degraded in transfer to disc.

The scene—a room in Hampstead with self and Loll Coxhill—late thirties, shaved head, ex-German Army clothes bought cheaply in Holland, soprano saxophone and dry humour. Apart from the occasional pyjama'd child passing through in search of the perennial drink of water, we're alone with a Stenorette.

AH: Does Peel make money out of Dandelion?

LC: He's lost on every record so far.

AH: People probably associate him with the type of music he puts on his radio programme and think he doesn't want a hit record anyway.

LC: Well it's certainly not true. What he doesn't want is something to be spoilt for the sake of giving it a better chance of being a hit. He'd be happy if everything was a hit. But he's not prepared to compromise.

AH: What's your connection with Peel? Presumably he heard you busking at some time.

LC: He's known me through the groups I've been with. (Various groups including Kevin Ayers and Gass, the original Catch My Soul band.)

AH: How did the busking and solo work start? It's unusual to find someone playing solo saxophone at all, let alone giving the kind of music the crowds probably hate in a London street.

LC: It started about four years ago when I went through a bad patch financially. The original idea was to get by when there wasn't much work with the band. But it didn't work that way. I never made much money out of it but it did things like paying my expenses and getting people to hear me.

AH: What kind of reaction did you get?

LC: Once I realised I wasn't going to earn much out of it, I stopped worrying about what most people thought and played what I wanted to play for the few that liked it.

AH: I've seen you play a lot of times, on Hungerford Bridge, outside the Festival Hall, in Oxford Street and outside one of the Jazz Expo concerts. But you never had anyone to pass round the hat.

LC: No that's not the way I wanted to do it. I tried to play where it was possible for people to stop and listen if they wished, and put money in my sax case if they felt like it. It was often stolen by passing meths drinkers anyway.

AH: Were the police generally helpful?

LC: Pretty helpful really. They *would* call me Acker though.

AH: And the idea of the record you're making for John Peel is to capture that type of street feeling.

LC: Not just that. The solo street thing has developed now to the extent that I'm doing it mostly in clubs and at concerts. I suppose they think I'm a cheap band. Anyway John liked the way I was doing it and suggested that I get a tape-recorder.

AH: I know that on the record there's some fairly conventional studio recording of fairly conventional music. But the location recording, was it done by you or did you have someone along?

LC: Some of the English location recording was done by Peter Gibson and Alex Hooper with a Japanese tape recorder. But you can ask them about that.

I did, and they confirmed that the work was done at 19 cm/s on a Nagra *3B* with an AKG moving-coil cardioid microphone. Higher tape speeds would have given insufficient reel time for the takes involved. They told me that the main problem was not so much traffic noise but the fact that it kept changing in level. On the 'if-you-can't-beat-it, join-it' principle they persuaded Loll to go along with the traffic level in his playing.

At the beginning of one take, the pressure roller on the Nagra was inadvertently left in the open position. So the tape went through at around 38 cm/s. When the roller was closed, it reverted to the intended 19 cm/s speed. At the transfer stage in the studio (8-track equipment) they used the result as an effect.

LC: Most of the rest comprises copies of tapes made by people who asked if they could record me on the streets or in clubs. I agreed if they'd let me borrow the tape for a few days afterwards.

AH: What is finally issued will have been taken from all over the place on all sorts of equipment and it will be interesting to see what the overall quality will be. Have you heard any of it?

LC: I've heard some of it. Some of the things which I thought wouldn't be very good are surprisingly good. Even a couple of the things that are in mono. But I don't know much about it technically.

AH: How much editing has there been?

LC: Every piece is in its entirety except in one section. Something went wrong with the tape recorder and it cut out for a while which means we lost about five bars. I cut out a 12-bar section just to get rid of that lapse.

AH: How did you and Peel go about that side of things?

LC: I took all the tapes to R. G. Jones Studios in Wimbledon and we went through the lot, putting them all on 38 cm/s.

AH: Before you did anything else—went straight on to 15?

LC: Yes, And then decided which sections I liked and which I didn't. I'm very pleased with what R. G. Jones have done.

AH: Was there any overdubbing?

LC: A boy of nine and a little girl of six were so good at singing that we recorded the singing first and then let them make their own backing track. I played some intentionally amateurish flute, trying to make it fit in with what the children are doing. I'm doing some things at the zoo but found I have so much material it will have to be held over for the next LP. I'm going to do some songs with Bridget St John, animals and all. We'll form some sections from animals; in effect make them sing certain lines.

AH: What animals have you in mind?

LC: Anything available. If they're in the zoo, I'll have them. We might get something for 'Top of the Pops' from the seal at Regents Park who swims round and round in his pool barking the same line all day.

After finishing the above interview, I had the chance of hearing the test pressings. Musically it's a mixed bag which more or less amounts to a statement in music of one man's interests. A lot of it isn't musically up my street but some is and other parts might be in future. In any case, this is not a review of the record.

The recording quality on some of the outdoor tracks is remarkably good. I rang the engineer at R. G. Jones, Gerry Kitchingham, to learn their approach to this kind of work.

Inevitably, the first stage is the transfer to 38 cm/s. Then comes equalisation to compensate for deficiencies in the original tapes. Honks in domestic loudspeakers are de-emphasised around 300 Hz and the HF end lifted. Tape hiss is reduced by a filter active at about 15 kHz and upwards. At the engineer's request, Loll was present when the master disc was cut. This is intended to guard against tape head misalignment since the person best qualified to spot the resultant loss of top will be the musician who produced the original sound.

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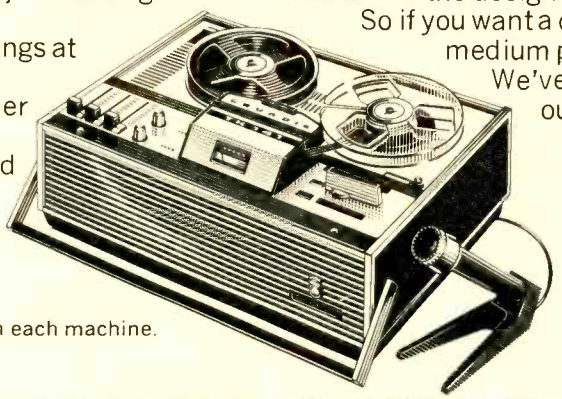

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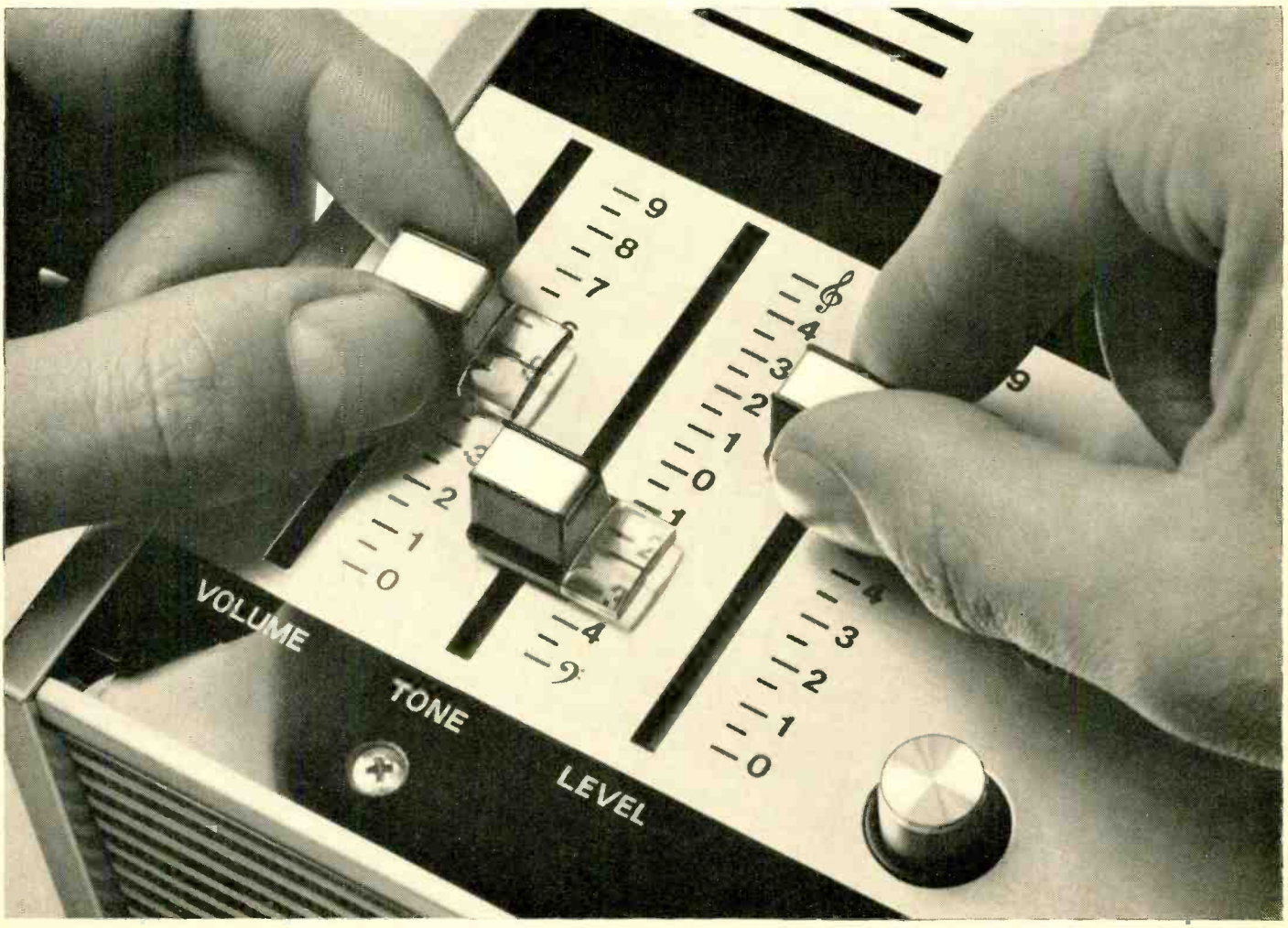


# THE SOUND OF RADIO £

## Keith Wicks begins a two-part examination of commercial radio and its prospects

SINCE the Tories won the general election, and made it clear that commercial radio was coming to Britain, hundreds of organisations have been preparing to fight for licences. The would-be broadcasters who have already registered their companies must include many fortune hunters who remember the expression 'a licence to print money' which was bandied about in the prosperous good old days of Independent Television. Some of the potential contenders for contracts are small groups of individuals with one or two tape machines and record players, and the idea of installing a transmitter in their loft. Some of the more serious ones have joined the Local Radio Association, whose secretary John Gorst (Hendon North Tory MP) had originally planned to launch 150 stations. The 60-odd members of the LRA include several local newspaper groups, and Radio Rentals. The Rank Organisation has registered 30 radio companies, and Hughie Green's firm, Commercial Broadcasting Consultants, were hoping to be granted a licence to allow them to organise the running of commercial radio in this country.

