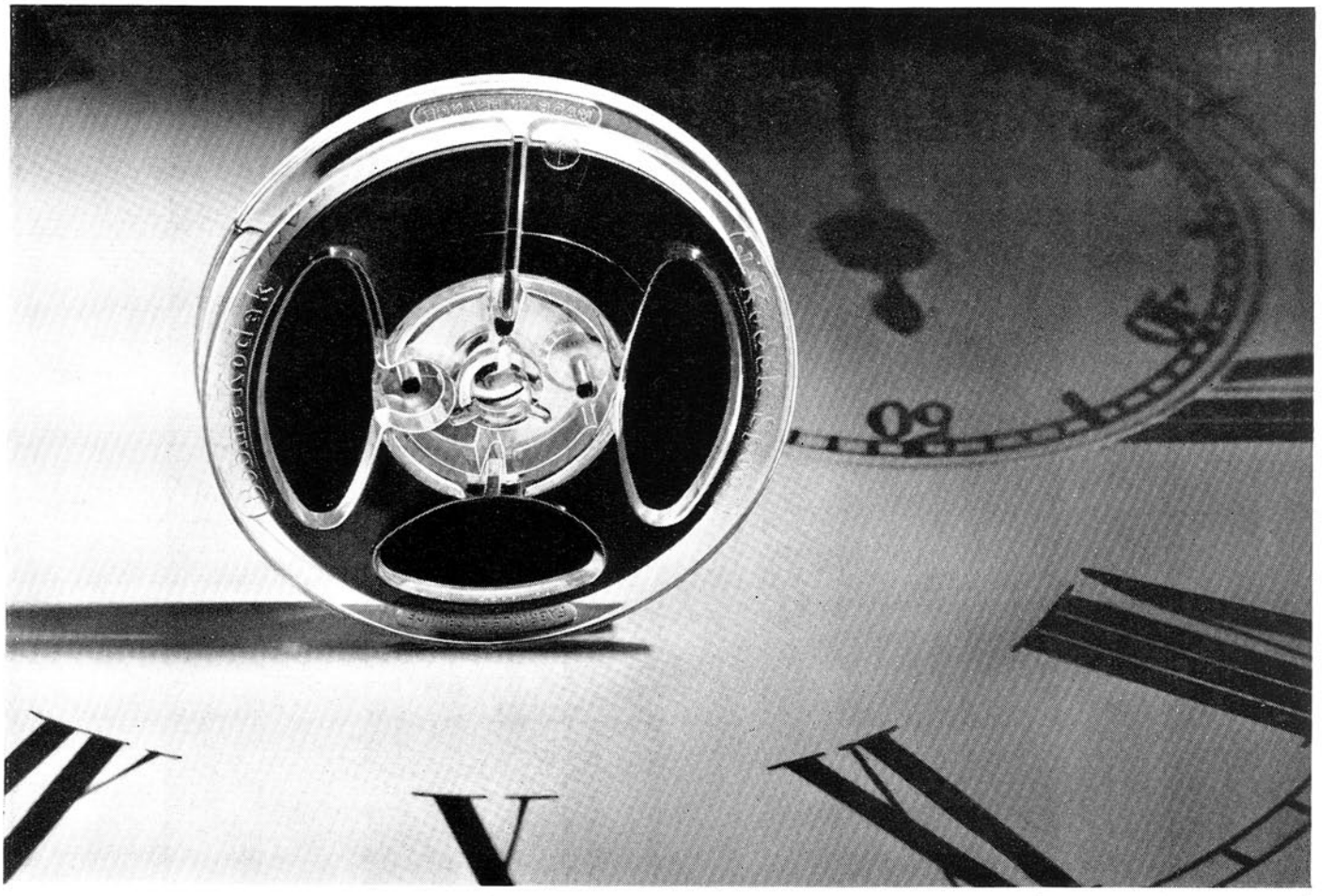
DECEMBER 1964 TWO SHILLINGS

tape recorder

THE AUCTIONEER - A TAPE PLAY ■ VISIT TO THORN
SABA TK230S REVIEWED ■ SERVICING THE "MAGIC EAR"



3¼-inch reel . . . 5½ hours playing time!

Now Kodak introduce the world's first quadruple play tape

From today your battery portable has mains recorder capacity. Kodak's amazing new Quadruple Play tape provides an unprecedented 5½ hours playing time—that's more than 100 'pops' or all Beethoven's nine symphonies—on a single 3¼-inch reel.* Small as they are, these reels hold no less than 800 feet of tape. And for smaller recorders 3-inch reels are available. But if your recorder has a greater reel capacity you're even better off. 4-inch reels—holding 1,200 ft. of tape and giving 7¾ hours playing time—are on the way.

