

DECEMBER 1968 2/6d

tape recorder

SURVEY OF TAPE
TO DISC STUDIOS

TANDBERG 7 SERVICING

A VISIT TO
LEEVERS-RICH

RECORDING OUTDOORS

GRUNDIG TK2200
AND C200 REVIEWS

ANNUAL INDEX

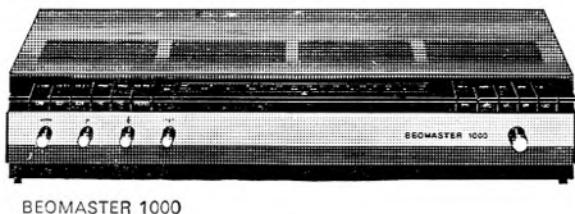
REPORT ON THE
NORTHERN AUDIO FAIR



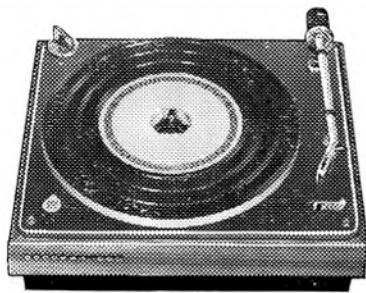


Bang & Olufsen— for those who consider design and quality before price

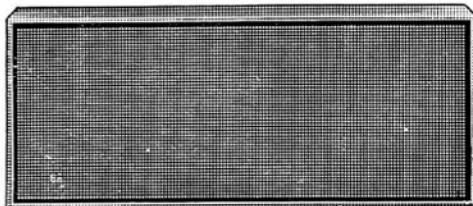
Bang & Olufsen audio equipment is made for those who consider design and quality first. There is a wide range of radios, record players, amplifiers, loudspeakers and radiograms, all designed to give unprecedented pleasure to ear and eye. Your B & O dealer will advise you how to start a system that will give you enjoyment for the years ahead. Here is just one selection.



BEOMASTER 1000



BEOGRAM 1000



BEOVOX 2400

BEOMASTER 1000 The complete audio spectrum is reproduced naturally and faithfully by the Beomaster 1000. Truly magnificent to look at, this stereo FM radio/amplifier is available in teak or rosewood finish. The front panel is worked in stainless steel with piano-key selector switches. The long, low-line cabinet lies elegantly along your bookshelf—the centre-piece of an advanced high-fidelity music system. Technically superb, giving 15 watts

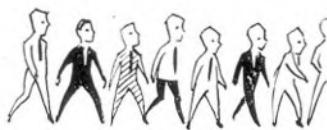
audio output per stereo channel, the Beomaster 1000 allows instant choice between radio, tape recorder, gramophone and two separate sets of stereophonic loudspeaker systems. There are individual bass, treble, and stereo balance controls, plus 'scratch' and 'rumble' filters. A B&O stereo decoder is fitted for reception of stereo broadcasts, and the illuminated radio dial has flywheel tuning. Price £99. 5. Od.*

BEOGRAM 1000 A stereo turntable unit mounted on a suspended shock-proof plinth and featuring the world famous ST/L 15° tone arm, hydraulic lowering device and SP7 diamond stylus. Specially engineered speed selector with vernier adjustment. Available in teak or rosewood finish. Price £40. 15. Od.*

BEOVOX 2400 The Beovox 2400 is a high fidelity wall mounting or bookshelf speaker, to DIN standard, with one bass, one mid range and one tweeter unit (9½" x 23¾" x 10¾"). The neat simple lines contain the acknowledged skill and craftsmanship of this world famous Danish range, that will add exceptional tonal quality to your audio system. Available in teak or rosewood finish. Price £33. 0. Od.*

*Recommended retail price

Fully descriptive literature is available from your B & O dealer or direct from
Bang & Olufsen United Kingdom Division, Eastbrook Road, Gloucester. Telephone: 0452 21591
London Showrooms: 70/71 Welbeck Street, London, W.1. Telephone: 01-486 2144



NuSound
BRITAIN'S LARGEST SPECIALISTS



TAPE RECORDER AND HI-FI CENTRES

EVERY LEADING MAKE AVAILABLE

- EASIEST HIRE PURCHASE TERMS
- GENEROUS PART EXCHANGES
- FINEST AFTER-SALES SERVICING
- EXPERT STAFF AND EXPERT ADVICE

Stockists of: Akai, Ampex, Arena, Armstrong, B. & O., Brenell, Dynatron, EMI, Elizabethan, Ferguson, Ferrograph, Garrard, Goldring, Goodmans, Grundig, H.M.V., Hacker, Kef, Leak, Loewe-Opta, National, NuSound, Ortofon, Philips, Quad, Reps, Rogers, Sanyo, Sony, Stereosound, Tandberg, Telefunken, Thorens, Truvox, Uher, Van Der Molen, Vortexion, Wharfedale, Wyndson, etc.

Every make and model of Tape Recorder and Hi-Fi Unit is available for immediate demonstration by our specialist staff who will be delighted to assist you in selecting equipment to suit your individual requirements. Only from NuSound can you benefit from all these invaluable features—the most comprehensive range of equipment on display in the country, expert staff, free technical advice, immediate demonstration of any model and the finest after-sales servicing available.

WE OPERATE A PERSONAL EXPORT SCHEME
SAVING UP TO 20% ON LIST PRICE



TAPE RECORDER CENTRES

WEST END

82 HIGH HOLBORN, W.C.1. Tel. 01-242-7401
(200 yds. Kingsway—Half-day Saturday)

CITY

228 BISHOPSGATE, E.C.2. Tel. 01-247 2609
(Opp. Liverpool St. Stn.—Closed Sat. Open Sun. 10-2)

E. LONDON

2 MARYLAND STATION, E.15. Tel. 01-543 5879
(Adjacent Maryland Point Stn.—Half-day Thursday)

N.W. LONDON

360 KILBURN HIGH RD, N.W.6. Tel. 01-624 1656
(Opp. Kilburn Tube Stn.—Half-day Thursday)

TAPE AND HI-FI CENTRES

N. LONDON

242/4 PENTONVILLE RD., N.1. Tel. 01-837 8200
(200 yds. Kings Cross Stn.—Half-day Thursday)

ILFORD/ESSEX

85-100 ILFORD LANE, PIONEER MARKET.
Tel. 01-478 2291 (200 yds. Ilford Stn.—Half-day Thur.)

S.E. & KENT

36 LEWISHAM HIGH ST., S.E.13. Tel. 01-852 2399
(Opposite Chiesmans — Half-day Thursday)

SEE

AKAI

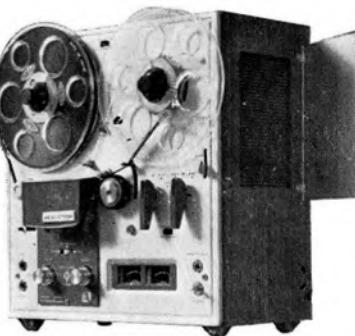
THIS EQUIPMENT
AT ALL OUR
CENTRES

See, hear and compare the complete range of Akai Stereo Tape Recorders. Our experienced staff are able to give expert advice and also demonstrate the many outstanding features of this wonderful range of equipment.

Model 1710W —
Four track, three speed complete stereotaperecorder.

A FEW AVAILABLE AT OUR
SPECIAL PRICE
OF £89.10.0.

(MANUFACTURER'S LIST
PRICE £109.17.3)



**BRITAIN'S
LARGEST
TAPE
& HI-FI
SPECIALISTS**

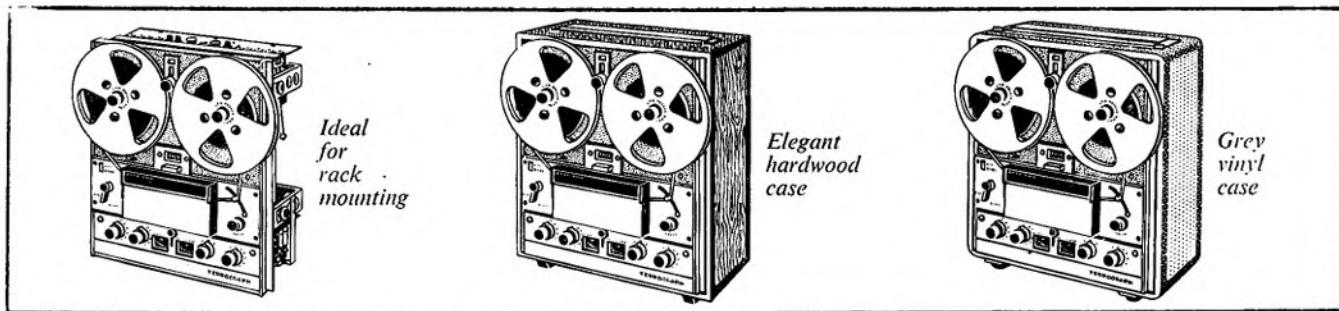
At every NuSound showroom you'll find a wonderfully comprehensive range of equipment backed by over 13 years' experience in this ever growing and highly specialised field—in which the NuSound reputation is "second to none".

Four NuSound Centres are devoted exclusively to Tape Recorders and Accessories and the other three NuSound centres specialise in both High Fidelity Equipment and Tape Recorders.

Visit any NuSound Centre and you'll be certain of 100% Service and Satisfaction.

Ferrograph New Generation Series 7 -





not a year old and already a classic

Ferrograph Tape Recorders, Series 1 to 6, have been famous since 1949, and although Series 7 was introduced only a year ago it is already acknowledged as a classic. No other recorder to-day gives you quality like this, reliability like this, and offers so many desirable facilities.

It has the finest specification—and when Ferrograph gives you a figure, it is a conservative minimum. Ferrograph guarantees it. Every instrument is finally individually adjusted for optimum performance. With Ferrograph you know where you are—exactly.

Available in Mono, and in Stereo with and without end amplifiers; embodying a unique range of 30 features including:

- All silicon solid-state electronics with FET input stages and wide input overload margins.
- Vertical or horizontal operation.
- Unit construction: The 3 individual units i.e. tape deck, power unit and amplifier complex are mounted on a single frame easily removable from cabinet for service or installation in other cabinets or racks.
- 3 motors (no belts).
- 3 tape speeds.
- Variable speed spooling control for easy indexing and editing.
- Electrical deck operation allowing pre-setting for time-switch starting without need for machine to be previously powered.
- Provision for instantaneous stop/start by electrical remote control.
- Immediate access head block for editing and cleaning.
- Single lever-knob deck operation with pause position.
- Independent press-to-record button for safety and to permit click-free recordings and insertions.
- Adjustable reel height control.
- Damped tension arms for slur-free starting.
- 8½" reel capacity.
- Endless loop cassette facility.
- Provision for signal operated switching units.
- Internal loud speakers (2)—1 each channel on stereo, 2 phased on mono.
- 4 digit, one-press re-set, gear-driven index counter.
- 2 inputs per channel with independent mixing (ability to mix 4 inputs into one channel on stereo machine).
- Signal level meter for each channel operative on playback as well as record.
- Tape/original switching through to output stages.
- Re-record facility on stereo models for multi-play, echo effects etc., without external connections.
- Meters switchable to read 100 kHz bias and erase supply with accessible preset adjustment.
- Three outputs per channel i.e. (1) line out—level response. (2) line out—after tone controls. (3) power output—8-15 ohms.
- Power output 10W per channel.
- Independent tone controls giving full lift and cut to both bass and treble each channel.
- Retractable carrying handle permitting carrying by one or two persons.
- Available in several alternative presentations.

U.K. Retail prices from £135 incl. P.T.
Please see next page for list of Ferrograph Stockists



FERROGRAPH

THE FERROGRAPH CO LTD, FERROGRAPH HOUSE, 84 BLACKFRIARS ROAD, SE1. TELEPHONE: 01-928 1981

Listen for yourself

To know the Ferrograph New Generation Series 7 you must look at it, listen to it, for yourself. You will find New Generation instruments soon in stock at many of the best tape-recording and Hi-Fi specialists in the country, including the following:

Ferrograph stockists

London Dealers	Blackpool	Doncaster	Leicester	Salisbury
Telonic Ltd., 92 Tottenham Court Rd., London, W.1.	F. Benfell Ltd., 17 Cheapside.	Tom Jaques Ltd., 16 Wood Street, Doncaster, Yorks.	United Film Services, 7 Kings Street. Tape Recorder Centre, 72a Church Gate.	Suttons Hi-Fi Centre Ltd., 50 Blue Boar Row, Salisbury, Wilts.
Larg of Holborn Ltd., 76/77 High Holborn, London, W.C.1.	Bolton	Edinburgh	Linton	Skegness
Nusound, 82 High Holborn, London, W.C.1.	Harker & Howarth (Music) Ltd., Goodwin Street, Bolton, Lancs.	J. Nicolson (Hi-Fi Corner) Ltd., 1 Haddington Place, Edinburgh 7.	H. S. W. Speechley & Co., 49 High Street, Linton, Cambs.	Norman Throp Ltd., 68 Lumley Road, Skegness, Lincs.
Nusound, 228 Bishopsgate, London, E.C.2.	Bournemouth	Epping	Liverpool	Sheffield
Nusound, 360 Kilburn High Road, London, N.W.6.	Tape Recorders (Bournemouth) Ltd., 874 Old Christchurch Rd., Boscombe, Bournemouth.	Chew and Osborne Ltd., 148 High Street.	Beaver Radio (Liverpool) Ltd., 60 Whitechapel, Liverpool, Lancs.	Sheffield Photo Co. Ltd., 6 Norfolk Row, Fargate.
Nusound, 36 Lewisham High Street, London, S.E.13.	Brighton	Exeter	Luton	Shrewsbury
Francis of Streatham, 169-171 Streatham High Road, London, S.W.16.	John King Films Ltd., 71 East Street.	Electrosure Ltd., 162-163 Fore Street.	Coventry Radio Ltd., 189 Dunstable Road,	Avon Hi-Fi Ltd., 13 Wyle Cop, Shrewsbury, Salop.
Hampstead High Fidelity Ltd., 91 Heath Street, London, N.W.3.	Avery's Ltd., 77 St. James's Street.	Farnham	Luton, Beds.	Southampton
The Recorder Company, 188 West End Lane, London, N.W.6.	Lanes Radio Ltd., 11 Gardiner Street.	Lloyd & Keyworth Ltd., 26-27 Downing Street, Farnham, Surrey.	Hamiltons Ltd., 35 London Road.	
C. C. Goodwin Ltd., 7 The Broadway, London, N.22.	Bristol	Gerrards Cross	Maidstone	Southport
Nusound, 2 Maryland Point Station, Stratford, London E.15.	Tape Recorder and Hi-Fi Centres Ltd., Stokes Croft.	Eric Films Ltd., 34-36 Oak End Way, Gerrards Cross, Bucks.	Sloman & Pettit, Pudding Lane.	Wayfarers Radio Ltd., Burton Arcade.
Studio Tapes Ltd., 199 Hoe Street, Walthamstow, E.17.	Sound Selection Ltd., 361-363 Gloucester Road, Bristol 7.	Gillingham	Manchester	Stafford
Aberdeen	Bromley	E. Hadaway, Waiting Street.	Lancs Hi-Fi Ltd., 8 Deansgate,	Tom Reekie Ltd., 10 Bridge Street.
Aberdeen Sound Centre 25a Belmont Street.	Bromley Sound, 22 Letchworth Drive.	Glasgow	Manchester 3.	St. Helens
C. Bruce Miller, 51 George Street.	Bury	McCormacks (Music) Ltd., 33 Bath Street, Glasgow, C.2.	Godleys Radio & T.V. Ltd., Shude Hill.	Harold Stott Ltd., 18 Westfield Street, St. Helens, Lancs.
Aberdeen Radio Ltd., 9 Hadden Street.	John Smith & Son (The Rock) Ltd., 184 The Rock, Bury, Lancs.	Goodmayes	Mansfield	Stoke-on-Trent
Barnsley	Cambridge	Unique Radio Ltd., 6 The Facade, Goodmayes, Essex.	Syd Booth, 11 Queens Street.	Wilson's Radio Ltd., 30-32 Liverpool Road,
Geoffrey Barnard, 3 Pitt Street.	University Audio, 1-2 Peas Hill.	Gravesend	Middlesbrough	Stoke-on-Trent, Staffs.
Barnstaple	K.P. Cameras Ltd., 12a Kings Parade.	Bennett & Brown Ltd., 50, 60b and 60c Wrotham Road, Gravesend, Kent.	McKenna & Brown Ltd., 122 Linthorpe Road, Middlesbrough, Yorks.	Stockport
O. Nicklin & Son Ltd., The Square.	Canterbury	Great Yarmouth	Newcastle-upon-Tyne	W. J. & M. Bayliss Ltd., 611 Gorton Road, Reddish, Stockport.
Bath	Canterbury Hi-Fi, St. Dunstan Street.	Norfolk Radio, 12 Broad Row, Great Yarmouth.	Turners (Newcastle- upon-Tyne) Ltd., Camera House, Pink Lane.	Swansea
C. Milsom & Son Ltd., Northgate.	Cardiff	Guildford	J. G. Windows Ltd., 1-7 Central Arcade.	Wilson's Radio Ltd., 30-32 Liverpool Road,
Birkenhead	Sound Film Services Ltd., (Cinema Liaison Ltd.), 27 Charles Street.	P.J. Equipments, 21 Onslow Street.	Nottingham	Teddington
James McKenzie Ltd., Grange Road.	Carlisle	Huddersfield	Petes Electronics Ltd., 165 Arkwright Street.	Daytronics Ltd., 119a High Street,
Birmingham	Coventry	J. Wood & Son Ltd., 67 New Street, Huddersfield, Yorks.	Nuneaton	Teddington Lock, Middx.
C.H. (High-Fidelity) Ltd., 167/169 Bromsgrove St., Birmingham 5.	Coventry Tape Recorder Services, 33 King William Street.	Ilford	Tottenham	Truro
Chas. H. Young Ltd., 170 Corporation Street.	R.E.S. Ltd., 13 City Arcade.	Nusound, 87-100 Pioneer Market, Ilford Lane, Ilford, Essex.	Audiocraft Ltd., Abington Square.	John Fry Ltd., Hi-Fi Centre, 6 Cathedral Lane,
Griffin Radio Ltd., 94 Bristol Street, Birmingham 5.	Crewe	Kirkcaldy	Nottingham	Truro, Cornwall.
Blackburn	J. H. Charlesworth (Crewe) Ltd., 28 Hightown, Crewe, Cheshire.	Caithness Brothers, 270 High Street.	Plymouth	Winchester
Holdings of Blackburn Ltd., 39-41 Mincing Lane.	Darlington	Leamington Spa	A. E. Ford Ltd., 84 Cornwall Street.	Southern Recorder Service,
	Geoffrey A. Williams & Son Ltd., Blackwell Gate.	W. M. Tysons, 41 Russell Street, Leamington Spa, Warks.	Portsmouth	34 St. George's Street.
	Derby	Becketts Film Services Ltd., The Headrow, Leeds 1, Yorks.	H. R. Knight, 71 Tangier Road.	Woking
	Victor Buckland Ltd., 41-49 London Road.	Leeds	Redcar	D. W. Hughes & Sons Ltd., 5 Central Buildings, Chobham Road.
		Becketts Film Services Ltd., The Headrow, Leeds 1, Yorks.	Rugby	Worcester
			McKenna & Brown Ltd., 135 High Street, Redcar, Yorks.	Johnson's Sound Service, Sidbury.
			Berwick Hi-Fi Centre, 5 Sheeps Street, Rugby, Yorks.	Wilmslow
				Transistor Centre, Green Lane, Wilmslow, Cheshire.
				Worthing
				Bowers & Wilkins Ltd., 1 Beckett Buildings, Littlehampton, Worthing.

If none of these is near enough to you, in case of difficulty, or for free literature, send us the coupon, or give us a ring on WATERloo 1981.

FERROGRAPH

To The Ferrograph Co Ltd

Ferrograph House

84 Blackfriars Road London SE1

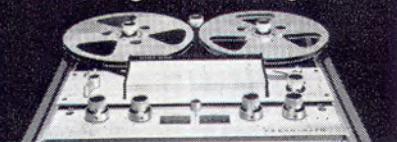
Please send me a free brochure on the
Ferrograph New Generation Series 7

NAME

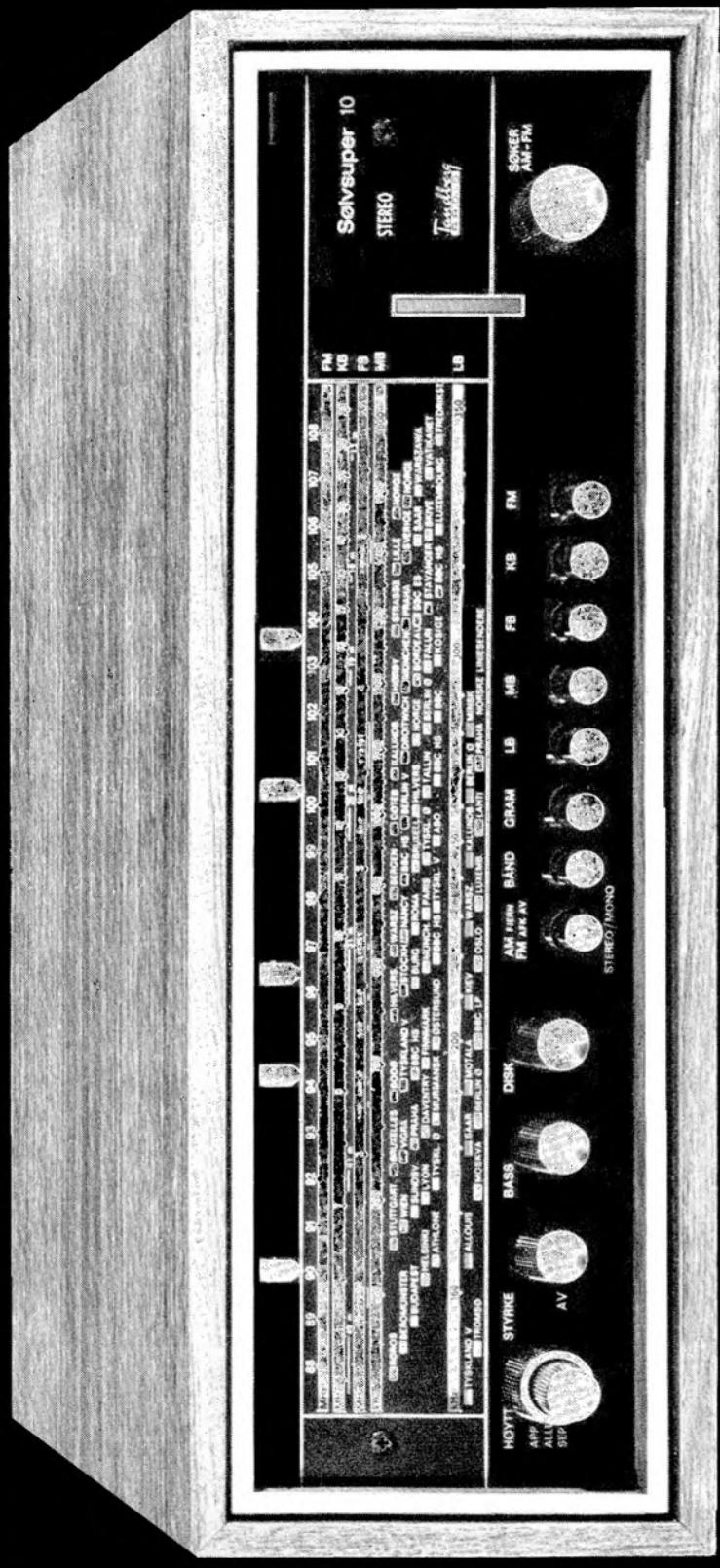
ADDRESS

TR

the tape recorder with
the hearing-is-believing sound



New from Tandberg



Solvsuper 10.71 combined FM/AM Tuner and Stereo Amplifier

It's all there. Everything the heart of your Hi-Fi system should have. A 1.2 watt stereo amplifier. An exceptional FM/AM tuner with provision for a stereo reception decoder. Combined in an elegant low line teak case.

on FM.

The Solvsupper 10.71 incorporates these features:—

- ★ 5 wavebands: long, medium, short, coastal and FM.
- ★ Automatic frequency control

- ★ Push button selection of wavebands, or external gramophone tape recorder etc.
- ★ Separate bass and treble controls.
- ★ Adjustable FM station indicators.
- ★ Separate gain controls on each channel.
- ★ Electronic beam tuning indicator.
- ★ 2 x 6 watts output.
- ★ 15" long x 9" wide x 5 $\frac{1}{4}$ " high.
- ★ £65.0.0.

The Solvsupper is also available in two other versions:—

- 10.70 with a single built in speaker (mono)
- 10.72 with two built in speakers (stereo)

Elistone Electronics Limited,
Hereford House,
Vicar Lane, Leeds 2.

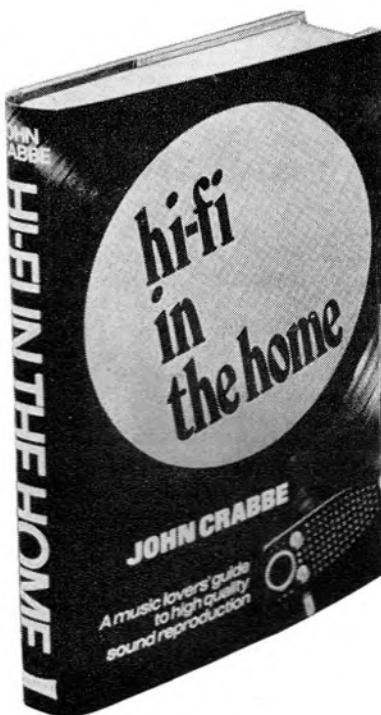
'Tandberg'
move up to

HI-FI in the Home

by John Crabbe, editor of Hi-Fi News and Tape Recorder

This fully illustrated book has been written for the music lover who wants to understand how to achieve the best possible domestic sound quality.

Technicalities are clearly explained and terms defined throughout the text. It deals very satisfactorily with its subject, through musical sounds, components, choosing equipment, installation, care of records, to future developments. There is a comprehensive glossary, bibliography and index.



HI-FI in the Home

has an authority and excellence you will appreciate

40/- from booksellers,

or direct from the publishers (post 2/-)

**BLANDFORD PRESS, 167 High Holborn,
LONDON, W.C.1**



LUXOR

brings you the
Swinging Sound
from Sweden

MP613 MALAR



Stereo Tape Recorder—4-track, 3-speed. Frequency response: $7\frac{1}{2}$ i.p.s. 50—19,000 c/s. $3\frac{3}{4}$ i.p.s. 50—12,000 c/s. $1\frac{1}{2}$ i.p.s. 80—6,000 c/s. Output 4 watts mono, 2 x 2 watts stereo. Automatic stop, three position speaker switch. Dual volume control. Four push buttons: recording (special lock prevents erasing) radio, gramophone and microphone. Three position channel selector. High speed rewind. Instant stop. Pause control. Built-in four-channel mixer, multi playback, synchro playback. Combination head, fine laminated Fe-Ni-core, range 50 dB. Max. 7" reel. Available in teak or rosewood with transparent dust cover. Size $15\frac{1}{2}$ " x $12\frac{1}{2}$ " x 7".

For name and address of nearest stockist phone or write

LUXITONE

84 Bolsover Street, London W.I.

Telephone 01-636 2901 (4 lines)



AKAI and R.E.W.

... a range to
suit every pocket
and every need

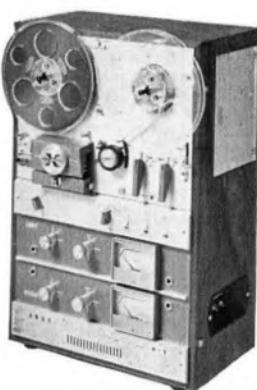
... the name that
stands for service
and a better deal

NOW... FABULOUS FREE OFFERS with superb AKAI Tape Recorders!



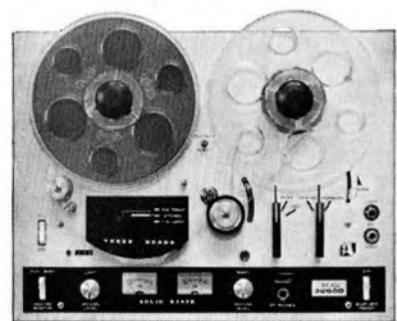
1710W

AKAI M9 High Fidelity Stereo Tape Recorder (right) Cross-field Head. All Silicon Transistor Amplifier. 4-track stereo/monaural recording and playback. 3 speeds ($\frac{1}{2}$, $3\frac{1}{2}$ and $7\frac{1}{2}$ ips) plus 15 ips with 15 ips adaptor kit. Hysteresis synchronous 2-speed motor. Wide Cross-field frequency response. All silicon transistor amplifier. Sound on sound. Automatic shut off. Automatic stop. Automatic pinch wheel release. Automatic lever release. Recording mode switch. Bass switch. Tape shifter in fast forward/rewind operation. DIN jack, stereo headphone jacks. Four digit index counter with reset button, VU meters. Finely oil-finished wooden cabinet or vinyl/leather wooden cabinet. £195—PLUS—SENSATIONAL OFFER to every purchaser of the M9, a FREE pair of Wharfedale Super Lynton Speakers currently valued at no less than £41 4s. 0d.!



M9

AKAI 1710W Stereo Tape Recorder (left) The Shield Type Head for High S/N Ratio. 4-track stereo/monaural recording and playback. 3 speeds ($\frac{1}{2}$, $3\frac{1}{2}$ and $7\frac{1}{2}$ ips (15ips optional)). Automatic shut off. Pause lever. Tape cleaner. Tape shifter in fast forward/rewind operation. 4 hours maximum stereo recording capacity with a 1,200ft. tape. DIN jack, Stereo headphone jack. 3-digit index counter with reset button, VU meters. Finely oil-finished wooden cabinet. £109—PLUS—SPECIAL OFFER with each machine—FREE ACCESSORY KIT (value £12 18s.) PLUS FREE pair of Stereo Headphones value £6 10s.



3000D

AKAI 3000D 4-track Stereo Tape Deck (left) High Quality Three Heads System. 4-track stereo/monaural recording and playback. For playback, the 3000D requires external power amplifier and speakers. 2 speeds ($3\frac{1}{2}$ and $7\frac{1}{2}$ ips). Three heads (erase, recording and playback heads). All silicon transistor pre-amplifier. Automatic shut off, pause lever. Tape cleaner. DIN jack. Stereo headphone jack. 3-digit index counter with reset button. VU meters. Beautifully grained wooden cabinet. £99 10s. PLUS—SPECIAL OFFER with every deck FREE pair of Stereo Headphones listed at £6 10s. PLUS FREE COVER—PLUS TWO FREE MICROPHONES listed at 6 gns.



AKAI X-300. 10in. Reel Studio Type Stereo Tape Recorder (right) (No Belts... Direct Driven Capstan). Crossfield Head. Solid State Amplifier. 4-track stereo/monaural recording and playback. 2 speeds ($3\frac{1}{2}$, $7\frac{1}{2}$ and 15 ips optional). 4-heads (erase, recording, playback/monitor plus bias heads), 3 outer-rotor motors (Hysteresis synchronous 2-speed motor for direct driven capstan, two torque motors for fast forward and rewind). 50 watts solid state amplifier. Unitized amplifier circuit cards. Sound over sound. Automatic stop. Automatic shut off. Specially 90kc biased for recording of FM multiplex. Reel accommodation up to 10in. Piano key controls. Tape cleaner. 4-digit index counter with reset button. List price £263.18.3. OUR PRICE only 179 gns.!

All these superb machines available on INTEREST FREE TERMS, one quarter of cash price deposit, balance over 12 months.

R.E.W.

R.E.W. (EARLSFIELD) LTD.

★ LEADERS IN MAIL ORDER HI-FI

● HEADQUARTER SHOWROOMS AND MAIL ORDER:

DEPT. TR, 266-8 UPPER TOOTING ROAD, LONDON, S.W.17 Tel: 01-672 4471/2 & 9175

● WEST END SHOWROOMS: 146 CHARING CROSS ROAD, LONDON, W.C.2. Tel: 01-836 3365 (opposite Astoria Cinema)

Look what HEATHKIT offer in High-Fidelity sound

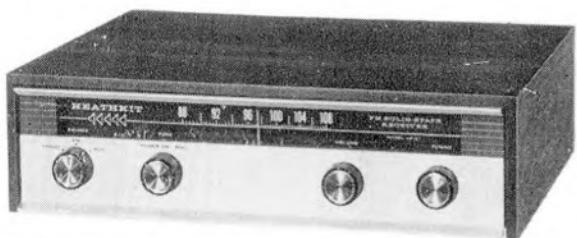
Top Value in a 30 watt FM
Stereo Receiver, AR-14



A 31 transistor, 10 diode circuit for cool instant operation. Wide frequency coverage at 10 watts output per channel, continuous 15 watts per channel IHF music power. Wide band FM/FM stereo tuner plus the pre amplifiers and two power amplifiers. All at a low budget-saving price.

Kit K/AR-14 (less cabinet) ... £54.0.0 pp 13/6
Ready-to-use A/AR-14 (less cabinet) £75.0.0 pp 13/6
Cabinet (teak or walnut) ... £4.10.0 extra

A Quality Table Radio FM Mono Receiver, AR-27



A 13 transistor 6 diode circuit gives 5 watts rms output over wide frequency range.