At the end of March, after months of anxious speculation, the Minister of Posts and Telecommunications, Christopher Chataway, presented his White Paper. Entitled 'An Alternative Service of Radio Broadcasting', it gave a broad outline of the way in which commercial radio will operate. Below is a summary of the main points in this paper, paragraph by paragraph.

### Introduction

1. As in television, alternative radio services should prove beneficial to programme quality.
2. Commercial radio must offer a public service.
3. High standards must be maintained, particularly in the provision of news programmes.

### The Independent Broadcasting Authority

4. The supervision of broadcasting is broadly the same task in television and radio.
5. The new service will therefore be entrusted to the ITA, which will be renamed the Independent Broadcasting Authority.

### BBC Local Radio

6. BBC local stations should continue to operate, and should concentrate on serving minority audiences.

### The IBA Radio Stations

7. It is intended to establish a network of up to 60 stations, transmitting on VHF and MF, in order to reach as many people as possible.
8. The new stations, although part of a network, must concentrate on providing material of local interest. The size of the populations served by these stations will vary greatly.
9. The IBA programmes will have to maintain a wide appeal in order to compete with the BBC's programmes.

### IBA Radio News

10. A central company should be set up to supply news to the commercial stations. One possibility is to have a specialist London station providing news for its own listeners and for other stations.

### The Financial Arrangement for IBA Stations

11. The income for commercial stations will be obtained from spot advertising. No sponsored programmes will be allowed.
12. Finances must be carefully controlled.

### Programme Contracts

13. Stations will provide programmes, and sell advertising time. Contracts will be granted for a three-year period but at the end of each year it will be possible to extend these contracts by one year.
14. This 'rolling' contract system will encourage high standards and provide good security for the programme contractors, giving them a chance to rectify any shortcomings in the event of being refused an extension of contract.
15. Although it will be possible for one company to run more than one station, steps will be taken to prevent any company or individual acquiring an excessive financial interest in commercial radio.

### Implications for other media

16. Other businesses will be safeguarded, and local newspapers will have the right to acquire an interest in the station serving their areas. Television companies, and newspapers with a monopoly in any area, will not be allowed to have a controlling interest in their local radio stations.

### Conclusion

17. Radio has a bright future.

### Appendices A and B

These deal with frequency plans and standards.

Next month, some reactions to this White Paper and its implications.

Roger Sinclair of Sound Developments Ltd, one of several new companies looking ahead to commercial radio.

# Servicing

by H. W. HELLYER

FLING wide the gates! Thus, our editor, discussing the terms of reference of this series, when he gave me my brief. Tackle the service aspect, the practical approach, the test method of any equipment that STUDIO SOUND deals with, he said, not merely tape recorders.

When we started the 'Tape Recorder Service' section, back in January 1962, my instructions were to deal with 'a deck a time'. Later, the approach broadened and groups of related apparatus were discussed. Gradually, we crystallised until the sub-title 'a machine a month' could have been given. Then, with numerous direct requests for information—so many that it became impossible to deal with my postbag—the editor decided to publish a circuit with each article, but again we maintained the machine-a-month approach. To date, this has continued, one possible break when I was ill last year being forestalled by the editor, who published a collection of answered queries. Such a nice, kind, understanding man. [*No, you don't get a rise.* **Ed.**]

Since STUDIO SOUND went all hi-falutin', this column has worried about its kitchen-table approach. Occasional reassurances have been offered: 'The professionals possess Hum-Boxes too' or 'We have kept our enthusiast amateur readers'. Now the opportunity arises, with a change of masthead, for an occasional contribution by the sort of professional who uses a gold-plated screwdriver, while Henry William keeps his humble approach, discussing servicing in general. It is something he knows about, being engaged in this struggle daily. Some of the tales I could tell you, my children, would make your back hairs curl!

So, from me you will not see talk of microphones or loudspeakers—except for a few very elementary remarks, and where they relate to the servicing of other equipment. But we *shall* fling off the shackles and take in amplifiers, test equipment and ancillary equipment, as well as tape recorders.

For this month, as an hors d'oeuvre, a pictorial roam around the workshop, spotlighting some of the problems we regularly meet.

Let's begin with brakes. If they don't come off we cannot start—efficiently, at least. One of the problems common to nearly all types of machine is tape spillage. Either the brakes do not come off together or do not apply in correct sequence. Note the subtle play on words—it matters. Brakes that engage two rotating surfaces must give some precedence to the lagging drum, or spillage will ensue. Coming off, they must leave the leading drum very slightly ahead, so that the tape is taut. In some of the worst cases, the slack tape allows a tape-sensor trip to fall out. Or worse, to become intermittent. The result—occasional jerks that used inevitably to break the tape, but nowadays more often stretch it.

**Fig. 1**, our first picture, shows the simplest (Magnavox *Studio*) of brake devices. With variations, other people have used it; reversing the materials, steel band brake on rubber. Revox themselves had a great measure of success. Secret of service in all cases is a clean and true application. The speed of rotation does the rest.

Philips, of course, are very much with us, and you could not wish for a more uncertain brake method than the angled lever with attached rubber that grips a turning plastic spool carrier. **Fig. 2**, inspected closely, shows what happens when things are neglected. The brake path gets polished, the rubber worn, the

**Fig. 1** Differential braking is effected by a flexible strap.

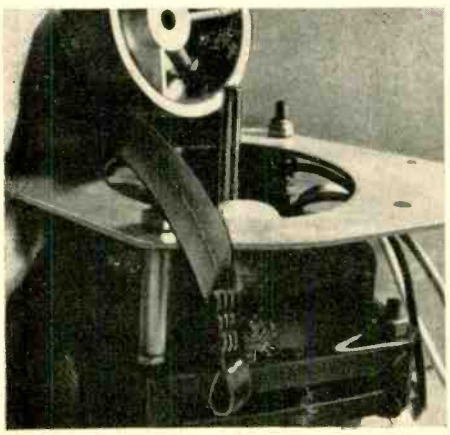


**Fig. 2** Simple rim brake.

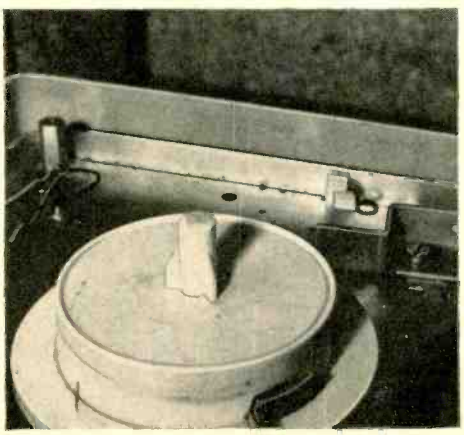
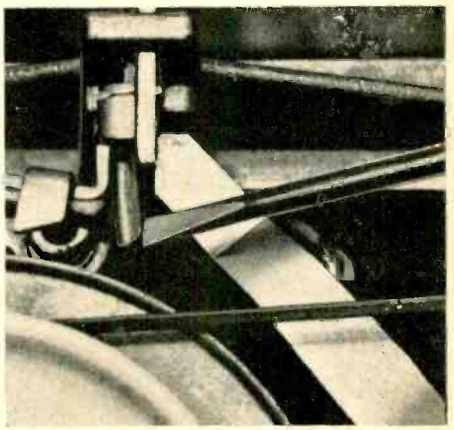


**Fig. 3** Braking pressure depends on the direction of spool carrier rotation.



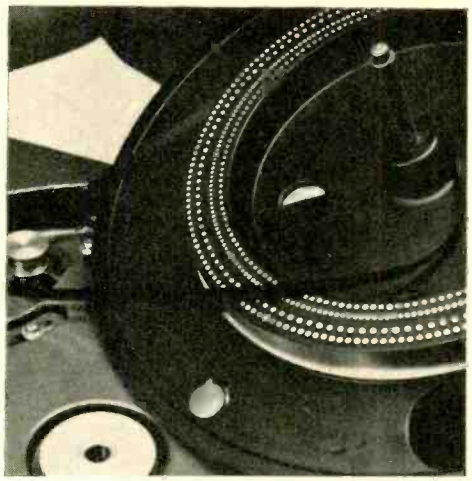


**Fig. 6** Belt drive and deceptive simplicity for this gramophone turntable. The motor is servo controlled with electronic speedchange.

lever bent, and the tape spills all over the deck. With this type of mechanism, one needs to check the lever system. Impulses originate at point A, miles away from the point of application, Z.

Some attempt at differential braking is to be seen in **fig. 3**, where the principle of a bent lever again applies. But this time the way the rubber tongue engages and brakes the spool depends on which way the latter is turning. This deck is also obsolete, again a Philips, but many are in use. The trick is to adjust (by bending, of course, what else?) with brakes applied, testing torsional moment by hand with the power off, then checking again with power on. These are gravity clutches and much depends on the lower spinning drums.

Our next, **fig. 4**, is also a Philips. Not that their brakes are worse than many others: just that their layout often lends itself to convenient illustration. This case is typical; a pivoted lever with a felt pad contained in a claw. The pad wears and braking gets both noisy and inefficient. Even regular maintenance can overlook this one, and wear becomes progressively rapid once the pad gets hard and dirty.

A pad again, **fig. 5**, but this time a much more elegant method with auxiliary braking supplied by this fluffy pad on a rubber tyre. As with the Ferrograph method, the accent is on good surfaces. If it should be fluffy, keep it so.