Strength with length

The polyester base of this remarkable new tape is specially prestretched and treated to overcome distortion during use. In fact, Kodak Quadruple Play tape is tough enough to stand up to every stress likely to be met with under all normal conditions, no matter what the make of your battery recorder.

Same famous quality

Unique experience of emulsion coating methods, gained during years at the top of the film business, gives Kodak unrivalled advantages in the manufacture of tape. For instance, the magnetic oxide layer on Kodak tapes is laid down to an accuracy of *millionths* of an inch. No other tapes in the world can give you the combination of uniformity, sensitivity and high signal-to-noise ratio that stems from this.

Planned for low-speeds

New Kodak Quadruple Play Tape, with its characteristics planned especially for low-speed operation, provides in addition, superior high frequency response at low tape speeds. And, microscopically thin as it is, print-through is up by only 2dB on standard play tape. Let new Kodak Quadruple Play Tape extend your enjoyment the very next time you buy tape.

*1¾ i.p.s. 4-track

Post this coupon today

Please send me full details of Kodak Quadruple Play tape

NAME .....

ADDRESS .....

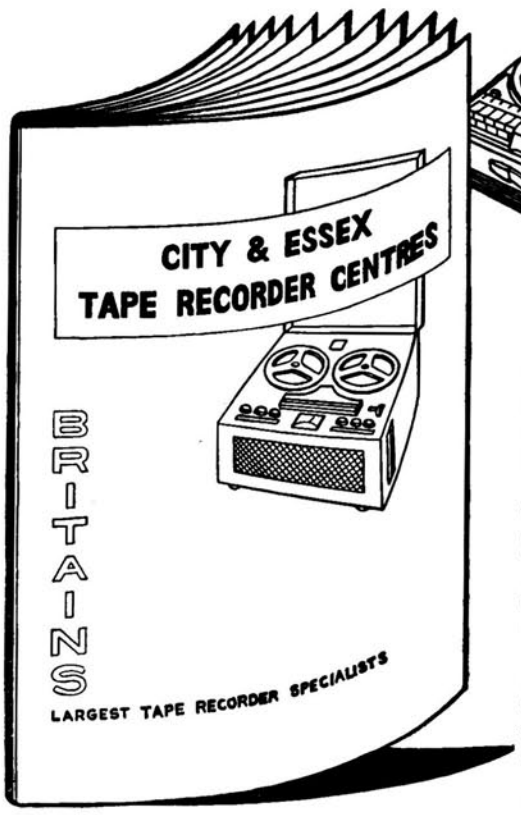
.....

Kodak Ltd., Dept. 70, Kodak House, Kingsway, London, W.C.2

6

Kodak sound recording tapes . . . the best tapes in the world

FREE! COLOUR BROCHURE



This wonderful new, attractively illustrated FREE brochure brings you full details of the tremendous range of tape recorders and many unique features that we as BRITAIN'S LARGEST TAPE RECORDER SPECIALISTS offer you.

Full details of recorders we particularly recommend giving prices, specifications, etc., and a comprehensive list of all models available today are contained in the brochure, together with our unique FREE TRAVEL VOUCHER entitling you as a customer to full refund of your travelling expenses to and from any of our showrooms.

Hurry and send for your FREE copy today.

5 STAR FEATURES

- ★ FREE TRAVEL TO AND FROM OUR SHOWROOMS
- ★ FREE DEMONSTRATIONS IN YOUR HOME
- ★ OVER 300 MODELS FROM 15-243 GNS.
- ★ FREE ONE YEAR SERVICING
- ★ FREE TECHNICAL ADVICE

NOTE—BISHOPSGATE SHOWROOMS OPEN MON.-FRI. 9a.m.-6p.m. SUNDAY 9.30a.m.-2p.m. CLOSED ALL DAY SATURDAY. OTHER SHOWROOMS OPEN MON.-SATURDAY 9a.m.-6p.m. THURSDAY TO 1p.m.

POST THIS COUPON NOW!

CITY & ESSEX

TAPE RECORDER CENTRES

228 BISHOPSGATE, E.C.2 (*opposite Liverpool St. Station.*)	**BIS 2609**
2 MARYLAND STATION, STRATFORD, E.15 (*adj. Maryland Station*)	**MAR 5879**
205 HIGH STREET NORTH E.6 (*opposite East Ham Station*)	**GRA 6543**
232 EAST INDIA DOCK RD., POPLAR, E.14 (*adj. Blackwall Tunnel*)	**EAS 5978**

Please send me your **FREE BROCHURE**

Name.....

Address.....

.....