Kit K/AR-27 (less cabinet) ... £22.10.0 pp 10/6
Ready-to-use A/AR-27 (less cabinet) £32.0.0 pp 10/6
Cabinet (walnut or teak) ... £3.10.0 extra

AND OF COURSE . . .

HEATHKIT QUALITY LOUDSPEAKER SYSTEMS

**See these and more, in
full colour in the latest
FREE catalogue**



DAYSTROM LTD., Dept. HT-12, Gloucester 29451

- Please send FREE Heathkit catalogue.
 Enclosed is £ plus post and packing

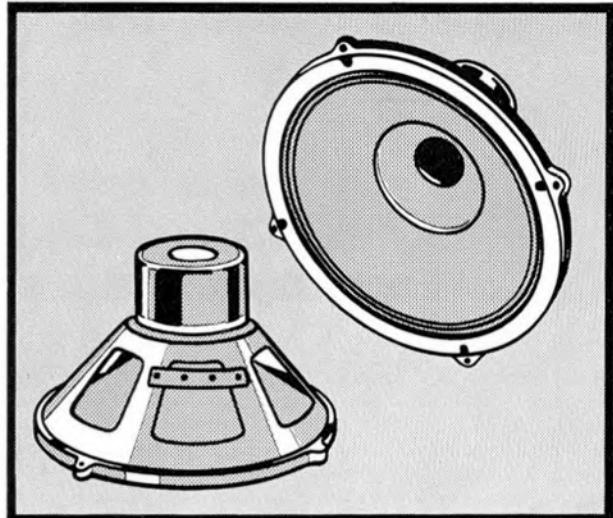
Please send model(s)

NAME

ADDRESS

.....
Prices and specification subject to change without prior notice

Faithful Reproduction



with the Grampian TC12 loudspeaker

The Grampian TC12 loudspeaker is a high quality twin cone unit at a reasonable price. The loudspeaker is built of high quality materials to a rigid specification and is eminently suitable for good quality sound reproduction. Let us send you full details or better still go and hear one at your local dealers now.

Design for suitable cabinet available.

Grampian manufacture high grade microphones, parabolic reflectors, windshields and accessories, also mixers and amplifiers.

Grampian SOUND EQUIPMENT

Integrity that you hear

Send for leaflet giving full details

GRAMPIAN REPRODUCERS LTD

Hanworth Trading Estate, Feltham, Middlesex

Tel: 01-894 9141 3 Cables REAMP FELTHAM

SHARP

to the point of perfection



Model RD 303E. An all transistor solid state Tape Recorder. Two speeds, twin track. Fully portable with operation from internal batteries or AC Mains. Automatic or manual recording level control. Remote control switch on microphone for instant start/stop. Uses 3" reels. Utmost simplicity of control with brilliant performance—truly a miniature marvel. Dimensions: 11 $\frac{1}{2}$ " x 3 $\frac{1}{2}$ " x 7 $\frac{1}{2}$ ". Complete with dynamic microphone, recording lead, earphone, batteries (4 x Ever Ready LP U2 or equivalent) 3" reel of tape and empty spool. R.R.P. £28 17 6.



RD 504. An all transistor solid state Tape Recorder, twin track, two speeds. Superb recording and reproduction. Entirely portable, will operate anywhere. Automatic change over from batteries to its own built-in A.C. power unit. Designed to play or record in any position. Remote control switch on microphone allows full flexibility in use. Dimensions: 12" x 3 $\frac{1}{2}$ " x 9 $\frac{1}{2}$ ". Complete with dynamic microphone, recording lead, earphone, batteries (6 x Ever Ready LP U2 or equivalent) 5" reel of tape and empty spool. A.C. mains 240 V. R.R.P. £36 15 0.



Model RD 505. Solid state all transistor tape recorder twin track, two speeds. Superb recording reproduction with outstanding simplicity of control. Entirely portable will operate anywhere from internal batteries or AC mains. Designed to play or record in any position. Remote control switch on microphone allows full flexibility in use. Dimensions 12" x 10" x 4". Additional features include 3 digit tape counter, fully variable tone control, large internal speaker, automatic or manual level control and level/battery meter. Comes complete with dynamic microphone, recording lead, earphone, batteries (6 x Ever Ready LP U2 or equivalent) 5" reel of tape and empty spool. R.R.P. £39 18 0.

THE SETS WITH THE 5 YEAR GUARANTEE

SHARP

16/18 WORSLEY ROAD, SWINTON, LANCS

Tel : SWinton 3232 (5 lines)

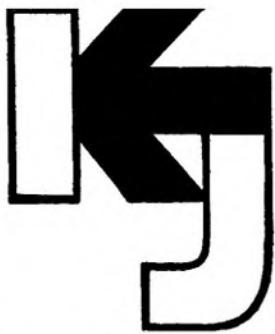


SALES AND
SERVICE

For further details and leaflet contact:
SHARP SALES & SERVICE, 16/18 WORSLEY ROAD, SWINTON, LANCS.
Tel: SWinton 3232 (5 lines)

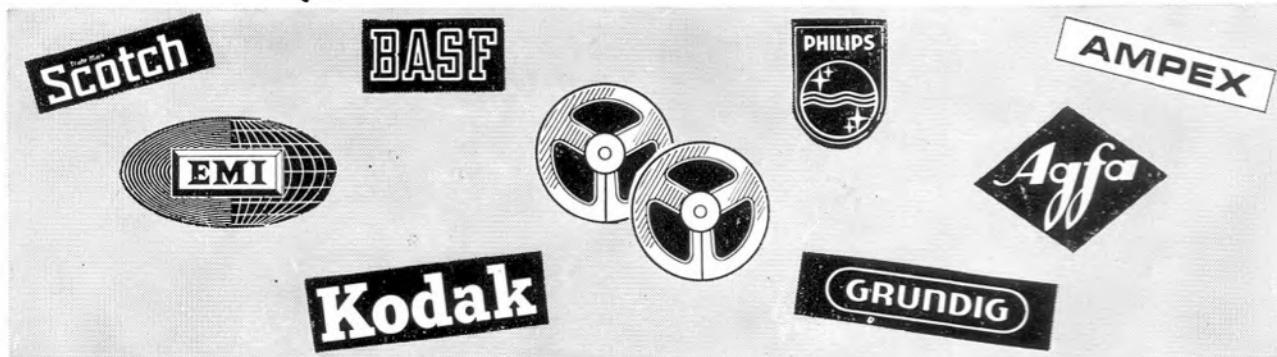
Name _____
Address _____

T.14.



K. J. ENTERPRISES for tapes

UP TO 40% OFF



BRANDED TAPE

BASF—EMI—GRUNDIG
PHILIPS—SCOTCH
AGFA

Brand New, Fully Guaranteed and in normal manufacturer's pack

STANDARD PLAY	LIST PRICE	OUR PRICE
5" 600' {	22/2	18/-
5½" 900' { Except Agfa	29/5	24/-
7" 1200' }	36/7	29/6

LONG PLAY	LIST PRICE	OUR PRICE
3" 210' Not Scotch	9/3	7/6
3" 300' Scotch only	9/7	7/9
4" 450'	14/9	12/2
4½" 600' BASF, Agfa only	22/-	18/-
5" 900'	29/2	23/9
5½" 1200'	36/5	29/6
7" 1800'	51/7	41/9
8" 2400' BASF Scotch	74/-	59/6
10" 3280' Agfa only	85/9	68/9
10" 3600' BASF only	96/6	77/6
10½" 4200' Agfa, BASF only	113/6	91/6

SCOTCH DYNARANGE (L/P)	LIST PRICE	OUR PRICE
5" 900'	32/8	26/3
5½" 1200'	41/-	33/2
7" 1800'	58/1	46/6
8½" 2400' (Metal Reel)	84/3	67/6

BASF PES.35 L/P Low Noise	LIST PRICE	OUR PRICE
5" 900'	36/10	29/9
5½" 1200'	45/6	35/6
7" 1800'	63/-	50/9
10" 3600'	115/-	91/-

Postage and Packing 2/6. Order over £3 post free.

DOUBLE PLAY	LIST PRICE	OUR PRICE
3" 300' Not Scotch	14/3	11/6
3" 400' Scotch only	16/7	13/3
4" 600'	26/-	21/-
4½" 900' Agfa, BASF only	31/-	25/-
5" 1200'	43/2	35/-
5½" 1800'	56/11	46/-
7" 2400'	79/-	63/6
10" 4600' Agfa only	140/9	112/9

TRIPLE PLAY	LIST PRICE	OUR PRICE
3" 450' Not Scotch	22/3	18/-
3" 600' Scotch only	24/10	19/9
4" 900'	40/-	32/3
4½" 1200' Agfa, BASF only	50/-	40/3
5" 1800' Not Scotch	67/2	54/-
5½" 2400' Agfa, BASF	91/4	73/6
7" 3600' only	116/6	93/6

QUADRUPLE PLAY	LIST PRICE	OUR PRICE
3" 600'	37/-	29/6
3½" 800' Kodak only	46/3	37/-
4" 1200'	64/6	51/6

COMPACT CASSETTES	LIST PRICE	OUR PRICE
C.60	17/6	14/3
C.90	25/-	20/3
C.120	33/6	27/-

GRUNDIG TAPE AVAILABLE ONLY WHERE MARKED WITH ASTERISK

ILFORD - ZONAL TAPE

40% OFF!



NEW KJ SPECTACULAR

From the Motion Picture & Magnetic Products Division of ILFORD LTD. we are proud to present a New Stupendous BARGAIN OFFER! Never before have you been offered such a breathtaking opportunity. ILFORD-ZONAL premium grade magnetic tape (extensively used by the B.B.C.) at a terrific reduction of 40%! Brand New, Boxed, Fully Guaranteed and complete with leaders, trailers and stop foil. UNIQUE TO KJ

DESCRIPTION	LIST PRICE	ONE	THREE	SIX
900' on 5" reel Long play P.V.C.	29/1	17/6	50/6	96/6
1200' on 5½" reel Long play P.V.C.	36/1	22/6	65/-	125/-
1800' on 7" reel Long play P.V.C.	51/4	29/6	86/-	165/-
1200' on 5" reel Double Play (Polyester)	43/1	27/9	81/-	157/6
1800' on 5½" reel Double Play (Polyester)	56/1	36/-	105/-	204/-
2400' on 7" reel Double Play (Polyester)	78/10	49/6	145/6	285/-

Orders over £3 post free

KODAK TAPE—30% OFF

Brand new, fully guaranteed and in normal manufacturer's pack. Superb quality polyester base tape for top performance. Complete with full leader and stop foil.

TYPE	DESCRIPTION	LIST PRICE	ONE	THREE	SIX
P.150/12	1200' Long Play on 5½" reel	38/6	25/6	75/-	144/-
P.150/18	1800' Long Play on 7" reel	55/-	37/6	111/-	216/-
P.200/16	1650' Double Play on 5½" reel	57/9	40/6	120/-	234/-

POST & PACKING 2/6. ORDERS OVER £3 POST FREE.

**K. J. ENTERPRISES, (Dept. T.R.), 17 The Bridge,
Britain's premier mail-order audio specialists**

and hi-fi discount bargains— free catalogue

Name

Address

K.J. ENTERPRISES, 17 THE BRIDGE, WEALDSTONE, MIDDX. (Dept. TR)



**TAPE RECORDERS
and
AUDIO EQUIPMENT**

By the following manufacturers:

ACOUSTICAL ADC
ARMSTRONG CELESTION
DECCA EAGLE
FERGUSON GARRARD
GOODMANS GRAMPIAN
KEF LEAK
PHILIPS ROGERS
SANYO SHURE
SONOTONE THORENS
WHARFEDALE

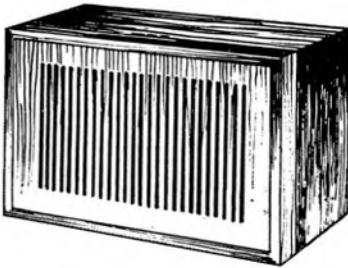
AKG CONNOISSEUR
ELAC GOLDRING
GRUNDIG ORTOFON
RESLO S.M.E.
W.B.

and many others—send for FREE CATALOGUE



NOW FROM KJ THE FULL RANGE OF
MUSICASSETTES
AVAILABLE BY RETURN POST
SEND FOR FREE CATALOGUE

BARGAINS OF THE MONTH



SONOTONE "SOLENT"

SAVE £6.10.0 on this SPEAKER SYSTEM

The fabulous bookshelf speaker system designed and manufactured by Plessey, one of the country's largest electronic groups. Acoustically designed two-speaker system with crossover network.

THIS OFFER REMAINS OPEN ONLY WHILE STOCKS LAST !

Technical Specification
Cabinet Size 14" X 9" X 8½"
Woofer 6½, 10,000 Gauss, 1 pole.
Tweeter, 3½" Acoustically loaded
Frequency response 40—20,000 cps.
Power Handling 12 watts.
Impedance 8—15 Ohms. (4 ohm. if specified)
Scandinavian style finish.

WHAT THE REVIEWERS SAID:
"Recommended without reservation for this category of Loudspeaker".
David Phillips and Donald Aldous.
"Sonotone 'Solent' deserves to reach a wide Public". John Borwick.
"A worthy member of the Hi-Fi family". R. L. West.

ORIGINAL LIST PRICE £18.0.0

Our Price Only £11.10.0

CARRIAGE 10/- EXTRA PER UNIT

FINEST LOUDSPEAKER VALUE ANYWHERE !

SPECIAL OFFER COMPACT CASSETTES

at HALF PRICE



Compact Cassettes with 60 and 90 minutes playing time. Brand New and packed in normal plastic library box. Available at this exceptional price.

Standard pattern to fit
Philips, Stella, Elizabethan
Dansette, Sanyo, etc.

MC. 60	MC. 90
1 for 10/6	1 for 14/-
3 for 30/-	3 for 40/6
6 for 55/6	6 for 78/-
12 for 105/-	12 for 150/-

Post and Packing 2/6. Orders over £3 Post Free.

Wealdstone, Middlesex Tel: 01-427 7758
Return of post service on advertised lines



DESIGN NOTES (Number 1)

By Tom Reps (Magnetic Tapes Ltd.)

Why a single motor?

There is no reason why the performance of a single motor recorder cannot equal, if not exceed, that of a three motor design—provided the spool capacity is kept within eighteen centimetres. The rewind although slower can be made neater, and the tension matched to that of the record/play mode, ensuring more accurate operation of the tape position indicator. Generally the rewind speed is effectively reduced by half, by gearing down the motor drive to the relevant spool. This, however, doubles the effective motor power, enabling back tension to be applied to the feed spool, resulting in a matched spooling tension.

Heat dissipation, which is an important factor in the design of any tape recorder, is obviously improved by the use of one motor. Further, the motor supply is reduced in the record/play mode to limit motor temperature rise and, incidentally, reduce flutter.

On fast wind the motor is switched to full power, giving high acceleration, even in maximum drag conditions. One of the major drawbacks of a single motor tape mechanism has been the more complicated linkage and drive systems required to effect the necessary modes of operation—fast wind, record/play, etc.

The Chilton 100S has overcome this problem by using four solenoids, operating directly on the relevant mechanism, avoiding superfluous linkages and enabling the push button mechanism to be feather light. As the solenoids are operated at a low voltage DC, and are diode suppressed, they have proved to be trouble free. Normally with three motor mechanisms employing reverse torque on the feed spool, the back tension increases towards the end of the reel, even with constant torque motors. The Chilton 100S employs a constant back tensioning system which, together with tensioned rollers, not only maintains the low flutter towards the end of the spool, but enables smooth rewind to be achieved at all times. This feature was remarked upon many times by visitors at this year's Northern Audio Fair.

In conclusion, using one motor (Papst) reduces the weight, the cost and the heat dissipation. To ensure the utmost reliability, Polyurethane is used in preference to rubber where necessary.

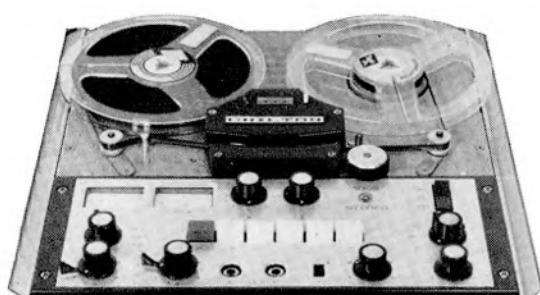
Polyurethane is a high compression moulding material with the following properties making it vastly superior to rubber:

1. Completely unaffected by oil, petrol and solvents.
2. Will not form flats unless compressed beyond 8%.
3. Has a constant density (which reduces wow when used for pinch or idler wheels).
4. Has good traction properties.
5. Does not crack or deteriorate with time.

This 100% British tape recorder sets a new standard in precision engineering, and your guarantee is that we would not manufacture any product in which we do not have complete confidence.

Available in chassis or portable forms from £127 3s. 4d. incl. P.T.

Magnetic Tapes Ltd., Chilton Works,
Garden Road, Richmond, Surrey
Telephone: 01-876 7957



LONDON MICROPHONES Quality sound -at low cost

The London Microphone range offers you quality microphones, good characteristics—and good looks, too, at remarkably little cost. All made in Britain.

NEW to the range: LM 300 dynamic cardioid microphone incorporating top-quality moving-coil capsule. Gives maximum front-to-back ratio over a frequency range of 50-15,000 Hz. Elegant styling, robust metal case, natural anodised finish.

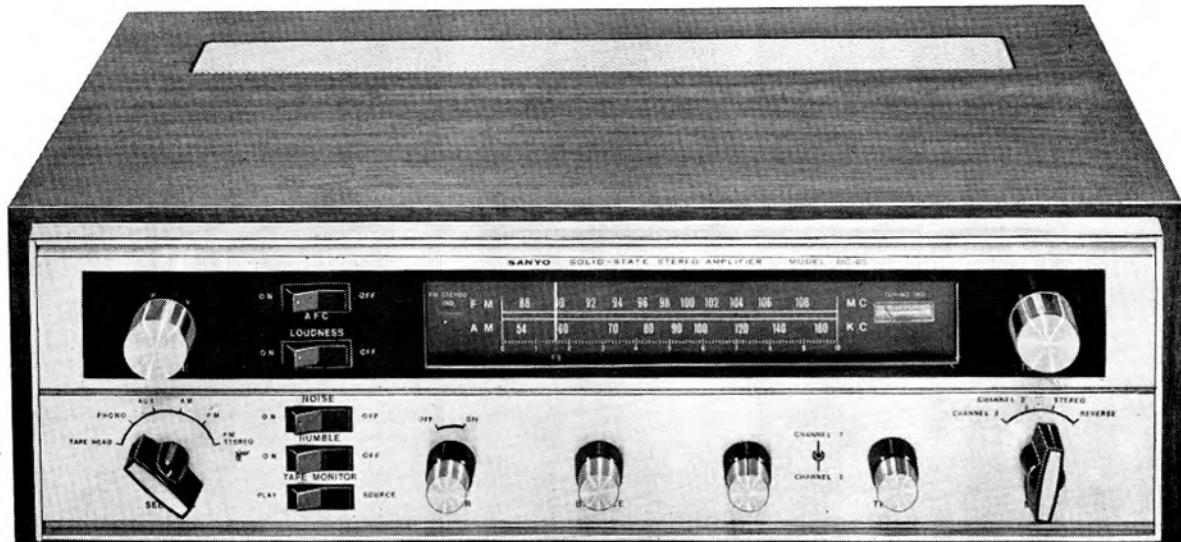
	Low imp.	Dual imp.
LM 300 (Cardioid)	£11.10.0.	£12.10.0.
LM 200S ..	£ 5.19.6.	£ 6.15.0.
LM 200 ..	£ 4.19.6.	£ 5.15.0.
LM 100 (Omni)	£ 3. 3.0.	£ 3.18.6.

Home or overseas trade enquiries welcome. Write or ring for details.

London Microphone Company Ltd

182-4 Campden Hill Road, London W.8. Telephone:
01-727 0711 (24 hour answering service) Telex: 23894

Sanyo puts you in the world class



The DC60 solid state stereo amplifier/tuner

- Transistorised circuit
- Accepts magnetic or crystal cartridge
- Extremely low distortion
- Optimum amplification and sensitivity on AM, FM,/FM stereo

Frequency Range
AM 566-185 m
FM 87.5-110 Mc

Sensitivity
AM 300 μ V
FM 3 μ V
Noise
-10 dB at 10 K cps
Rumble
-10 dB at 50 cps
Cross Talk
50 dB at 1,000 cps

MPX Separation
Better than 25 dB
per channel
at 1,000 cps

Frequency Response
30-20,000 cps \pm 1 dB

Output Impedance
4 to 16 ohm

Power Output
15 Watts per
channel RMS

Harmonic Distortion
Less than 1%
at 12W per channel

Dimensions
18" wide x 12" deep
x 6" high
(460 x 290 x 145mm)

Weight
22 lbs. (9.9 kg)

Recommended
Retail Price
£99.0.0

SANYO
RELIABILITY IS BUILT IN

Ferguson make 'more for



Model 3232

LOOK! a Ferguson stereo recorder with track transfer and 2nd channel monitoring.

This sophisticated 3-speed ½-track Stereo Tape Recorder is packed with special features - much more than you could expect for the money. It has 7" reels and accommodates standard pre-recorded tapes. Employing all transistor circuits it is, in effect, two recorders and replay amplifiers independently controllable and integrated to provide stereophonic recording and reproduction. Housed in an attractive teak veneered cabinet with transparent lid.

- Twin all transistor amplifiers • 3 speeds, 7" spools play up to 17 hours on double play tape (mono) • Automatic end of tape stops • Clutched dual concentric controls • Input mixing facilities • Latching pause control • Calibrated meter record indicators
- Monitoring while recording on built-in speakers • Track transfer on mono • Second channel monitoring • Comprehensive input and output sockets • Suitable extension loudspeaker available • Supplied complete with two dynamic microphones, reel of tape (1200'), take-up spool and connecting leads.

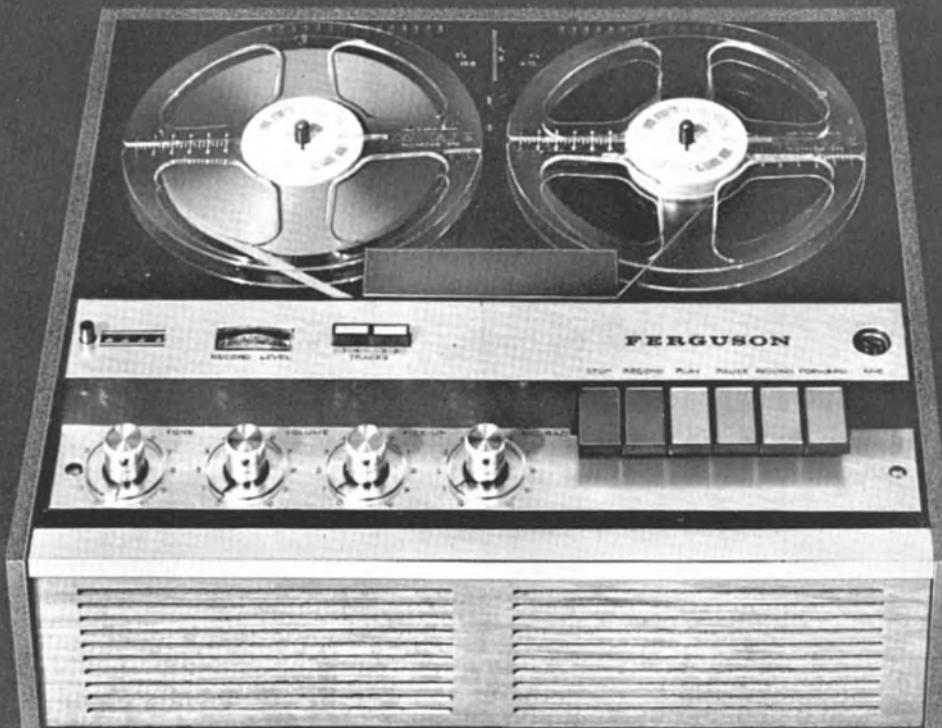
Model 3232 - £91.13s.

LOOK! a Ferguson mono tape recorder with 3 speeds and input mixing.

Outstanding value is offered by this 3-speed 4-track mono Tape Recorder. With 3-Watts audio output on speech and music, interlocking controls that prevent accidental 'wiping' of tapes, a metal foil operated automatic stop and a solenoid operated remote pause control. The unit incorporates a new symmetrical motor with low hum field and extensive signal head shielding reduces mains hum to minimum. The cabinet is attractively veneered in teak with a transparent lid.

Model 3216 - £64.19s.

your money' tape recorders



Model 3238

LOOK! a new Ferguson portable tape recorder.

A 3-speed, 4-track Tape Recorder with 7" spools, presented in black leathercloth with a teak-veneered loudspeaker grille. A removable cover at the rear provides access to input and output sockets, storage space for mains lead and microphone, etc.

- Four tracks, 3 speeds, 7" spools play up to 17 hours on double play tape
- Automatic end of tape stop • Input mixing controls • Remote control from microphone • Latching pause control • Double track replay • Monitoring while recording • Meter record level indicator • 4-digit, push-button position indicator • Graduated dials on rotary controls • Tape editing index • Comprehensive input and output sockets • Powered socket for accessories • Microphone with remote control switch • 1200 ft LP tape, take-up spool and connecting lead included.

Model 3238 - £58.11s.

A wide range of accessories are available for all Ferguson Tape Recorders.

To : British Radio Corporation Ltd.
284 Southbury Road, Enfield, Middlesex

Please send me your free full-colour fact-filled leaflets about Ferguson Tape Recorders.

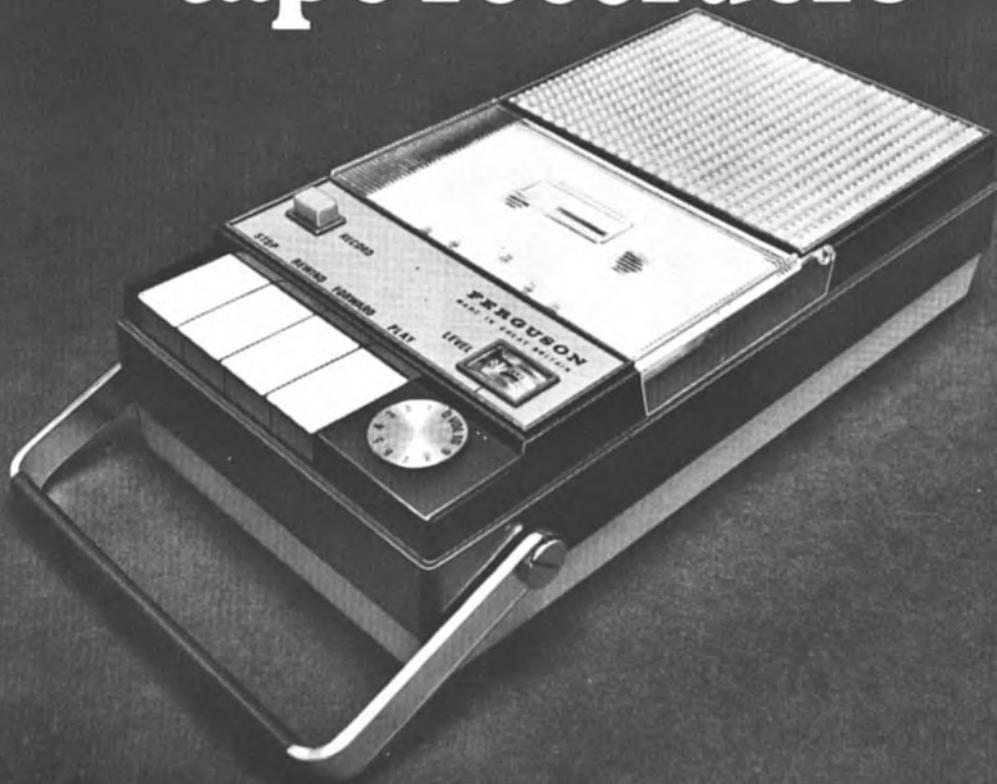
Name _____
BLOCK CAPITALS PLEASE
Address _____

THORN British Radio Corporation is a member of The Thorn Group

T.21

Fine! It's a FERGUSON

Ferguson make 'more for your money' tape recorders



LOOK! a superb compact Ferguson Cassette Recorder

This Ferguson Cassette Recorder is the enthusiasts sketch-book and enables you to pick up material for transfer later to the tapes in your library. It is housed in a cabinet moulded from high impact material in black, contrasted with light grey and has a silver coloured metal grille. This machine is battery powered utilising the new instant loading 'Compact Cassette'. It may also be used to reproduce 'Musicassette' pre-recorded tapes monophonically. It has simple piano type keys for tape motion control and a dynamic microphone with remote stop/start control. It is powered by 5 HP 11 type cells and a socket is provided for external power supply. The dimensions of this recorder are: Length 8 $\frac{7}{8}$ ", width 5", depth 2 $\frac{1}{2}$ " and it weighs only 3 $\frac{1}{2}$ lbs.

Model 3236 £26.14s.

- Moulded black cabinet with light grey contrast and silver coloured metal grille.
- Ideal for indoor and outdoor use and as a dictating machine.
- Simple piano keys for tape motion control.
- Dynamic microphone with remote stop/start control.
- The instant loading 'Compact Cassette' of tape provided, plays for one hour.
- Meter level and battery condition indicator.
- Will reproduce 'Musicassettes'.
- Operates on five HP 11 batteries or external power supply.
- Comprehensive input/output socket.
- Supplied complete with remote control microphone, cassette of tape, radio connecting lead and muting plug.

Fine! It's a **FERGUSON**



British Radio Corporation is a Member of The Thorn Group.

INCORPORATING
SOUND AND CINE

EDITOR
JOHN CRABBE

DEPUTY EDITOR
DAVID KIRK

ADVERTISEMENT MANAGER
ROBIN WELLS

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

© Link House Publications Ltd., 1968
All rights reserved

COVER PICTURE

A new generation of studio recorders, the *R Series*, is now being developed by Leavers-Rich. The eight-channel *R165* is claimed to be the most advanced multi-track audio recorder ever conceived and will be followed ultimately by a 16-channel version.

SUBSCRIPTION RATES

Annual subscription rates to *Tape Recorder* and its associated journal *Hi-Fi News* are 36s. and 47s. respectively. Overseas subscriptions are 38s. 6d. (U.S.A. \$4.60) for *Tape Recorder* and 48s. 6d. (U.S.A. \$5.80) for *Hi-Fi News*, from Link House Publications Ltd., Dingwall Avenue, Croydon, CR9 2TA.

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

WHO WANTS to make a disc, and why? Two questions raised in the course of preparing our survey of private tape-to-disc studios (page 584). The answer, perhaps, is reflected in the occasional reader's letter querying the lifetime of tape recorded programmes. Few tape recordists can be persuaded to commit themselves to a definite 'they should last forever' and we ourselves would only quote a vague 'indefinitely'. Perhaps the tape manufacturers have calculated the theoretical life of a magnetic recording, but they appear never to have published the results. We must turn to the BBC archives, therefore, where we learn that steel tape Blattner Stille recordings made in the nineteen thirties are still up to their original standard. Common-sense suggests that print-through will accumulate in any spooled magnetic recording stored over a period of centuries, and this has yet to be disproved in fact or published in theory. Gradual erasure, or spreading, and the mechanical deterioration of base and coating materials during storage and in use all imply that tape recordings have a limited lifetime, but the yardstick is one of centuries.

It is interesting to note the quality of one's own early recordings against the quality obtainable on today's equipment. The further back one goes in time, the poorer is the sound quality. This phenomenon is obviously due to the gradual accumulation of experience in recording, and to the improved performance of modern tape and recorders. It is easily misinterpreted, however, as proof of magnetic decay! The attraction of gramophone records is the apparent permanence of a plastic moulding compared with a tenuous magnetic pattern. In terms of long-term storage, this may be a reasonable opinion. But being a purely mechanical recording medium, disc quality is directly related to physical wear and such wear is inevitable even with the lightest and finest of pickups. A really good pickup on a well-designed arm may cause negligible wear to a decent pressing, yet only the keenest audio enthusiast will meet the cost of such equipment.

Precisely how a direct-cut lacquer disc behaves when tracked by a very good pickup is debatable and must depend greatly on the disc material and the competence of the cutting engineer. It seems reasonable to assume that wear will be greater than in the case of a good vinyl pressing. Under less well controlled circumstances, reproducing a one-off disc with a poorly made gramophone, the record groove can literally be chewed off its lacquered plate. We must not overlook, of course, the application of private discs in communication between families overseas; gramophones still outnumber tape recorders by a substantial ratio. Far from gaining a secure long-term storage medium, private disc owners are really obliged to keep their master tapes in case the 'permanent' copy should wear or be damaged.

This issue of *Tape Recorder*, the largest we have ever published, celebrates the end of our tenth year. An eventful year, during which editorial pens have stretched to Japan (*Akai* and *Sony* visits in February and March), Czechoslovakia (*Tesla* in April), Norway (*Tandberg* in May) and finally home to *Leavers-Rich* (page 592). We have published fourteen commercial tape recorder circuits, 13 constructional articles and reviewed 13 tape recorders. Including field trials and tests of minor items, we have produced a total of 43 reviews this year, most of them detailed and all of them honest.