Belts, too, can be devils. As we saw in the previous picture, quite a lot of tape recorder mechanisms rely on both. But the gramophone turntable, where belt-driven, is a very different case. In **fig. 6** we see a gram deck, or part of it, that costs as much as the previous two machines put together—and that's without an amplifier. The first thing that strikes one is a deceptive air of simplicity. This Sony depends on a flat, accurately ground drive belt and a servo-controlled motor. The turntable bearing is so good that you have to walk around the block while you wait for it to settle. But it *can* rumble, if you overlook a three-monthly smear of grease. The studs beneath the platter are part of the stroboscopic design, with a neon lamp and mirrors doing the rest. The motor pulley is essentially simple, and all that is needed here is attention to cleanliness.

The same Sony deck has levers and pivots, springs, switches, and even a solenoid to worry about. The bother is not to be laid at the door of the humble autochanger. This one has a magnetic-sensed reject system and a natty lowering device. The pivots shown (**fig. 7**), especially the locked one in the foreground, need the regimen of occasional cleaning and the smallest smear of lubrication. Look out for odd screws that secure plates—they work loose occasionally and produce the most devastating side effects. Watch, too, for circlips and grip-rings that trap dirt, become almost solid to the spindle and retard lever action.

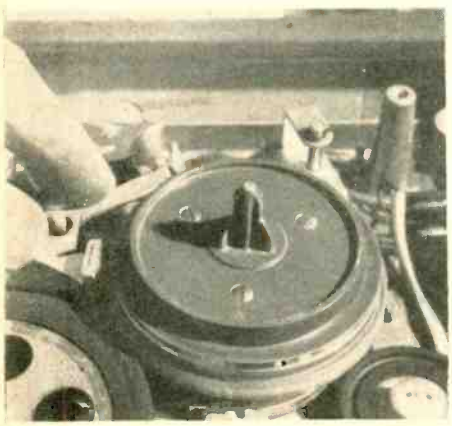
Another corner of the same deck is to be seen in **fig. 8**, where the sensing magnet at the turntable base is visible. No extra friction here; the magnet is part of an electrical circuit.

Another example, is the cable run of this Uher deck. It looks casual and unsupported, but the stiff outer covering of the cables will prevent untoward movement. It is up to us to keep it that way. (There's an interesting clutch on that one, too, but we will not be tempted.)

Which brings me neatly to another Uher

(*continued on page 359*)

**Fig. 4** Rim brake with felt pad, acting as auxiliary retarding device.



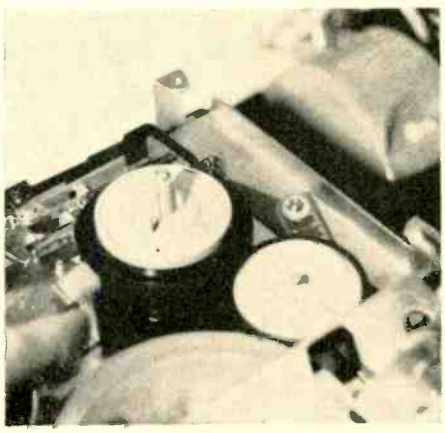


**Fig. 5** Good braking depends on the softness of the pad.

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# FILM SOUND TECHNIQUE

## Part Four
## Post-Production

by Tim Blackham

BEFORE I begin the description of what is involved in post-production work, this is a good place to describe how the equipment stood up to over six months of hard use. In last month's article, I described how it was used but gave little indication of the sort of problems that can and do arise. At the time of writing, John Shuttleworth's review of the Nagra *4L* has yet to be published (June issue), but it will be interesting to compare his findings with the results gained on our six-month 'road test'.

When we checked all the equipment before shooting started, the only fault was a dry joint on one of the PA amps. All other items had survived the journey to Yugoslavia intact. One of the radio-telephone base stations was found to be down in power when we did a long range test. It was returned to London for repair and was back and in use before shooting started.

In the summer, the roads and locations were covered with very fine dust which managed to creep in everywhere. To combat this, the camera department used compressed air to blow out the magazines and camera movements each evening and we made use of this to keep the Nagras clear. When I was selecting a second Nagra to convert to two track working, I found the cases of several machines were bent. This seemed to be caused by the machine being put down rather heavily. There are two eyes on the rear part of the case for the attachment of a carrying strap and these take the weight when the machine is stood in an upright position. The *4* case is of rather thinner metal than that of the Nagra *3* and can easily be damaged, sometimes resulting in the motor speed board (directly above the strap eyes) cracking its edge connectors. The dust was kept at bay and we had no problems that could be attributed directly to it or to the mud that replaced it as winter approached. The cables were in terrible state at the end of each day but the connectors were constantly washed out with Inhibisol and no trouble was experienced other than a couple of conductor breaks in loudspeaker cables.

One of the worst faults we experienced was the sudden refusal of one of the playback *4L* Nagras to run at the selected speed. When switched on, it would only run fast forward. This was traced to an open circuit inductor on the speed stabilizer board so a spare board was flown out from London and fitted.

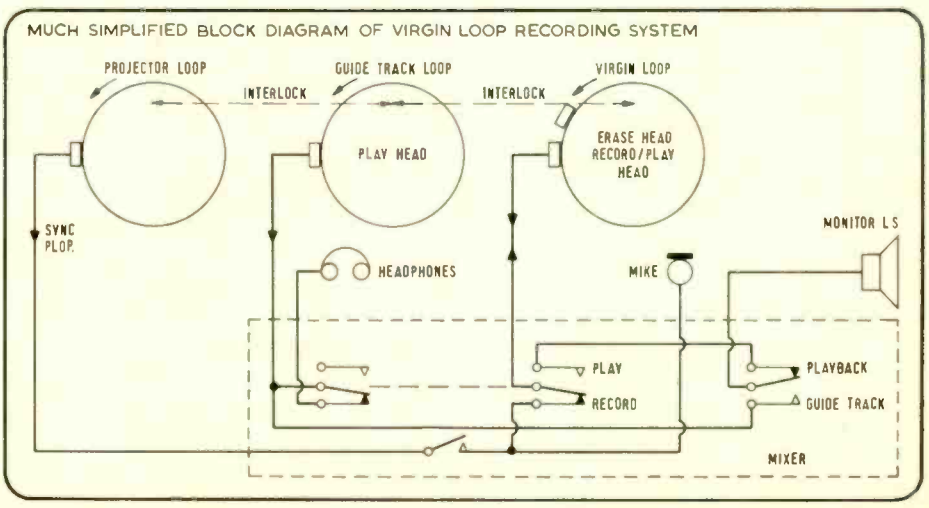
All was once again normal. The Nagra *4* is constructed rather like a three dimensional jigsaw. Most assemblies plug in and even motor removal is a fairly easy task (this was necessary when wiring the under side of the deck to take the two-track heads). The Nagra *3* we took as a spare was not without a peculiar fault. While being used to record some wild effects tracks of women washing clothes and slapping them against wash boards, an echo was noticed. The location had a natural echo due to high river banks but this was strangely enhanced. Close inspection of the layout and circuit diagrams showed the fault to be a resistor that had been badly trimmed and had penetrated the insulation of a lead in a nearby board. In so doing, it provided a feedback loop from playback to record circuits.

The only other serious faults were a transistor failure in one of the radio-telephones that resulted in a quiet afternoon as the production office could not hear us. That and a burnt out mains transformer in the radio-telephone at the dome stage. The only microphone fault was with one of the *805* Sennheisers, which was replaced. The Perfectone mixer also had its problems. When we commenced night shooting in the early autumn the nights proved very cold. As the temperature decreased the output became perceptibly distorted. This was traced to the output amplifier so frantic telex messages whizzed between the unit and Perfectone in Beinne, Switzerland. They arranged for a replacement amplifier to be sent. This was then held up by the local customs who released it on payment of import duty even though it was obviously to be re-exported at the end of the production. In the meantime, limited mixing was carried out directly on the Nagra. So while we were spared some of the more tiresome faults such as mike cables going down and broken plugs, we had a number of unusual problems to make up for it. To sum up, I think the equipment performed very well under extreme conditions and the modifications to the Nagras for stereo proved both reliable and practical. Meanwhile the stereo Nagras we used have been returned to Location Sound Facilities and I am told have since been used and are available for other jobs.

My job with the production ended with the finish of shooting so the description now becomes partly second-hand and partly drawn from past experience. Dubbing is, at the moment of writing, some time away.

As the sequences are edited, the sections that for various reasons require to be looped (post synchronised) are prepared. The principal reasons for looping are as previously stated: the director requires a change in the delivery of a line; a part may be re-voiced or may suffer from extraneous noise. Several shots we did one day in autumn had leaves blowing through them and when we came to complete the

*(continued on page 359)*



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# THE MISSING LINK.


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sequence the next day, though the light was right, there was no wind. Wind machines were used and this resulted in the dialogue being almost totally blotted out. Vocals can be, and are, looped in the same way as dialogue. The looping in 'Fiddler on the Roof' is being done both at Anvil and Pinewood studios. When dialogue looping, an attempt is usually made to match closely the acoustics of the original recording. This is not possible in all cases, though the method then being to record in a deader acoustic than the original and to even up the looped sections in dubbing, matching them to the original quality.

Three loops are required for dialogue looping (two only for effects). The action loop carries no sound but has special leader usually with a clear frame and a sync 'plop'. The guide track loop contains the original recording that is to be replaced. The third or virgin loop from which the system takes its name is blank and is used on the recorder. As many takes as are necessary are made and most studios are now equipped to loop on three tracks. That is to say, a second and third attempt can be made before the first has to be erased to make way for a subsequent effort. This way, a loop can be a composite of several takes and even the takes can have corrections inserted into them.

The music unscoring is, as with the pre-scoring, at Anvil. Eric Tomlinson tells me that they expect not to have to record any fresh music for the LP. This is usually necessary to 'heal' cuts that may make sense when they accompany picture but are intolerable standing alone. The LP will be mixed from the edited sprocketed master recordings, probably to eight track (Anvil use a Studer *A80*) and then down to a 6.25 mm master track (Studer *C37*).

This then leads to the dubbing process where all the sound sources are combined to form the final stereo and mono mixes. During the early days of sound in the film industry, when discs were used, the re-recording of disc master recording was known as duplicating or doubling. This degenerated into dubbing and became the general expression for re-recording with both terms in use today.