CITY & ESSEX TAPE RECORDER CENTRES

HEAD OFFICE: CITEX HOUSE, 191 PLASHET RD., LONDON, E.13

THE TAPE WITH THE OSCAR-WINNING RECORDING QUALITY

Zonatape is available in four grades and four spool sizes. Each is colour coded as follows:

Clear Spool: ***Diacetate Standard Play.***
Red Spool: ***PVC Standard Play.***
Green Spool: ***Polyester Extra Play.***
Blue Spool: ***Polyester Double Play.***

A full range of Zonatape recording accessories includes printed leader and timing tapes supplied in 5 colours, splicing tapes and metal stop foil. These professional quality tapes are obtainable from good-class dealers but in case of difficulty send to us for name and address of your nearest Zonatape stockist.

ZONATAPE

(A PYRAL SA PROCESS)

FOR SOUND RECORDING

ZONAL FILM (MAGNETIC COATINGS) LTD.

A SUBSIDIARY OF **ILFORD** *ILFORD ESSEX*

• Hi-Fi Equipment • Speaker Systems • Radios • Educational • Amateur Gear • Test Instruments •

TA-IS

TO ALL MUSIC LOVERS AND HI-FI ENTHUSIASTS

No electronic or soldering experience is necessary *to build any Heathkit model: our simple, well illustrated manual guides you step by step.* **A FREE CATALOGUE of the full range,** *and detailed specifications of any item, will be gladly sent on request without obligation on your part.*

TAPE AMPLIFIER UNITS
Models TA-IM and TA-IS

The monophonic version (TA-IM) can be modified to the stereo version (TA-IS) by modification kit (TA-IC). Special features include the provision of a bias level control, easy-to-read thermometer-type recording level indicators; large printed circuit boards. Both models have identical presentation. TA-IM £19.18.0 kit
TA-IS £25.10.0 kit TA-IC £6.15.0 kit
TA-IM £28.18.0 Assembled
TA-IS £35.18.0 Assembled

D-93

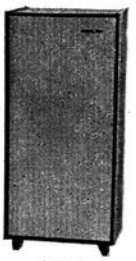
TRUVOX D93 TAPE DECKS

Standard. High-quality stereo tape decks. D93/2 ¼-track for highest fidelity £36.15.0
With TA-IM £52.18.0
With TA-IS £58.10.0

D93/4, ¼-track, for most economical use of tape. **£36.15.0. With TA-IS £58.10.0**

MONO CONTROL UNIT. Model UMC-1. Designed to operate with our model MA-12 or any amplifier requiring 0.25 V or less for full output. Suitable for cabinet mounting or free standing. Size 10" × 7" × 4". **£8.12.6** kit **£13.12.6** Assembled

UMC-1



MFS

"COTSWOLD" MFS SPEAKER SYSTEM
A minimum floor space model. Size 36in. high × 16½in. wide × 14½in. deep with performance similar to the standard model. Specially designed for small rooms.

"COTSWOLD" STANDARD SPEAKER SYSTEM
This is an acoustically designed enclosure 26in. × 23in. × 14in. housing a 12in. bass speaker with 2in. speech coil, elliptical mid-range speaker and a pressure unit to cover the full frequency range of 30-20,000 c/s. Capable of doing justice to the finest programme source. Delivered complete with speakers, cross-over unit, level control, grille cloth, etc. Either Model **£23.4.0** kit **£30.15.0** (Assembled in the white)

"OXFORD" TRANSISTOR RADIO Model UXR-2. Luxury solid leather case, full long and medium wave coverage. Printed circuit facilitates assembly. 7" × 4". high-flux speaker. Send for full details. **£14.18.0** incl. P.T.

POWER AMPLIFIER 12-WATT Model MA-12. 0.1% THD at 10W. Wide frequency range. Ideal for use with USC-1 and UMC-1. **£11.18.0** kit **£15.18.0** Assembled

COLLARO "STUDIO" TAPE DECK. Operating speeds: 1⅞in., 3¾in. and 7½in. p.s. Wow and flutter not greater than 0.15% at 7½in. p.s. **£17.10.0**
With TA-IM **£31.5.6**

Heathkit
DAYSTROM

Save Money and enjoy yourself building these Heathkit models

NO SPECIAL EQUIPMENT OR PREVIOUS EXPERIENCE NECESSARY TO BUILD ANY HEATHKIT MODEL

STEREO CONTROL UNIT Model USC.1

Push-button selection, accurately matched ganged controls to — 1dB. Negative feedback, rumble and variable low-pass filters. Printed circuit boards. Accepts inputs from most tape heads and any stereo or mono pick-up. **£19.10.0** kit **£26.10.0** Assembled