Even the April budget did not prevent a boom in demand for recording equipment, so far as we can gauge from increased advertising support and a steadily rising circulation. Perhaps we should take this opportunity to thank the 46 contributors to Volume Ten for their efforts, and also our readers for their enthusiasm. Perhaps we should also wish everyone an enjoyable Christmas holiday but, December issue or not, there is still another month to go.

FEATURE ARTICLES

- 575 TAPE RECORDINGS ON TRIAL
By Brian W. Haines
- 581 RECORDING OUTDOORS
By Peter Bastin
- 583 PPM POSTSCRIPT
By John Fisher
- 584 TAPE TO DISC
- 589 BEGINNER'S LUCK
By E. R. Levett
- 591 THE HARROGATE FAIR
- 592 LEEVERS-RICH
By Richard Golding
- 597 CLOSED CIRCUIT
By Richard Golding

REGULAR ITEMS

- 573 WORLD OF TAPE
- 576 TAPE RECORDER SERVICE
By H. W. Hellyer
- 611 VOLUME TEN INDEX

EQUIPMENT REVIEWS

- 600 GRUNDIG TK2200
By A. Tutchings
- 605 GRUNDIG C200
By A. Tutchings

Bib

AUDIO AIDS FOR TAPE RECORDER USERS

Save wear—improve recording and reproduction

Use a Bib Tape Head Maintenance Kit

Cleans easily tape heads and all parts of the tape path.

Approved by the Technical Editors of the Audio Journals.

Size E contains in a plastic wallet 2 each Applicator & Polisher Tools, 10 Applicator & Polisher Sticks, double ended brush, packet of cleaning tissues, bottle of Bib Cleaner and full instructions. 16/6 inc. P.T.



Edit tapes easily—use all odd lengths

Bib Tape Splicers have tape clamps which secure the tape without damage, whilst cutting and jointing are easily undertaken. Chrome plated, plastic coated non-slip base, razor cutter. May be mounted direct on the tape deck. Model 20 for $\frac{1}{4}$ " tape, 19/6d. Model 21 Video $\frac{1}{2}$ " Tape Splicer Kit also available.



NEW! the first inexpensive-automatic opening WIRE STRIPPER & CUTTER



MODEL 6

Strips insulation without nicking the wire, cuts cleanly and splits twin extruded flex. Easily adjusted for all wire sizes. Plastic covered handles give a comfortable grip and have a retaining clip. Price 8/6d.

Obtainable from most audio stockists.
If in difficulty write to:

BIB DIVISION · MULTICORE SOLDERS LTD.
HEMEL HEMPSTEAD · HERTS



UP TO 50% OFF!

BRITAIN'S ONLY TAPE RECORDER MART

specialising in the SALE, EXCHANGE and PURCHASE of every make of high quality Tape Recorder. Brenell, Ferrograph, Ampex, B & O, etc., we have the lot! Fantastic savings of up to 50 per cent off original list prices for Personal Callers only. Our stocks change daily—call today—well over 100 models to choose from—all guaranteed you pay no tax on secondhand machines.

TYPICAL BARGAINS

ALL WITH 3 MONTHS WRITTEN GUARANTEE

(Note: M=Mono, S=Stereo, BP=Battery Portable, 4=4 track, 2=2 track)	ROBUK RK3 (M/2) ...	...	...	Our price ONLY 15 gns.
	GRUNDIG TK20 (M/2) ...	...	...	Our price ONLY 15 gns.
	PHILIPS EL3301 (BP/M/2) ...	...	...	Our price ONLY 15 gns.
	TELEFUNKEN 75 (M/2) ...	...	...	Our price ONLY 19 gns.
	BRENELL 3 STAR (M/2) ...	...	...	Our price ONLY 19 gns.
	GRUNDIG TK30 (M/2) ...	...	...	Our price ONLY 25 gns.
	REPS R10 (M/2) ...	...	...	Our price ONLY 29 gns.
	GRUNDIG TK6 (BP/M/2) ...	...	...	Our price ONLY 35 gns.
	BRENELL Mk 5 (M/2) ...	...	...	Our price ONLY 35 gns.
	BUTOBA MT5 (BP/M/2) ...	...	...	Our price ONLY 35 gns.
	REPS R10 (M/4) ...	...	...	Our price ONLY 35 gns.
	GRUNDIG TM60 (S/2) ...	...	...	Our price ONLY 35 gns.
	PHILIPS EL3536 (S/4) ...	...	...	Our price ONLY 39 gns.
	GRUNDIG TK46 (S/4) ...	...	...	Our price ONLY 45 gns.

NOTE:—THESE ARE NOW EVEN BETTER VALUE AS YOU PAY NO TAX ON SECONDHAND RECORDERS.

FERROGRAPH 4/AN (M/2) ...	...	...	Our price ONLY 45 gns.
VORTEXION WVB (M/2) ...	...	...	Our price ONLY 45 gns.
TELEFUNKEN 97 (S/4) ...	...	...	Our price ONLY 49 gns.
TRUVOX RI02 (M/2) ...	...	...	Our price ONLY 49 gns.
AKAI M6 (2/4) ...	...	...	Our price ONLY 59 gns.
SONY TC500 (S/4) ...	...	...	Our price ONLY 59 gns.
SANYO MR929 (S/4) Brand New ...	...	...	Our price ONLY 59 gns.
TRUVOX PD104 (S/4) ...	...	...	Our price ONLY 59 gns.
FERROGRAPH 631 (M/2) ...	...	...	Our price ONLY 59 gns.
REVOX E36 (S/4) ...	...	...	Our price ONLY 59 gns.
SANYO MR939 (S/4) ...	...	...	Our price ONLY 65 gns.
GRUNDIG TC340 (S/4) ...	...	...	Our price ONLY 65 gns.
AKAI M7 (S/4) ...	...	...	Our price ONLY 65 gns.
TELEFUNKEN 204E (S/4) ...	...	...	Our price ONLY 69 gns.
TANDBERG I241 (S/4) ...	...	...	Our price ONLY 69 gns.
AKAI I710W (S/4) Brand New ...	...	...	Our price ONLY £89 10s.
SONY TC260 (S/4) Brand New ...	...	...	Our price ONLY 79 gns.
B & O 1500 TAPE DECK (S/4) Brand New ...	...	...	Our price ONLY 79 gns.
TELEFUNKEN 204E (S/4) Brand New ...	...	...	Our price ONLY 89 gns.
BRENELL STB2 TAPE UNIT (S/2) ...	...	...	Our price ONLY 89 gns.
B & O 2000 De Luxe (S/2) ...	...	...	Our price ONLY 99 gns.

PERSONAL CALLERS ONLY

NEW TAPE RECORDERS

We also stock every make and model of New Tape Recorder plus a complete range of accessories.

— Part of the NuSound Organisation —

THE **TAPE RECORDER MART**

242/4 PENTONVILLE ROAD, LONDON, N.1

(200 YDS. KINGS CROSS) TERMINUS 8200 (HALF DAY THURSDAY)

AAU TELEVISION ADAPTOR

CHOOSING and wiring an isolating transformer to domestic television receivers, for the purpose of recording the sound programme, has long presented problems to tape recordists. The need for a fool-proof matching unit has been met by the *MAC Electronic Company, Villacousta, Portsmouth Road, Ripley, Surrey*, with the £7 7s. *AAU-TV*. Fitted with a satin chrome facia, the 8.3 x 8.3 x 9 cm unit may be mounted in the receiver cabinet if so desired. A three-position switch provides the following distribution of loudspeaker signals: *internal on with external off*, *internal off with external on*, and *internal plus external on*. A pre-set attenuator is incorporated in the external socket, facilities for loudspeaker impedance matching being provided by a three-way plug at the rear. A plug-in steep cut filter is available as an optional extra to overcome any difficulties experienced with the 10 kHz line whistle. The unit is supplied complete with standard jack plug, miniature plug and socket, and wiring data.

NEW HEATHKIT CATALOGUE

MORE than 250 audio, radio and educational products are listed in the 1968/69 Heathkit Catalogue, now available on request from *Daystrom Ltd., Gloucester*. A stereo tape recorder based on the 19/9.5/4.75 cm/s BSR *TD10* deck is included, costing £72 assembled or £58 in kit form (with purchase tax).



BRITIMPEX MOVE

BRITIMPEX Ltd., importers of semiconductors, valves, lamps and other electric components, are now occupying larger premises near the Earls Court exhibition hall. The new address is 8-12 Rickett Street, London S.W.6. (Telephone 01-385 0883 and 1007.)

IEE EVENING LECTURES

COLOUR Television, Educational Aids, and Radio and Sound Reproduction—three lectures in the IEE calendar for November. P. I. Nicholson will discourse upon colour television at the Engineering Lecture Theatre, University of Sheffield, on Thursday November 14. Educational Aids will be covered by R. C. Winton of Mullard Ltd. at the Large Engineering Lecture Theatre, Queens Building, University of Bristol, on Tuesday November 19. On Wednesday November 27, R. L. West will

cover Radio and Sound Reproduction in Lecture Room CG91, University of Durham. Further details are available from *E. A. Bromfield, Secretary, The Institution of Electrical and Electronics Technician Engineers, 2 Savoy Hill, London, W.C.2.* (Telephone: 01-836 3357.)

AUDIO EQUIPMENT AT DESIGN CENTRE

TRUVOX, Reslo and the British Radio Corporation are among contributors to a display of sound reproducing equipment now being held by the Council of Industrial Design. Acoustical, Richard Allan, Armstrong, BSR, Garrard, Goodmans, Jordan Watts, Wharfedale, Rogers, Rola, SME and Tripletone complete the list, their products being on show at *The Design Centre, 28 Haymarket, London S.W.1*, until November 16.

AN AUDIO REPORT FROM OCCUPIED PRAGUE

ON August 21, when the foreign military units came to Prague, they first occupied the most important buildings in the city, driving out the staff. In spite of losing all broadcasting media, the personnel of Radio Prague were ready to operate substitute equipment almost immediately. Several underground studios were prepared, interconnected with an old emergency transmitter by way of telephone lines. Then the first announcements were made from various spots directly into telephones after dialling the appropriate number.

Only later were magnetic tapes applied but even this was not without problems. It appeared that the only available tape recorder had been shot through, though fortunately its mechanical system was undamaged. The amplifier inside was completely destroyed but was replaced with a new one in minutes by amateur assistants.

A number of Prague enthusiasts, who in the past had designed and built their own gramophones, mixers, etc., having no other sources, found their equipment being used for the purposes of official state broadcasting. The microphones that sometimes made the voices of popular radio announcers unrecognisable also belonged to amateurs. At such a time, of course, high fidelity was by no means essential. Similarly some old and very worn gramophone records which had rested for years on home shelves were unexpectedly put on turntables and played to the nation, making the pauses between news items more bearable.

This activity, though carried out with courage and devotion, did not satisfy the amateur participants very much; they knew their audio ambitions would be stifled, to say nothing of other troubles. It is the heart-felt desire of all Czechoslovak audio enthusiasts that the strained conditions in their homeland will soon be relieved.

FIRST INTERNATIONAL ELECTRONIC MUSIC COMPETITION

O. W. Wilson (USA) has been judged winner of the world's first international electronic music competition. The contest was organised by the Department of Music at Dartmouth College, New Hampshire, and the



winning recordings by Mr. Wilson and five finalists are being released by Vox this autumn. The finalists were Pril Smiley (USA), Josef Malovec (Czechoslovakia), Eugeniusz Rudnik (Poland), William Hellermann (USA), and Bohdan Mazurek (Poland).

A second competition for an outstanding composition of electronic music will be held in the spring of 1969. Copies of the rules may be obtained from *Jon H. Appleton, Director, Electronic Music Studio, Dartmouth College, Hanover, New Hampshire 03755, USA*.

FERROGRAPH APPOINT TECHNICAL CONSULTANT

M. R. H. Davies, former Head of Sound Group in the BBC Engineering Designs Department, has joined the Board of the Ferrograph Company. His position will be that of Technical Consultant.

ITN ORDER ELCOM

A N order for 24-channel mixing consoles, transmission desks and 12-channel film dubbing units has been placed by Independent Television News. The equipment employs plug-in modules from the new Elcom 50 V rail range and is styled by Ware-Macgregor.

AUDIO DIARY 1969

SIXTY-EIGHT pages of audio, electronics and sound recording data are offered in the 1969 Audio Diary, now available at 8s. 6d. including post and packing from *Link House Publications, Dingwall Avenue, Croydon CR9 2TA*. The data section is divided into four categories entitled "Hi-Fi Information", "Tape Recording", "Audio Reference Data" and "Music, Acoustics and Hearing". Tape playing times, track positions and equalisation are included under "Tape Recording". A two-pages-per week personal section, five address pages and a full colour Underground map complete the diary.

NEXT MONTH

FRITJOF BRODTKORB analyses the Tandberg cross-field bias system in the January issue, appearing on December 14, while Alec Tutchings reviews the (conventionally biased) Tandberg 11 professional portable. For constructors, John Fisher contributes a tone-source and line-up meter and L. Hayward describes a method of producing 'phasing' effects on popular music.



**Ever Ready
High Power
Batteries**

**Ever Ready pack the
Performance!
into battery operated tape recorders**

Ever Ready is the power that performs best in today's cordless record players and tape recorders. Ever Ready High Power Batteries pack in bright sound, crisp reproduction and much, much longer playing time!

Load up with Ever Ready Power - your customers will be expecting it.

The Ever Ready Co (GB) Ltd • Ever Ready House
1255 High Rd • Whetstone • London N20 • 01-445 8877



**Ever Ready
pack the power in**

tape recordings on trial

THE story of a criminal trial is always fascinating; especially when the public as a whole are affected. *R v Ali and Hussain* (1965) is a case in point, not only for its unusual features but because it seemed to create a licence to invade privacy. It was an appeal against a conviction of murder and during the judgement the Court expressly stated that a tape recording could be admissible evidence. This gave rise to the general impression that a wave of prosecutions would follow based solely upon recorded conversations which had been secretly obtained. There was an even greater fear that such recordings would be edited to provide the most damning evidence against the accused.

Over three years have passed since this case was decided and hardly any use has been made of this particular piece of law, so it is worth examining why the threat was never realised.

COMMON SENSE

In the first place the Court was only stating what was common sense. It would have been idle to pretend that tape recorders did not exist, or that the machine was not capable of reproducing an accurate rendering of what it had recorded. Counsel for the accused recognised this, and never attempted to argue that tape recordings were inadmissible evidence as such, but only that the particular recordings were inadmissible. In order to clarify the law the Court asked to hear arguments relating to tape recording generally; then, having heard the arguments, decided that "it would be wrong to deny to the law of evidence advantages to be gained by new techniques and new devices, provided the accuracy of the recording could be proved and provided the evidence is relevant and otherwise admissible." The Court added that this did not mean all such recordings are admissible whatever the circumstances of the case. In other words, you can use a tape recording as evidence provided it complies with the rules of evidence.

In fact the case added little to the law of evidence that was not there before. As far

back as 1927 the issue arose as to whether a recording, in that case a dictaphone, could be used as evidence; then again in 1954, 1956, 1960 and 1962, so it was hardly a new problem. In every instance the argument centred around the admissibility of a particular recording as it did in the Ali and Hussain case, and not recordings in general because no one denied that a recording had been made.

WHY PRESENTED

Evidence is the means whereby facts are proved. It is not proof of a fact itself, it is the foundation of the proof. So, when evidence is presented to the court, not only will a lot depend upon why it is being presented but also upon how much weight or importance can be given to it. A tape recording is certainly evidence of a recording having been made but it is not necessarily evidence of the truth of what has been recorded. It might be completely irrelevant.

The rules of the law of evidence are formidably numerous and complex. They have grown up over the years to prevent the indiscriminate use of irrelevant evidence. It has also been said that they are based upon the fact that all witnesses are liars and all juries stupid which leads to the result that a great deal of evidence is excluded. Much argument would centre round whether the recording was relevant; relevant, that is, to the facts in issue, and not put in merely to support a proposition. And then there would be further argument as to whether the recording was hearsay. The hearsay rule says, broadly, that all evidence not directly perceived by a witness is barred unless it can be brought in as one of the exceptions to the rule. This would rather cut down the field in which the recorded evidence could be of vital importance to a case to that of "admissions against interest", in short confessions.

Confessions are subject to the most stringent examination before they can be used "in evidence". They must be proved to have been made freely and voluntarily. In the case of a

recording, as in the case of a written statement, it must also be proved to have been made by the accused. There was some speculation in 1927 as a consequence of this last requirement, that a host of voice experts would come into being to swear to the identification of a voice. So far the Courts have been spared this creature.

Having passed all the hurdles of the law of evidence, that is not the end of the matter; it is only the beginning. One of the over-riding principles of English law is that every man is presumed innocent until he has been proved guilty. And that proof must be beyond reasonable doubt. Further, the jury, a body of ordinary men and women are the final arbitrators of whether the prosecution have proved the guilt of the accused. It is not the Judge, or the lawyers, or any paid official who decides if a man is guilty, but the jury; they and they alone make the decision.

All juries today are familiar with tape recorders. They will be aware either from their own knowledge, or made aware by the defence, of the possibility of a tape recording having been tampered with, or completely fabricated. No jury is going to listen to a recording of a voice on a machine without some reservations in their minds of a degree of distortion of the truth or some basic unfairness about the presentation of mechanical evidence, especially if that should be the only evidence. They will decide just how much weight such evidence will carry, and if they decide it cannot carry much weight having regard to all the circumstances of how the recording came into existence, then they will pay little attention.

HOTLY CONTESTED

Regularly in the Courts the police give evidence that they were present when an accused voluntarily wrote out, and signed a confession. Yet these confessions, which the accused admits are in his own handwriting, are hotly contested by him, often very successfully. Little imagination is needed to appreciate the fate of a tape recording in similar circumstances.



TANDBERG

SERIES 7

BY H. W. HELLYER

OUR circuit this month is of the Tandberg 74B, and is the later version, with serial numbers above 715001. Comparing it with the *Series 6* range, which occupied our attention last month, we note a number of significant differences, and a general similarity of circuit design that will enable us to dispense with a great deal of discussion of circuit detail and concentrate more upon the mechanism.

Fortunately for our claim upon editorial space, we can kill both birds with this single stone, for the rudimentary factors of mechanical construction are the same, and are, indeed, carried through later versions of Tandberg tape recorders—a sure sign of a good quality approach. Freed from the need to bedazzle a fickle consumers' market with a change of model several times a season, the best manufacturers concentrate on gilding an already pretty perfect lily. Witness our own Ferrograph and Willi Studer's veteran Revox, who have only this year departed from well-tried basic designs. (Which is not to say that no evolution

has taken place within the familiar packages.)

Some of this evolution has centred around transistors. But while clinging to 'traditional' valved circuits and hesitating to take the plunge fully into solid-state circuitry until the *Model 12*, Tandberg, in common with many other leading makers, used the transistor for its special qualities rather than as a sop to modernity. The result was a single semiconductor stage in the *Series 7*, the first part of the two-stage playback preamplifier.

Because the signal being handled is extremely low at this point of a tape recorder circuit, the problem of noise eradication, particularly of eliminating hum, means that playback preamplifiers have to be very carefully designed. The use of DC heating for valves, low HT coupled with high stability components and careful layout, are all tricks that we have seen employed to get maximum signal gain without hum and noise, and the transistor, particularly the silicon transistor, provided the answer to the very delicate low-signal preamplifier stage. In fig. 1 quite conventional methods are employed, though they may seem unfamiliar at first inspection.

A *p-n-p* transistor is used, with the emitter connected to a potentiometer tap on the main 170 V HT line, to make it a few volts positive to the collector. The style of presentation shows this stage in a conventional 'signal' mode, i.e., apparently upside-down. This is a cross that we old-timers, suckled on valve circuitry, have to bear. The youngsters take valves and transistors in their stride, with an enviable equanimity. At a recent lecture, when I attempted to illustrate a 'signal chain' argument with the example of valve amplification, one bright star piped up with a question: "What is the parallel to hole travel in the way that valve is supposed to work?"

There are $\frac{1}{2}$ - and $\frac{1}{4}$ -track versions of the *Series 7*, numbered 72 and 74, and they are completely stereo record and replay deck-plus-preamp units, as was the *Series 6*, but with only two heads, and using common power amplifiers. Common, that is, to both record and playback preamplifiers, and selected by the switching. The two channels are quite separate, except for the oscillator. This push-pull stage is very similar to the one previously described, but operates at a higher frequency, 85.5 kHz, and has somewhat different switching arrangements. It is, of course, matched for bias to a record/play rather than a record-only head. Whether this head-matching, the higher frequency, or some other characteristic has escaped me, I do not know, but I have found that waveform eccentricity can have a more drastic effect on *Series 7* recordings than on the *Series 6*, which is remarkably 'self-adjusting.' A tendency to slight harshness, with choral work particularly, where so many other factors may be blamed, could indicate a need to try a new *ECC82* in the oscillator stage. And please, before denouncing the machine, check that supply voltages are correct, and that the HT rail really is up to its 270 V at the 'hot' side of the 1.2 K resistor.

The other variant is the 72B and 74B range, which incorporates an additional stage, a playback preamplifier output, giving 1 V output at 100 K. There must have been a temptation, during the design conferences, to add this stage (which was a bonus, due to the

use of a transistor first stage and double valves) to the playback chain, simply taking off a 'high-level' output. But Tandberg are well aware that this method is skimping and have done the honest thing. One would have liked to see an additional refinement of a cathode follower output after this stage, but you cannot have everything.

The *Series 7* has done away with the separate high and low level input circuits we noted last month, and, instead, has an adjustable line input between the very wide sensitivity limit of 2.5 mV and no less than 7 V. Presets for this adjustment are on the rear panel, adjacent to the phono sockets. Varying the sensitivity also varies the impedance, between 100 K and 500 K, but as these controls will generally be used for a semi-permanent arrangement, this is no drawback. As before, insertion of the microphone plug breaks this line input circuit, so mixing has to be external. Obviously, there are ways of getting over this if you insist on complete versatility.

Output stages are built around the ever-popular *ECL86* on the 74 model and the half *ECC83/EL84* combination for the B versions. In addition, the B models have a centre channel output and a different speaker selector switch arrangement. The impedance of the centre channel output is to be a minimum of 400 ohms, and this is rather important if you need to take advantage of the public address potentialities of these machines. There is the inevitable temptation to "stick another speaker in", with lamentable results. Do not blame Tandberg. For monitoring during recording, the output is reduced by the insertion of an 82 ohm resistor, R118 in our circuit. Full 3 W audio is available on playback, and the only tone control is a bass switch employed to give an 8 dB boost at 100 Hz. When this is in the 'normal' position, the feedback circuit gives a 4 dB boost at 50 Hz. Some care is needed when servicing, as a report of "one channel down" could so easily turn out to be a slight lack of the required boost, caused by a switching interconnection, or feedback loop component fault. Having been caught myself, I pass on the warning.

It is a fact that better quality equipment has to be more critically judged. Ironically, better quality tape recorders may be affected more drastically by small faults than their less ambitious counterparts. Hence, one valve slightly below par will not pass unnoticed on machines such as the 7, whereas a cheaper recorder will tootle away quite happily for a year before the owner becomes aware that the distortion has gone up!

In other words, before getting involved in complicated tests and service procedures with circuits such as that accompanying this article, always check with a valve replacement for the stage you diagnose to be the probable root of the fault.

Mechanical details of the 6 and 7 ranges are the same, and the following notes may be taken to refer to both. Foremost is the balanced clutch system, which is so efficient on this range of machines that brakes can be dispensed with altogether. The only drawback, from the operator's point of view, is that tape loading needs a little more dexterity. It is disconcerting, the first few times one laces up a

(continued on page 579)

FIG. 2

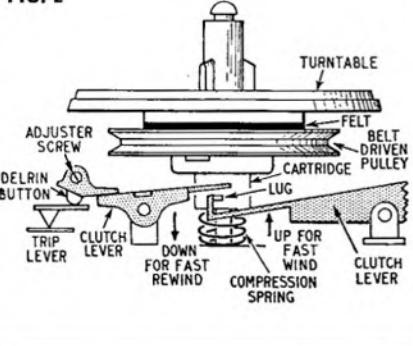
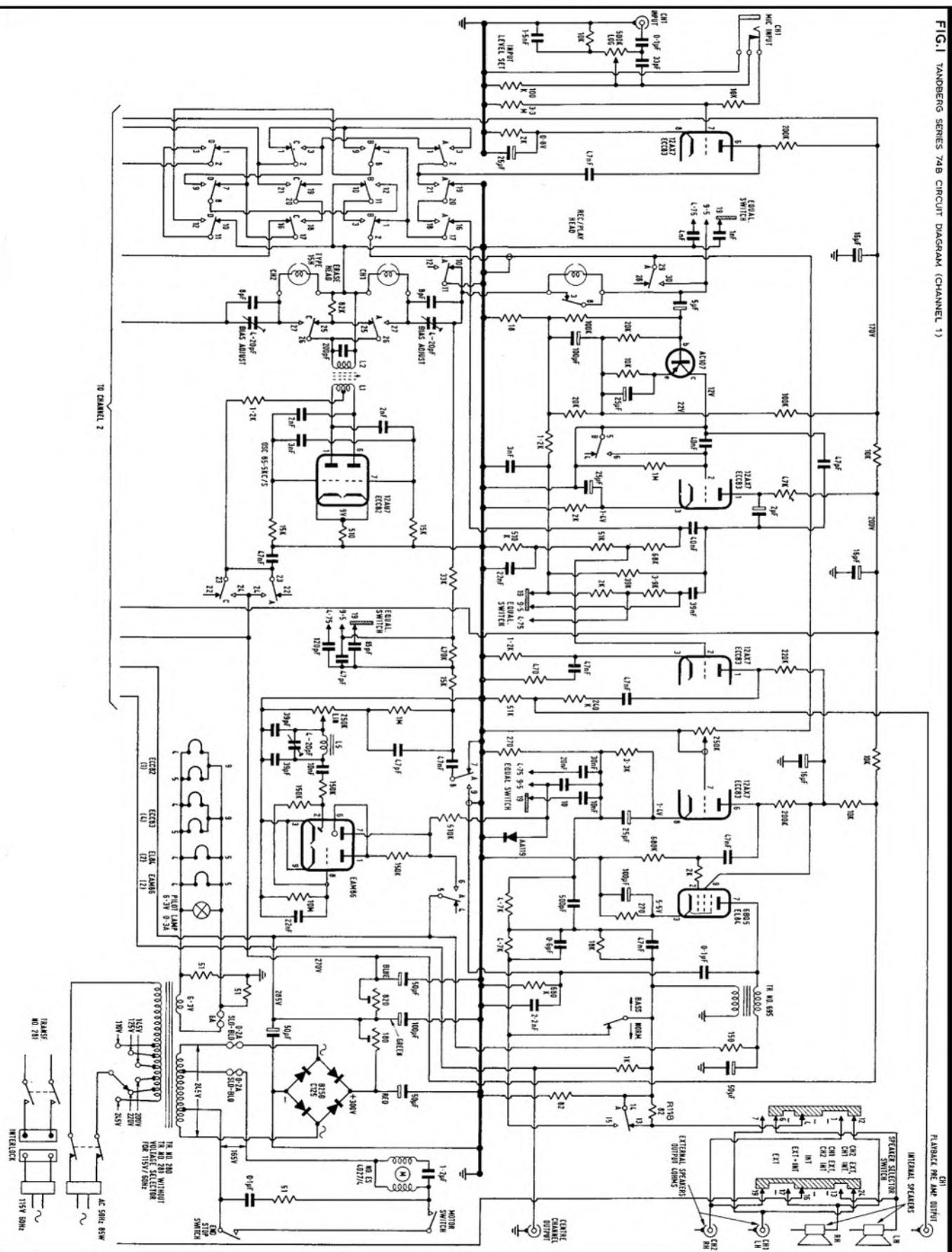


FIG. 1 TANDBERG SERIES 74B CIRCUIT DIAGRAM (CHANNEL 1)



The new
EMITAPE A^lfonic
range of
low noise tape



don't buy any tape - buy
EMITAPE



EMITAPE LIMITED
HAYES MIDDLESEX,
ENGLAND

TAPE RECORDER SERVICE CONTINUED

Tandberg, to juggle the tape in the auto-stop spring space and around the take-up spool, then find it flying back to the feed spool as the power is applied. It becomes a little easier when we know how the clutch system works.

Some reference was made to the clutch system of Tandberg machines in an article devoted solely to this subject in September of this year, and we can refer to a drawing (repeated as our fig. 2) which shows the rudiments of the system. The spool carrier turntable rests on a belt-driven pulley. The single belt of quite respectable diameter, is crossed and runs in flanges of the motor pulley (crossed at the left, running in the upper flange to the front—this is important). Before making any adjustments at all, the setting of the height of the motor pulley should be checked. Many a "noisy mechanism" complaint turns out to be no more than a pulley set too high, or a belt running in the wrong groove. The pulley is secured by a single Allen screw. Its flange between the two belt grooves should be slightly below the line drawn from the bottom of the groove of the belt pulley of each side (as in fig. 2). Actual spacing is 0.5 mm, and this should bring the speed change idler into the middle of the appropriate diameter. What is most important, at the lowest speed of 4.75 cm/s, there should be a similar clearance between the top of the speed pulley and the next step up, i.e. the 9.5 cm/s diameter. It is rather difficult to judge this, and I have found it better to ensure that the lifting mechanism puts the drive pulley smack into the middle of the diameter for 19.5 cm/s, and work from this point.

It should not be necessary to alter the height of the lifting mechanism, and certainly not in an effort to cure a fault, but there is always the possibility that one may have to reset a machine that has been tampered with. Here, we must stress, first get the motor pulley at the right height, then select speeds and check the way the drive wheel lands, and only adjust by adding or subtracting washers between the crescent shaped arm and the holder, at the end remote from the pulley wheel. In the faster speed position, the pulley should be only 1 mm below the upper rim of the flywheel. The flywheel height can be altered by addition of little washers in the lower bearing. (It is wise to check these for wear when irregular running is the fault.)

There are two types of lifting mechanism, the later version being designed to release the pulley from motor and flywheel in the neutral position, which stops scuffing, but makes it more than ever necessary to use the start facility rather than the joystick alone when doing frequent 'stop-start' work, as when editing.

If any finer adjustment of the motor drive system is needed, the speed change idler may have to be adjusted for each individual speed. This is a bit of a chore, but when the mechanism tends to be slightly more noisy on one speed, usually the fastest, than another, this adjustment will often cure it. On the inner side of the curve of the crescent lever a small lifting arm can be seen, and this has bent forks. Check first that the lifting operation is correct in relation to the joystick movement, because this

is tied up with the power switching. The lift-off should be complete before the switch operates to cut off the current. Movement is very small, and this should be done with the power off and a meter connected to check switch closure, rather than as a hit or miss adjustment during running. Make sure there is adequate clearance between the drive pulley and the motor pulley when the lift-off is completed.

Next, loosen the screw on the transverse arm to which the forked bracket is attached, adjust the forks for individual lift, and retighten the screw. Finally, check the motor pulley and relative drive wheel heights as before, and you are ready to tackle the clutches.

Fig. 2 shows the take-up clutch. The supply turntable has something similar, except that the upward lifting lever is absent. This is the seesaw to the right of our diagram. Imagine the whole thing reversed, left to right, with this lever absent, and you have it. (That saves a drawing!)

First, check the free function. Here, the motor is running and therefore the pulleys are driven, but there should be 0.5 mm clearance between pulley upper face and turntable lower face—in other words, not enough to compress the felt and inaugurate drive. Try this with no spools loaded, then with a full spool loaded, and the auto-stop spring held on with a piece of card to take the place of the tape.

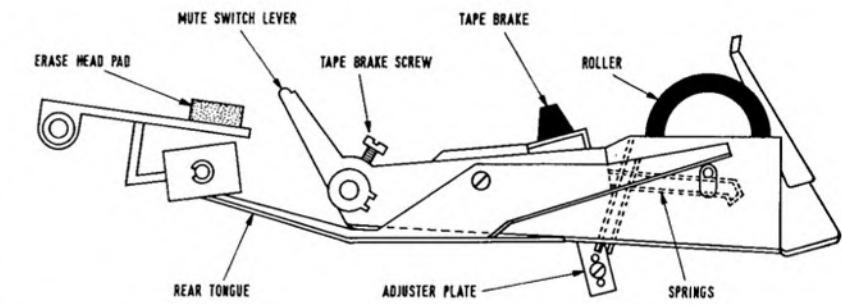
When neutral is selected and the motor power

is shut off, the left-hand clutch lever of fig. 2, and its counterpart for the supply turntable, both rise to the position shown, when the maximum friction between upper and lower halves is obtained.

Take-up is provided when the left section of the clutch lever in fig. 2 and the right section both sit in a position that allows the lug on the lower cartridge of the clutch to be free. Under this condition, the compression spring below the cartridge just gives enough upward pressure to work in conjunction with the weight of the spool and supply take-up torque. The screw on the outer end of the lever sets the position relative to the Delrin button and thus the amount of lift the clutch lever will be given by the trip lever. This should be set for correct clearance, testing with a full and an empty spool, with motor off, and again when running.

After this, fast winding can be checked.