'Fiddler on the Roof' will be released around December in 70 mm format. Of six magnetic tracks, five feed speakers arranged behind the screen and the sixth the ambient (surround) speakers at the sides of the theatre. Without going into the subject of five track pan pots, the system in most dubbing theatres is to have two or more balancers at one or two mixing desks. ('Fiddler' is to be dubbed at Pinewood.) The second desk is usually reserved for panning. Pre-mixes are made and afterwards the final dub, combining the pre-mixes and adding any further components. In this country, a feature film dubbing theatre has ten to 15 reproducers feeding a desk with 15 to 30 inputs as several of the reproducers will be multitrack feeding a recorder that can work one or any of the track standards used (one, three, four or six track). In the USA they often have far larger numbers of reproducers. The machines are also capable of being reversed (rock 'n roll) for rehearsing and correcting mistakes during recording while still maintaining sync. Thus the recorder, as in the case of the looping recorder, has to go in and out of record without introductory noises or clicks.

The editors, as well as providing all the tracks for dubbing, make up cue charts marking the distance from the start of action where a track comes in and goes out. Thus a head can be keyed out when it is not contributing as a source, so holding system noise to a minimum. The chart is used in conjunction with a reversible electronic footage counter that is reset each time the machines are relaced. The counter is reset to 985 feet (a reel is usually 1,000 feet or less). The run up from start mark is usually 15 feet and thus the counter is at 000 at the start of action.

The dubbing takes several weeks. Most of the time, two or three balancers are employed with an army of editors, making additions and final adjustments. When the final six track mix has been made, this is transferred to the picture print that has been striped with a magnetic coating and the composite result is ready for showing. Mono mixes are made for 35 mm release and in this case an optical recording is made for optical copying on to the release print.

All this has been rather a gloss over the very complex subject of film sound but I hope it has served to stimulate interest. I hope also, in the future, to explore particular areas that may have been a little too vague.



matter. Following my recent look, in three servicing articles, at the Uher *4000L* and related models, their man in Britain, R. K. Wilson, has dropped me a line to correct a couple of misleading statements. His points, in order, are these: Mono recording, *4200* or *4400* (no *L* suffix on stereo models). Mono recording is possible on upper or lower tracks individually if required, by pressing the appropriate selector button. With both buttons relaxed, no recording is possible but parallel replay is available, both channels fed through the left amplifier. There will be slight attenuation, both tracks (head sections) being in parallel. Depressing single buttons for mono recording brings in only the left channel and this one is also used for monitoring. The *Z124* battery charger unit can be used to recharge lead-acid and nickel-cadmium cells by the appropriate cable. Earlier *Z114* units charge only lead-acid cells. With a small modification, they can be upgraded to charge the *Z212* but are then useless for the *Z211*.

The little green light I complained about. It is supposed to go out when lead-acid cells are charged but stays alight for nickel-cadmium cells. The right cable must be used, grey *K713* for lead-acid and red *K714* for nickel-cadmium.

Sonnenschein, the makers of Dryfit lead-acid accumulators, are hinting at a longer-life *Z212*. But Mr Wilson rightly emphasises that long life will always depend on their being stored fully charged.

The output transistors of the mono *4000L* are now AC187/188.

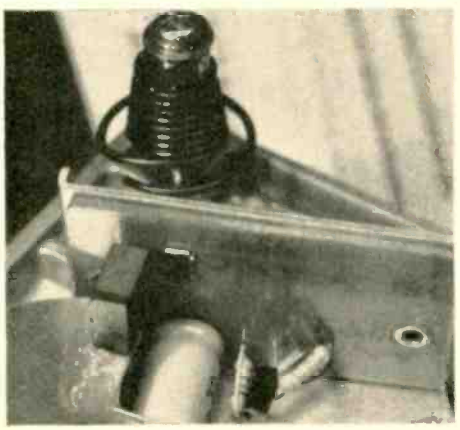

**Fig. 8** Magnetic switching for rejection.

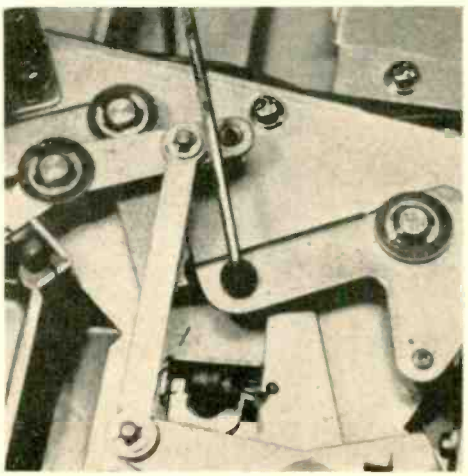

**Fig. 7** Watch for pivot points.

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# WORK SHOP

by John Fisher

### TALKBACK AND DIMMING SWITCHES

A RECENT letter in the editorial mailbag asked for details of how to incorporate switching into a mixer to dim or mute the monitoring amplifier, and how to provide talkback switching for communication with performers in the studio or concert hall.

The control room monitor has to be silenced during talkback to the studio, to avoid acoustic feedback. It is sometimes useful to have a 12 to 20 dB 'dimming' switch to converse with other people in the control room while recording goes on, to take a telephone call or (for those who *must* monitor with their eardrums meeting at every throb) to hear what the balance sounds like at a domestic listening level.

There are many ways of achieving this. The way suggested to the reader may be of interest to others and the block circuitry shown here is based on the reply. As drawn it uses a single keyswitch for talkback/normal/dim, but two separate switches could equally well be used. A way of playing tape, disc or other inserts into the studio via the talkback system is also indicated.

Resistors R1 and R4 protect preamp outputs from possible damage by shortcircuit, and isolate the preamp outputs (which may be feeding other equipment as well) from the switching stages. This assumes low-impedance outputs from all the amplifiers which is normal practice. R1 resistors also form part of the dim switch attenuator.

In the normal position of the switch, the tape or mixer output selected by the comparison switch is fed to the control room monitor amplifier via its gain control R2. The amplified output from the talkback microphone is shorted to earth by one pole of the changeover switch (one side of the keyswitch) but the talkback amplifier and studio loudspeaker are left available for playing inserts or echo to the studio via the sub-mixer. In the talkback position the input to the monitor amplifier is shorted to prevent howl round and the talkback mike signal is unshorted. In the dim position, the talkback shorting is left unaffected whether a common keyswitch or separate switches are used, while R3 (which is switched between the junction R1/R2 and earth) attenuates the signal by the required amount. Typically RL might equal R2; R1=9R3 for approximately 20 dB attenuation. R4=R5=about R6. Absolute values are not given as they must depend on the values of fader resistance used.

### CONNECTING BOXES

A FRIEND OF mine has a useful little gadget which I see frequently in use. It consists simply of a small metal box with two phono sockets, four jack sockets and a piece of flexible mains-connector strip. Coloured wires are permanently soldered to the contacts on the sockets, and are connected up rapidly as required, using the connector strip and screwdriver, to provide several possible arrangements of parallel sockets, jack-to-phono adapters and phase reversers etc.

A convenient unit can be made up in a rectangular tobacco tin, using (for instance) two three-contact PO jacks, four phono sockets, three and five pin DIN sockets, with a flexible connector strip bolted inside the tin. It is a good idea to tin the ends of the flexible leads to help make firm and reliable connections. Unused leads should be taped or strapped out of the way, where they cannot come into contact with other leads or socket tags.

### TERRY CLIPS

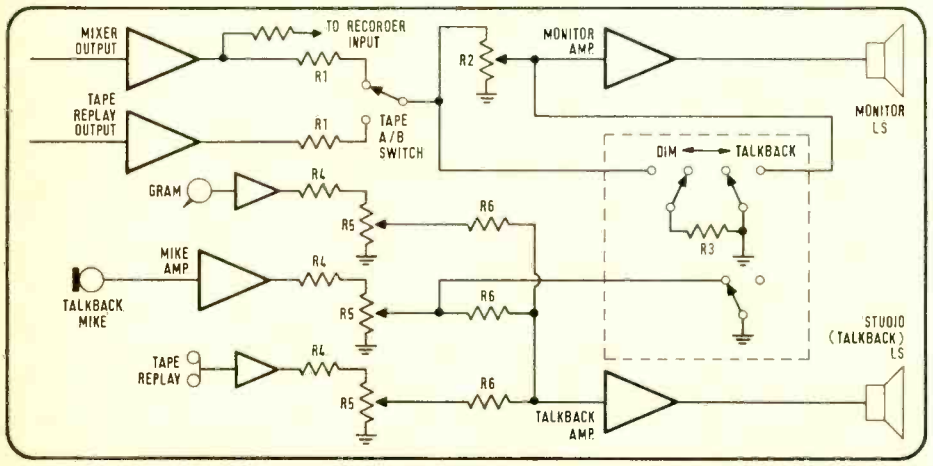
TERRY CLIPS can be useful as a means of holding cable against a microphone stand or, with very light mike and a home-made adapter, as an inexpensive holder for a pencil mike. The only snag is that the edges tend to scratch soft metal and plastics, and to chip paint. This can be avoided by slipping fine transparent or coloured plastic tubing over the clip; suitable tubing is available from chemists and car accessory shops. If necessary, the clip can be warmed and the tubing softened in hot water.

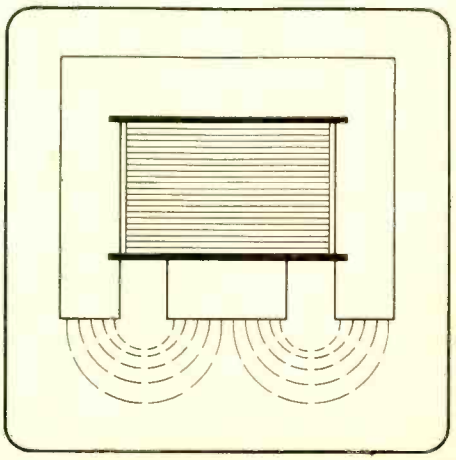
### BULK ERASERS

THERE HAS recently been some consideration of the merits of bulk erasers in these columns. Certainly, metal spools are a nuisance as they are apt to cast noise shadows on the tape. However, unless one uses an effective full-track erase head, the bulk eraser remains the only effective way of completely wiping a tape. Winding on to plastic spools instead of the metal NAB types is one answer to the shadow problem. There is a further point: many of the small hand erasers sold are relatively weak and really glorified head demagnetisers.

The author has a powerful and seemingly effective eraser made from an old transformer. It was intended for a valve power supply and was rated at 250V 200 mA or thereabouts. When it became redundant, the core was dismantled, the *I* laminations discarded and the *E* laminations replaced all in the same direction. The mains is connected to the primary, all the secondary connections being open circuit and insulated, and the eraser is contained in a cardboard box with the lead coming out from one corner. The open side of the core is the one which does the erasing. As well as being an effective bulk eraser, the device can be used to demagnetise a whole deck. The eraser should be switched on and off as far away as possible from both deck and tape, and should not be used anywhere near valued recorded tapes. A long lead and good fused plug are desirable. Amplifiers are likely to put a loud plop through speakers as the eraser is switched on or off.

The device should not be used continuously for more than about 30 seconds as the windings heat up considerably during the operation. The eraser should be moved in small circles over both faces of the tape spool to ensure that all parts of the tape come into the erase field. Watches should be removed before the eraser is used, to preserve the sanity of the hairspring.



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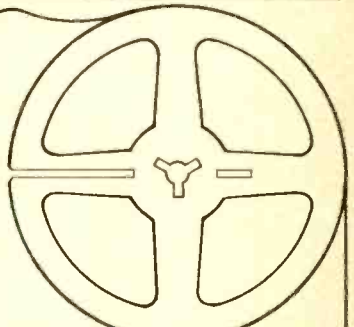

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# equipment reviews

## MINIFLUX ME104
## WOW AND FLUTTER METER

**MANUFACTURER'S SPECIFICATION**
**Mains supply:** 110 to 125V or 220 to 240V, 40 to 60 Hz.
**Wattage:** 6W.
**Oscillator frequency:** 3.15 kHz (1 x $10^{-5}$ after starting period).
**Oscillator output:** 0.4V or 20 mV.
**Calibrating device:** +2% detuning for static and ±3% (mains frequency square-wave) for dynamic recalibration of measuring unit.
**Input voltage:** 30 mV to 30V, 3.15 kHz ±5%.
**Input resistance:** 10K.
**Measuring ranges:** ±0.3%, ±1% and 3%. Approximate peak value indication according to CCIR and DIN.
**Frequency response: Linear:** 0.5 to 500 Hz −3 dB.
**Weighted:** to DIN or CCIR, or external filter.
**Drift indication:** ±4.25% maximum.
**Pen recorder output:** 10V p-p into 22K.
**Weight:** 5 kg.
**Dimensions:** 188 x 212 x 296 mm.
**Price:** £135.
**Manufacturer and distributor:** See next specification.

THE measurement of wow and flutter confirms one of the more vital performance parameters of tape recorders and gram turntables. Both wow and flutter take the form of minor speed variations. Wow is normally considered to cover speed variations with a frequency from 0.1 to between 10 and 20 Hz while the higher frequency speed variations up to 500 Hz or so are normally identified as flutter. Most wow and flutter meters measure the total wow and flutter, which is an integration of the two.

Equipment manufacturers differ in the way they measure wow and flutter. American and Japanese manufacturers commonly quote root mean square (rms) values of total wow and flutter, without any weighting to correct for the human brain's sensitivity variation at different frequencies.

European specifications almost always quote quasi-peak values of total wow and flutter as measured through a weighting network which attenuates components above and below 4 Hz. This weighting curve (as specified by DIN 45507) attempts to correct for the variations in the brain's sensitivity to flutter frequency.

There is no accurate way of translating one type of measurement to the other. Either measurement technique depends to a very large extent upon the waveform of the short term speed variations, as well as their frequency.

The Miniflux range of wow and flutter meters fall into the DIN peak-weighted category and consist of two meters plus a low frequency wave analyser. The *ME104* wow and flutter meter described here is the simpler of the two instruments, but the *ME102B* (used by the author) has ranges of ±1.0, ±0.3 and ±0.1 per cent, together with the facility for switching between the standard measuring frequencies of 3.15 and 3 kHz.

The *ME104* has two clearly calibrated meters mounted on the front panel, together with a row of nine pushbutton switches which select the range, weighting network in/out, power on/off and internal calibration. On the back of the instrument is a socket outlet for an oscilloscope or pen recorder, a five pin DIN socket for direct connection to domestic tape recorders, and well shielded controls for calibration of the instrument by means of its internal line-up facility.

The instrument incorporates a 3.15 kHz oscillator for recording through either the front panel banana sockets which provide a 0.42V squarewave, or from the rear panel DIN connector which provides about 20 mV for connection to the 'diode' socket of European domestic tape recorders. The frequency stability of the internal oscillator is very important for the measurement of tape speed drift and is specified by the manufacturer as 1 x $10^{-3}$ after initial warm-up. Our measurements confirmed this specification after only five minutes operation from cold, during which time the frequency only drifted from 3,145 to 3,147 Hz. Once the unit had achieved constant temperature, the long term frequency drift was better than 3 parts in $10^4$, far better than is required!

The left front-panel meter is calibrated for reading tape speed drift within the limits ±4.25 per cent on the nominal 3.15 kHz replayed tone, and may be set to zero by means of a front panel potentiometer which can be used to offset small deviations from the nominal 3.15 kHz replayed tone.

The accuracy of the drift meter was measured at indications of ±1, ±2, ±3, and ±4 per cent and found to be within ±0.5 per cent of the actual reading (i.e. an indication of 1 per cent was in fact 0.95) which is perfectly adequate for all normal measurements. A word of caution, however. The accuracy of the instrument depends upon the required minimum 30 mV being applied to the input—less than 20 mV was found to lead to errors but still gave a steady indication.

The frequency response of the instrument in weighted and unweighted modes was carefully measured by applying an input signal from a specially calibrated FM audio oscillator operating at a mean frequency of 3.15 kHz.

The instrument specification states that the unweighted response is 0.5 to 500 Hz (−3 dB). We measured 1 dB limits from 1 to 200 Hz, with a −3 dB low frequency cutoff at exactly 0.5 Hz. The −3 dB high frequency cutoff was found to be at 400 Hz, with an attenuation of −5.5 dB at 500 Hz. This is not to specification but such a small deviation from a flat response is unlikely to be significant in practical measurements.

The more important weighted frequency response was found to be well within 1 dB of the DIN curve up to 40 Hz, tending above 50 Hz to the lower limit of the DIN 45507 specification.

The accuracy of the instrument was first determined by applying a 3.15 kHz tone which was frequency modulated to a known deviation with a 10 Hz sinewave. The indications in the ±3 and ±1 per cent wow and flutter ranges was within a creditable 5 per cent of actual reading, but the error on the 0.3 per cent range was found to be 15 per cent leading to an actual wow and flutter of 0.2 being indicated as 0.23 per cent.

Impulse testing with rectangular pulses of 'wow and flutter' confirmed the larger error on the 0.3 per cent range but showed that the instrument conformed to the requirements of DIN 45507 from the point of view of quasi-peak indication.

This examination of the *ME104* naturally aimed at discovering the instrument's limitations. The unit passed the requirements of the DIN standard in all the functions examined and in most cases exceeded the requirements by a fair margin. It is a delightfully simple instrument to use, easy to calibrate and light to carry around.

The one thing that must be regarded with caution is the minimum input voltage; unfortunately there is no indication that sufficient voltage is being applied, and the instrument can give inaccurate readings on too low an input.

Well worth £135 if you need a DIN peak-weighted wow and flutter meter. **H. Ford**

## MINIFLUX ME301
## WAVE ANALYSER

THE ME301 wave analyser is primarily intended for use with the Miniflux range of wow and flutter meters, for the analysis of flutter frequencies. No meter is included but the output may be fed to an external indicator.

The front control panel consists of a large tuning dial calibrated 10 to 33 and 32 to 100, to correspond with the five tuning ranges which are selected by a rotary switch. The latter also incorporates an off position. Input, output and four well-proportioned pushbuttons complete the front panel controls. The rear panel supports a five pin DIN socket for connecting the wave analyser directly to a Miniflux wow and flutter meter.

Two recessed screwdriver adjustments are incorporated for adjusting the gain of the analyser. One adjusts the gain across the front panel input and output, and the other the gain between the input and output of the rear panel DIN socket.

*(continued on page 365)*

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## AKAI TAPE DECKS AND RECORDERS

Prove for yourself the outstanding merits of the Akai 4000D. Having all the essential functional facilities, it also has many extras normally found on more expensive machines. The Akai 4000, the full tape recorder version of this excellent deck adds playback amplifiers and a pair of fine built-in-speakers for stereo monitoring or just listening. And the Akai 1710 is surely one of the best complete tape recorder buys on the market today, combining all the best features of Akai engineering and construction. The above three models and the whole Akai range are available from Caves at very low prices.

AKAI 1710L

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| Grundig TK121 | £54·78 | £45·25 |
| Grundig TK141 | £59·23 | £50·00 |
| Grundig TK146 | £68·14 | £54·25 |
| Grundig TK124 | £44·90 | £36·50 |
| Grundig TK144 | £49·95 | £38·25 |
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| Akai 4000D | £89·95½ | £69·95 |
| Akai 1710L | £89·00 | £65·95 |
| Akai X-5000L | £177·97½ | £145·00 |
| Akai X-5000W | £177·97½ | £155·00 |
| Akai M-10L | £245·05 | £189·95 |
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| Philips N4407 | £105·00 | £90·10 |
| Philips N4408 | £139·00 | £119·30 |
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| 5¾″ | 1800′ | 3·39 | 2·00 |
| 7″ | 2400′ | 3·83 | 2·50 |
| 5″ | 1800′ | 3·09 | 2·05 |
| 5¾″ | 2400′ | 3·82 | 2·50 |
| 7″ | 3600′ | 4·75 | 3·15 |

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| C90 | 1·02 | 0·70 |
| C120 | 1·52 | 1·00 |

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The four front panel pushbuttons are clearly labelled and carry out the following functions:

ON switches the mains supply on or off.

CAL provides a mains frequency calibration waveform.

DIRECT switches out the analysis network and connects the input signal to the output stages for setting instrument gain.

FILTER inserts the analysis network for normal operation.

Setting up the instrument was very simple. The direct and cal buttons are pressed and the reading of the output indicator noted; the filter button is then pressed, the unit tuned to mains frequency, and the internal calibrating control adjusted for the previous reading on the output indicator. The manufacturer's literature stated that the internal calibrating voltage was approximately 0.4V connected to the input stage of the analyser. We found it to be 0.23V rms (3.4V peak). This error does not upset the calibration procedure but could lead to some confusion!

Our initial investigations into the electrical performance of the *ME301* were concerned with the accuracy of frequency calibration and the effective bandwidth of the instrument. The table shows how remarkably close to the specified bandwidth of 10 per cent for 3 dB fall in response the performance is maintained, and also shows very good frequency calibration.