FIG. 3 TANDBERG PINCH ARM



is shut off, the left-hand clutch lever of fig. 2, and its counterpart for the supply turntable, both rise to the position shown, when the maximum friction between upper and lower halves is obtained.

Take-up is provided when the left section of the clutch lever in fig. 2 and the right section both sit in a position that allows the lug on the lower cartridge of the clutch to be free. Under this condition, the compression spring below the cartridge just gives enough upward pressure to work in conjunction with the weight of the spool and supply take-up torque. The screw on the outer end of the lever sets the position relative to the Delrin button and thus the amount of lift the clutch lever will be given by the trip lever. This should be set for correct clearance, testing with a full and an empty spool, with motor off, and again when running.

After this, fast winding can be checked.

springs for verticality of the roller, and this is best adjusted under running conditions, and with several different tapes. Next there is the tape brake, the small pad used for pause operation, which must be clear during normal run. The adjustment screw is near the hinge of the lever. Because there is always a slight clockwise pull with the left turntable, to prevent tape loops, and the selection of forward drive corrects for this, there may be a tendency for 'creep' unless this tape brake is exactly adjusted. Over-compensation can cause flutter due to inadequate clearance. It is not always obvious on first inspection, but both these points should be checked.

Do not overlook the tongue to the muting switch which may be 'on' too hard and again affect the pressure to some small extent. This is a minor fault, seldom encountered, but like other small things, vital to the good quality of which this machine is capable.

Snap-in sound

At home...

Our mains stereo recorder EL 3312 brings you all the exciting 3-dimensional sound realism of Musicassettes: Push-button controls include cassette ejector, fast wind and re-wind and pause. Playback or recording (on blank

Compact Cassettes) is simply superb.

Matching teak-finished loudspeakers are available. And the 3312 has socket facilities for microphone, radio, gramophone, amplifier and second recorder, too.



And away...



You've hundreds of Musicassettes to choose from . . .

There's a magnificent selection of pops and classics available on Musicassettes. They play as long as an EP or LP record. And they're permanent good value, because the tape, sealed in its dustproof cassette, can't get scratched or broken. Special offer - 3 EPs for only 34/6 and the voucher packed with every Philips cassette recorder.

Our battery portable cassette recorder EL 3302 is great for 'music on the move'.

You can record or play back anywhere. Quick as you like. This slick little portable makes it all so easy.

All you do is snap in a Compact Cassette or Musicassette—you've hundreds and hundreds to choose from—and you're in business!

The simple controls include a battery level indicator. And the EL 3302 is complete with microphone in a sturdy carrying case.

You'll have to go a long long way to find a sounder buy at 30 gns!

Send for full colour brochure.

PHILIPS

Philips Electrical Limited, (Dept. TRC2), Century House, Shaftesbury Avenue, London W.C.2.

recording outdoors by Peter Bastin

A DEPUTY-Editor—whose sanity I sometimes wonder about—once declared that his aim in life was to take a cheap battery portable recorder, suitably wrapped in a plastic bag, two feet down at Shoebury Ness. What he might do at that dizzy depth is his affair, but I have wondered how he would (a) manage to gurgle into a water-logged microphone and (b) ever get anywhere with bits of equipment floating all round him. Deputy editors have these cantankerous ideas; that's why they aren't editors.

Outdoor recording—including Shoebury Ness—is a matter of taste or preference. I don't care for it unless the material is to serve some worthwhile purpose. I see no value in taping tiny kids shrieking on the sands at Clacton or recording sweating fairground engines. It's all been done before. But, if the stuff is for a specific purpose, such as a documentary or a sound story, go ahead—but, at least get a *good* recording. Let people hear the sounds you have collected. Record them close up; nothing is worse than seeing poor Uncle Fred cupping his ear, trying to pick out Martha's kids from a background of traffic and wind. A good tip for starters is to take your machine into a bar and record, at full gain, the dreadful din of boozers and barmaids. It makes an excellent background atmosphere for all sorts of things and you can produce a tape-loop quite easily from it. I once heard that the BBC, for general crowd noises, used to use a recording taken at a Japanese football match, played backwards. Presumably they had run out of rhubarb.

GREAT URGE

There used to be a great urge to build up libraries of sound effects—trains, cars, buses and so on, but the present record library lists make this an unnecessary chore. Not that all commercially-produced sound effects are good; far from it. I have some records, produced by professionals, which leave a very great deal to be desired so far as quality and suitability are concerned. And the practice of marketing American sound effects without telling people is nothing short of misrepresentation. An American telephone bell is quite different to its British counterpart and is therefore a useless sound-effect. What is rarely marketed is the background or atmosphere type of recording—the bar-room noises, a football crowd cheering, the chatter in a cafe or a theatre foyer, and it is these effects which should be collected and stored.

I once recorded a noisy crowd in a bar in

North Wales. I chopped a length of the tape in two and joined it up, producing a perfect loop. Any consistent and jumbled-up sound can be joined together without the join being at all noticeable. I did this with a stream and with breakers on the shore. All these tapes, recorded on location, will be used at some time or another and may well save me a trip to the seaside.

Location recording has its hazards, of course. What is worse than standing in the centre of Birmingham, recording church bells, when a ripe Brummie accent asks you where the nearest Ansell's pub is? Wind (elemental, that is) has its hazards, too. This is why you should never attempt outside recording on any but a very still day without a wind shield. One can be made from a bit of thin plastic foam and some good glue and, in passing, a wind shield has other good uses: it can reduce excess top frequencies and can be useful in conditions where there are too many overtones or harmonics. Not to mention protection from spit when recording pop singers.

I once did a documentary about a small country town. This involved a considerable amount of location recording, ranging from a choir in the Abbey to kids playing in a park. The script called for a run-down on the historic Abbey and I decided that the best person to give such a run-down was the incumbent. So we walked up and down the Abbey while he talked but the finished recording sounded dead, no life. The reverberation of the great Abbey just didn't come through for the simple reason that we were in the middle of the Abbey and our voices did not reach the walls to start off the reverberation. So I added a recording of the Abbey choir, taken some months previously, with very satisfactory results. I also wanted the bells of a certain church, which I knew rang most convincingly at eight at night. I saddled up my (then) Fi-Cord and went forth. The rain was coming down in lumps and I cursed all that recording stood for. I took up position, got the setting right and switched on 30 seconds before eight. The bells were magnificent and didn't appear to be at all upset by the torrential downpour. I scuttled home and played back. Nothing. Nothing at all. I hadn't even switched the blasted thing on. Perhaps that's why I got rid of the Fi-Cord.

On the subject of recorders for location work—and by that one must, of course, mean battery portables—I have used seven different makes. The first was called a Clarion, back in 1959, and was a complete contradiction in

name. The second was a Grundig *Cub*, the most awkward thing in the world to handle, with a performance to match. Then an Elpico, followed by a Fi-Cord. The Fi-Cord was excellent at 19 cm/s, hopeless at 4.75 and the very devil to thread up. In fact, a BBC chap told me that they would like to use them but found that commentators fumbled them up so much that they had to go in for repair every few weeks. Then a vertical Philips job, very good but with no means of suitably slinging it over the shoulder unless you bought a carrying case. Which I did and I used this machine for quite a long time. A miniature Japanese toy costing 12 gns. was bought in the Edgware Road more or less as a joke. And joke it was. I tried everywhere to get a microphone to improve the scratchy and constipated speech quality, but failed. I used a Grundig *TK6* for about two years. Very good but with a maximum recording speed of only 9.5 cm/s. In the end, I bought a Philips *EL3301* cassette recorder, which I still use and swear by. I use a Grampian *DP4M* or 200 ohm Beyer microphone, boosted, with it and get recordings well up to professional location recording standards. I have had a good deal of material broadcast which has been recorded on this machine. It is, of course, the microphone which is the all-important link in location recording and if you use a good microphone, properly matched, you will be surprised at the results you can obtain, even on a £15 recorder. I once did a location interview for County Archives, where the microphone cost more than the recorder. This is not unusual and emphasises the point.

AUSTRIAN BAND

Sometimes balance can be your enemy. Not so long ago, I was in Austria recording the proceedings on a Saturday night, when the town band, resplendent in brown uniforms and little green hats with fevers, marched into the town square to sit down and oop-pa-pa for an hour or so. I milled about, picking up the wild, wild foreign accents of the German/Austrian/Danish/French/Italian/English crowd (to make into loops) and stood by. The band could be heard in the distance; slowly it approached. Wonderful stuff. Everyone clapped. The resulting recording was splendid right up to the point where the bass-drummer walked within five feet of me (or should I say two metres?). The healthy thump scattered the rest of the band and that particular bit of the recording sounded like the berserk innards

(continued overleaf)

of a faulty radiogram. Which is a distinct object lesson. Keep your eye on your modulation meter. The bright instruments of a band, the swirl of kilts or the whatever-happens-to-mini-skirts is your deadly enemy.

I recorded a little old man playing a harp in his stocking feet, 5,300 feet up in the Alps—or rather, my son did. This turned out very well, despite the fact that this cheery old peasant, in his eyrie nearly two miles in the sky, was using plastic strings on the harp. As a matter of interest, the only way up to this section of heaven was by chairlift—a wood and plastic baby-seat on a metal pole suspended from a wire, used by he-man skiers in the winter. My son wanted to know why I had not recorded the unique experience of soaring over tree-tops and ravines. I replied with all candour that I was too petrified to think of tape-speeds, modulation meters and loops and that my only thought on the terrifying 3000 feet climb was whether or not there would be a bar at the top selling brandy.

SEEK PERMISSION

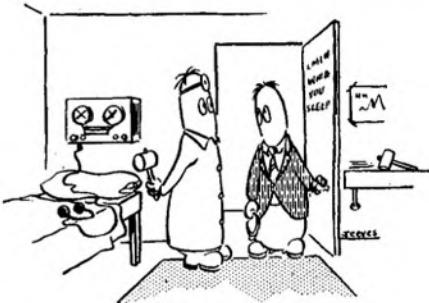
Recording speech from a public address system is usually a miserable failure. If you get too near, you pick up the normal deafening mains-hum from these things and if you get too far away, the result is a sort of booming, burbling grunting, nearly overpowered by general crowd noise. The best answer to this sort of problem is to seek permission to

mount your microphone next to the public address microphone. This is all right so long as the speaker doesn't use the technique employed by Belgian sailors on the cross-channel steamers: grab the microphone, stuff it in your mouth and shout like hell. If there is some alternative to recording the mess from PA systems—and there usually is—use it.

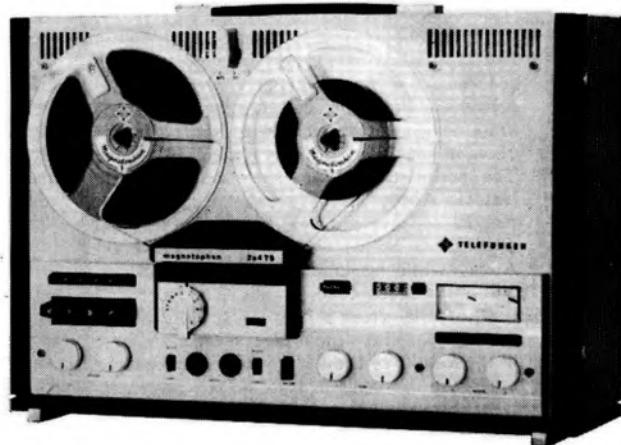
Outdoor recording requires a very special technique and it is not quite so easy as the average amateur thinks. Interviews must be carefully considered, with the interviewer in the background as much as possible—or, even better, out of it altogether. I have heard so many amateur interviews which have been too long or too boring or too badly recorded. There is a tendency amongst amateurs and many professionals to enjoy the sound of their own voices. After all, it's the person being interviewed whom the listener wants to hear. Recording open-air bands is a dicey one and should be approached, if possible, on studio lines. A small battery recorder, even with a good microphone, cannot do justice to a 60-piece band—not unless you are lucky and strike a point of natural balance and that is very debatable. Recording crowds, especially if they are getting steamed up about something, is the most rewarding work and requires little ability on the part of the recordist.

Never try a close-up recording of a horse neighing. Microphones are expensive and can give horses indigestion. Don't try recording trains (if you *must* record trains) very close. All you'll get is a classy sort of swishing-clonk which is very little use for any purpose. A motor-mower or moped engine is a useful

bit of equipment: played back at various speeds, all sorts of effects can be obtained. I suppose I could write a hundred do's and don'ts and I don't expect anyone would take any notice. Therefore, all I can say is what I said at the beginning: record outdoors only if you must and if you must, make sure you do it properly. Most people are now rather blasé about tape-recorders and playing a squeaky bit of tape which is supposed to be the family setting off for a week at Bognor, no longer fascinates them. People now (thank heaven) are beginning to expect recordings to sound like the real thing. And I wish some of them did.



"We have the Sleep-Inducing Tape at three guineas or, for a mere ten bob . . ."



The four track recorder with a one track mind!

The Telefunken 204 TS all-stereo recorder. Offers you an interesting combination of features. But one thing above all, it has its mind set on the most important single requirement, totally faithful reproduction.

What you get out of the 204 TS is exactly what you put in. It adds nothing of its own. Takes away nothing from the original sound. That's the Telefunken philosophy:

dedication to faithful reproduction.

Technical brief

Vertical or horizontal operation. Front controls. Multiple 6 function switch. Sound on sound recordings. Separate controls for recording and playback, 2 level (each with calibrated meter), 2 volume and 2 tone. 2 built in speakers. Mains 'pre-select' switch.

Response characteristics (Din 45,511).

40–15,000 cps at 3½ ips

40–18,000 cps at 7½ ips

40–8,000 cps at 1⅓ ips

Signal to noise ratio

50 db at 7½ ips, 48 db at 3½ ips

Wow and flutter, $\leq \pm 0.25\%$ at 3½ ips

$\leq \pm 0.15\%$ at 7½ ips, $\leq \pm 0.4\%$ at 1⅓ ips

£136.12.5

Telefunken,

dedicated to faithful reproduction

AEG/Telefunken

27 Chancery Lane London WC2



PPM

Postscript

MODIFYING THE BUDGET PPM TO ACCEPT A TURNER METER

AS promised in the October *Budget PPM* article, a little more information on suitable transformers and meters. My original source of transformers has dried up but the components may still be obtainable at one or two surplus stores. They are about 2.5 cm cubic, painted grey and with six tags. Markings are CAH 43142.5 or 10K/18886. Both are similar to the meters used in the prototype and I would be interested to hear of new sources.

However, I have meanwhile contacted *Transformer Equipment Ltd, Railway Place, Wimbledon, London S.W.18*, who will produce the transformers to specification in small quantities (one up) for 31s. 6d. (specify "higher grade core for maintained inductance") in an unscreened version with solder tags; or 44s. (specify "higher grade core, etc.") in a Mumetal screening can which makes the transformer more suitable for use in compact or miniaturised amplifiers. I have not had an opportunity to examine one of the transformers as yet, but Transformer Equipment's price for small quantities is by far the most realistic that I have so far been given.

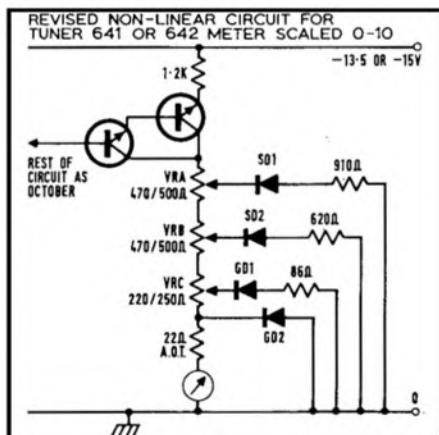
On the subject of meters, *Ernest Turner Electrical Instruments, Chiltern Works, High Wycombe*, have been most helpful and I am indebted to them for much information and willing assistance, for which I would like to express my thanks here. The original Turner meter units were type *W909* with standard spade pointers, not *W309* as I unfortunately wrote in the October article: apologies to all concerned.

Suitable 1 mA surplus units can from time to time be found at many London component and surplus stores—Smiths and others of Lisle Street, and the Edgware and Tottenham Court Roads are good hunting grounds. For those who do not relish carving up meters, Turners can supply a very elegant 1 mA 56 mm sq. clear front meter Type *641*—highly recommended. This is available with a standard PPM scale (calibrated 1-7, white on black) for just under £7. Alternatively they can supply an equally elegant version of the *641*, scaled

0-10 black on white for £3 17s. 9d., of which more below. These are the most suitable for mounting in pairs; anyone using the single meter arrangement might like to consider the 72 x 45 mm version, *Type 642*, which costs 7s. 9d. scaled 0-10.

Although one could ease off the Perspex front of the *641* meter and recalibrate by hand, this seems rather a pity, and a circuit using the meter as it stands seemed worthwhile. I have been playing with one of these movements with a view to using it in a PPM circuit, and the non-linear network—arrived at empirically from the original circuit—is illustrated here. The meter circuit is adjusted to read in 3 dB steps between 1 and 7, and 2 dB steps between 7 and 10. The result is a meter covering the same range as a standard PPM ($6 \times 3 \text{ dB} + 3 \times 2 \text{ dB} = 6 \times 4 \text{ dB}$). With peak level at 8 (PPM 6), mid-scale 5 (PPM 4) is 8 dB below peak, and the meter reads 4 dB overload as on the PPM. Anyone used to a PPM therefore adjusts rapidly to it; the divisions are more useful than those of a linear voltage scale, and the circuit retains all the advantages of a PPM while being considerably cheaper.

The circuit is adjusted in much the same way as the original circuit. With the three presets at mid travel, sensitivity is adjusted for a reading of 1; increase signal 6 dB and adjust VRC for a reading of 3; increase the signal 6 dB and adjust VRA for a reading of 5; increase signal 6 dB and adjust VRB for a reading of 7; increase signal 6 dB and adjust VRC again for a reading of 10. VRB should now need little adjustment, and the process can be repeated three times so that the scale reads in 6 dB steps 1-3, 3-5, 5-7, and 7-10, with the intermediate steps of 3 dB and 2 dB per division as described above. If necessary the 22-ohm resistor may be adjusted if the top end of the scale needs further correction. The circuit will just work with a 13.5 V supply, allowing for battery aging; a 15 V supply would give more latitude. Note that the meter zero should be set about 1 mm left of scale zero so that the standing current brings the circuit to read zero in the absence of a signal.



Meter: 1 mA fsd moving-coil Ernest Turner 641 or 642, scaled 1-10. No title.

SD1, SD2: SX11, OA202 or equivalent silicon diodes.

GD1, GD2: OA5 or equivalent germanium junction diodes.

Calibration Data

0-1 = ∞ dB	5-6 = 3 dB
1-2 = 3 dB	6-7 = 3 dB
2-3 = 3 dB	7-8 = 2 dB
3-4 = 3 dB	8-9 = 2 dB
4-5 = 3 dB	9-10 = 2 dB

1 = -12 dB = PPM 1

5 = zero level = PPM 4

8 = peak level = PPM 6

10 = +4 dB overload = PPM 7

The performance of the *641* in the modified circuit and one of my doctored Model 909 units in the original circuit have been compared on programme and with pulsed inputs, and there seems little or no difference; if anything the *641* appeared fractionally better and certainly very suitable.

TAPE TO DISC

A SURVEY OF PRIVATE DISC RECORDING STUDIOS



Trusound disc-cutting installation

* APRS, 47 Wallenden Road,
Kenley, Surrey

COMPANY	AUDIO DESIGN (RECORDINGS) LTD.	CALDER RECORDINGS LTD.	COUNTY RECORDINGS SERVICE	CRAIGHALL RECORDING STUDIOS (George Jeffrey Ltd.)
ADDRESS	45 HIGH STREET, BURNHAM, BUCKINGHAMSHIRE	REGENT STREET, HEBDEN BRIDGE, YORKSHIRE	LONDON RD., BINFIELD, BRACKNELL, BERKSHIRE	68 CRAIGHALL ROAD, EDINBURGH 6
TELEPHONE NUMBER	BURNHAM 1303	HEBDEN BRIDGE 2159	BRACKNELL 4935	031-552-3685
STUDIO FACILITIES	—	YES	YES	YES
STANDARD DIRECT-CUTTING	YES	YES	YES	YES
VARI-GROOVE DIRECT-CUTTING	YES	—	YES	YES
MASTER DISCS FOR VINYL PRESSINGS	YES	YES	YES	YES
DISCOUNT FOR CASH WITH ORDER	YES	—	YES	—
MOBILE RECORDING FACILITIES	YES	YES	YES	YES
POSTAGE & PACKING:				
18 CM DISC AND RETURNED TAPE	3/-	2/6	4/6	
25.5 CM DISC AND RETURNED TAPE	4/6	3/-	4/6	
30.5 CM DISC AND RETURNED TAPE	5/-	3/-	4/6	
STEREO MASTER DISC CUTTING	—	—	YES	—
SPECIAL FACILITIES	Baby doll records cut on vertical cutter head. Tape transfer from Teac to Revox editing, etc.	Reverberation plate, dynamic limiter, twelve channel mixer fed from capacitor microphones.	Manufacturers of cutting styli.	Tape duplication.

TAPE TO DISC

A SURVEY OF PRIVATE DISC RECORDING STUDIOS

THE published list of Members and Associates of the *Association of Professional Recording Studios** indicates that there are, in the British Isles, about eighty organisations with disc cutting facilities. It is doubtful if even this list is complete. For the purpose of our survey, only those organisations which announce their services in the nationally distributed journals have been included. This survey, in no way purports to be comprehensive for such a task would be impossible. Further, a number of organisations do not undertake to cut records for private purposes. Questionnaires were sent out to nineteen organisations and replies were received from thirteen. Those from *Warren Recordings* (N.W.4) and *Studio Sound* (Hitchin) arrived too late for inclusion.

Direct recording, a technique first pioneered by the BBC, uses a lacquer-coated aluminium disc as the recording medium, the lacquer usually being a softish material con-

taining nitro-acetate or simply acetate. These direct cut discs are used where only a few copies of a recording are required. A fact not often pointed out by organisations specialising in direct cut discs is that the surface of the disc is much softer than a commercial pressing and hence greater care is required in handling. A lightweight pickup is strongly recommended. Furthermore, older autochangers can damage the disc. The modern lightweight-pickup autochanger of the Garrard 3000 type can be used without appreciable disc damage. Due to the frightening speed with which some auto-changers hit the surface of the disc at the beginning of the record, it is recommended that manual control is used and the pickup lowered gently on to the record. With reasonable care, one can expect about 250 playings from a direct cut disc.

If more than a dozen copies of a recording

(continued overleaf)

DEROY SOUND SERVICE (1948) HIGH BANK STUDIOS, HAWK STREET, CARNFORTH, LANCS. CARNFORTH 2273 (DAY OR NIGHT)	EDEN STUDIOS LTD. 11B EDEN STREET, KINGSTON-UPON- THAMES, SURREY 01-546-5577	EXCEL SERVICES 49 BRADFORD ROAD, SHIPLEY, YORKSHIRE SHIPLEY 55779	JOHN HASSELL RECORDINGS 21 NASSAU ROAD, BARNES, LONDON S.W.13 01-748-7150	J & B RECORDINGS (MORDEN) 14 WILLOWS AVENUE, MORDEN, SURREY 648-9952 (DAY OR NIGHT)	THREE COUNTIES RECORDINGS I BROOMFIELD CLOSE, RYDES HILL, GUILDFORD, SURREY GUILDFORD 61684	TRUSOUND RECORDING SERVICES 4 HITCHIN ROAD, SHEFFORD, BEDFORDSHIRE SHEFFORD 355
YES	YES	YES	YES	YES	YES	YES
YES	YES	YES	YES	YES	YES	YES
YES	—	YES	—	—	YES	YES
YES	YES	YES	YES	YES	YES	YES
YES*	—	—	—	—	—	YES (2.5%)
YES	YES	YES	YES	YES	YES	YES
5/- 5/- 5/- 5/6	3/-		2/- 2/6 3/-	2/- 2/- 2/-	2/- 3/- 3/-	APPROXIMATELY 5/- PER ORDER
YES	*YES	—	—	—	—	—
New £6,000 Neumann cutter Backing groups and vocalists supplied. Songs orchestrated. *Discount to trade only.	Fifteen channel mixer. Response control, echo, compression, as requested. *For pressing orders only.	Equaliser, limiter double tracking.		Compressor/limiting and filtering during tape to disc copying. Professional EMI tape machines, Neumann, AKG and STC microphones. Our recordists are all professionals with musical background and can play at least 2 instruments each. They are capable of giving advice to musicians and talk their language. Special effects can be prepared for groups.		

VINYL PRESSINGS (DOUBLE SIDE)

18 CM 45 SP VARIGROOVE

(SAME PRICES FOR STANDARD UNLESS ASTERISKED)

	12 DISCS	25 DISCS	50 DISCS	99 DISCS
AUDIO & DESIGN	—	20/-	15/6	11/3
CALDER RECORDINGS	—	—	15/-	12/6
COUNTY RECORDINGS * * ...	6/-	5/6	5/3	4/9
CRAIGHALL RECORDING ...	12/-	9/6	7/6	5/11
DEROY SOUND SERVICE ...	21/-	14/-	12/-	10/-
EDEN STUDIOS	22/-	17/6	10/3	6/9
EXCEL SERVICES	20/10	12/9	8/8	6/7
JOHN HASSELL	30/-	21/6	14/-	9/4
J & B RECORDINGS	26/-	18/-	13/6	8/7
THREE COUNTIES	20/-*	15/-	—	—
TRUSOUND RECORDING ...	—	21/-	15/-	9/6

**Prices exclude cost of Master

30.5 CM 33 RPM LP

	12 DISCS	25 DISCS	50 DISCS	99 DISCS
AUDIO & DESIGN	60/-*	48/-*	48/-*	36/6*
CALDER RECORDINGS	—	—	34/-	30/-
COUNTY RECORDINGS** ...	13/9	12/3	12/-	11/3
CRAIGHALL RECORDING ...	37/6	32/-	25/-	17/-
DEROY SOUND SERVICE ...	55/-	35/-	30/-	25/-
EDEN STUDIOS	68/-	45/-	28/-	19/6
EXCEL SERVICES	45/10	28/10	20/6	16/-
JOHN HASSELL	55/-	44/-	26/-	20/-
J & B RECORDINGS	54/-	38/-	26/-	20/-
THREE COUNTIES	45/-	38/-*	33/-*	28/-
TRUSOUND RECORDING ...	—	44/-	26/-	20/-

are required, then it is cheaper to have a master made from the direct cut disc. Depending on the number of pressings required, either half-processing or full-processing may be used (up to about 100 pressings, half-processing is normally used), but in both cases pressings are made from the master or 'stamper'. The pressings are made from vinylite, a plastic which is soft at high temperatures, but becomes hard at normal temperatures. This form of disc is far more durable than the direct cut disc, but due to the cost of producing a master disc (about £6 per side for a 30.5 cm disc), it is only economic to produce pressings in quantity and becomes very reasonable (about £1 per double sided disc) for quantities of 100 or so. It should be mentioned here that for quantities of 100 or more pressings, every disc then becomes subject to purchase tax.

Direct cut discs were unobtainable until recently, Deroy now offering both these and stereo pressings. Few of the organisations had stereo cutting facilities, the work normally being done by one of the larger record companies (as is the processing).

Only one organisation in its supporting literature stated to which equalisation standard their records were cut. The BS (British Standard) equalisation curve for discs is often used, as is the RIAA (Record Industry Association of America) curve, both equalisation curves being within $\pm 1\text{dB}$ of each other; however RIAA equalisation is more frequently encountered in commercial amplifiers. Another facility offered by a number of organisations is called 'Varigroove'. Whilst disc cutting machines will always cut grooves at constant pitch (normally around 80 grooves per cm for fine grooves), some machine can vary the pitch if the dynamics of the recording will permit this (Varigroove).

Thus the playback time can be extended by about 25% per side, but a 15% extension on the standard playing time is preferred by most organisations. Due to the more sophisticated machinery involved, varigroove prices tend to be correspondingly higher. Similarly disc cutting equipment varies greatly in price and this is reflected in the charges for undertaking the work. The extended playing time offered by the Varigroove facility is clearly dependent upon the type of recording made. For, if the recording contains many long loud passages of music or speech, the spacing may finish up with only a few more grooves per cm than Standard cut records. The basic principle underlying the cutting of Varigroove records is the use of a pre-hearing head on the tape playback machine, which senses the volume of the signal before the tape reaches the playback head. Thus as the tape passes the sensing head, the recorded signal generates a voltage which is passed to a servo mechanism controlling within certain limits the pitch of the recording. Due to the softer surfaces of direct cut records, it is preferable to use a coarser pitch than is normally used in commercial vinylite pressings.

A point frequently overlooked when pressings are being made from a master disc is *copyright*. Material is sometimes recorded which is protected by copyright and consequently a fee is charged by the Mechanical Copyright Protection Society Ltd. (MCPS) for the use of such material. The whole question

DIRECT CUT DISCS (PLAYING TIMES AND PRICES)

STANDARD GROOVE 18 CM 45 RPM SP

	PLAYING TIME PER SIDE [Minutes]	PRICE	
		Single Side	Double Side
AUDIO & DESIGN	3.5	24/-	30/-
CALDER RECORDINGS	3.5	19/-	21/-
COUNTY RECORDING	3.5	26/3	26/3
CRAIGHALL RECORDING ...	2.5	26/-	32/6
DEROY SOUND SERVICE ...	—	—	—
EDEN STUDIOS	3	19/6	22/6
EXCEL SERVICES	3	24/-	27/6
JOHN HASSELL	6	30/-	35/-
J & B RECORDINGS	5	21/6	26/-
THREE COUNTIES	4	22/6	25/-
TRUSOUND RECORDING ...	3.5	18/-	21/-

VARI-GROOVE 18 CM 45 RPM SP

	PLAYING TIME PER SIDE [Minutes]	PRICE	
		Single Side	Double Side
AUDIO & DESIGN	7	28/-	36/-
CALDER RECORDINGS	—	—	—
COUNTY RECORDING	6	29/-	29/-
CRAIGHALL RECORDING ...	4	26/-	32/6
DEROY SOUND SERVICE ...	4	18/-	21/-
EDEN STUDIOS	—	—	—
EXCEL SERVICES	not quoted	24/-	27/6
JOHN HASSELL	—	—	—
J & B RECORDINGS	—	—	—
THREE COUNTIES	—	—	—
TRUSOUND RECORDING ...	5	18/-	25/-

of copyright has been considerably simplified in recent years and a fixed scale of charges to recording organisations is now in force for small numbers of pressings; which replaced a system of charges that bordered on the ludicrous.

A number of organisations provide permanent studios for a wide variety of recording purposes. Many of these studios provide excellent facilities and the results compare favourably with much larger commercial studios. The majority of organisations undertake mobile recordings—the recording of a wedding service surely ranking as the most popular. Due to the high competition between companies making outside recordings, prices tend to be very reasonable, considering the time, travelling and work involved.

Finally, if you wish to submit your own tape from which you want a disc cut, these are the golden rules to remember :

1. Record at as high a speed as possible, preferably 38 cm/s or 19 cm/s.
2. If at all possible, leave the rest of the tape free from recorded material.
3. Time accurately the length of the tape, and do not over-run on maximum recording times.
4. Indicate the beginning and end of each side of the record, by a marker or leader in the tape.
5. Try not to over-record. Due to the treble boost applied on record, distortion becomes much more apparent on disc than on the original tape.

When you submit a tape, it is useful to inform the organisation of the following facts:

1. The speed at which the recording was made.
2. Whether a full, half or quarter-track machine was employed.
3. The tape recorder used to make the recording.
4. The running time of each section of the tape to be transferred to disc.
5. Any details to be printed on the labels.

(continued on page 609)



Trusound recording studio.

Our sound studio has a carrying handle!

The new trans-portable PRO12 from Philips:
the stereo studio recorder that's at home at home.

- Twin-track mono, dual-track mono, and twin-track stereo recording and playback.
- Tape speeds $7\frac{1}{2}$ and $3\frac{3}{4}$ i.p.s..
- Electro-magnetic speed control.
- Three inputs for each channel.
- Built-in facilities for mixing 2 inputs.
- dB Switch for lining up purposes.
- Multi-play and sound on sound.
- Permits check of recorded signal during recording (before and after tape).
- Built-in monitor amplifier with loudspeaker.
- Socket for headphone monitoring.

- Cue and dubbing facilities, with tape lifting devices.
- End-of-tape switch.
- Pause button.
- Very low cross talk between the two channels.
- 3 separate motors for individual drive of the capstan and tape reels.
- Correction filters for both speeds, automatically selected and independently adjustable.
- Independent bias adjustment
- Correction filters to CCIR standard.
- Diode input-output and extra

monitor output.

- VU meter for each channel.
- Operation by means of relays.

Negligible start and stop times due to electro/mechanical control of pressure roller and braking system.

- Performance meets studio standards (DIN 45511).

PHILIPS ELECTRICAL LIMITED,
Electro Acoustics Division, Century House,
Shaftesbury Avenue, London WC2, England



PHILIPS



Beginner's Luck



IF John Shuttleworth's very interesting article in the August issue had been published last year, I would never have felt competent enough to have entered for the FBTRC competition.

All this ancillary equipment, wobble meters, signal generators, the pre-planning, know-how and care taken to produce a tape thought fit to enter. When I compare it with my effort, then I know that luck was with me to a great extent, as the recording was very much of an afterthought.