Our next investigation concerned the rejection characteristics of the filters. Plots of the filter characteristics on a Brüel & Kjaer level recorder showed highly symmetrical characteristics with normal rejection of 42 or 43 dB one-octave either side of the fundamental, some 2 or 3 dB better than the 40 dB specification. Rejection of the third harmonic was in the order of 50 dB.

Another very important characteristic of filters is that the attenuation or gain at the filter frequency should remain sensibly constant as the filter frequency is varied. The *ME301* specifies ±1 dB; we measured a performance of (+0.8 to −0.4 dB) from 2 to 330 Hz, but measured +1.5 dB at 1 Hz. We also noted that the gain varied by as much as 0.8 dB when we changed from one measuring range to another at the 'overlap point'. This fact is one of the irritations one learns to live with. It is the sort of thing one finds in instruments costing many times the price of this unit.

Finally we measured the input and output impedances at 1.59 kHz and found them to be 6.6K and 122 ohms respectively, the latter well within the specification but the input impedance considerably lower than the specified 9K.

Summarising our findings, with the exceptions of the filter 'gain' at 1 Hz and the input impedance, the instrument was well within its specification and showed exceptionally good filter characteristics. The higher gain at 1 Hz still places the overall filter characteristics within ±1.9 dB according to our measurements, which is a very high standard and may be interpreted as being within the specified ±1 dB, depending upon the determination of the 0 dB reference point! The specified 9K reference input resistance is inconveniently low for some applications, but one must bear in mind that this unit is primarily intended for use with Miniflux wow and flutter meters.

However, the performance of the instrument is really excellent for the £275 price and it should find many applications in the field of vibration analysis where low frequency phenomena are of fundamental interest.

Reverting to its intended use in conjunction with Miniflux wow and flutter meters, it is an invaluable tool for production line testing of turntables and tape transports because it enables the quality of individual components to be assessed as a result of their particular individual contributions to the total wow and flutter of the completed production unit. Unfortunately £275 is probably beyond the pockets of many establishments where this instrument could be of great assistance. There, trial and error cures will persist.

**H. Ford**

**MANUFACTURER'S SPECIFICATION**

**Mains supply:** 110 to 125V or 200 to 240V, 40 to 60 Hz.
**Wattage:** 3W.
**Frequency range: Direct:** 0.5 Hz to 20 kHz.
**Filter:** 1 to 3.2 Hz, 3.2 to 10 Hz, 10 to 32 Hz, 32 to 100 Hz, 100 to 330 Hz.
**Bandwidth:** 10% (response down 3 dB).
**Filter damping:** ±1 dB.
**Block damping:** 40 dB per octave.
**Input resistance:** 9K.
**Output resistance:** 200 ohms.
**Input voltage:** 2.2V at fundamental frequencies.
**Temperature range:** 0 to 50°C.
**Weight:** 4 kg.
**Dimensions:** 188 x 212 x 296 mm.
**Price:** £275.
**Manufacturer:** Technisch-Physikalisches Laboratorium Dipl.-Ing. Bruno Woelke, 8 Munich 2, Nymphenburger Strasse 47, West Germany.

**DISTRIBUTOR: Lennard Developments Ltd, Locksfield Avenue, Brimsdown, Enfield.**

| Frequency | Measured Bandwidth | Frequency Calibration Error |
|---|---|---|
| 2 Hz | 10% | 0% |
| 6 Hz | 10% | 0% |
| 20 Hz | 10.5% | 0.5% |
| 60 Hz | 10.3% | 0.5% |
| 100 Hz | 10% | 0.3% |
| 200 Hz | 10.5% | 0.5% |
| 330 Hz | 10.5% | 1.2% |

## ACOUSTIC RESEARCH AR-3A LOUDSPEAKER

**MANUFACTURER'S SPECIFICATION**

**Recommended power amplifier:** Not less than 25W.

**Impedance:** 4 ohms.

**Drive units:** 305 mm woofer, 35 mm mid-range, 18 mm tweeter. Paper cone woofer, hemispherical moulded dome mid and HF units.

**Controls:** Mid-range and HF levels.

**Guarantee:** Five years.

**Finish:** Oiled walnut, oiled teak, unfinished pine and white.

**Price:** £153 to £178, depending on finish.

**Manufacturer:** Acoustic Research Inc, Cambridge, Mass. USA.

**Distributor: Bell & Howell Ltd, Audio Products Division, Alperton House, Bridgwater Road, Wembley, Middlesex.**

A SHORT while ago AR held a seminar on 'Valid Measurements for Loudspeaker Performance' and, from a transcript of the proceedings, two paragraphs are so important that they are quoted here:

'AR . . . believe that loudspeakers should have no sound of their own; that they should be neutral. We believe that they should approach as nearly as possible the ideal of a perfectly linear and uniform transducer of electrical to acoustical energy. We believe that it is possible to make objective and valid measurements of performance and to use those measurements in assessing the quality of the loudspeaker. In short, we believe that rational and scientific methods are applicable to loudspeaker design and evaluation, just as they are applicable to other physical objects made for a specific purpose. The only thing necessary to establish the validity of this approach is acceptance of the premise that a loudspeaker should be a reproducer of sound, not a creator of sounds different from the original.'

The second extract gives criteria for loudspeaker design:

'The speaker should produce radiation *at every angle* that is a perfect sound pressure replica of the electrical input. This implies perfectly flat frequency response and perfect dispersion at all frequencies; in turn, flat energy response is also implied.

'It should produce no distortion of any kind.

'It should be efficient enough to produce SPL's as high as are wanted with reasonable amplifier power levels.

'It should be reliable and sturdy enough to accept all reasonable electrical inputs without damage.

'It should be small, light in weight, and attractive in appearance.

'It should be inexpensive.'

The interesting advertisements for AR speakers and the review in *Hi-Fi News* of the *3A* may have aroused curiosity regarding their value as monitors.

From their literature, it seems that AR have designed the *3A* to be used in an 'average' living room (which they take to be 7 x 5m), with the back of the speakers close to a wall and mounted 1m high, and for it to make corrections for the recording. They assume that the average disc record has a rise in HF response and that this justifies a drop in the response of the speaker.

AR also assume that most recordings are

*(continued overleaf)*

made with a 'close microphone' technique and therefore have more presence than one would normally experience in a concert hall. They also claim that it is not possible to make a more efficient tweeter than the one used in the *3A* without degrading its performance, so they accept a drop in efficiency at the treble end as being desirable.

This rather looks like trying to make a virtue out of necessity, but the results obtained with the speakers should show how successful they have been. AR state in their literature that the acid test of a speaker's accuracy is a live/recorded test, that they have used a string quartet, a classical guitarist and a nickelodeon for their tests, and that these are in increasing order of difficulty. They have missed out the most searching of the live/recorded tests, speech and choral music.

Too many speaker designers fall into the trap of thinking that, since speakers are used mainly for the reproduction of music, all is well if they sound 'right' on music. The trouble here, as the speaker test tape used for these reviews shows, is that speakers can sound 'right' on many types of music but still be caught out badly on other types. If a speaker sounds right on speech, however, it is almost certain to get by on music generally. It is on the speech and choral sections of the test tape that the faults in many speaker systems become most obvious.

Fortunately it is possible to arrange a live/recorded speech comparison without much difficulty. All that is necessary is a recording of a colleague's voice made in the middle of a field on a windless day using first class equipment, and the colleague to be about when the speaker is being tested. A sound level meter is necessary to maintain correct record/replay levels.

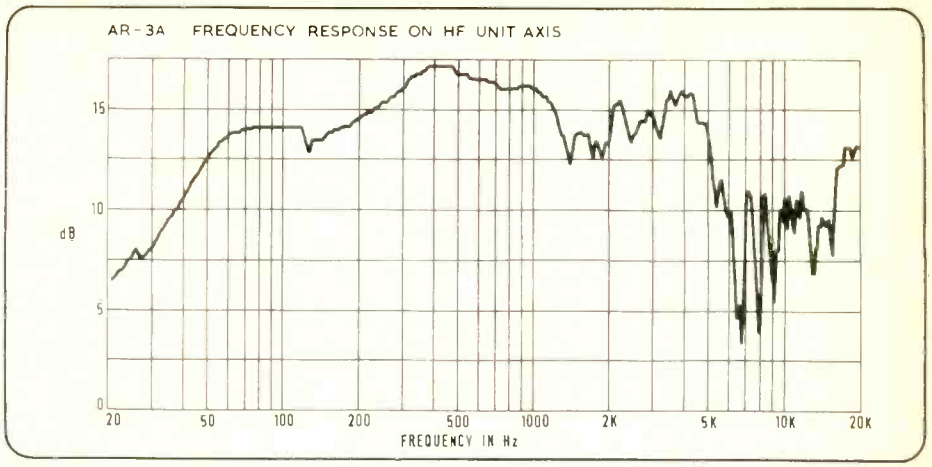
The recording I used for this test was made on a Nagra *4* using an AKG *C451* capacitor microphone and BASF *LP35LH* tape. It is probably as high a quality as one can get. The person whose voice has been recorded in this way stands next to the speaker being tested and speaks during gaps in his recording. The results obtained from this test with a wide variety of speakers show that very few manufacturers ever try this, or if they do they are unable or unwilling to do anything about the faults they must hear.

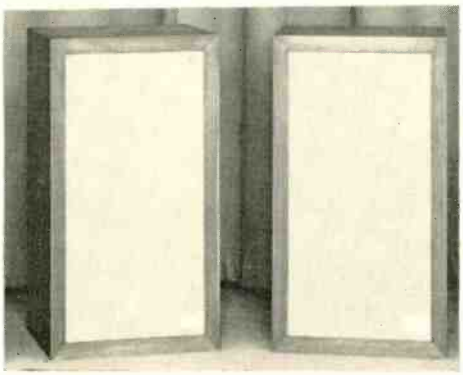
The *3A* speaker is small by monitor standards (see specification). It is very sturdily constructed and an IB design.

The units are a 305 mm bass unit with a long speech coil, a 35 mm mid-range unit and an 18 mm tweeter. The output levels of the latter two are adjustable by controls on the rear panel.