BELL RINGING

I was invited to tape some bell ringing to be replayed at a talk to be given at the Beaford Art Centre by the Rev. John Scott and illustrated by colour slides of various churches and bells in that area.

"Come along to Down St. Mary about 6.30 next Monday evening. A pretty set of six there." It was certainly a pretty little church and I had plenty of time to find the best spot for the mic, sheltered from a light wind, connect up to the mains supply and await the arrival of the bell ringers.

That recording seemed to be quite reasonable and I thought how pleasant everything had been. "Now we are going off to several other churches for more recordings, so just follow us". Then began a kind of Monte Carlo practice dash through the countryside led by the intrepid reverend gentleman, with the bell ringers in close pursuit, and followed by an ever wondering recordist as hamlets and villages were passed at what seemed an alarming rate, but then high hedged lanes make 20 m.p.h. seem fast. On arrival at the next church, which was oil lit, the bell ringers

were ready before I had found the nearest electric supply, in a cow shed !

There was a loud mains hum when everything was connected up, but nothing could be done in tracing this as the farmer was busy milking his cows and the power could not be cut off.

So it went on with a race at each church trying to have the set all ready for the three chimes warning that the ringers gave me before starting a full peal. Fortunately I had one of those universal plugs as the source varied from church to church. Lugging a Revox at half gallop round a churchyard was a little akin to "mad dogs and Englishmen" but one had to be ready for those three fateful chimes.

Four different churches, 85 miles, and all done in three hours. A far cry from the quiet peaceful evening I had envisaged at the start. I later learnt that bell ringing in the villages had to be finished by 9 p.m., hence all the hurry.

I went out again with another champion team from West Down, but unfortunately there was a half gale blowing. Despite the use of wind shields, and in one instance having the mic 'up my jumper', most of this was a write off. Various other churches were visited at odd times and at the end of many recordings I was able to appreciate when a champion team was ringing, which in the words of the Devon folk song should be "steady and true like the men of Northlew".

The talk with slides and tape was well received by the audience, though I missed the speaker's cue twice and put out the wrong bell sequence. But folk are always kind and bear with one at these moments of distress.

So I finished with numerous mono and

stereo tapes, and there seemed to be little further use for them, except for the suggestion my wife made after some hours of enforced listening ! Then I read in the *Tape Recorder* the full details of the FBTRC competition and suddenly thought the bells were just the thing for the documentary class.

An unusual subject with good quality ringing from fine old bells and with a new script written and beautifully spoken by the Rev. John Scott, himself a bell ringer and an authority on the subject, I had been given every opportunity to produce what could be a very interesting tape, at least that is what I felt.

The final assembly of the tape was an anti-climax as we had moved home and were now in an old farm house with the bare essentials being carried out by the builder and seven years of overgrowth in the garden. Somewhere in 36 tea chests were the recorders and the tapes.

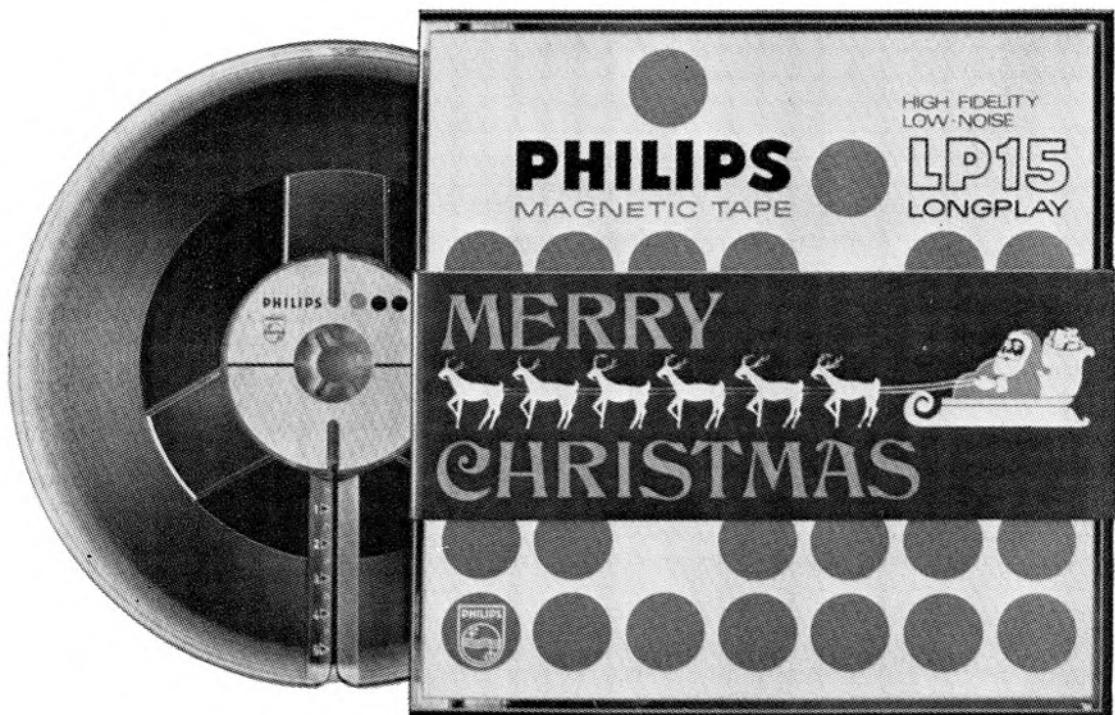
IRREGULAR SUPPLY

D-Day approached and, with an irregular electric supply subject to voltage drops and so many other pressing matters to attend to, it seemed that the gremlins would win and the tape would be a non-starter.

However the tape was put into the post, just in time, and eventually it met with approval by the judges.

A good maxim for a beginner seems to be : never fail to take any recording opportunity, as one can never tell where the final trail will lead. Sometimes an interesting subject can be more important than technical quality, though a combination of the two is the ultimate goal of every keen recordist.

Give 'em a bit of hush for Christmas!



Give them our new High-Fidelity Low-Noise tape. It has a new magnetic oxide which virtually eliminates background noise from your recordings. Giving clearer, more brilliant sound than ever before.

We've come up with a new-style calibrated reel in an ever-lasting pack. They stand in clip-together racks to form a sound library.

Best of all, our quiet new tape costs no more than the noisy old-fashioned sort. So it costs no more to give 'em a bit of hush for Christmas!



PHILIPS  **HIGH FIDELITY**
LOW-NOISE

Philips Electrical Ltd., Century House, Shaftesbury Ave., London, W.C.2.

a report on tape recorders seen, and tape recordings heard, at the Northern Audio Fair

THE last Audio Fair at Harrogate took place in 1958, a year before the first issue of *Tape Recorder* appeared on the bookstalls. It was the year Ferrograph introduced the *Series 3S* and the year of the first stereo discs. Reference to the catalogue for that event reveals a healthy complement of tape recorder manufacturers, though out of the eleven who were at the Grand Hotel then only three have survived, two of them returning to the Hotel Majestic in 1968. There were plenty of newer names as well, though how many of them will survive a further decade is a moot point, especially as the next ten years will see severe foreign (Japanese—the words are almost synonymous) competition as well as economic pressure at home.

Tape at the Audio Fair now assumes two rather paradoxical extremes, in that expensive high-quality instruments are exhibited along with tape cartridges and cassettes. The middle of the road 'good quality domestics' are usually frowned upon as this is a hi-fi exhibition, and although it might be legitimate to exclude the cassette and cartridge machines at present available on quality grounds, no one has made any such moves.

Anyone who did, would be confronted with the problematic Akai *X-1800* and *1800* which are intended to operate as conventional reel-to-reel machines but with the facility for playing and recording eight-track cartridges as well. The machines are a conventional three-speed Akai, with and without cross-field bias, and the cartridge slips into the side of the recorder. Although the facility of recording on eight-track cartridges is entirely confined to these machines, one cannot help thinking that 40 minutes of playing time—interrupted every 10 minutes—and with no fast wind or rewind is a trifle inflexible. A Philips cassette might be slightly more useful as it would enable owners of Philips machines to edit their tapes—dubbing on to reels, cutting and splicing, and then dubbing back again. The quality of the cartridge was poor—especially when compared with 19 cm/s tapes from the same recorders.

Another new machine, successor to the *X-355*, is the *X-360*, available with or without power amplifiers, and using a switched three-speed synchronous capstan motor. The machine has four speeds (a capstan sleeve, still!) all-solenoid operation, and a *Computomatic AVC* unit. This uses a servo-motor to operate a potentiometer—one can actually see the device rotating when recording—but the machine was so new that Akai engineers were quite unable to explain its advantages.



Akai X-360

Reverso-matic (automatic reversing) is carried over from the *355*, but a new idea is the *Automatic Dust Minder* which tells the owner when the replay head needs cleaning. The device consists of a pilot light actuated by a frequency-selective circuit which samples the replay signal; the system operates on the doubtful assumption that nothing detected over 7.5 kHz after ten seconds means the heads are dirty. The Akai demonstration tapes certainly were not lacking in the upper octaves, but 7.5 kHz is nearly one octave above the highest note on the piano, and most AM sets would not produce anything at this frequency whatever the programme.

SOLENOID MECHANISM

Taking advantage of the solenoid system, Akai have duplicated the *X-360* control panel on their *A-8000* tuner-amplifier, and all functions including *record* can be selected remotely by uses of these units.

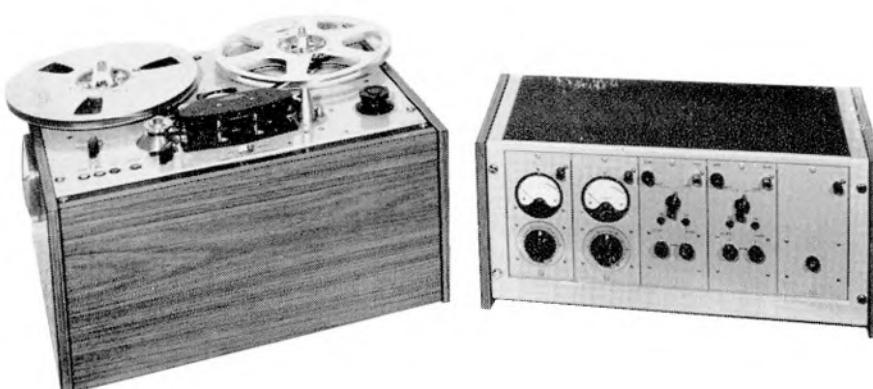
Not new, but only recently introduced, the Akai *X-V* was played through its own amplifiers into Wharfedale speakers. Even 2 W per channel is sufficient to produce a decent volume level and there was no trace of motor noise—presumably the brushless servo-system is doing its job.

From an established Japanese manufacturer to a new British manufacturer *Magnetic Tapes Ltd.* For some time we have been subjected to tempting rumours about

their *Chilton* recorder but early production problems delayed the appearance of the machine until Harrogate. The *Chilton 100S* is a three speed stereo machine, available with or without built-in power amplifiers in $\frac{1}{2}$ - or 4-track versions. Motive power is provided by a Papst hysteresis synchronous motor, which is under-run in the record/replay modes and also fan cools the electronics when the amplifier is used separately. Spring-loaded rollers are used to stabilize tape motion and one of these incorporates a microswitch which neutralises the solenoid controlled deck in the event of tape breakage. Of particular interest is the provision of high quality 10 W RMS per channel amplifiers with a fully stabilized supply (no music power nonsense) which also incorporates a current-operated non-latching overload protection device. Tom Reps, the designer, demonstrated his faith in the performance of this section with a pair of wire cutters, changing speakers while the recorder continued playing—none the worse for the experience. With PPMs, Bogen heads, switched bias, and prices starting at £127 3s. 4d. (less power amplifiers but including tax), this machine appears to offer impressive value for money.

From the sublime to ingenious, Slot Stereo were showing an AM radio tuner shaped like an eight-track cartridge and designed to fit into their car/home players to give radio reception. This cost just over £4 and a version to fit into Philips' new *N2200 Casettophone* might prove a money spinner. The *Casettophone* is a cassette player with rewind only (to go forward turn the cassette over). Cheap and cheerful, it could well prove popular, especially if the pre-recorded *Musicassettes* could be reduced in price. Besides their *PRO12*, seen at the Hotel Russell, Philips had four new domestic machines, two stereo and two mono, offering quite a lot for their price in terms of facilities. Ferrograph and Revox were both at Harrogate, the latter showing their *Disappearing 736* film—now rather the worse for wear. Confidentially, the 736 depicted at the centre of a small explosion was just a case with no mechanism—well that's their story anyway. The *A77* is now definitely subject to purchase tax, except for professional customers, and will be available at new prices starting at £140 14s. for the chassis-only version less power amplifiers.

Elstone Electronics were showing the new Tandberg *12X*. This has cross-field bias—the system used in the *6X* machines—built (continued on page 607)



A visit to Britain's largest manufacturer of studio tape recorders

Leavers Rich

BY RICHARD GOLDING

IN my wanderings around the studios, I have come to take Leavers-Rich tape recorders very much for granted as basic pieces of professional equipment which go on working without fuss or drama for years at a stretch. One comes across them most frequently in the sound, radio and television departments of the BBC, Central Office of Information, and ITA, all committed to providing a public service or its equivalent and all demanding absolute reliability.

When I heard the other day that the BBC were going to send about 150 Leavers-Rich machines back to the makers for alteration to slow speed operation, I felt sure there must be a story behind this, particularly as a proportion of these machines had been in service for over ten years and according to normal practice would have been written off the books years ago. At first sight it looked as though Auntie had gone to extremes and developed a veteran car complex about her tape recorders.

What I found of course was something quite different. Since the early 50's an increasing proportion of studio recorders have been bought from Leavers-Rich until today the complement in service totals many hundreds, and it seems that neither price (the machines are in the higher price category) nor sentiment (except for the usual "Back Britain" policy) were major factors. On the other hand, the BBC have over the years developed a most efficient maintenance system covering all types of technical equipment, including programme recorders, and keeping detailed records of any breakdowns and their cause. In recent years this information has been accessible (internally) for computer analysis, to be taken into account when evaluating equipment for similar conditions of use—one cannot get much less sentimental than that when deciding on a 'best buy'.

The BBC has been long in deciding to change from its present practice of 38 and 19 cm/s working, but it must be remembered that programme quality standards are very high in all respects and must be maintained throughout complex sequences of editing and dubbing and must also be practical in terms of International programme exchange on tape. It has in fact taken over two years of careful tests to establish the lower tape speeds as a reliable operation. The changeover of the BBC overseas service to the new standards will involve the

conversion of about 150 Leavers-Rich machines but costly as this will be, the annual consumption of tape is now so large that the total conversion and refurbishing cost will be saved in the first full year's operation.

Having gathered these facts, I made my way to Wandsworth to talk to the men who make these recorders and to see where and how they do it. Frankly, my first impressions were mixed, and the "hiding one's light under a bushel" phrase sprang to mind. A stone's throw from the forbidding gates of Wandsworth Prison, *Leavers-Rich Equipment Limited* faces the world with the facade of a sober Victorian dwelling house. This contains the offices and commercial departments. Looking out to the rear I saw a sizeable vegetable garden (with some of the largest cabbages I have ever come across) beyond which was a much more recent single storey factory building.

Within this building are the production departments, fabricating almost every part of a Leavers-Rich recorder. Largest of these, and easily the noisiest, is the Sheet Metal Department with its power guillotines, presses, gas, arc and spot welding machines used in making metal consoles, cases, trays, chassis, etc.

In a second bay is the production machine shop carrying out turning, drilling, milling, grinding and other machining processes on the component parts of the recorder mechanisms, which are assembled in an adjacent workshop. In this assembly shop I became aware that studio tape recorders are not the only products being manufactured and that a range of magnetic film recorders is in production for use in film and television studios. There are very practical reasons for manufacturing both products in the same factory: common amplifier designs, similar control circuits, spooling arrangements and in general similar manufacturing skills, yet Leavers-Rich is the only firm in this country manufacturing for both professional film and tape recording markets.

This use of common manufacturing facilities and skills is also to be seen in the magnetic head department, where heads for both purposes are in course of manufacture. Indeed certain types such as 4-channel on 25.4 mm tape and 35 mm film are identical for the two applications.

The sections dealing with the assembly and wiring of amplifiers, and wiring of control

circuits, also produce accessory products such as *Leeraser* tape demagnetisers and audio equalisers.

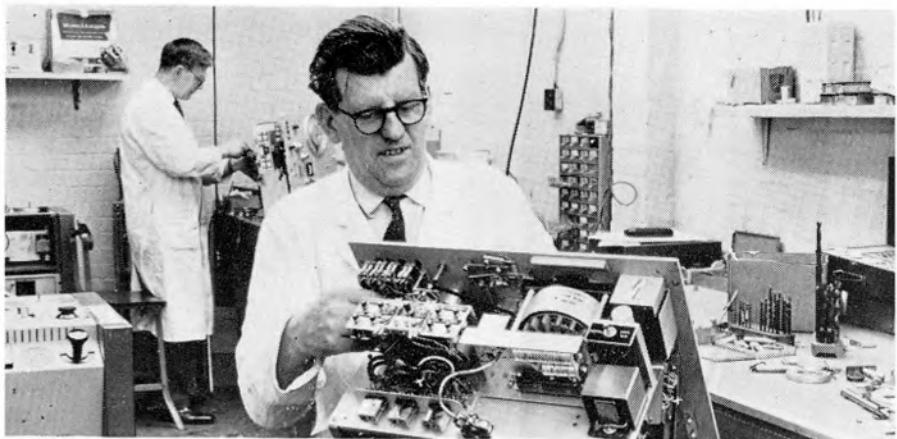
The final adjustment and testing of finished machines is carried out in a separate suite of rooms. Here each completed machine faces a rigid programme of tests covering every aspect of its performance specification. This may take several hours for one of the standard recorders. For the more elaborate installations the whole process may take days, but the test department is the most vital operation in maintaining a company's reputation, and everyone here seems to realise that.

The variety of machines on test gives some idea of the range of the firm's products. The greater part of production is concerned with the standard *Series E* audio recorder and its derivatives. This machine is now in its *Mk 5* version and although little changed in appearance and mechanical design from its earlier generations, it has been progressively improved in performance and refined in detail to keep abreast of the continual progress in magnetic recording techniques and materials. This steady improvement has been possible without fundamental redesign because the original mechanical design employed a form of unit construction in which such items as capstan drive unit, head unit, spool motors, and control pack, were both accessible and easily removed as complete assemblies for service or, as sometimes occurs, for modification to suit new requirements. Thus, special models for purposes such as high speed copying, long duration monitoring, or speed lock to a reference time base, can be produced without undue difficulty.

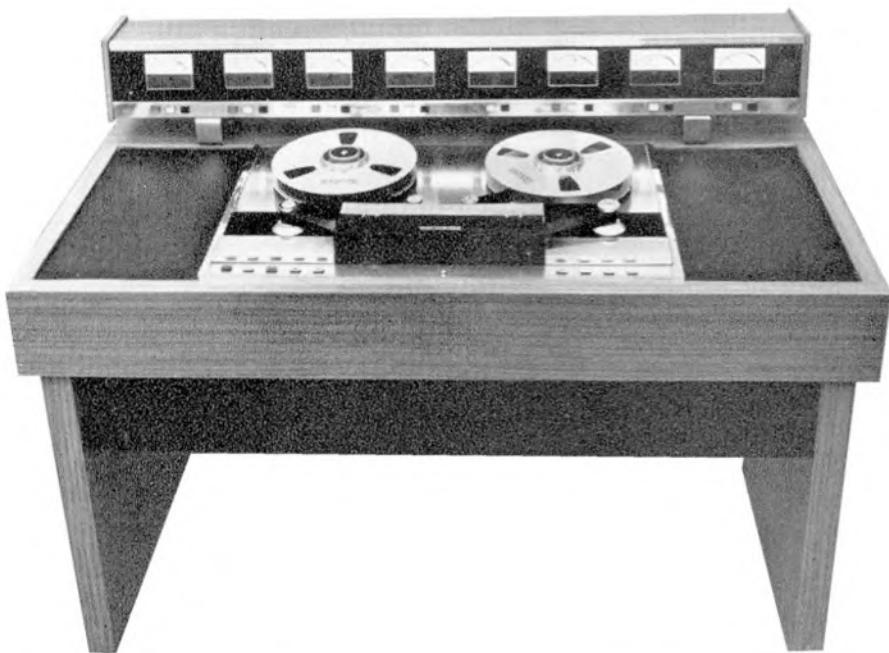
The removable plug-in head unit containing the erase, record and replay heads held in accurate alignment has been a notable feature of all Leavers-Rich models since the firm began operations in 1951. It enables the machine to be converted from one track format to another in a matter of minutes, and in the case of the 6.25 cm model *E242* covers 1/1, 1/2, 2/2 and 2/4 arrangements (i.e. full track, $\frac{1}{2}$ -track, twin $\frac{1}{2}$ -track and twin $\frac{1}{4}$ -track).

The unit itself consists of a ground steel base carrying the connecting plug and the three head cages—separate Mu-metal screening boxes in which each head is mounted with a three-dimensional screw adjustment. The erase head is a ferrite cored two-gap type,

Left: Model E transportable recorder.

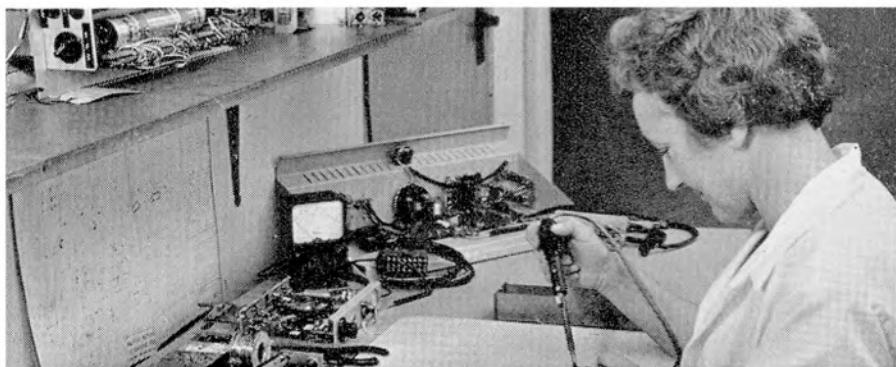


Right: Work progressing on slow-speed BBC recorders in the Engineering Assembly Department.



Above: The new Model R multi-track studio console.

Below: Production of printed circuit boards used in Series E recorders.

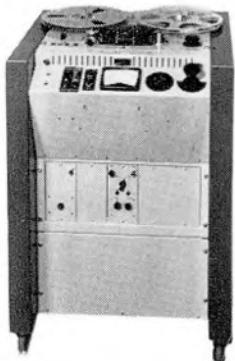


while the record and replay heads incorporate laminated Mu-metal cores with gap and pole face surfaces hand lapped to a micro-finish to achieve the high resolution required. Since separate record and replay heads are always used, there is no compromise on gap length, that of the record head being set at 25 microns (μ) to secure low noise-level with the 100 kHz oscillator used, while that of the replay head is 2.5μ for maximum resolution of the very short wave lengths at the top of the frequency spectrum. The pole face is contoured to avoid the irregularities in LF response often met with due to head wavelength effects.

So fine is the finish obtained on the pole face that a microscope is necessary to see the replay gap. I asked a test engineer "how do you know the gap is 2.5μ if you can barely see it—let alone measure it?" To which he replied, "We don't measure the gap itself, we measure the gap spacer, then after assembly we use electrical tests to ensure the correct mating pressure against this spacer." Cross checking by measuring the frequency at which head output dips to a nul (i.e. at which wavelength on tape equals the effective gap length), has proved the method to be very reliable. A further question as to how long a head lasts before it is worn out proved slightly tactless, the reply being "No professional would use a head to the point where it is worn out. We recommend that heads be changed as soon as the measured inductance has dropped to half its rated value."

With the exception of the motors, which are made by Croydon or Papst, every mechanical component is made within the factory under strict quality control and inspection. The wide use of ball races, light alloys, appropriate protective finishes, all speak of instrument engineering practice applied to a mechanism which has been designed to operate for many years without deterioration. I noticed, for example, that substantial machined bars and sections are used for the various operational linkages where one so often sees pressings and stampings of sheet metal used in other makes.

The deck itself is of pre-stressed Dural plate, machined to close tolerances, which is hinged at the rear so that it may be easily raised and locked open for access to the underside. It is so easy to get at any part of the recorder that there is really no excuse for neglecting the routine inspection checks
(continued overleaf)



Left: BBC version of the Series E console.
Mechanism and amplifiers are readily accessible
for maintenance.



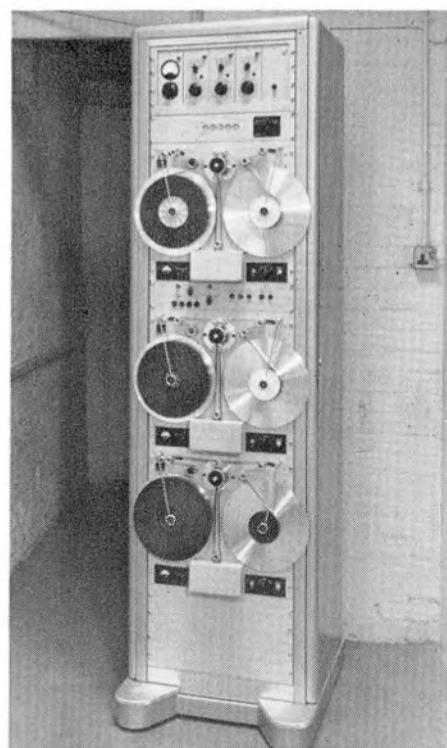
Below left: Manufacture of head shells.



Below right: Assembly of data recorder for
flight simulator programming.

Bottom left: Assembly of a magnetic head.

Bottom right: 16 mm magnetic film
transfer system.



employed by the larger commercial users, and this no doubt contributes to the reputation for reliability in use.

The tape transport employs three motors, the spool motors being of the torque type fitted with large brake drums and fail safe solenoid brakes. When in the fast wind mode, the tape motion can be continuously controlled from *fast rewind* to *fast forward* by means of a large potentiometer, a very useful facility for editing purposes. The capstan unit comprises a two-speed switched-pole hysteresis-synchronous motor mounted in line with the capstan shaft, to which it is coupled by a low-pass mechanical filter, the capstan shaft carrying a balanced flywheel. Thus motor hunting or flutter is filtered out and does not appear at the capstan shaft itself. Watching flutter tests being carried out, I became aware that in this firm a specified 0.1% RMS flutter figure does not mean you *can* achieve this figure on a good machine if you are lucky, it means that on no machine do you exceed this limit at any part of any sized spool in practice and the test engineers are concerned if they exceed half this figure on test.

The tape path, after leaving the left hand spool, passes round a sensing jockey roller to the spinwheel on the left, which is free running and carries a stroboscopic speed indicator for tape speeds of 38, 19 and 9.5 cm/s. The jockey/flywheel combination isolates the tape motion at the heads from the effects of bent spools or sticky splices, etc., occurring as it leaves the feed spool.

Passing on through the head group and capstan pinch, the tape finally drives a digital timing indicator which guides it on to the take up spool. As is customary on professional machines, no pressure pads are used in order to avoid flutter due to head friction, and wear of polefaces during fast spooling is overcome by two ceramic lift pins which normally hold the tape clear when spooling.

For editing purposes, it is necessary to listen off tape when spooling and a control button is incorporated to lower the tape on the replay head only, when required.

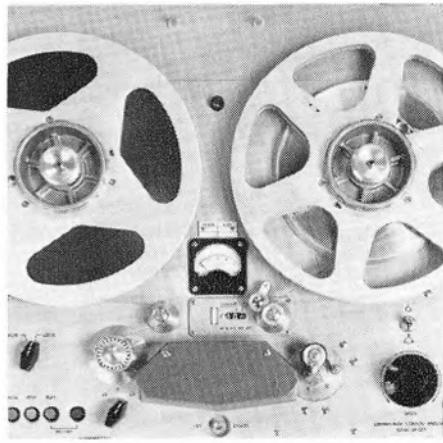
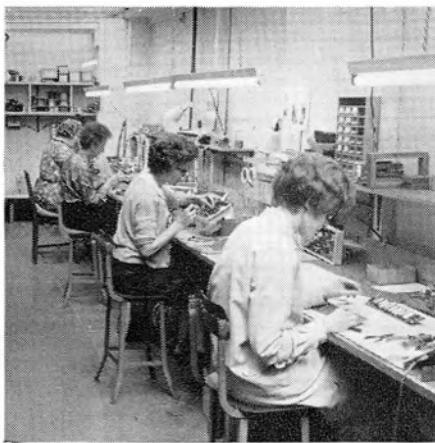
The functioning of the machine is controlled by a set of four illuminated push buttons, *spool*, *stop*, *play* and *record*. These actuate the main control relays in the correct sequence in each function, so avoiding risk of tape damage. For example if the machine is recording, pressure on the *spool* button will cancel the record circuits, open the pinch, lift the tape and



Right: General view of Wiring Department.

Far right: Plan view of the Series E deck.

Bottom right: An eight-channel R.165 undergoing development.



wind at the speed and direction set by the spool potentiometer. On the other hand if tape is being fast wound it would be dangerous to close the pinch, therefore play and record buttons are inactive until you press the stop button and bring the tape to rest.

A selector switch adjacent to the push buttons enables the deck to be switched to remote control, when all functions can be initiated by a similar push button group at a remote point such as a mixing console. In this condition the operation of the machine cannot be interfered with at the machine by accidental pressure on the deck push buttons, but the illuminating bulbs still indicate the function is in use at both machine and remote control point.

As with the deck mechanism, the associated amplifiers also conform to a unit assembly system, in this case of modular form based on five units side by side in the standard 48 cm rack width. Thus a complete recording amplifier forms a 17.8 high by 8.9 cm wide module; the replay amplifier is of identical size, all plugging into a 48 cm frame or nest taking their power supplies from a common supply unit. This system is adhered to, not only in the normal range of multitrack versions of the 6.25 mm Series E but also in the larger 12.5 mm and 25 mm machines coded Series H and Series G.

These larger machines follow the mechanical layout of the Series E but are built on an even more substantial deck plate with larger motors and of course the appropriate changes in pulley, capstan and head dimensions. Originally designed for data recording and instrumentation use, they are increasingly being purchased for four and eight channel mastering purposes in the larger disc recording studios.

I was interested to observe the differing emphasis placed on performance as between a standard audio recorder and the same machine in data recording form. A 38 cm/s audio recorder is designed to satisfy BS 1568 and uses CCIR/ISO equalisation, i.e. it is equalised to be within a total error of 2 dB for a bandwidth from 50 Hz to 15 kHz (in practice they are tested to give this accuracy up to 18 kHz). Unweighted signal-to-noise ratio will be 60 dB with 1/1 track. A data machine will be equalised on a constant recording current basis—no recording pre-emphasis—and, with the same tape speed and heads as the audio machine, will be within ± 2 dB from

50 Hz to 25 kHz. However, the effective unweighted signal to noise ratio will be some 10-12 dB less. *Which all goes to prove that when reading maker's frequency response figures on audio machines, wide frequency response is not in itself a desirable aim and will often involve serious penalties in regard to noise and distortion which make the actual recordings sound unpleasant to the ear, particularly when one or more generations of re-recording are carried out.* (Our italics—Ed.)

During my visit I saw a number of highly interesting tape recorders for special applications, including four-channel machines using the FM carrier system destined for programming aircraft flight simulator installations. Also a variant of the Series E carrying a replay head on a miniature lathe slide which permits the phase angle between tracks to be varied over a wide range.

This is a valuable research tool in autocorrelation work and the machine I saw was being supplied for a research project which involves investigation of the sonar system by which bats 'see' in the absence of light. Perhaps the Flanders and Swan *Song of Reproduction* was not so far-fetched after all.

One of the most impressive uses of the Series E machine is in tape copying plants, many of which have come into use in recent years, both in the pre-recorded tape industry and in educational establishments. The conditions of use are very severe, the machines working virtually all day long at speeds of 76 or 38 cm/s. Careful monitoring of every copy at normal running speed is completely impracticable in this sort of operation, and accordingly the penalties of any gradual deterioration of quality, let alone a complete breakdown, can be both embarrassing and expensive, particularly if a fault is not detected immediately.

A typical copying system I saw under construction comprised a master tape reproducer and five slave recorders, all mounted in a three-bay 48 cm rack. Its output capacity is more than 230.5 hour tape copies per eight hour day. At the maximum speed, the recorded frequency spectrum extends to over 100 kHz and calls for RF wiring and circuitry. The bias oscillator runs at 440 kHz and effective shielding has to be employed.

Another interesting machine based on the same tape transport is the S.T.2 recorder-reproducer. This embodies the Syncropulse

interlock system pioneered by Norman Leavers in the early 50's and records a synchronising control tone adjacent to the audio track. On reproduction this tone is used to control the capstan motor which is of the servo type. This feature is particularly valuable where recordings must be reproduced in accurate synchronism with film. In recording, the capstan motor speed is compared with the mains frequency (or other time base) and locks-in rather like a synchronous motor. On replay, the control tone on the tape is compared with the same time base and controls the capstan motor in a similar way to re-establish the exact tape speed. So far so good, but some half dozen different types of synchronised tape recorder are now in film and television use, each with a different track arrangement and time base pattern, and the transcription departments of studios are required to deal with all of these.

The S.T.2 deals with these problems, having interchangeable head units to suit the various track formats, and a choice of time base and pulse shaping circuits for deriving the motor control information. The circuitry of such a device must necessarily be complex, yet all the units are arranged in an orderly pattern for easy maintenance, and the controls are so arranged that after a short driving lesson from the chief test engineer, Peter Harding, I felt I had acquired reasonable operating proficiency.

The S.T.2 is normally used for tape-to-film transcription work in conjunction with the Series F magnetic film recorder, of which three main types are in production. These are called F8, F16 and F35, taking 8 mm, 16 mm and 35 mm film respectively. Here, as with the Series E, a standard basic mechanism is

(continued on page 599)



SONY

All the way and back again...TC-560D, SONY'S ingenious auto-reverse tape deck. The secret is E.S.P. (Electronic Sensory Perceptor), which automatically changes tracks and reverses the tape at the end of the recorded signal. This means uninterrupted stereo reproduction over the full length of the tape. Recommended Retail Price £174.

Specifications

Recording system:	4-track stereo/mono recording and playback
Power requirement:	AC 100, 110, 117, 125, 220 or 240V, 50/60 Hz
	16 watts, DC 12V
Tape Speed:	7½ ips, 3½ ips, 1½ ips
Reel capacity:	7" or smaller
Frequency response:	20 - 21,000 Hz at 7½ ips 50 - 17,000 Hz ±3dB at 7½ ips 20 - 15,000 Hz at 3½ ips 20 - 8,000 Hz at 1½ ips
Signal-to-noise ratio:	Better than 52dB
Wow and Flutter:	Less than 0.15% at 7½ ips Less than 0.2% at 3½ ips Less than 0.35% at 1½ ips

Harmonic distortion:	Less than 2.5% at normal recording level
Level indication:	Dual VU meter
Fast forward and rewind time:	Within 2 min. 20 sec (1,200' tape)
Inputs:	Microphone input jack: Sensitivity: -72dB (0.19mV) Impedance: 600 ohms
	Auxiliary input jack: Sensitivity: -22dB (61mV) Impedance: Approx. 100K ohms
Outputs:	Line output jack: Output level: 0dB (0.775V) Impedance: 100K ohms
	Headphone jack:

Dimensions:	16¾" (W) x 6½" (H) x 15⅞" (D)
Weight:	28 lbs, 11 oz
Accessories:	Empty reel R-7 A 1 Connecting cord RK-56 2 Head cleaning ribbon 1 Reel cap 2 Dust protector DP-560D 1 Power cord 1

SONY®
RESEARCH MAKES THE DIFFERENCE
Sony (U.K.) Limited,
Ascot Road, Bedfont, Middlesex.



The National NV-1020E

By Richard Golding

CLOSED CIRCUIT



THE National NV-1020E is the latest low-priced helical-scan VTR from the Matsushita Electric Company of Japan to make its appearance in this country. It has undergone continual development while being used extensively in education and industry in Japan and now embodies several unique features of special interest to potential users over here. Among these is a still-picture control, an automatic head-cleaning button, an idler arm which stops the drive motor immediately if the tape happens to break, piano-key control for mechanical operation, and complete compatibility with all other 1020E models.

There are many variations of the helical-scan principle; some recorders employ a single head with a 360° tape wrap, with either an omega or an alpha tape path; other recorders use two heads with a 180° tape wrap; and one recorder, still in prototype form, uses four heads with a 180° tape wrap and a very complicated system of guides. All these systems are designed to achieve the very high writing speed necessary to record the detail in the TV picture. Writing speed refers to the effective head-to-tape speed, not the speed at which the tape passes through the transport, although this is important in audio-track terms and one would not expect to find a tape speed used that was lower than 15 cm/s. The writing speed in quadruplex studio VTRs is very high, and to achieve the resolution required in broadcast application it is in the order of 3800 cm/s. In the type of work required in education and industry, at least 760 cm/s is necessary.

The writing speed of the National NV-1020E is 1232 cm/s. This is achieved by using 12.5mm tape with a rotating two-head system, the tape being wound around half the drum in a 180° helical loop. The two video heads are mounted 180° apart on the head-disc assembly which rotates at 1500 r.p.m. thus recording the required 50 interlaced fields per second on slanting tracks across the tape. The slant is effected by placing the feed spool on a higher plane than the take-up spool and by giving a pre-determined inclination to the video head tracking on the tape. As the tape speed used is 24.9 cm/s the resultant writing speed is well above the minimum required.

There are three other heads in use. A combined audio control head records audio signals with AC bias on the top edge of the tape, and the control signal on the bottom edge. The control signal synchronises the rotating speed of the head against the vertical sync signal present in the video signal. The second head is a full-width erase used except when the machine is set in audio mode only. The third is the audio track erase for audio dubbing purposes.

The automatic head-cleaning button is set just above the head-disc assembly housing. This may be depressed when the recording appears to suffer through undue head clogging. It is an important factor with video that the tape should be in intimate contact with the head at all times, and that the head-gap should be very narrow. Generally the gap of an audio tape recorder is approximately 5 microns which enables it to record frequencies of up to 20 kHz; in video, however, the HF region is at least 150 times that of an audio recorder and so requires a head-gap as

narrow as 1 micron. The video head is subject to the accumulation of oxide and dust during use which, of course, degrades the recording and reproduction quality. The automatic head cleaning button requires only an occasional operation, for one or two seconds, and entirely removes the risk of physical damage to the heads.

The other controls on the deck are situated front right. Five press tabs govern stop, fast rewind, fast forward, play and record. The tape transport principle is conventional. When AC power is applied, the capstan and head motors begin to rotate. The capstan motor is attached to the motor pulley. Capstan flywheel, take-up reel, hub, and rewind idler are connected to each other by means of a belt. Therefore, when the capstan motor begins rotation, these satellite mechanical parts rotate simultaneously. When the play button is depressed, the pinch roller engages the capstan and tape transport starts simultaneously. The take-up reel pulley pushes the reel hub slightly upward by means of a clutch. The reel hub is driven by friction between felt placed on the surface of the reel pulley and the reel hub.

To the right of these controls are the video gain controls, the tape counter with re-set button, and the audio vu-meter. All the controls are together within more-or-less the span of the hand.

When the *record* button is depressed, the tape does not start, but the picture to be recorded appears on the screen of the monitor. By observing the picture, the modulation may be increased by turning the *Video control knob* to the right. Excessive modulation will produce a striping effect on the screen; the most desirable recording level is the point just before the stripes appear on the screen. When the adjustment is made, both *record* and *play* must be depressed simultaneously for the recording to begin.

The *audio control knob* contains both power source switching and sound recording adjustment, but it also needs to be used in conjunction with the *record* button. When this is depressed, the pointer of the level meter will swing, and the level should be set so that the needle deflects within the black zone during peak volume of the source material.

A still picture may be obtained and held quite easily on playback, by selecting a suitable moment on the monitor and then depressing the *Stop* button. The video heads still rotate but scan only one frame on the stationary tape. To obtain a clear picture and cut out any bending of vertical lines, the reels may be very slightly inched by hand. There is, however, a *reel handle* available for slow motion and framing.

In a recessed panel in the right-hand side of the VTR are the input and output sockets together with recording and playback phase controls. These should not be adjusted except for the following occasions: recording phase only when the VTR is serviced; playback phase when (1) playing a tape recorded by another VTR, (2) playing old tape, (3) the power source voltage is suddenly altered, (4) the signal-to-noise ratio of the recorded picture is excessively poor. The panel also contains video and audio output sockets, together with

(continued on page 599)

A Grundig never tells a lie.

Most of the better tape recorders are expensive.

Some very expensive.

But when you come to think about it, stereo and other gadgets aside, all they really have to offer is the truth.

Record your son's violin playing and you get it back.



With the Grundig TK 247, you get this ultimate truth of reproduction for much less money.

You get full solid state stereo, four tracks, twin speeds, plus twin recording and playback amplifiers.

You get facilities for multiple-synchronous recordings, monitoring via headphones and remote control.

It's fully transistorised with an output of 2 x 4 watts through 4 speakers.

It has a built-in mixer control, illuminated VU input meters and auto tape-stop.

And looks pretty good in its graphite and silver steel case.

The reproduction quality of the Grundig TK 247 is among the best in the world, no matter what you record or at what level.

At 122 gns. we can't make your son a better violinist.

We can only offer the truth.

GRUNDIG

For people who listen.

Grundig (Great Britain) Ltd. London, SE26

CLOSED CIRCUIT CONTINUED

power supply, for a plug-in RZ converter unit thus allowing a domestic receiver to be used as monitor if required. A plug-in video adaptor is available to provide signals for use with any type of video monitor.

The NV-1020E uses a synchronous motor which syncs its rotation to the driving signal. The direct driving system is much simpler than a servo system. The head-disc motor is rotated at 1500 rpm and syncs with the vertical sync in the TV signal and the contacting period of the head against the tape becomes 1/50 sec. Noise is unavoidably created at the moment of head switching. If noise appears in the image it distorts the picture, so to eliminate this problem it is necessary to adjust the timing of the switching period a few lines of horizontal scanning above the vertical blanking portion of the TV signal.

In reproduction this operation is identical to recording. The locus recorded by head-A must be traced by head-A in reproduction. This operation is called head-sensing. To match both locus and head perfectly during reproduction, phase adjustment of the reproducing signal becomes necessary, for if the heads are tracing outside of the recording locus the signal to noise ratio and picture quality will be degraded.

As both phase controls are pre-set, there should be no need to adjust them except for the four conditions noted above.

The 40 dB signal-to-noise ratio is acceptable for industrial work. For any serious work performance needs to lie between 36 and 42 dB, while anything above 42 dB is likely to be wasted by shortcomings in other items of a CCTV system. The signal-to-noise ratio of a VTR generally improves with initial use as the head surface beds in, thus promoting more intimate contact with the tape. The bedding-in time varies, but optimum performance is

usually reached after about 40 hours of recording. The life of a head varies too, and can last 2000 hours. The National heads carry a guarantee of 500 hours or 3 months whichever is reached first, with replacement sets available at £25 per pair.

The price of the VTR is £398 and this includes take-up spool, a 2.5 metre AC cable 1.5 metre video cable and splicing tape. Beulah Electronics also distribute a great variety of ancillary TV equipment, including TV cameras and tripods, remote control camera panning units, monitors, and a very interesting Special Effects unit.

The National *Special Effects Generator* is an extremely versatile unit that, in view of its low price (£150), may be of special interest to CCTV operators already established. It allows a variety of special effects such as superimposition, fade-in and fade-out, and horizontal, vertical and corner-inset wipes. It accepts three signal inputs of TV cameras (composite 1.4 V p-p) and provides composite output. Two optional TV cameras out of three can be selected by operating the Camera Selector Switch. An external sync input connector is provided so that all TV cameras connected to the device can be converted to perfect 2:1 interface by the addition of the National Sync Generator. The price of the latter is £165.

Beulah Electronics operate a Video Industrial Training Plan to enable companies to hire a complete CCTV system including VTR and Special Effects unit, if needed, for a few pounds weekly leasing charge. Specimen charges are: National TV Camera with 13 cm viewfinder, NV-1020E VTR, 63 cm Tutor Monitor and UHF/VHF Receiver:

Leasing charge	£4 11 10 per week
Less 42½% Corporation Tax	£1 19 0
Weekly Outlay	£2 12 10

Purchase Tax is not chargeable on National VTRs and consequently they will not be available for domestic purposes.

SPECIFICATION OF THE NV-1020E

Video

Recording system	Two-head helical-scan
TV signal	625 line
Recording time	45 minutes
Tape width	12.5 mm
Spool capacity	18 cm
Tape speed	24.9 cms
Video input	0.5-1.5 Vp-p 75 ohms
Video output	1 Vp-p (0 dB)
Frequency response	2.2 MHz
Signal to noise ratio	40 dB
Still picture playback	

Audio

Microphone input	-60 dB 20K unbalanced
Auxiliary input	-20 dB 1M unbalanced
Output	-20 dB 600 ohms unbalanced
Frequency range	80 Hz-10 kHz
Signal-to-noise ratio	40 dB

General

Power supplies	117, 127, 200, 220, 230 or 245 V AC 50 Hz
Dimensions	26.6, 43.8, 42.5 cm (h w d)
Weight	23 Kg (51 lb)

Distributor

Beulah Electronics
Ltd., 126 Hamilton
Road, West
Norwood,
London S.E.27.

LEEVERS-RICH CONTINUED

common to all three types, the main differences being in gear ratios, sprocket and roller sizes and, of course, the plug-in head unit.

The film transport mechanism is a very substantially built unit with large torque motors for the spools and a symmetrical tape path of the closed-loop type. Only one film drive sprocket is used and changing speed between 24 and 25 f/s for film or TV standards is accomplished by changing this sprocket, which takes about a minute at the most.

The design is unusual in that no pad arms are used to hold the film on the teeth of the sprocket, nor are they necessary. This means that there are no friction surfaces in contact with the film anywhere and the machine can be used not only for SEPMAG film (separate sound track) but also for COMMAG (married prints) without risk of damage.

Another unusual feature is the magnetic clutch in the drive to the sprocket which not only facilitates adjusting the start position of the film but also permits fast rewind without unthreading.

The chief engineer, Arthur Barr, pointed out

to me the special changeover facilities on the F8 model which accommodate either 8 mm or Super 8 mm and I felt prompted to ask who on earth would buy a machine like this to record 8 mm movies. "Probably no one" he said, "but we are selling quite a number in fast copying plants for producing 8 mm copies from 16 mm and 35 mm masters—it's about the only machine which will stand up to this sort of service."

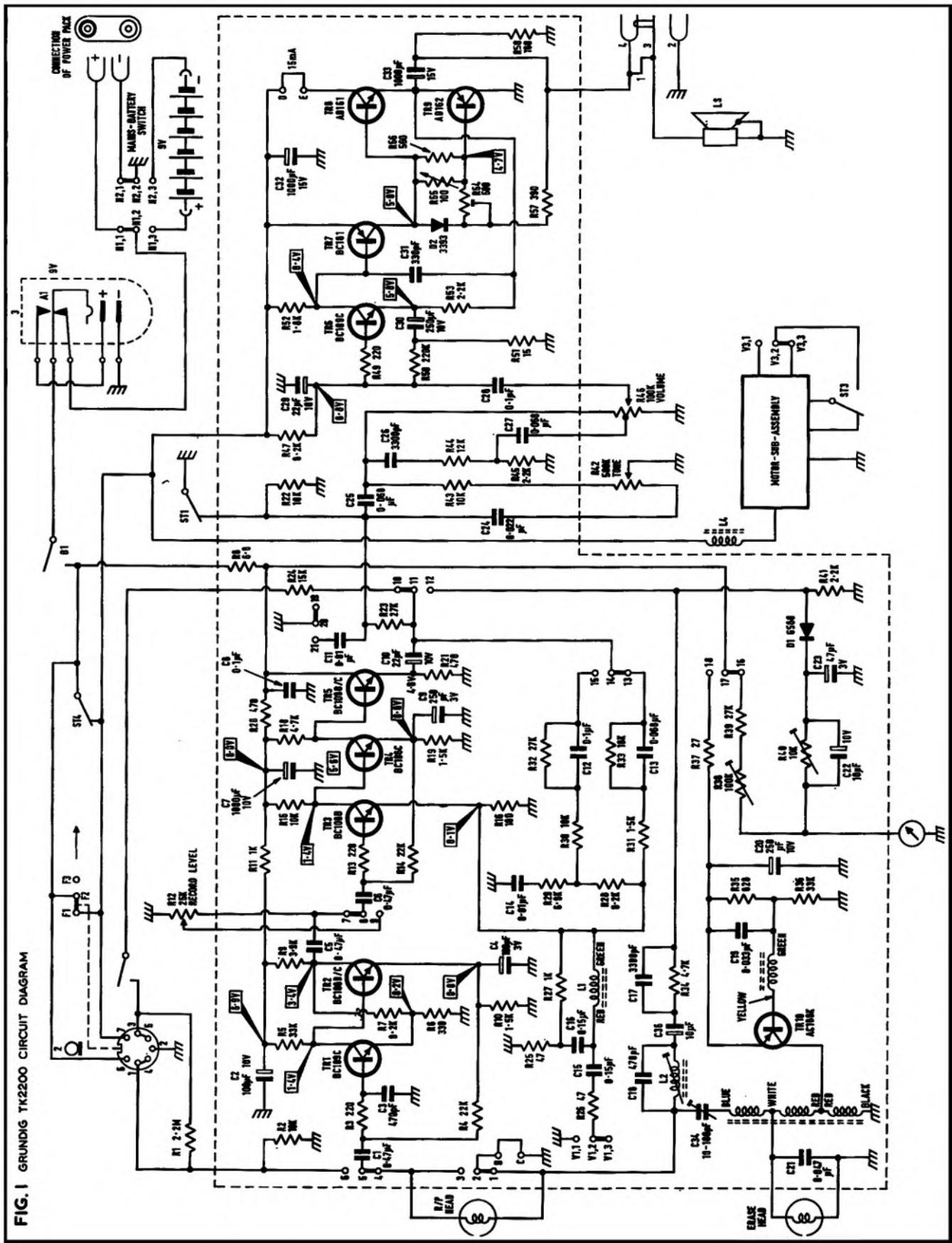
Most manufacturers are understandably shy about letting visitors prowl about their development departments, but I did manage to have a talk with Robin Bransbury who has been working on the new series of recording and replay amplifiers, and who showed me prototypes of the models which go into production in December. These have been designed particularly to suit the increasing requirements of multi-track selective recording machines, especially where facilities for simultaneous replay from the record head stack is required. They are very compact and a full complement of four record and replay amplifiers occupies only 17.8 cm of rack space, including oscillator and power unit. The record amplifier module contains its own record,

equaliser and monitor relays, and a plug-in equaliser network permits rapid change of speed range, or NAB/CCIR standard. The latest transistor and integrated circuit types have been used, and a power amplifier for bias and erase is included, working from a master oscillator in the power supply unit.

The associated replay amplifier has a similar plug-in equaliser arrangement. As with all professional equipment the output level is nominally 0 dBm into 600 line and in this case the clip level is +20 dBm.

During a final chat with Norman Leavers and John Alcock, his sales executive, I made suitable complimentary remarks about the pioneering work done by this, one of our longest established firms in the recording field, and was agreeably surprised to find both these men much more interested in discussing forward plans for their products and how they will satisfy the studio requirements of the future. A new range of multi-track tape consoles, new styling, an original approach to constant speed drives—all these are in the pipe line and served to whet my appetite for a second visit which I look forward to in due course.

FIG. I GRUNDIG TK2200 CIRCUIT DIAGRAM



equipment reviews



GRUNDIG TK2200

MANUFACTURER'S SPECIFICATION (9.5 cm/s). Battery powered 4-track tape recorder. Frequency range: 40 Hz-15 kHz. Signal-to-noise ratio: 47 dB. Wow and flutter: $\pm 0.25\%$. Power supply: Six U2 cells or equivalent, or TN12 mains power pack. Tape speeds: 9.5 and 4.75 cm/s. Spool capacity: 13 cm. Weight: 12.5 lb. Dimensions: 35 x 21 x 10.5 cm (l x w x h). Price: £96 12s. including purchase tax. Manufacturer: Grundig Werke GmbH, 851 Furth, Kurgartenstrasse 37, West Germany. Distributor: Grundig (Great Britain) Ltd., London S.E.26.

THE upright styling of this machine has allowed the loudspeaker to be placed on one side of the case and the spools and drive mechanism on the other. The controls are on the top of the recorder and the batteries, or power pack, are inserted by removing a slide plate at the bottom of the case. The tape motion controls are rectangular press buttons labelled *stop*, *start*, *pause*, *wind* and *rewind*, with a round press button for *record* which is locked down by simultaneous operation of the *start* key. A three-digit tape position indicator, with press button reset, is conveniently placed at the right hand end of the control area and this is driven from the take-up reel with 10 turns of the reel clocking up 7 digits. At the left hand of the panel is the playback volume control which looks like a double edge operated control, but the two drums are locked together. The other control, on the other side of the record level meter, is a true double control with the front drum operating as record level control and the rear one acting as playback tone control—bass cut on clockwise rotation and

FIG. 2 GRUNDIG TK2200 RECORD/PLAY WOW AND FLUTTER

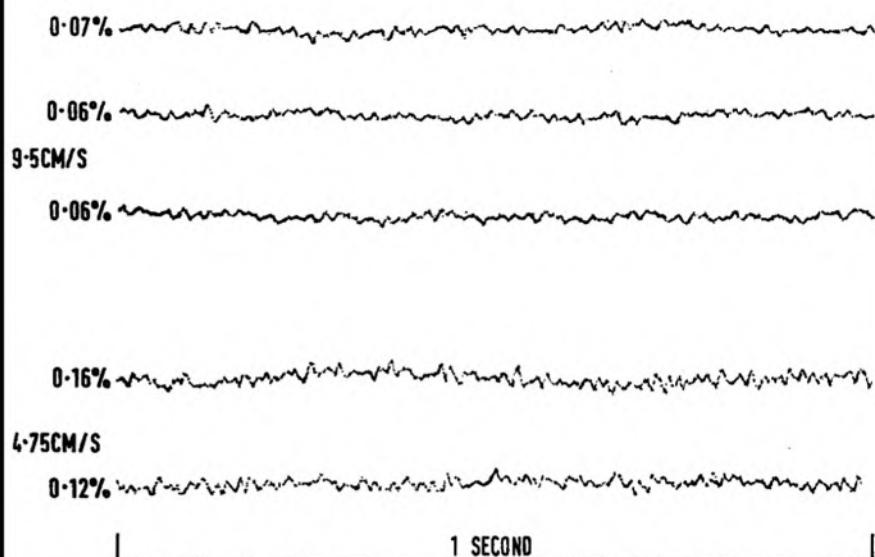
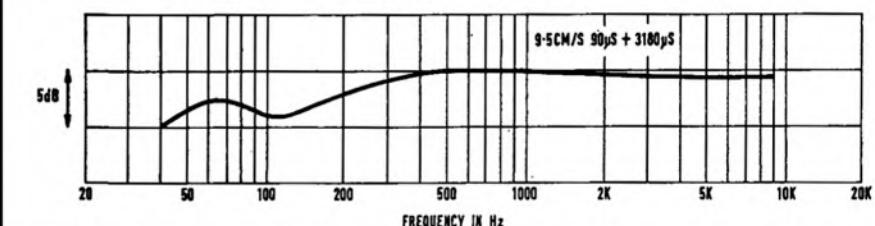


FIG. 3 GRUNDIG TK2200 PLAY ONLY RESPONSE (TEST TAPE TO LINE OUTPUT)



treble cut on anticlockwise rotation from a central level-response position.

Full wind or rewind of a 13 cm reel of LP tape (900 ft) took a fraction over two minutes in either direction, but wind or rewind on to a nearly full reel was rather sluggish and sometimes needed a helping hand to get things moving.

Long term tape speed was constant from beginning to end of reel but the mean speed at 9.5 cm/s was nearly 2% fast and is therefore

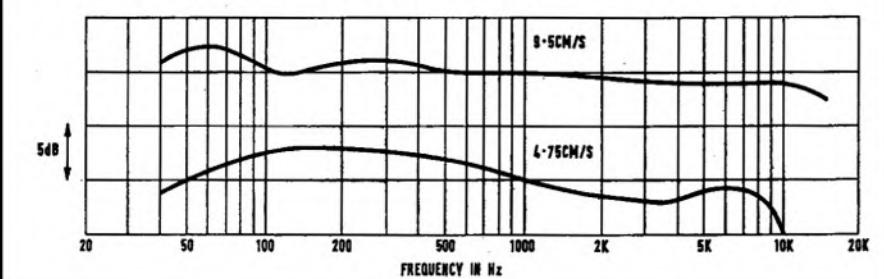
near the top limit at this speed. At 4.75 cm/s the speed was 1.4% fast. This is one of the few recorders where the speeds can be adjusted by pre-sets in the motor control electronics, but I will leave Mr. Hellyer to sort out the exact procedure in his excellent service notes.

Short term speed fluctuations were extremely small as will be seen by the fluttergrams of fig. 2. The meter readings were very steady and it was not possible to phase the record and play cyclical speed variations to build up a steady high value. This shows that the speed fluctuations are fairly random in nature so that cumulative record-play adding is unlikely. A low wow and flutter test tape also read 0.06% RMS at 9.5 cm/s. At the lower speed, a 1.5 Hz wow can just be seen on the top trace, giving a cumulative reading of 1.6% RMS. This is much lower than the capstan rotation frequency and is probably due to a slightly eccentric pressure roller.

The contra-rotating flywheels seem to be effective in maintaining a constant tape speed despite severe agitation of the recorder. Shaking the recorder with a twisting motion in the plane of the flywheels, so that the take-up

(continued on page 603)

FIG. 4 GRUNDIG TK2200 RECORD/PLAY RESPONSE (LINE IN TO LINE OUTPUT)



Bishopsgate
Institute

BISHOPSGATE

Liverpool Street Station

228 BISHOPSGATE LONDON, E.C.2.

Telephone: 01-247 2609

Opposite Liverpool Street Station

Hours of Business:

MONDAY to FRIDAY
9 a.m. to 6 p.m.

Closed all day Saturday

OPEN SUNDAY

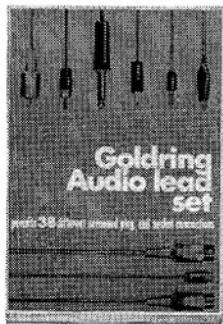
10 a.m. to 2 p.m.

Part of the NuSound Organisation



Short of a lead?

With a 3-pin DIN plug on one end and 3.5mm jack on the other? With the Goldring Screened Audio Lead Set, you've got it—instantly—at your finger tips. And 37 other different equipment-to-equipment connections as well. With cable lengths of 20", 40", or 60" according to the combinations you use. All tidily and instantly to hand in a small neat storage box. There's no longer any need to have an unwieldy collection of dozens of different leads... and still be short of the right one! This new Goldring set will give you most of the connections you're ever likely to want—without searching for cables and plugs, without soldering, without waiting, without further expense. The Goldring Audio Lead Set, from your Hi-Fi dealer, is a real investment at £3.60. Goldring are now marketing an extremely useful range of individually packed leads, plugs, sockets and connections for audio enthusiasts.



Goldring
Audio lead
set

GOLDRING MANUFACTURING CO. (G.B.) LTD.,

G 486-488 High Road, Leytonstone, London, E.11.
Tel: Leytonstone 8343.

CITY TAPE RECORDER CENTRE

At the City Tape Recorder Centre you can see one of the finest selections of tape recorders on display in London. Every leading make and model from Akai to Vortexion.

SPECIAL OFFERS—

We still have a very limited quantity of B & O 2000 DE LUXE TAPE RECORDERS at the Pre-Budget price of £145, also TANDBERG 12 at 105 gns. Buy now while stocks last and save from £21 to £40!

We are easy to get to being almost opposite Liverpool St. Station (see diagram above) and remember we are the only tape recorder specialists in Gt. Britain open on Sunday!

Do your weekly rush shopping on Saturday with your wife and visit us on Sunday at your leisure!

● GENEROUS PART EXCHANGES

● FREE AFTER SALES SERVICE

● UNBEATABLE SPECIAL OFFERS

● EXPERT STAFF EXPERT ADVICE

WE OPERATE A PERSONAL EXPORT SCHEME—SAVING UP TO 20% ON LIST PRICE



Our manager Bob Hookings is a keen tape recording enthusiast. Bang & Olufsen's are his speciality, having used B. & O. equipment for several years his knowledge of this wonderful range is second to none. He is able to give personal callers his expert advice (please avoid telephoning) not only on B. & O. but on any other recorder suitable to your individual requirements and pocket.

WHEN IN THE CITY—CALL IN AT THE CITY!

THE BANG & OLUFSEN SPECIALISTS



We are happy to announce that we can now supply

BRAND NEW BRITISH & GERMAN RECORDING TAPES

P.V.C. POLYESTER & MYLAR
(ALSO PRE-RECORDED FOREIGN LANGUAGES)
RECORDED ON SCOTCH and EMI TAPE

Both manufactured by world reputable British and German firms. Fitted with leaders and stop foils. Not rejects or sub-standard in any way—tapes are splice free and are boxed. Remember: full refund plus postage should goods not meet with your full approval.

Standard Play	Length	English price	German price
3"	150'	2/-	2/-
4"	300'	4/-	3/6
5"	600'	9/-	6/6
5½"	900'	11/-	8/-
7"	1200'	16/-	10/-
Long Play			
3"	220'	3/-	2/6
4"	450'	6/-	5/-
5"	900'	11/-	9/-
5½"	1200'	16/-	10/6
7"	1800'	23/-	14/-
Double Play			
3"	400'	6/-	4/-
4"	600'	8/-	7/-
5"	1200'	21/-	13/-
5½"	1800'	24/-	17/-
7"	2400'	39/-	22/-

LEARN FOREIGN LANGUAGES the easy way from BRAND NEW PRE-RECORDED TAPES in GERMAN, FRENCH, SPANISH and ITALIAN. 26 step-by-step easy lessons on each tape recorded at 3½ i.p.s. supplied complete with Handbook. Retail 59/6 each. OUR PRICE 19/6 each.

Postage and packing 1/9 per order.

EMPTY SPOOLS: 3" 9d. 5" 2/-. 5½" 2/3. 7" 2/6.

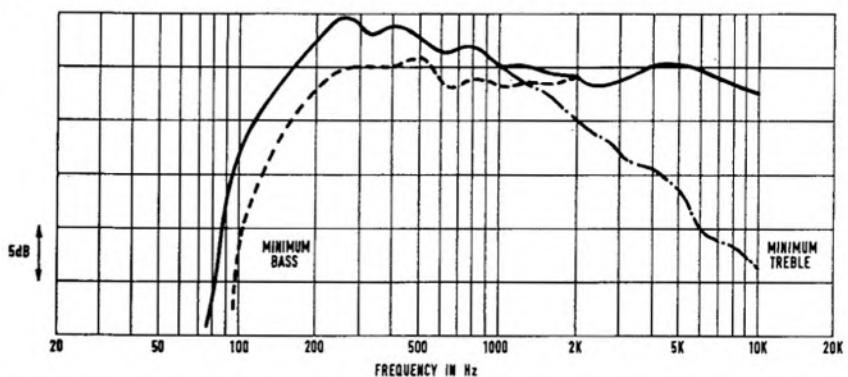
N. WALKER Ltd.
28 Linkscroft Ave., Ashford, Middx. Phone : 53020

reel was momentarily stopped with a slight spillage of tape, produced no wow, in fact the only audible effect was a slight chirp as the take up reel took up the slack and jerked the tape slightly.

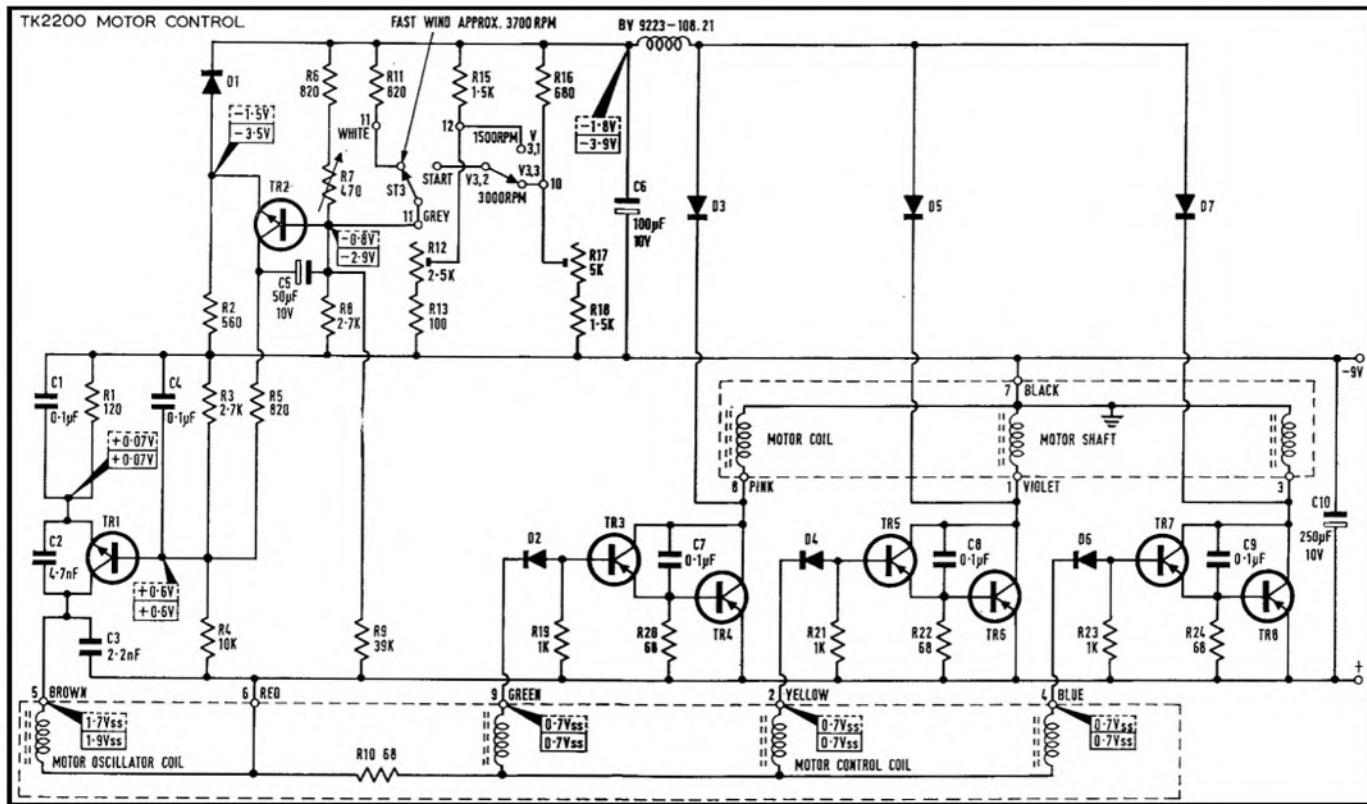
Fig. 3 shows the playback response to line output while playing a 9.5 cm/s test tape recorded to the new 90 μ s characteristic with bass pre-emphasis of 3180 μ s. It will be seen that, despite the bass rise on the tape, the playback response falls slightly at low frequencies.