The pair supplied for review were a set of chocolate brown (probably the ones described as 'oiled walnut') with light grey grille cloth. They were a 'service' pair, mechanically, electrically and acoustically normal but decoratively not up to AR standards and therefore not saleable. Comments on their appearance are therefore hardly fair.

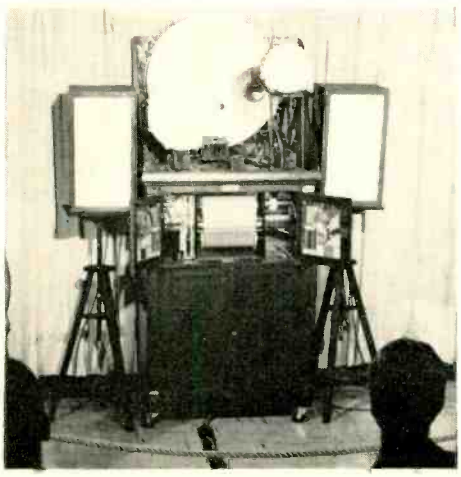
The usual sections of my test tape were played with the speakers placed as recommended by AR and with various settings of the level controls. The final tests, and those reported here, were made with the controls in the position that gave the best results on the widest range of material: the tweeters at maximum and the mid-range units on 'normal'. The sections of the test tape used, and the impression given, were as follows:



AR-3A

*Bells and Percussion.* Excellent transient and HF response. The musical box sounded fuller and warmer than usual but was very pleasant and easy to listen to.



*Organ.* Good firm bass and pleasing sound from all stops.

*Wind Quintet.* Very pleasant generally but the flute seemed to have lost a little of its brightness and the horn stuck out more than I remembered on the original.

*Full Orchestra.* Pleasant on the tutti passages, with full climaxes handled very well, but a little 'boxy' on the quiet string passages.

*Dance Orchestra.* Pleasant and fairly close to the original although slightly 'dull'. The snare drum sounded very muffled.

*Piano Concerto.* The strings had a 'boxy' sound and the piano did not sing as it did on the original.

*Choir.* This section caught the *3A*s out; the choir had a nasal and unnatural sound which was not at all pleasant.

*Folk Singer with guitar.* As with the choir, the voice was 'nasal'. The guitar was pleasant but not quite right.

*Speech.* The *3A*s really failed on this section, one listener suggesting 'the subject sounded as if he had swallowed half a hundredweight of cotton wool and put his head in a box'.

Nevertheless, comparison with other monitor speakers showed it to be a very good speaker, different from some of the others but no more than they were from each other. It was only when compared with the Quad *ELS* and an outstanding monitor that it was obvious the *3A* had a fair bit of coloration. This was confirmed by listening tests on live/recorded music between the AR and speaker *x*.

An A-B test from speaker *x* into the AR gave the impression that the performers had moved back into a resonant box. Switching from the AR to speaker *x*, the performers came forward out of their box again.

The *3A*s really came into their own handling fairly high level pop. The sound was a distinct improvement over both the Quads and the others and the ARs were able to give more output long after the Quads and model *x* had started to crack. In a room the size AR consider to be 'average', the level would satisfy even the most demanding teenager.

Used as a stereo pair in the way recommended by AR (backs to the wall about 1m above the ground), the *3A*s were very successful though the stereo image was less clearly defined than with some conventional speakers used away from walls at the usual angle. There was still quite a noticeable difference in the sound picture away from the 'stereo seat'. American users apparently do not usually bother about angling speakers.

**'Live' simulation**

A method of doing a live/recorded comparison with a simulated 'live' source was given in the AR literature. This was tried for this review. Various sections of the test tape were played into another speaker (the type used for this is not important but type *x* was handy). The output from the *x* was recorded on one track of a stereo machine, while the signal being fed to the *x* was recorded on the other track.

The model *x* was placed in a field on a fairly windless day for this recording, which was made with the AKG *C451*. The *x* and the speaker being tested, the *3A*, were then placed together in a listening room. The recording of the reference speaker was fed to the *3A* and the 'straight-through' recording on the other track fed to the other model. The resultant coloration is disturbing. I suggest AR examine the recording balance they use in their live-recorded tests, and that they seriously consider using more speech and choral music.

The axial response curve obtained on the review model is plainly bad, and it is unlikely that any speaker placing or room acoustics could compensate for this. The surprising thing is that the speakers sound as good as they do. It should be noted incidentally that all listening tests are held and reports on them written *before* the measurements are taken. It is easy to be convinced that wobbles in a response curve can be heard after seeing the curve, though they were inaudible before.

The *3A* cannot be recommended for monitoring classical or orchestral music, but, as they have a firm bass and handle power at this end exceptionally well, they are worth considering for studios recording 'pop'. **John Shuttleworth**

# AES ON CASSETTES

THE May meeting of the Audio Engineering Society was held on Tuesday, May 11, in a lecture room at Imperial College, Exhibition Road, Kensington, now the usual meeting place of the society. J. Eyres of Dolby Laboratories gave a talk and demonstration on the history of cassette tape recorders and discussed possible developments.

To acquaint the audience with the best quality that could be obtained from cassettes using the Dolby system, he played an excerpt copied from Decca's master of the Verdi *Requiem*, conducted by Solti. The replay equipment included a Wollensak cassette machine and Dolby *A505* system driving two 100W amplifiers coupled to KEF loudspeakers. The demonstration was most effective, although rather too loud to begin with, proving that very fine quality indeed can be expected from cassettes with a remarkably low hiss level. He then traced a history of the better known makes of cassette equipment, starting with the Garrard *Magazine*, on to the Grundig *DC1* cassette, and finally to the Philips system, also making reference to the RCA *Stereo 8* system. He showed the different generations of Philips cassette systems and also explained many of the problems in the manufacture of cassette hardware and tape duplication.

Photomicrographs were shown which, to almost everyone's amazement, proved that even the most delicate head cleaning in a cassette recorder is much more liable to scratch its surface and even damage the gap than the use of a cassette cleaning tape.

Mr Eyres commented on the performance of fine-gap record/play heads in recording. He concluded inevitably, after experiments, that recording with very fine gap heads tends to restrict the penetration of longer wavelength signals into the oxide, particularly on the thicker C60 cassettes, thus giving a lower peak recording level than would otherwise be possible. He suggested that an integrated head with a large gap for recording and finer gap for replay would solve the difficulty which is as much a space problem as anything else—and said it might not be long before such a head is produced.

A number of graphs displayed the peak recording level capabilities of chrome dioxide tape as opposed to ferric oxide. Chrome requires between 2 and 4 dB higher bias than is normal for ferric oxide. Mr Eyres had found that chrome tape has a considerable advantage over ordinary tape. Even with a 70 μS replay characteristic instead of 120 μS, and therefore 5 dB less playback HF than normal, chrome was capable of a respectably flat frequency response and considerably wider dynamic range than ferric oxide.

Mr Eyres played a current Decca prerecorded cassette of Stravinsky's *Petrushka* which sounded quite reasonable, showing the cassette system to have promise for the future.

**A.M.**

# PATENTS REVIEW

## ADRIAN HOPE

NEWELL Industries Inc of USA have an American Patent (US Patent 3,370,803) for a tape transport system in which a capstan engages supply and take-up tape rolls and rim-drives them. The tape rolls in such a set-up are supported on swing arms and urged towards the capstan for the necessary frictional engagement.

In their new British Patent (BP 1,224,250) Newell note the suggestion that the roll support spindle bearings and motor bearings suffer heavy demands due to the cantilevering forces involved. In other words, it's a safe bet that there has been bearing trouble in practice. The British Patent also refers to a problem involving what are usually called 'once around' motor speed fluctuations. Although these are usually small in a system like Newell's, they can give problems.

Needless to say the new British Patent seeks to overcome such problems and one thing they do is to put a resilient link between the capstan and the motor driving it. The resilient link is in the form of a hub with outwardly extending closed loops of spring steel. Rigid posts engage the resilient loops. The drive train to the capstan is via these. The idea is that, in the event of speed fluctuations appearing on the motor shaft, the capstan will be virtually unaffected because these speed fluctuations will be absorbed by the loop resilience.

To cope with the other problems, Newell intend packing grease or silicone fluid between some of the rotating parts which carry the tape rolls, the idea being not only to provide mutual viscous support between these surfaces but also to impose a viscous drag upon the movement of one relative to another. This should minimise transient disturbances and keep a proper tension on the tape running through the capstan. Obviously success or failure lies in finding the right grease and using the right filler to generate kinetic resistance. If their tape decks are going to work reliably all the year round, Newell will have to find themselves a grease which is unaffected by temperature and shows no tendency to dry out. Perhaps they already have but the patent doesn't give much clue.

Another type of tape transport system crops up in A. & M. Fell (Manufacturing) Ltd's British patent 1,217,667. Although this one is concerned mostly with flight recorders, it seems worth a mention because the whole point of the patent is to provide a particularly compact tape machine.

Anyone scared stiff of flying can take heart from the fact that most planes carry a performance recorder in the tail—because it is from here that they stand the best chance of being thrown clear. So far crash recorders have tended to record only instrumentation data—engine performance, fuel, etc. Because of the slow speed used (to cope with long flights), it has not been usual to record any speech from the pilot.

Fell have in mind a crash recorder which uses two separate tape systems, one running at relatively low speed for digital data recording, and one running faster for audio work. The two systems lie in a padded sphere, one on top of the other. Both use continuous tape loops. The continuous tape loop system used is a freely rotatable tape spool with a flat spiral stack of lubricated tape loosely coiled on it. The tape runs through a tape deck mounted on the opposite side of the spool and Fell say they can provide a seven hour loop in the available space.

I hope the recorder can reliably switch itself off after a crash, otherwise a rescuer taking more than seven hours to find it will be rewarded with a blank tape.

Finally, what the Ampex Corporation describe as a 'Magnetic Transducer for Low-error Rate Recording and Reproduction'. In BP 1,222,268, Ampex set out an interesting idea for coping with dropouts due to oxide voids. Although their invention is concerned mostly with recording and reproducing digital signals, the system is clearly applicable to audio and video recording. Ampex explain that it is often really essential to avoid dropouts and the only sure way of doing this is to record the signal on two parallel tracks and read both tracks at the same time. The theory is that it is highly unlikely that there will be a dropout from both tracks at the same time. The Ampex 'redundant track' transducer uses a common pole linked to two magnetic circuits and two non-magnetic recording gaps. The gaps are off-set across the tape and also spaced apart by a distance which is slightly greater than the width of potential dropout.

The tracks are recorded by the gaps in this staggered relationship, exactly the same recording signal being applied to the coils associated with both gaps. Reproduction is by similarly staggered gaps and, when there is no dropout problem, the same signal will be picked up from both gaps. When a dropout occurs at either gap, the processing electronics will still receive a signal, but it will be 6 dB less than the double signal. Such a reduction in signal can easily be coped with electronically.

The coils can be connected in series or parallel and, by using a rotary transformer arrangement, the technique can be applied to rotary heads. There's a lot more to it than that and plenty of food for thought for anyone concerned with the problem of excluding dropout effects, either to keep Frank Sinatra in good voice or to stop bank computers from dropping the odd zero here and there.

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| WHARFEDALE 100-I | £149·00 | **£119·00** |

Starred items above take ceramic cartridges only. All others take both ceramic and magnetic cartridges.

All the above Tuners and Tuner/Amplifiers include MPX Stereo Decoder with the exception of Armstrong where decoder is extra as listed.

## PICKUP ARMS

| | | |
|---|---|---|
| GOLDRING Lenco L75 | £12·33 | **£10·50** |
| GOLDRING Lenco L69 | £9·29 | **£7·00** |
| SME 3009 with S2 Shell | £34·47 | **£28·00** |
| SME 3012 with S2 Shell | £36·71 | **£31·50** |

## TURNTABLES

**GARRARD AP76 turntable, fully wired complete with Goldring G800 Cartridge, base and cover. Special Price £30·95.**
**GARRARD SP25 Mk III fully wired with Goldring G800 Magnetic Cartridge. Complete with base, plinth and cover. Special Price £21·98.**
**GARRARD 2025 fully wired with Sonotone 9TAHC Cartridge complete with base and cover. Special Price £15·50.**
**GOLDRING 705/P turntable, fully wired complete with Goldring G850 cartridge, base and cover. Rec. Ret. Price £25·00. Comet Price £15·95.**

| | | |
|---|---|---|
| DUAL 1219 transcription | £60·40 | **£50·00** |
| DUAL 1209 transcription | £42·62 | **£35·00** |
| GARRARD SP25 Mk III | £16·45 | **£11·90** |
| GARRARD SL65B | £21·25 | **£15·90** |
| GARRARD SL75B | £39·20 | **£27·50** |
| GARRARD SL95B | £50·01 | **£35·50** |
| GARRARD 401 | £38·07 | **£29·50** |
| GARRARD SL72B | £33·11 | **£27·90** |

| | Rec. Retail Price | Comet Price |
|---|---|---|
| GARRARD 3500, with GKS Cartridge | £17·23 | **£12·90** |
| Base and Cover to fit GARRARD SP25, SL 55, SL65B and 3500 Special Price | | **£4·00** |
| GARRARD 40B | £13·84 | **£10·97** |
| GARRARD AP76 | £28·88 | **£21·50** |
| GOLDRING GL69 Mk. II | £26·63 | **£21·25** |
| GOLDRING GL69P Mk. II | £35·14 | **£28·50** |
| GOLDRING GL75 | £36·41 | **£31·50** |
| GOLDRING GL75P | £46·94 | **£38·50** |
| GOLDRING Covers for 69P and 75P | £4·21 | **£3·50** |
| GOLDRING C99—plinth and cover for G99 | £11·45 | **£9·90** |
| GOLDRING G99 | £26·00 | **£22·90** |
| GOODMANS 3025 | £37·74 | **£26·90** |
| McDONALD MP60 | £15·75 | **£12·95** |
| McDONALD 610 | £20·00 | **£16·50** |
| Base and Cover for McDONALD MP60 and 610 Special Price | | **£4·50** |
| PHILIPS 228 | £20·00 | **£17·00** |
| PHILIPS GA146 | £31·50 | **£25·00** |
| PHILIPS 202 Electronic | £69·00 | **£57·50** |
| PIONEER PL12A with base and cover | £49·93 | **£37·95** |
| THORENS TX25 cover | £8·85 | **£7·00** |
| THORENS TD125 | £79·04 | **£61·95** |
| THORENS TD125AB | £120·20 | **£100·00** |
| THORENS TD150A Mk. II | £46·16 | **£35·95** |
| THORENS TD150AB Mk II | £49·96 | **£42·95** |
| THORENS TXII Cover | £4·43 | **£3·95** |

## SPEAKERS

| | | |
|---|---|---|
| ARENA HT 16 | £13·00 | **£10·95** |
| B & W Model 70 | £159·50 | **£121·95** |
| B & W DM3 | £63·00 | **£49·95** |
| B & W DMI | £32·00 | **£25·50** |
| CELESTION Ditton 120 | £24·00 | **£18·00** |
| CELESTION Ditton 15 | £32·00 | **£25·50** |
| CELESTION Ditton 25 | £65·00 | **£51·50** |
| GOODMANS Minister | £25·00 | **£21·20** |
| GOODMANS Magister | £62·50 | **£47·95** |
| GOODMANS Maxim | £20·39 | **£16·75** |
| GOODMANS Mezzo 3 | £34·00 | **£26·50** |
| GOODMANS Magnum K2 | £44·00 | **£33·00** |
| KEF Cresta | £22·17 | **£18·00** |
| KELETRON KN500 4 speaker system (pair) | £23·00 | **£17·95** |
| KELETRON KN700 4 speaker system (pair) | £27·50 | **£21·95** |
| KELETRON KN1000 4 speaker system | £19·25 | **£14·95** |
| KELETRON KN1500 4 speaker system | £24·75 | **£19·95** |
| KELETRON KN2000 4 speaker system | £28·75 | **£21·95** |
| LEAK 200 | £24·95 | **£18·90** |
| LEAK 300 | £32·50 | **£23·95** |
| LEAK 600 | £49·50 | **£36·90** |
| LOWTHER Acousta (with PM6) | £45·50 | **£38·50** |
| LOWTHER Acousta (with PM7) | £53·00 | **£46·00** |
| LOWTHER Ideal Baffle | £35·50 | **£30·00** |
| METROSOUND HFS 20 (pair) | £39·00 | **£25·95** |
| METROSOUND HFS 10 (pair) | £27·44 | **£22·95** |
| PHILIPS RH481 | £11·00 | **£9·25** |
| PHILIPS RH482 | £18·00 | **£15·00** |
| SINCLAIR Q16 | £8·98 | **£8·00** |
| STE-MA 275 3 speaker system | £23·10 | **£15·95** |

| | Rec. Retail Price | Comet Price |
|---|---|---|
| WHARFEDALE Speakers | | |
| Airedale | £69·50 | **£54·95** |
| Denton | £19·95 | **£15·90** |
| Super Linton | £24·95 | **£20·50** |
| Melton | £32·50 | **£25·50** |
| Dovedale 3 | £42·50 | **£32·50** |
| Rosedale | £65·00 | **£52·50** |
| Triton (pair) | £59·90 | **£46·90** |
| Unit 3 Speaker Kit | £13·00 | **£10·50** |
| Unit 4 Speaker Kit | £18·00 | **£14·25** |
| Unit 5 Speaker Kit | £26·00 | **£20·50** |

## TAPE RECORDERS AND TAPE DECKS

| | | |
|---|---|---|
| AKAI M10L | £245·05 | **£189·00** |
| AKAI X200D | £190·00 | **£159·95** |
| AKAI X5000 W/L | £177·98 | **£135·95** |
| AKAI 1800SD | £199·42 | **£167·00** |
| AKAI 1710L | £89·85 | **£65·95** |
| AKAI CR80 8-track stereo recorder | £115·03 | **£99·95** |
| AKAI CR80D 8-track stereo tape deck | £95·00 | **£79·95** |
| AKAI 4000 4-track Stereo | £124·90 | **£99·95** |
| AKAI 4000 D 4-track Stereo Deck | £89·95 | **£69·95** |
| BUSH TP 60 Cassette Tape Recorder | £29·40 | **£24·95** |
| BUSH TP 70 Cassette Battery/Mains Tape Recorder | £29·95 | **£23·95** |
| BUSH Discassette DC70 | £21·95 | **£16·95** |
| FERGUSON 3252 | £104·30 | **£83·95** |
| FERGUSON 3245 Twin track | £38·00 | **£29·95** |
| FERROGRAPH 722 | £266·41 | **£219·00** |
| FERROGRAPH 724 | £266·41 | **£219·00** |
| FERROGRAPH 702 2 track tape deck | £228·71 | **£193·00** |
| FERROGRAPH 704/W 4 track tape deck | £228·71 | **£193·00** |
| GRUNDIG C200L Cassette | £39·90 | **£29·95** |
| GRUNDIG TK 121 (Twin-track) | £56·85 | **£43·95** |
| GRUNDIG TK 146 (4-track Auto | £68·14 | **£53·95** |
| GRUNDIG TK 149 4-track | £57·63 | **£47·95** |
| MIDLAND TC144 Cassette | £18·00 | **£13·95** |
| PHILIPS 4307 4-track | £49·50 | **£38·95** |
| PHILIPS 4407 4-track stereo recorder | £110·00 | **£89·95** |
| PHILIPS 4500 4-Track Stereo Tape Deck | £126·00 | **£98·95** |
| PHILIPS 4408 4-Track Stereo | £139·00 | **£109·00** |
| PHILIPS 4308 | £60·50 | **£45·50** |
| PYE Cassette Recorder/Radio (Batt./Mains) | £45·50 | **£36·95** |
| TELETON 511 Battery/Mains Cassette | £29·50 | **£17·50** |
| TELETON TRC 130 cassette | £41·75 | **£31·90** |
| TELETON TC110 cassette | £27·75 | **£20·00** |
| TOSHIBA GT 840S | £110·00 | **£67·95** |
| TOSHIBA GT 601v Twin Track | £45·15 | **£29·95** |
| TOSHIBA 850 SA | £94·00 | **£59·95** |

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● **Interchangeable head assembly** comprising half-track, stereo, erase, record and playback heads, is mounted on a single rigid plate fixed to the main chassis. It is normally not necessary to replace or adjust heads during the normal life of the machine.

*Broadcast-studio versions Models 28B and 28C are provided with tape speeds of 15 and 7½ ips, but have no mixing or monitoring and VU-meter amplifier. Model 28B is equipped with full-track heads. Model 28C has two-track heads and track selector switch.*