Fig. 4 shows that extra bass pre-emphasis is used in the recording process to give a more even response and that the high frequency

FIG. 5 GRUNDIG TK2200 ACOUSTIC RESPONSE (WHITE NOISE TO SPEAKER SOUND OUTPUT)



TK2200 MOTOR CONTROL



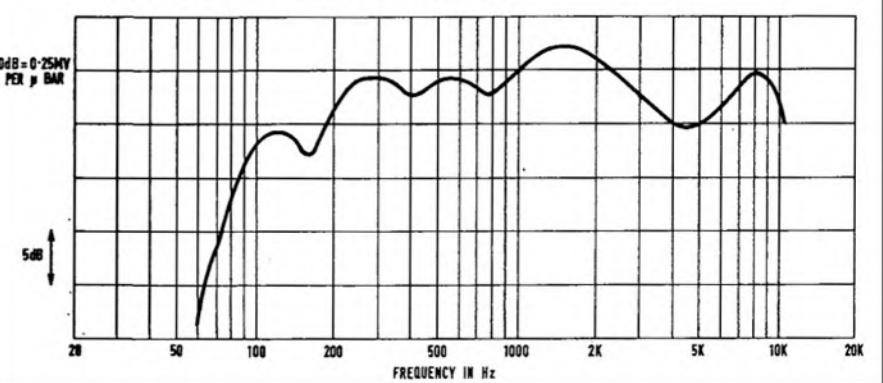
recording characteristic is close to the desired 90 μ s response. At 4.75 cm/s, the response is not quite so level, but is within ± 3 dB limits over the range 40 Hz to 9 kHz range.

System noise, with no tape passing the heads, was at the extremely low level of 47 dB below test tape level or 59 dB below peak recording level.

Recording distortion measurements at 1 kHz using BASF LGS35 tape showed 3.5% third harmonic distortion with the record level meter pointer just entering the red sector of the scale. Unweighted noise after erasing peak recording was 55 dB below peak recording level.

The acoustic response of fig. 5 was obtained by recording 25 one-third octave bands of
(continued on page 605)

FIG. 6 GRUNDIG GOM 305 MOVING COIL MICROPHONE (IK)



NATIONAL TAPE RECORDERS



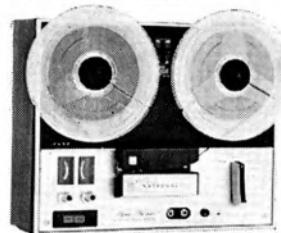
RQ.231/S. Combined tape recorder and radio. This takes the Philips-type cassettes, incorporates VHF and MW wavebands, and will record from microphone (included), or from radio receiver. Dual mains/battery, sound monitor (public address system). One-touch lever operation, VU meter and battery check, tone control, A.F.C. switch, accessories supplied, remote control microphone with stand, C.60 cassette, and earphone. Complete at 67 gns.



RQ.194/S. The latest from National is the new four-track mono tape recorder, which offers more use and more fun in recording, and has features, usually only found on very expensive and larger machines. It lets you make multiple recordings, with sound-on-sound, and sound-with sound, e.g., tape some music, and then sing along, as you tape again. Presto! You are singing with an orchestra! It has automatic record levels, and it also changes automatically, from mains to battery, as required. Other attractions, are its monitoring system, two-speeds and attaché-case styling. Six spools, P.A. system, and easy push-button operation. Complete with accessories, only £70.7.0.



RQ.401/S New system, records and plays, backwards and forwards. Features: mechanical reverse, automatic recording, Dual mains/battery, sound monitor, P.A. system, 2-speeds (3½ and 1½ i.p.s.), fast forward-rewind, record level and battery check, 4in. spools, 2-track, and complete with accessories. Priced at £39.17.2.



RS.766/US. Stereo tape-deck. Solid state.
★ Stereo tape-deck with quality internal mechanism, inclusive of high performance, record amplifier, and playback pre-amplifier.
★ Vertical or horizontal operation, and 4 digital push-reset tape counter.
★ 3 tape speeds (7½, 3½, 1½ i.p.s.).
★ Automatic shut-off switch, and large, easy-to-read VU meter.
★ Wooden cabinet, and solid state, with 11 transistors. Priced at £86.2.0.

PART EXCHANGES TOP PRICES OFFERED

Wallace Heaton (City Sale) Ltd.

Send for further details.

Wallace Heaton (City Sale) Ltd., 93 Fleet Street, London EC4
Telephone 01-353 9391/2

I have for Part Exchange

Please send details on

Easy payment details

Name.....

Address.....

Have you noticed it too?

With so many shops to choose from, there must be excellent reasons why people prefer to buy more and more from **Francis of Streatham**. Perhaps you would care to find out by calling or writing to us about your requirements in tape and hi-fi equipment too. (S.a.e. with written enquiries please.)

EVERYTHING IN RECORDERS AND HI-FI ON THE BEST OF TERMS

- ★ VERY LARGE STOCKS OF EQUIPMENT AND ACCESSORIES
- ★ NO EXTRA FOR CREDIT UP TO 18 MONTHS
- ★ FREE SERVICE DURING GUARANTEE PERIOD—OWN SERVICE DEPT.

We are TANDBERG specialists and carry full stocks of these famous products.

Also FERROGRAPH, VORTEXION, AKAI, PHILIPS, ETC., ETC.

FOR A FAIR and DEPENDABLE DEAL—BUY IT FROM

SPECIAL OFFER OF WORLD FAMOUS 'SHAMROCK' TAPE		
Brand new, top quality polyester.		
2400', 7" reel	... 25/-	
1800', 7" ...	... 21/-	
1200', 7" or 5½" or 5"	... 15/-	
900', 5" ...	... 12/6	
600', 5" ...	... 10/-	
P. and P. 1/6 per reel. Orders over post free. Cash with order please. £3		

FRANCIS OF STREATHAM

169-173 STREATHAM HIGH ROAD, LONDON, S.W.16

Between St. Leonard's Church and Streatham Station

Phone: 01-769 0466: 01-769 0192

Please note our only address Free Car Park, Prentis Road nearby
OPEN ALL DAY SATURDAY—EARLY CLOSING WEDNESDAY

audio diary 69

68 pages of essential audio information makes this beautifully produced pocket diary a must for every audio enthusiast and craftsman. Scope covers Music, Acoustics, Hearing, Hi-Fi, Tape Recording, Audio Reference Data, and includes: Musical terms; sound wavelength/frequency; pickup tracking error; interconnections and impedance matching; loudspeaker crossovers; glossary of hi-fi terms; tape playing time; tape track position; units and abbreviations; common circuit symbols; decibels; compliance, mass, resonance; useful equivalents; metric/British conversions—and more, *more, MORE!* Price 8/6

A LINK HOUSE GROUP PUBLICATION,
Link House, Dingwall Avenue, Croydon CR9 2TA.

filtered white noise and then measuring the sound output on the speaker axis during replay. The 'level' response position of the tone control gives a slightly bass heavy sound quality and the clockwise bass cut setting gave a response level within 3 dB limits from 200 Hz to 10 kHz.

The microphone response of fig. 6 was also measured using the white noise technique. The dip in the mid HF range from 3 to 6 kHz makes some voices sound slightly dull on this recorder.

The circuit diagram reproduced with this review shows that direct coupling of groups of transistors with DC feedback over as many as three stages is used for high thermal stability. The 'brushless' motor control is worth

attention as the current to each coil of the motor is switched in sequence through pairs of transistors which are biased 'on' by rectified high frequency signals derived from a rotating coil high frequency commutator. The back-EMF from the unswitched coils, which is directly proportional to the motor speed, feed a control transistor which alters the HF current to the 'commutator' so that the mean speed is governed to a high degree of accuracy.

A big feature of this recorder is the excellent signal-to-noise ratio. The system noise, at -60 dB level is a quiet, smooth, white noise, hiss with no vestige of governed motor noise or annoying high frequency spikes.

Wow and flutter remain low under the most extreme handling conditions, in fact I think the term "Easy G" should be borrowed from the advertising of other Grundig recorders and

used for this one in a different way!

The only mild criticisms I can make on this machine are the slightly 'lazy' wind and rewind, which may be a fault in this particular review model, and the location of the tone control. I feel that the proper place for this is for it to be paired with the playback volume control and not with the recording gain control. I also found during my tests that the azimuth of the head was wildly out and nearly two turns of the sealed adjusting screw were needed to bring it into correct azimuth as indicated by the official DIN 45513 test tape.

Nearly £100 is a lot to pay for a portable recorder, but for the true enthusiast, who wants something better than the £25-£35 fixed speed machines and can not afford to rise to the Uher or Nagra, this machine is well worth considering.

A. Tutchings.

GRUNDIG
C200
CASSETTE
PORTABLE



MANUFACTURER'S SPECIFICATION (4.75 cm/s). Battery powered single speed recorder using Philips cassettes. Frequency range: 80 Hz-10 kHz. Dynamic range: 45 dB. Output power: 800 mW. Power supply: Five U11 cells or equivalent, external 5 to 7.5 V power pack, or car battery. Rewind time: 55 seconds for C60 cassette. Weight: 5.25 lb. Dimensions: 15 x 24.5 x 6.5 cm (l x w x h). Price: £49 7s. Manufacturer: Grundig Werke GmbH, 851 Furth, Kurgartenstrasse 37, West Germany. Distributor: Grundig (Great Britain) Ltd., London S.E.26.

THIS is the baby daughter of the Grundig TK2200 recorder reviewed on the previous pages. It is obviously female because of its kangaroo pouch cassette loading. Being conditioned by the use of a long line of cassette loaded machines, I dutifully laid this one flat on the table and loaded the cassette in the usual way, only to find that all controls were labelled upside down. Turning it over I found that the speaker was playing into the table top, and it was only on my third attempt that I tried it in the upright position and found, on turning the *Easy G* knob to the cassette eject position, that it was simply asking to be lifted out from its near vertical position.

Mr. Hellyer's comments about the *Easy G* control of the TK145 in the October issue make me hesitate to describe the version in this little recorder. It is certainly easy to use: one turn anti-clockwise to eject the cassette; one

FIG. 1 GRUNDIG C200 RECORD/PLAY WOW AND FLUTTER

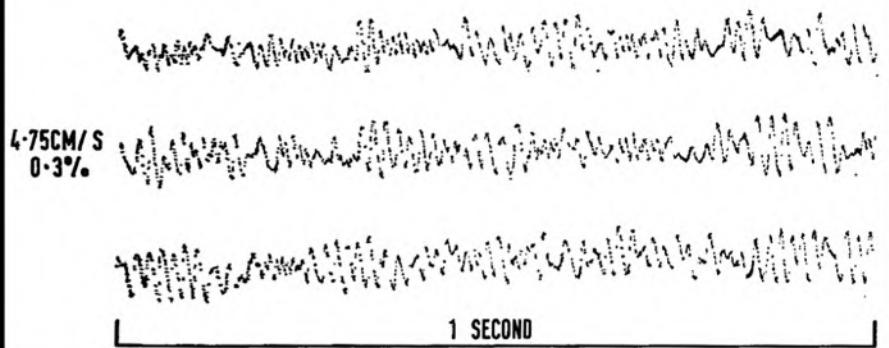
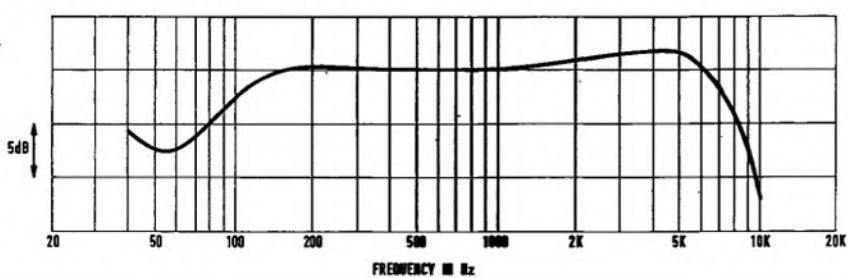


FIG. 2 GRUNDIG C200 RECORD/PLAY RESPONSE (LINE IN/OUT)



turn clockwise to the *pause* position; and one further step to *record* or *play*, depending on whether the record button has been pressed. Right and left movements of the control give rewind and wind respectively.

The record controls, meter, record key and record gain control are grouped together directly below the centre of the carrying handle so that the fluted edge of the record gain control can be operated by one finger of the hand carrying the recorder. Playback volume and tone controls are much larger edge-operated controls on the right of the simple control panel.

The short term speed variations were measured (continued on page 607)



ONE WAY TO SATISFACTION

4-TRACK STEREO / MONO		12 Monthly Deposit	Payments	Cash Price
		£ s. d.	£ s. d.	£ s. d.
Philips EL3312...	16 19 10	4 3 4	66 19 10	
Ferguson 3232...	22 18 3	5 14 7	91 13 0	
Sony TC200...	23 15 0	5 18 9	95 0 0	
Sanyo MR929...	24 0 0	6 0 0	96 0 0	
Philips EL3555...	25 19 4	6 5 8	101 19 4	
Aiwa TPI012...	26 0 0	6 8 2	102 18 0	
Akai I710W...	27 17 3	6 16 8	109 17 3	
Sanyo MR939...	28 0 0	6 16 8	110 0 0	
Sony TC260...	29 5 0	7 5 0	116 5 0	
Tandberg 12/21/41...	31 10 0	7 17 6	126 0 0	
Philips EL4408...	33 16 8	8 6 8	133 16 8	
Telefunken 204 'E'...	34 12 5	8 10 0	136 12 5	
Beocord 2000K...	39 10 0	9 13 4	155 10 0	
Beocord 2000T...	40 10 0	10 2 6	162 0 0	
Sony TC530...	41 10 0	10 6 3	165 5 0	
Ferrograph 722/4...	46 15 0	11 10 0	185 0 0	
Akai M9...	49 3 5	12 3 4	195 3 5	

STEREO TAPE UNITS

Sanyo MR-801...	20 0 0	4 13 4	78 0 0
Sony TC250A...	20 10 0	4 18 4	79 10 0
Akai 3000D...	26 11 4	6 11 8	105 11 4
Sony TC350...	27 5 0	6 16 3	109 0 0
Beocord 1500...	31 10 0	7 11 8	122 10 0
Tandberg 62/64X...	36 18 0	9 0 0	144 18 0
Ferrograph 702/704...	40 6 8	10 0 0	160 6 8

4-TRACK MONAURAL

Grundig TKI40...	11 14 6	2 18 4	46 14 6
Philips EL4305...	11 17 9	2 18 8	45 17 9

4-TRACK MONAURAL		12 Monthly Deposit	Cash Payments	Cash Price
		£ s. d.	£ s. d.	£ s. d.
Ferguson 3226...	11 10 0	2 16 8	45 10 0	
Telefunken 201...	11 18 9	2 19 7	47 13 9	
Ferguson 3228...	11 19 0	3 0 0	47 19 0	
Philips EL4306...	14 1 8	3 10 0	56 1 8	
Ferguson 3230...	14 13 0	3 13 2	58 11 0	
Ferguson 3216...	16 19 0	4 0 0	64 19 0	
REPS M10...	18 18 0	4 14 6	75 12 0	
Wyndson...				
Vanguard...	18 18 0	4 14 6	75 12 0	
Truvox R54...	18 18 3	4 14 11	75 17 3	
Tandberg 1526...	20 19 0	5 3 4	82 19 0	
Truvox R204...	31 14 2	7 15 0	124 14 2	

MAINS TWIN TRACK

Fidelity Playtime...	7 18 6	1 16 8	29 18 6
Ferguson 3224...	8 6 0	2 1 4	33 2 0
Grundig TK120...	9 17 6	2 9 2	39 7 6
Philips EL3310...	10 5 10	1 11 5	41 2 10
Tandberg 1521...	18 19 6	4 10 0	72 19 6
Truvox R52...	18 18 3	4 4 11	75 17 3
Beocord 1100...	24 10 0	6 2 6	98 0 0
Brenell MkV/3...	26 17 9	6 10 0	104 17 9
Brenell MkV/3Mtr...	28 0 2	7 0 0	112 0 2
Truvox R202...	31 14 2	7 15 0	124 14 2
Brenell V/3(M)...	32 16 8	8 5 0	131 16 8
Ferrograph 713...	33 18 4	8 9 7	135 13 4
Ferrograph 713/H 35 16 8	8 16 8	141 16 8	

INTEREST FREE H.P. TERMS. OPEN SATURDAY 6 p.m. FRIDAY 6.30 p.m. IF UNABLE TO CALL WRITE FOR BROCHURES, PART EXCHANGES. ALSO 18 AND 24 MONTHLY TERMS

SPECIAL OFFER! SAVE £100

AKAI X-355 Outstanding features:-

- ★ 3 speeds, 3½, 7½ and 15 i.p.s.
- ★ 4 Heads—Erase, Record, Playback/Monitor plus Crossfield
- ★ 2 Loudspeakers
- ★ 3 Motors
- ★ 40 Watts undistorted all transistor Amplifier
- ★ Automatic Reverse. Automatic Repeat Auto Stop/Shut Off. Sound-on-Sound. Reverberation.
- ★ 10½" Reel Adaptable.
- ★ Vertical or Horizontal Operation.
- 2 or 4 track models available.
- BRAND NEW. MAKERS GUARANTEE.

Present List Price £331.86 — £231.00
Deposit £58.00 and 18 monthly payments £11.49.
(H.P. Price £256.19.0)

AKAI X-300

- ★ Speeds 3½, 7½ and 15 i.p.s. Optional
- ★ 4 Heads—Erase, Record, Playback/Monitor plus Crossfield.
- ★ 2 Loudspeakers
- ★ 40 Watts undistorted all transistor Amplifier
- ★ Sound-over-Sound. Auto Stop. Auto Shut-off
- ★ 10½" Spool capacity. 4 Digit Counter
- 2 or 4-track models available.
- BRAND NEW. MAKERS GUARANTEE.

Present List Price £263.18.3 — £193.10.0
Deposit £48.10.0 and 18 monthly payments £9.5.4.
(H.P. Price £225.5.0)

LIMITED SUPPLIES

THE RECORDER CO

this is the name

(DEPT. R) 186-188 WEST END LANE, WEST HAMPSTEAD, LONDON, NW6
Telephone: 01-794 4977

WE SPECIALISE IN BRAND NEW

TOP QUALITY BRITISH P.V.C. MYLAR & POLYESTER RECORDING TAPES WITH FITTED LEADERS, Etc., EX 3"

Thanks to bulk purchase we can offer tensilled HI-FI tapes, manufactured by a British firm of world repute. All boxed individually (sealed if required) in polythene. Our tapes are not to be confused with imported sub-standard or used tapes. Full-money refund if not delighted.

This month: "DRY SPLICE" (3/9) given FREE with every order.

Std.	L.P.	D.P.	Boxed
Length ea. 3 for	Length ea. 3 for	Length ea. 3 for	empty spls
3" 150'	2/- 5/9	3" 220' 2/6	7/- 3" 400' 4/6
4" 300'	4/- 10/-	4" 450' 5/-	14/- 4" 600' 6/9
5" 600'	6/- 17/6	5" 900' 8/-	23/6 5" 1200' 12/6
5½" 900'	7/- 20/6	5½" 1200' 10/6	30/6 5½" 1800' 17/-
7" 1200'	7/- 25/6	7" 1800' 13/-	38/6 7" 2400' 21/-

All orders despatched by return. Postage and Packing 1/9 per order.

STARMAN TAPES, 421 Staines Road, Bedfont, Middlesex

MORE QUALITY BARGAINS IN

EXCHANGE & MART 8d
EVERY THURSDAY

if you are a RADIO, TV or TAPE enthusiast

OPENING the BIBLE

by Stuart Allen

Principal of Wilson Street Chapel, London E.C.2
(Non-denominational)

A series of HALF-HOUR TAPE RECORDED ADDRESSES at 1½ ips, 4 track, on 5 inch spools. The first twelve addresses are available for £1 from:-

Mr. B. MARPLE (TR), 20 Rowley Gardens, Littleover, DERBY. DE3 7GF

Money refunded if not satisfactory

FULLY GUARANTEED

Size Base	Standard	P.V.C.
3"	150' 2/6	225' 3/3
4"	300' 4/3	450' 5/6
5"	600' 8/9	900' 10/3
5½"	900' 10/6	1200' 12/6
7"	1200' 12/6	1800' 17/9

Size Base	Double	Triple
3"	300' 4/6	600' 9/3
4"	600' 8/6	900' 13/3
5"	1200' 15/9	1800' 23/6
5½"	1800' 19/9	2400' 29/9
7"	2400' 22/6	3600' 39/9

Factory Fresh. Superb Quality. Leaders, Trailers and Stop Foils on all sizes 5" and above. We supply many local authorities and professional recording studios. May we supply you? P. & P. 2/6 per order. S.A.E. Full Lists.

LEDA TAPES (D), 30 BAKER ST., LONDON, W.I.
Phone: 01-226 7004

sured by recording a 3 kHz tone and playing it back into the WHM wow and flutter meter. The meter reading remained fairly steady at 0.3% wide band wow and flutter and 0.1% on wow, where the meter bandwidth was reduced to 10 Hz. The high speed pen recording of the flutter waveform shows that it is mainly 50 Hz flutter from the 3,000 RPM drive motor.

Fortunately the ear is not worried by HF flutter and, although the steady tone sounded slightly 'rough' and uneven, the pitch of the tone remained steady and pre-recorded music on the demonstration cassette sounded very smooth.

The record-play response of fig. 2 shows that the response is level within limits of ± 3 dB over the 100 Hz to 7.5 kHz range on line output and is worth feeding over the extension lead provided to a better amplifier and speaker. It does not really disgrace itself when fed to a high-quality sound system, and several visitors were very pleasantly surprised at the quality available from a Philips cassette.

The acoustic response was measured by recording bands of filtered white noise and measuring the sound output from the speaker during replay. The bass response is curtailed by the very small cabinet, but is reasonably level from 400 Hz to 8 kHz.

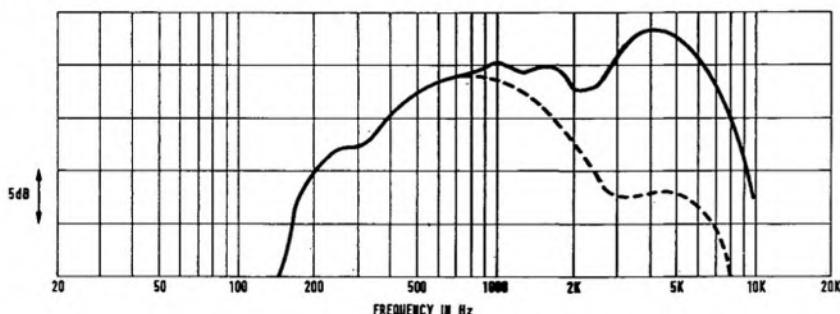
Speech quality from the microphone supplied with the recorder was exceptionally good and a glance at the measured response of the microphone (see fig. 6 of the Grundig TK2200 review) shows that the mid HF dip in response mentioned in the above review is compensated by the broad 4 kHz peak in the speaker response of the C200.

The C200 is practically as insensitive to handling as the larger TK2200 but for a different reason. In this case the mass of the flywheel and the cassette reels are low. Movement is little affected by swinging or spinning the light weight recorder.

At £50 this will hardly take the place of the ubiquitous transistor radio for teenagers, though its appearance is very similar, and one could 'twist', or whatever the modern equivalent is, without upsetting the beat of the music.

A. Tutchings.

FIG. 3 GRUNDIG C200 ACOUSTIC RESPONSE (WHITE NOISE TO SPEAKER SOUND OUTPUT)



THE HARROGATE FAIR CONTINUED

in power amplifiers and multiplex filters, a three speed deck, $\frac{1}{2}$ or $\frac{1}{4}$ -track heads to choice, and all-transistor circuitry. With the advent of the low voltage power supply for transistors, Tandberg have abandoned their magic eyes, which are dynamically similar to PPMs, opting for VU-meters instead. Although the change to meters makes sense it is a pity that only the Chilton is left offering the PPMs to those who appreciate this form of level indicator—presumably the majority of domestic manufacturers do not consider the extra cost justified. Of the Tandbergs, only the 6X machines now have magic-eyes. Other new machines included those in the Telefunken room, described in last month's *New Products*—similar in many respects to their earlier models, and identified by a TS reference number.

Dual had a revised version of their tape unit, to be called the CT9 28, probably slightly more expensive than the present unit and, they claim, rather better mechanically. The ganged independent volume controls are retained and the tension sensing mechanism has also been carried over to the new model which can be

used vertically or horizontally.

Outside the exhibition hall, tape and allied subjects were covered by Fred Judd in a well attended lecture on electronic music. Using a Tandberg recorder, Fred played a wide range of examples of electronic composition ranging from odd noises to a computer's very musical if rather monotonous rendering of *Daisy Daisy*. Although the results obtained vary from weird and fascinating to an unpleasant cacophony it was made abundantly clear that much effort and skill is needed to produce convincing tapes.

Tape also gave a convincing account of itself in a lecture by Gilbert Briggs of Wharfedale. Assisted by John Collinson, Bill Jamieson and Frank Thistlethwaite, Mr. Briggs had assembled a string quartet for the purposes of live/recording demonstration. The recording was made on an Akai 3000 with AKG microphones, and reproduced through Wharfedale speakers the results were extremely lifelike. Although not easily confused with the original, the sounds were very acceptable on their own account, and if the room used was by no means of recording studio quality, the results obtained showed that careful microphone positioning can overcome many other shortcomings, even using what is basically a domestic machine.

Your Tape Dealer

LONDON AREA

FOR ALL LEADING
AUDIO EQUIPMENT

Classical Records
by Mail Service
hampstead
HIGH FIDELITY
91a Heath Street,
Hampstead, N.W.3.
Tel. HAMpstead 6377

HAVEN
196-198 SOUTH EALING RD.
HIFI LONDON
W.5
Tel. 01-560 0194

**LASKY'S
RADIO**

Stockists for all the leading makes of Tape Equipment
207 EDGWARE ROAD, W.2. Tel.: PAD 3271
118 EDGWARE ROAD, W.2. Tel.: PAD 9789
33 TOTTENHAM CT. RD., W.1. Tel.: MUS 2605
42 TOTTENHAM CT. RD., W.1. Tel.: LAN 2573
152/3 FLEET STREET, E.C.4. Tel.: FLE 2833

**TAPE RECORDER HI-FI CENTRE
(SHEEN) LTD**

SPECIALISTS IN TAPE RECORDERS, ACCESSORIES,
HI-FI EQUIPMENT

YOUR CENTRE FOR FRIENDLY HELP, SALES AND
SERVICE

3 & 4 STATION PARADE, Open until 8 p.m. on Fridays
SHEEN LANE, SHEEN, PROSPECT 0985
LONDON, S.W.14 Opposite Mortlake Station, S.R.

CHESHIRE

go scandinavian hi-fi . . .

Bang & Olufsen, Tandberg, Arena, Dynatron, Radford, Sony, Philips, Quad, Leak, Fisher, Sanyo, Pioneer, Akai, Sansui, Wharfedale, Armstrong, Rogers, Ferrograph, Trio, Dual, Bryan, Normende, Eddystone, Goodmans, Braun, etc.

the hi-fi and tape recorder lounge

EXPERT STAFF • ADVICE SERVICE • PART EXCHANGE
• Home Demos • After Sales Service • Comparator Demos

GREEN LANE, WILMSLOW, CHES. SK9 1LR
Ring Wilmslow 24766 and ask for Mr. Bird
Closed Weds. except by appointment

FOR ALL YOUR REQUIREMENTS . . .

CHARLESWORTH'S
OF CREWE LTD.

Head Office : 14 Hightown, Crewe. Tel. 3327

Hi-Fi CENTRE: 28 HIGHTOWN, CREWE

Technical Division : 19 Ludford Street, Crewe

Your Tape Dealer

DEVON

THE SOUTH WEST

Tom Molland Ltd.

Invite you to visit their well-equipped Demonstration Theatre and compare all the leading makes of Hi-Fi and Tape Equipment at

110 CORNWALL STREET, PLYMOUTH

Telephone 69285

Immediate delivery to ALL Areas

ESSEX

EPPING — ESSEX
CHEW & OSBORNE LTD.
148 HIGH ST. TEL: 4242



AKAI — AMPEX — ARENA — ARMSTRONG — AUDIO TECHNICA — B & O — BRYAN — CELESTON FERROGRAPH — FISHER — GARRARD — GOLDRING GOODMAN — HACKER — KEF — LEAK — LOWTHER PHILIPS — QUAD — RADFORD — REVOX — ROGERS SHURE — SONY — THORENS — TRUVOX WHARFEDALE — WYNDSOR Home and Showroom Demonstrations : After Sales Service — H.P. Facilities Equipment and Records by post

GLoucestershire

Sound Selection
OF BRISTOL

Tape Recorder and Hi-Fi Specialists (Demonstration Room)

361-363 GLOUCESTER ROAD,
BRISTOL 7. Tel. 41181



High Fidelity Specialists

Hamilton Electronics



Hamilton Electronics (Southampton) Ltd.
35 London Road, Southampton. Phone: 28622. 3 Lines

FORRESTER'S
NATIONAL RADIO SUPPLIES LTD.

70-72 HOLDENHURST ROAD
BOURNEMOUTH HANTS

Largest hi-fi and radio component store in the south
Tel: 25232

HERTFORDSHIRE

WATFORD
High Fidelity Centre
at **RADIOLUX Ltd.**
36 WOODLANDS PARADE, HIGH ST.
WATFORD (opposite the pond)
WATFORD 29734, 41029
IF IT'S GOOD — WE STOCK IT!
Demonstrations in our Stereo Theatre. Also home demonstrations with no obligation.

Your Tape Dealer

LANCASHIRE

STOCKPORT AUDIO CENTRE

FINEST IN NORTH WEST

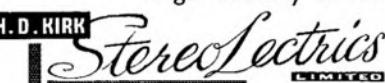


★ ALL MODELS ON COMPARISON DEMONSTRATION
★ EVENING DEMONSTRATIONS BY APPOINTMENT
FAIRBOTHAM & CO. LTD.,
58-62 Lower Hillgate, STO 4872

BOLTON

Specialists in
High Fidelity Sound

H.D.KIRK



203 St. George's Road
Phone 23093

BOLTON

J.SMITH & SON

HI-FI EQUIPMENT — STEREOGRAMS
TAPE RECORDERS — 2 SHOWROOMS
B & O, Dynatron, Hacker, Quad, Leak, Radford, Armstrong, Ferrograph, Revox, Truvox, Uher, Decca, Garrard, Thorens, Goodmans, KEF, etc.
Comparator Demos — Closed all Tuesday
Specialists in 'SOUND' for 36 years

184 THE ROCK, BURY Tel: 1242

ST. HELENS
HAROLD STOTT LTD.
Hi-Fi Consultant

Tape Recorder Specialist. Agents for all leading makes including Akai, B & O, Revox, Sony, etc. Advice and demonstrations given willingly.

18 Westfield Street, St. Helens

NORTHUMBERLAND

SOUND EQUIPMENT SPECIALISTS

Morton
sound Tel. 2-6902
12 OXFORD STREET

NEWCASTLE UPON TYNE 1

NOTTINGHAMSHIRE

Nottingham Tape Recorder Ltd.

BURTON ST. 2 mins. Victoria Station

Specialists in all the best makes of

- TAPE RECORDERS ● AMPLIFIERS ●
- HI-FI DISC EQUIPMENT ●

Telephone: Nottingham 45222

Your Tape Dealer

OXFORDSHIRE

Westwoods

for the

TAPE RECORDER

of your choice

46 George Street

Oxford 47783

SHROPSHIRE

Shrewsbury's New Sound Centre

Ferrograph-Leak-Akai-Rogers-Goodman etc.
HEAR THEM IN OUR DEMONSTRATION STUDIO

OPEN ALL DAY

TUESDAY-SATURDAY



Hi-Fi Ltd.

13 WYCLE COP.

(facing the famous Lion Hotel)

SURREY

FARNHAM

SURREY

- ★ Stockists of all good Hi-Fi apparatus.
- ★ Comparative demonstrations.
- ★ We offer a real after sales service.
- ★ Easiest of terms.
- ★ No parking problems.

Lloyd & Keyworth Ltd.

THE RECORD SHOP

26-27 DOWNING STREET, FARNHAM
SURREY Telephone: Farnham 5534
SURREY AND HAMPSHIRE'S HI-FI SPECIALISTS

CROYDON'S
TAPE RECORDER CENTRE

All leading makes in stock. Hi-Fi equipment, cabinets, etc. Service agents for AKAI Tape Recorders

SPALDING ELECTRICAL LTD.,
352/354 Lower Addiscombe Road,
CROYDON.

ADDISCOMBE 1231/2040

SUSSEX

WORTHING, SUSSEX

Stocking Ferrograph, Revox, Sony, Tandberg, Truvox, Philips, EMI, Luxor, etc., on fully comparative demonstration.

BOWERS & WILKINS LTD.

1 Becket Bldgs., Littlehampton Road,
Worthing 5142

WARWICKSHIRE

BIRMINGHAM
TAPE RECORDER CENTRE

266 BROAD STREET, BIRMINGHAM 1
(Opposite Bingley Hall)

Most leading makes high fidelity equipment.
Part exchanges welcomed.

Telephone Midland 2680

DIRECT CUT DISCS (PLAYING TIMES AND PRICES)

STANDARD GROOVE 30.5 CM 33 RPM LP

		PLAYING TIME PER SIDE [Minutes]	PRICE	
			Single Side	Double Side
AUDIO & DESIGN	...	24	52/6	67/6
CALDER RECORDINGS	...	20.5	43/-	48/-
COUNTY RECORDING	...	24	15/-*	69/-
CRAIGHALL RECORDING	...	20	55/-	69/6
DEROY SOUND SERVICE	...	—	—	—
EDEN STUDIOS	...	not quoted	39/6	50/6
EXCEL SERVICES	...	22	60/-	77/-
JOHN HASSELL	...	25	57/6	70/-
J & B RECORDINGS	...	25	48/6	54/-
THREE COUNTIES	...	22.5	50/-	55/-
TRUSOUND RECORDING	...	—	—	—

VARI-GROOVE 30.5 CM 33 RPM LP

		PLAYING TIME PER SIDE [Minutes]	PRICE	
			Single Side	Double Side
AUDIO & DESIGN	...	30	60/-	80/-
CALDER RECORDINGS	...	—	—	—
COUNTY RECORDING	...	—	—	—
CRAIGHALL RECORDING	...	26	55/-	69/6
DEROY SOUND SERVICE	...	25**	45/-	55/-
EDEN STUDIOS	...	—	—	—
EXCEL SERVICES	...	not quoted	60/-	77/-
JOHN HASSELL	...	—	—	—
J & B RECORDINGS	...	—	—	—
THREE COUNTIES	...	27	55/-	60/-
TRUSOUND RECORDING	...	23	45/-	55/-

*Special price of 15/- per side for discs cut on CRS Plastic.

**We can get 30 minutes on a 30.5 cm side if tape quality allows and replay is limited to transcription turntables. Deep grooves suit cheaper disc players but reduce capacity to 23-25 minutes.

Your Tape Dealer

WARWICKSHIRE (contd.)

Coventry's 100% tape recorder and hi-fi specialists for service and sales.

Akai — Ampex — Bang & Olufsen — Ferrograph — Leak — National — Radford — Revox — Sony — Tandberg — Truvox — Wyndson

Coventry Tape Recorder Service
33 King William Street, Coventry
Telephone Coventry 29668

GRiffin RADIO LTD

(the high fidelity people)

Fully comprehensive stocks and advisory service for

Monaural and Stereophonic High Fidelity, Radio, Tape and Disc Equipment

94 BRISTOL STREET
BIRMINGHAM 5 Telephone MID 1359

YORKSHIRE

TAPE RECORDER CENTRE (HALIFAX)

For all the best in Tape Recorders and Hi-Fi Sales and Service

30 King Cross Street,
Halifax Phone 66832



SCOTLAND

GLASGOW

Scotland's Leading Tape Recorder, Video and Hi-Fi Specialists

G. H. STEELE LTD.

Hear true Hi-Fi sound on our 22 speaker comparator system. 14 Hi-Fi combinations ready for demonstration.

SONY VIDEO CENTRE

Agents for : Armstrong, Leak, Fisher, Rogers, Quad, B & O, Goldring, Garrard, Thorens, Connoisseur, Goodmans, Wharfedale, Kef, Celestion, Decca, Truvox, Philips, Sony, Arena, Revox, Tandberg, Brenell, Ferrograph, Akai, Uher, Grundig.

CREDIT TERMS — PART EXCHANGES
Repairs and Servicing Tel. Douglas 7124

141 St Georges Road, Glasgow C3

Recording Studios



recording and transcription service

Mono and Stereo records . latest cutting methods, automatic varigroove, feedback cutter heads, limiters and equalisers, techniques hitherto available only to the professional, facilitating high undistorted cutting levels and extended playing times even from amateur recordings.

Booklet available.

45 HIGH STREET
BURNHAM
BERKS
Tel. 61303

TAPE RECORDERS - AUDIO EQUIPMENT - DISC CUTTING STD & LP FROM TAPE-STUDIO FACILITIES HIRE SERVICE-SALES-EXCHANGES

MAGNEGAPH

I Hanway Place, London, W.I. LAN 2156

CLASSIFIED ADVERTISEMENTS

Advertisements for this section must be pre-paid. The rate is 6d. per word (private), minimum 7s. 6d., Box Nos. 1s. 6d. extra. Trade rates 9d. per word, minimum 12s., Box Nos. 2s. extra. Copy and remittance for advertisements in JANUARY 1969 issue must reach these offices by 18th NOVEMBER addressed to: The Advertisement Manager, Tape Recorder, Link House, Dingwall Avenue, Croydon, CR9 2TA.

Replies to Box Nos. should be addressed to the Advertisement Manager, Tape Recorder, Link House, Dingwall Avenue, Croydon, CR9 2TA and the Box No. quoted on the outside of the envelope. The district after Box No. indicates its locality.

SITUATIONS VACANT

Hi-Fi and Tape Recorder salesman required by R.E.W. (Earlsfield) Ltd. at their Tooting branch. Good pay and conditions. Apply the Manager, 266 Upper Tooting Road, London S.W.17. Tel. 01-672 9175 or 672 8267.

UNIVERSITY OF KENT AT CANTERBURY THE LANGUAGE CENTRE

Applications are invited for the post of TECHNICIAN in the Language Centre. The person appointed will assist in the maintenance of the language laboratories and ancillary audio-visual equipment, and will be required to carry out recording and editing techniques. An interest in foreign languages would be an advantage. The salary scale is £722 to £1,007 p.a. Further particulars and application forms may be obtained from the Registrar, Beverley Farm, The University, Canterbury —quoting reference T68/11.

FOR SALE—PRIVATE

New Wyndor Trident 3-speed 2-track tape recorder, £18, collected, or exchange for Philips EL3302. 77 Newtonwood Road, Ashead, Surrey.

Brenell 5M. recorder. Mike, tapes, h/phones. £50. Dickens, 1 Pilgrims Way, Bedford.

Philips Cassette Recorder and six Cassettes, £25 o.n.o. Reps. R10 Mk. II just overhauled, £35 o.n.o. Reslo RBT mike and floor stand, £12 10s. All items perfect. Crombie, 01-958 9821.

Sony TC100 Ideal for car use. Will couple to radio. Uses cassettes. AC/DC cases, mic., leads and all possible extras. New with makers guarantee. 3W on AC £40 o.n.o. BASF C120 Cassettes, unrecorded, £1 o.n.o. Box No. 542. (Glasgow).

Philips EL 3536 stereo tape recorder with moving-coil stereo microphone. In tip-top condition, recently serviced by AES new tape-head. Cost 92 gns, selling at £50. Box No. 543 (London).

Uher 4000L and Butoba MT5 with mains unit. Both just overhauled by agents. £85 and £30 o.n.o. Will demonstrate up to 100 miles London. Gone stereo. Negus, Jenkins Farm, Bulmer, Sudbury, Suffolk.

FOR SALE—TRADE

Always be careful (and money-wise) before buying quality equipment. Send your requirement list to Audio Supply Association for evaluation and quotation. See below . . .

Blackburn has Lancashire's leading Hi-Fidelity/Tape Recorder stockists and Electronic Engineers at Holdings Audio Centre, Mincing Lane/Derwent Street, Blackburn (Tel. 59595).

If quality matters consult first our 70-page photographically illustrated catalogue (5/6) and equipment housing guide (1/6). Members enjoy unbiased advisory service, preferential terms. Membership 7/6. Our associates also manufacture records from your own tapes, or record the Master at our studios (Steinway Grand). Bulk terms for choirs, fund-raising. Please specify requirements. Audio Supply Association, 18 Blenheim Road, London, W.4.

Sony Video Tape Recorder Mod. CV 2000 B comprising of 1. The Video Tape Recorder Unit. 2. The Monitor (which also doubles as a normal 405 line TV Receiver.) 3. Camera and Tripod. All brand new with Manufacturers Guarantee. The recommended Retail Price for this equipment is £499.16.0. Special Offer £450. Sound Selection of Bristol, 361-363 Gloucester Road, Bristol 7. Tel. 41181.

MISCELLANEOUS

Repairs. Our modern service department equipped with the latest test equipment (including a wow and flutter meter and multiplex Stereo Signal Generator) is able to repair Hi-Fi and Tape Recording equipment to manufacturer's standards. Telesonic Ltd., 92 Tottenham Court Road, London, W.1. 01-636-8177.

Skilled tape recorder repairs carried out by expert personnel of many years' experience backed by extensive test equipment: Wow and flutter meter, audio valve voltmeter, audio generator, oscilloscope, etc., with final test performance figures quoted if required—Ferrograph specialists. Tape Recorder Centre, Tel-Lee-Radio, 220 The Broadway, Wimbledon, S.W.19. 01-542-4946.

Early flutter spoils Recording . . . A fact well known to many. Send 6d in stamps for important information on how to deal with this and many other problems connected with wow and flutter. Music Tapes, 36 High Street, Salisbury, Wilts.

TAPE EXCHANGE

All ages; all occupations; all interests; all creeds found in Britain's largest Tape-X-change Worldwide Tapetalk, 35 The Gardens, Harrow. Particulars: 4d stamp.

Tapespondents. Free sound magazine. Details free. Far and Wide Recording Club, Eccles, Maidstone, Kent. S.A.E. please.

STUDIO FACILITIES

J & B Recordings. Tape to disc—latest high level disc cutting, all speeds. Mastering pressings, studio, mobile. 14 Willows Avenue, Morden, Surrey. MITcham 9952.

Rapid Recording Service. Records made from your own tapes (48-hour service). Master Discs and pressings. Recording Studio—Demo Discs. Mobile Recordings, any distance. Brochure from 21 Bishops Close, E.17.

Your tapes to disc. 7in. 45—18/-, 10in. L.P.—48/-, 12in. L.P.—55/-. 4-day postal service Masters and Vinylite pressings. Top professional quality. S.A.E. photo leaflet: Deroy Studios, High Bank, Hawk Street, Carnforth, Lancs.

Studio Sound Recording Studios. Recording and disc transcription service. Latest high-level cutting techniques. Mono and stereo records. Exceptional quality obtained from amateur recordings. Members A.P.R.S. 31-36 Hermite Road, Hitchin, Herts. Telephone Hitchin 4537.

Graham Clark Records. Tape to Disc—Pressings. Top Quality yet lowest prices in country. 7" 45 from 12s. 6d. small studio available. S.A.E. leaflet. 23 The Grove, Walton-on-Thames, Surrey. Tel. WT 25627.

WANTED

Lee Electronics. The Tape Recorder and Hi-Fi Specialists wish to purchase good quality Tape and Hi-Fi Equipment for cash. 400 Edgware Road, W.2. Phone PAD 5521.

Highest prices offered for good quality Tape Recorders and Hi-Fi. R.E.W., 266 Upper Tooting Road, London, S.W.17.

Good Quality Tape Recorders purchased for cash. Telephone 01-472 2185.

Collector Requires recordings (tape or disc) dealing with Sir Ernest Shackleton, the Polar Explorer, or any of his expedition members. (Not the recent "James Cair" programme.) Walker, 58 The Brambles, London Road, Salisbury, Wilts.

Wanted. Service sheets for all tape recorders. Any quantity. State price. Caranna, 200 High Road, Finchley, N.2.

Wanted. Philips 1966/68 tape recorder in models EL3556, EL3558, EL3548, EL3549, EL3578, EL3576, record player NG5165, new condition. 64 Norman Road, Tunbridge Wells, Kent.

Wanted second-hand Uher Universal "S" or 5000 Tape Recorder (mono only). Offers, stating condition and price, to Pearlman, 1 Albion Street, Leeds, 1.

A

AAU Television Adaptor	573
Akai Develop Helical-Scan Video Recorder	395
Akai Factory Visit	76
Akai Helical-Scan VTR	343
Akai Revive Fixed Head VTR	299
Akai 1710W (see reviews)	
Akai 1800 and X-1800D	543
Akai 3000D (see field trials)	
Akai 3000D (see reviews)	
America Tomorrow (E. T. Canby)	467
Ampex 753	41
APRS Exhibition	343
Arriflex Electronic Cam (R. Golding)	347
Audac Appoint Distributor	163
Audio Equipment at Design Centre	573
Audio Fair Preview	218
Audio Fair Report	324
Audio Talk	515
August Cover (letter)	541

AUTHORS

Alderton, M. So You're Going To Buy A Language Tape	261
Anscomb, J. H. Cartoons 66, 83, 168, 186, 229, 299, 343, 549	
Ashcroft, J. The Trials And Tribulations of Tape Correspondence	37
Looking Trouble In The Phase	73
Inside Outside Oxide	473
Sound Evidence?	531
Barriedale, R. Frederick Turner's Victorian Carousel ..	522
Bastin, P. L. Bastin On Film	527
Bastin's Orchestra	448
Book Reviews	365, 366
On The Move, They Said, The BBC ..	169
Recording for Disc	421
Recording for Radio	259
Recording for Television	344
Recording Outdoors	581
Chevin, G. Understanding Bias	362
Canby, E. T. America Tomorrow	467
CrO ₂ —Tomorrow's Tape?	239
Capel, V. D. Dropout—Cause and Cure	178
Sound Effects	80
Cloud, G. A. Two Simple Accessories for Tape Recorders	405
'Dropout' Column Speaker 48, 193, 288, 427, 489	
Eden, A. J. Book Review	529
Made in Japan	26
Visit to Akai, A	76
Fisher, J. H. Book Reviews 365, 366, 529	
Budget PPM, A	462, 583
Equipment Review	483
Matching and Mixing	230
Two Microphone Mounting Accessories ..	323

(continued overleaf)

VOLUME TEN INDEX CONTINUED

Garratt, A.							
Professional Approach to Interviewing, A	270						
To Err is Human	406						
Golding, R.							
Arriflex Electronic Cam, The	347						
Closed Circuit:							
Practically No Standards At All	16						
The Price of Learning	85						
The Golfer's Eye	167						
Bromley Television Production Course	227						
Special Effects for Video	277						
Further Film & Television Courses	358						
The Rank Nivico System	471						
National VTR	597						
Home Tutor, The	475						
Laboratory Language Learning	396						
Leavers-Rich	592						
Pictures, Facts and Sound	519						
Goodall, G.							
Tape Review	75						
Graham, J.							
The Sound of Weymouth	13						
Gulston, L.							
Getting the Evidence Taped	62						
Haines, B.W.							
Tape Recordings on Trial	575						
Hart, K. C.							
Further Thoughts on Indexing	537						
Hellyer, H. W.							
Book Reviews	65, 413						
Tape Recorder Service:							
Reps R10 Mark 2	32						
Reps R10 Marks 2 and 3	69						
National RQ-150	132						
Van Der Molen VR7	170						
Van Der Molen VR4	236						
Van Der Molen Sonic-Eight	274						
Bang & Olufsen 1100	305						
Bang & Olufsen 1500 and 2000	350						
Bang & Olufsen 2000	400						
Grundig TK120, TK125, TK140 and TK145	454						
Tandberg Series 6	532						
Tandberg Series 7	576						
Your Obedient Servant	19						
Henry, W.							
Plague on Both, A	476						
What's in a Clutch?	357, 416						
Howell, M.							
Trust Your Ears	461						
Judd, F. C.							
Miniature Electronic Organ, A.	410, 451						
Variable Speed Drive System	525						
Kelly, S.							
Microphone Review	45						
Kirk, D. K.							
Field Trials:							
Schaub Lorenz 5001 Music Center	233						
Akai 3000D Stereo Tape Unit	283						
Revox A77	368						
Tandberg 64X	423						
Japanese English	15						
Tandberg—A Social Experiment	222						
Tricks and Artifices	516						
Understand Circuit Diagrams	398						
Levett, E. R.							
Beginner's Luck	589						
Matthews, C. N. G.							
Choosing and Using a Microphone	321						
Mellor, K.							
Power Pack for the Fi-Cord 202, A	279						
Mollon, J. D.							
Book Review	366						
Musil, O.							
Tesla—A Tale of New Bohemia	172						
Myall, W. H.							
Measuring Wow and Flutter	38						
Nutting, G.							
Evolution of a Tape System	164						
Plumtree, B. R. J.							
What's Wrong With Tape Records?	79						
Prizeman, R.							
BBC Radio Brighton	415						
Reeves, P. (and Sidhome, P.)							
Battersea Messiah	355						
Robinson, D. P.							
Practical Test of Five Microphones, A	308						
Robjhons, E.							
Four Ways Ahead	61						
Rogers, G. T.							
Elements of Tape Recorder Circuits:							
Recording Level Indicators	22						
The Bias Oscillator	86						
Tape Transport Mechanisms:							
Wow and Flutter	181						
Capstan and Flywheel	215						
Motors	265						
Speed Control and Drive Systems	301						
Shuttleworth, J.							
How Not to Win a Tape Recording Contest	367						
Sidhome, P. (and Reeves, P.)							
Battersea Messiah	355						
Skeet, M. G.							
One Man's Mixer	280, 319						
Turner, P. D.							
Survey Surveyed, A.	67						
Tutchings, A.							
Microphone Reviews	311						
Mixer Reviews	377						
Tape Recorder Reviews							
	43, 89, 93, 187, 241, 285, 329,						
	373, 375, 425, 479, 544, 600, 605						
Walker, E. W.							
Sort of Chain Reaction, A	458						
Watling, A. G.							
Cartoon	262						
Wilding, I.							
Cartoon	63						
Wiles, H.							
Cartoon	419						
Eagle TC450 (see reviews)							
Eden Studios							
Editing, Professional Tape Techniques (A. Garratt)							
	406						
Educational Television from Glasgow							
Electret Microphone							
Electronic Music Competition, First							
Electronic Music Survey							
Electroniques Hobbies Manual							
Elements of Tape Recorder Circuits							
Elliott offer DC to 40 kHz							
EMI Exhibition							
English English (letter)							
Evolution of a Tape System (G. Nutting)							

B

Balmain on Tape

F

Ferguson 3232 (see reviews)

Ferrograph Appoint Technical Consultant ..	573
Ferrograph Appoint New Chairman ..	447
Fi-Cord 202, A Power Pack for the (K. Mellor)	279
Fi-Cord Exhibit at Eastbourne ..	213
Fi-Cord Induction Loops at Fords ..	11

FIELD TRIALS

Akai 3000D ..	283
Revox A77 ..	368
Schaub Lorenz 5001 Music Centre ..	233
Tandberg 64X ..	423

F CONTINUED

Four Ways Ahead ..	61
Frederick Turner's Victorian Carousel (R. Golding) ..	522
Further Thoughts on Indexing (K. C. Hart) ..	537

G

Garrard to Import Rola ..	515
Getting the Evidence Taped ..	62
Grundig Head Alignment Tapes ..	543
Grundig to Form Accessory Division ..	59
Grundig C2000, TK200, TK6 and TK247 ..	185
Grundig TK200 (see reviews)	
Grundig C200 (see reviews)	

H

Harrogate Fair, The ..	591
Heathkit Catalogue ..	573
Hi-Fi In The Home (details) ..	515
Home-built video recorder (letter) ..	541
Home Tutor, The (R. Golding) ..	475
How Not to Win a Tape Recording Contest (J. Shuttleworth) ..	367

I

IC Television Receiver ..	299
IEE Evening Lectures ..	573
Imhofs Produce new Catalogue ..	447
Imitation Robots at the IEA ..	299
Insect Linguistics ..	11
Interviewing, A Professional Approach to (A. Garratt) ..	270
ITN Order Elcom ..	573

J

Japanese English (D. K. Kirk) ..	15
----------------------------------	----

K

Kerr Effect, New Work on ..	299
Kodama Radio Cassette ..	343

L

Laboratory Language Learning (R. Golding) ..	396
Language Tape, So You're Going to Buy a (M. Alderton) ..	261
Leavers-Rich (Richard Golding) ..	592
Listening to Hot Air ..	59
London Microphones Distribution ..	447

M

MAC Audio Adaptor Units (see reviews)

Made in Japan (A. J. Eden) ..	26
Magnavox Servicing ..	515
Magnetic Tapes Chilton 100S ..	185
Matching and Mixing ..	230
Measuring Wow and Flutter (W. H. Myall) ..	38
Meters and Metres (letter) ..	177
Metric Standardisation (Editorial) ..	57
Metrosound Move ..	343
Microphones, A Practical Test of Five ..	308
Microphone Survey ..	314
Miniature Electronic Organ (constructional feature) ..	410, 451
Monk Tape Recorder Testing ..	255
Multiplay (letter) ..	320
Music on the Move (cartoon feature) ..	66

N

Nagra Agency Re-Established ..	59
National Gramophone Musical Weekend ..	255
Newell Tape Transport System ..	11
New Format for the Audio Fair ..	515
New Nagra at the IBC ..	447
Northern Audio Fair ..	395, 591
Northern Hi-Fi Fair ..	11
North-West Tape Gathering ..	163
Nu-Sound Extend Their Chain ..	395

O

One Man's Mixer (M. G. Skeet) ..

280, 319

P

Peak Programme Meter on a Budget (J. H. Fisher) ..	463, 583
Personal Bias (J. Ashcroft) ..	37, 73, 473, 531
Philips EL 3303 Cassette Portable ..	41
Philips EL 1995 Slide Synchroniser ..	186
Philips 'Major' Cassette ..	213
Pictures, Facts and Sound (R. Golding) ..	519
Plague on Both, A (W. Henry) ..	476
Plessey CT80 Cassette Recorder ..	59
Power Pack for the Fi-Cord 202 (K. Mellor) ..	279
Prague Audio Exhibition ..	343
Pressure-Sensitive Semiconductor ..	395
Professional Approach to Interviewing, A (A. Garratt) ..	270
Professional Recording Exhibition ..	255
Punched Tape Goes Plastic ..	163
Purchase Tax (Editorial) ..	253
Pye Combine with Peto Scott ..	213

R

Radio Cassette Developed in Japan ..	343
Rank Nivico Video Recorder (feature) ..	471
Readers' Letters ..	177

READERS' PROBLEMS

Akai M8 Spooling ..	419
Bias & Dropout ..	539
Circuit for a Garrard Deck ..	263
Double-coated Tape ..	263
Faulty Winding on an EL 3541/15K ..	63
Hissing Bang & Olufsen 2000 ..	539
Hissing Sony TC350 ..	539
Hissing Truvox R.44 ..	263
Impedance Matching ..	263
Matching a TRD DPA/1 ..	541
Matching Tape and Recorders ..	263
No Pause on a TK41 ..	63
Replacing a Meter ..	63
Sony TC900 Remote Control ..	263
Sony TC200 Unstable Take-up ..	419
Squeaking Cassettes? ..	539
Suppressing Interference ..	63
Synchronising with Slides ..	63
Truvox Flashing Lamps ..	539
Truvox PD82 Wow ..	419
Voracious Spectone 161 ..	419

R CONTINUED

Recorders and Recordings at the Russell ..	324
Recording for Disc (P. L. Bastin) ..	421
Recording for Radio (P. L. Bastin) ..	259
Recording for Television (P. L. Bastin) ..	344
Recording in Eastern Europe (letter) ..	25
Recording Outdoors (P. L. Bastin) ..	581
Recotape Sound Effects ..	41

REVIEWS

Accessories

MAC AAU-1 and AAU-4 Audio Adaptor Units ..	483
--	-----

Books

Current Research in Hypnopaedia (F. Rubin) ..	366
Fun with Tape (J. G. Staab) ..	65
Philips Tape Recording Book (F. Purves) ..	413
Practical Wireless Service Manual (H. W. Hellyer) ..	365
Sound and Vision (P. E. Sharp) ..	365
Tape Recorders (P. Spring) ..	65
Tape Recorder Servicing Mechanics (H. Schroder) ..	65
Tape Recording for the Hobbyist (A. Zuckerman) ..	366
Tape Recording (C. N. G. Matthews) ..	529
Stereo Handbook (G. W. Schantz) ..	529
The Tape Recorder (C. J. Nijsen) ..	365

Microphones

Grampian GR2L ..	313
Philips EL7500 ..	45
Sennheiser MD211 ..	311
Sennheiser MD421HN ..	312
STC 4113A ..	313
Walchris 63M ..	313

Mixers

Grampian 20/3 ..	377
------------------	-----

Tapes

Ballet Music from the Opera ..	75
Mendelssohn/Bruch ..	75
Ravel/Debussy/Prokofiev ..	75
Stravinsky/Bartok ..	75
Tchaikovsky/Grieg/Sibelius ..	75
Waltzing in Vienna ..	75

(continued overleaf)

VOLUME TEN INDEX CONTINUED**Tape Recorders**

Akai 1710W	479
Akai 3000D	329
Ampex 753	375
Dual TG27	89
Eagle TC450	425
Ferguson 3232	544
Grundig TK145	373
Grundig TK2200	600
Grundig C200	605
Philips EL3313/GL559	43
Revox A77	285
Sony TC 530	187
Tandberg 64X	241
Tandberg Series 12 (Postscript)	93

R CONTINUED

Revox A77 (see field trials and reviews)	
Revox Buttons (letter)	25
Revox 736 (letter)	177
Royal National Institute for the Blind (Editorial)	9

S

Saba Servicing	447
Saja Spares Dry Up	255
Schaub Lorenz 5001 Music Centre (see field trials)	
Scottish Servicing	213
Sela 2880 Portable Mixer	185
Sennheiser MD405 Microphone	185
Shiba to Market £50 VTR?	59
Sifam Supply Ampex Meters	163
Sony TC105 and CV-2100CE	186
Sony TC-530 (see reviews)	
Sony VTR at Bath	11
Sort of Chain Reaction, A (feature)	458
Sound Effects	80
Sound of Weymouth (J. Graham)	13
So You're Going to Buy a Language Tape (M. Alderton)	261
Stencil Hoffman R.70 Recorder	59
Statistics of Tape Recorder Deliveries	59
Steel Tape Used in Data Recorder	515

Survey Surveyed, A (P. D. Turner)	67
Synchronising Two Channels (letter)	541
Synchroplay (letter)	320
Tricks and Artifices (D. K. Kirk)	516
Trust Your Ears (M. Howell)	461
Two Microphone Mounting Accessories (J. H. Fisher)	323
Two Simple Accessories for Tape Recorders (G. A. Cloud)	405

T

Tandberg—A Social Experiment (D. K. Kirk)	222
Tandberg Series 6 (see Tape Recorder Service)	532
Tandberg Series 7 (see Tape Recorder Service)	
Tandberg Series 12 (see reviews)	
Tandberg 64X (see field trials and reviews)	
Tape at the International Public Address Exhibition	213
Tape Recorder Delivery Statistics	59
'Tape Recorder' Distribution	343
Tape Recorder Facilities (Editorial)	211
Tape Recorder Maintenance Open Scottish Branch	213

TAPE RECORDER SERVICE

Bang & Olufsen 1100	305
Bang & Olufsen 1500/2000	350
Bang & Olufsen 2000	400
Grundig TK120, TK125, TK140, TK145	454
Reps R.10	69
Reps R.10 Mk. 2	32
Tandberg Series 6	532
Tandberg Series 7	576
Van Der Molen Sonic Eight	274
Van Der Molen VR4	236
Van Der Molen VR7	170

T CONTINUED

Tape Recorder Statistics	395
Tape Recordings on Trial (B. W. Haines)	575
Tape Transport Mechanisms (G. T. Rogers)	181, 215, 265, 301
Tape Transport Systems (Editorial)	341
Tape to Disc (survey)	584
Tax on Tape Recorders	213
TEAC Distribution	447
Telefunken M250 and 204TS	543
Telefunken M.28 Studio Recorder	41
Tesla—A Tale of New Bohemia (O. Musil)	172
'This England' Sound	447
Thornbury Tape Recording Competition	395
To Err is Human (A. Garratt)	406
Transatlantic Music Tapes Wide-Hub Spools	186

U

Uher Recorders Stolen	395
Ultra-Fast Tape Reader	343
Understanding Bias (Gerald Chevin)	362
Understanding Circuit Diagrams (D. K. Kirk)	398

V

Van Der Molen Sonic Eight (see Tape Recorder Service)	
Variable Speed Drive System, A (F. C. Judd)	525
Video recorder, Home Built (letter)	541
Viking 423 Stereo Tape Unit	41
Visit to Akai	76

W

What's in a Clutch? (feature)	357, 416
What's Wrong With Tape Records?	79
'Which?' Returns to Tape Recorders	11
Wildlife Recording Competition	515

Y

Your Obedient Servant	19
-----------------------	----

SANYO PORTABLES put you in the world class



Sanyo MR 400

Modern neatly styled cassette tape recorder. Battery (4UM-2)/mains operation. Double track. AC bias. Tape speed 1½ ips. Tape recording time 30 mins. 1 track, 60 mins. double track. Rewind and fast forward times 1 minute. Power output 650mW max. Frequency response: 150-7000 Hz. 2½ x 3½ PDS speaker, dynamic microphone with remote control switch.

Recommended selling price £39.19.6.

Even if you've a roomful of fixed hi-fi in your home, you'll still be impressed with the performance of these special SANYO portable radios and tape recorders. Everything about them is designed to give the highest possible

performance within a reasonable compass of size and price.

For further information write to:

Sales Manager, Marubeni-Iida Co. Ltd,
164 Clapham Park Road, London SW4.

SANYO reliability is built in

FREE

We're giving away 10,000 of these 5 $\frac{3}{4}$ " self threading reels. Each one's worth 9/10d.

All you need to do to get this: fill in the coupon and send it off with the front-end Tartan slip from your purchase of any reel of 'Scotch' Magnetic Tape of 4" diameter or larger—we'll send you your reel by return. So long as we've got one to send.

We've only 10,000. So hurry!

- *Automatic wind-on. Just lay tape in hub of spool. The reel then threads itself. *No loose ends.
- *Cuts down tape handling *Maximum tape protection *Fastest known method of threading reel.



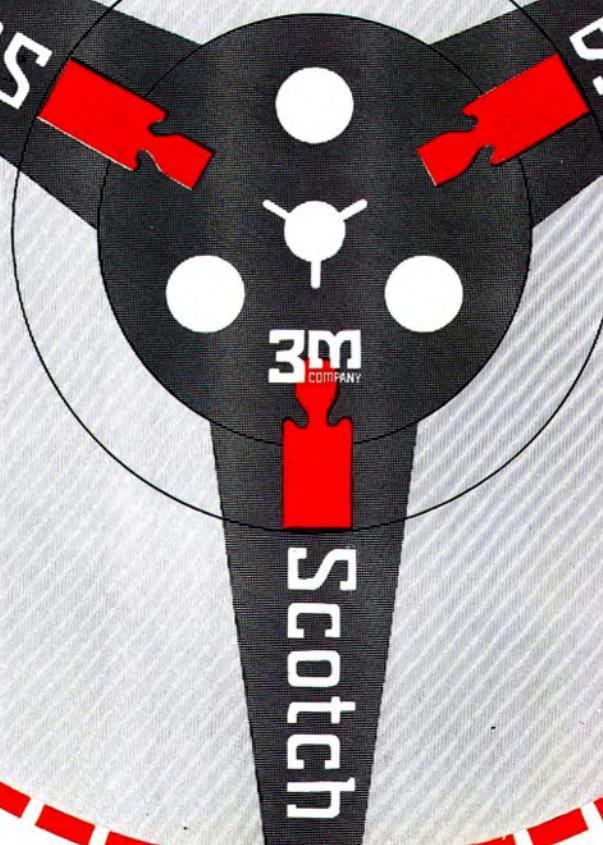
To: Mr. R. Perkins, 3M Company Limited,
3M House, Wigmore Street, London, W1A 1ET.

Please send me a free 5 $\frac{3}{4}$ " self threading reel.
I enclose the front-end Tartan slip from a 4"
(or larger) reel of 'Scotch' Magnetic Tape.

NAME _____

ADDRESS _____

This offer applies to the U.K. only.



A circular illustration of a magnetic tape reel. The reel is black with three circular holes and a central hub. The word 'Scotch' is printed twice on the top arm of the reel, once on each side of the hub. The word 'Scotch' is also printed vertically along the bottom arm of the reel. The center of the hub features the '3M COMPANY' logo. The entire reel is set against a light gray background with a red dashed circular border.

3M and 'Scotch' are trademarks.