GARRARD AUTO/RECORD PLAYER Model AT-6. 4-speed stereo and mono unit, manual or automatic record selection, Ronette 105 cartridge. **£13.12.1**
With Decca Deram cartridge **£14.6.1**

GOLDRING-LENCO TRANSCRIPTION RECORD PLAYER Model G.L.58. Fitted with the G.60 pick-up arm it has infinitely variable speed adjustment between 33⅓ and 80 r.p.m. and four fixed speeds. 3¾lb. turntable to reduce rumble "wow" and "flutter". With Ronette 105. **£20.1.3**

HI-FI FM TUNER, Model FM-4U
For your convenience, this model is available in two units sold separately: Tuning Unit (FMT-4U—**£2.15.0** including P.T.) with 10.7 Mc/s I.F. output, and Amplifier Unit (FMA-4U—**£13.3.0**). Built-in power supply; 7 valves. Total **£15.18.0** kit

MALVERN

HI-FI EQUIPMENT CABINETS
A range of over a dozen equipment cabinets is now available to meet differing needs of enthusiasts. Designed for maximum operating convenience or for where room space is an over-riding consideration, this range includes kits, ready assembled cabinets or assembled and fully furnished cabinets, and has at least one model to meet your requirements. Why not send for full details?
Prices from **£7.7.0—£33.12.0**

HI-FI MONO AMPLIFIER. Model MA-5. A general purpose 5 w. amplifier with inputs for Gram., Radio. Presentation similar to S-33. **£15.10.0** Assembled **£10.19.6** kit

AM/FM TUNER. Model AFM-1.

This model is available in two units sold separately. Tuning heart (AFM TI **£4.13.6** incl. P.T.) IF Amplifier (AFM-AI **£21.16.6**) range 88-108 Mc/s (FM) 16-50, 200-550, 900-2000 (AM). Printed circuit board. Total price **£26.10.0** kit.

HI-FI STEREO 6-WATT AMPLIFER Model S-33. Attractively styled. Printed circuit construction. 0.3% distortion at 2½ W/chal.; sensitivity 200 mV. ganged controls; low cost, compact unit for smaller rooms **£13.7.6** kit **£18.18.0** Assembled

DE LUXE STEREO AMPLIFIER Model S-33H. De luxe version of S-33 with many refinements. Ideal for use with Decca Deram pick-up. **£15.17.6** kit **£21.7.6** Assembled

AUDIO SIGNAL GENERATOR Model AG-9U. Delivers up to 10 volts pure sine-wave (less than 0.1% distortion, 20 c/s to 20 kc/s). Decade switch-selected frequencies from 10 to 100,000 c/s. Internal 600 Ohm N/I load, or external. **£30.10.0** Assembled **£22.10.0** kit

AUDIO SINE SQUARE WAVE GENERATOR AO-IU. Covers 20 c/s—150 kc/s in four ranges. Choice of sine or square waves, the latter up to 50 k/cs. **£21.5.0** Assembled **£14.15.0** kit

SUGDEN MOTOR UNIT "CONNOISSEUR CRAFTSMAN". Heavy duty motor operating at 33⅓ and 45 r.p.m. Very heavy 12 in. turn-table. Virtually no rumble. **£17.2.11**

HI-FI STEREO 18 WATT AMPLIFIER Model S-99. Within its power rating, this is the finest stereo amplifier available, regardless of price. Printed circuit board construction; ganged controls. U/L push-pull output. 0.2% distn. at 9 W/chal. **£27.19.6** kit **£37.19.6** Assembled

TRANSISTORISED TELEPHONE AMPLIFIER. Model TTA-1. Provides instant group listening and conversation. Freely portable for use with any telephone; hands-free operation; automatic switch; 9v battery operated; compact and neat cabinet. **£11.15.0** Assembled **£7.9.6** kit

ELECTRONIC WORKSHOP KIT, Model EW-1
The ideal present for youngsters. Will make over 20 exciting experiments, including Transistor Radios, Intercoms, Burglar Alarm. Electric Eye, etc. No soldering. 72-page well illustrated instruction manual. Two-colour Club badge given free with every kit. Total price **£7.13.6** incl. P.T.

HI-FI SPEAKER SYSTEM Model SSU-1. This kit is easily assembled. It contains two speakers and balance control in its ducted port reflex cabinet. It is equally suitable for stereo or mono in average room. (Legs 14/6) Less legs, **£10.17.6**

A WHOLE RANGE OF PACKAGED DEALS (INCLUDING "CONNOISSEUR CRAFTSMAN" TURNTABLE and DECCA fiss PICK-UP) NOW AVAILABLE TO SAVE YOU FURTHER MONEY.

All prices include free delivery in U.K. Deferred terms available on orders over £10

JUST POST THIS COUPON FOR FURTHER INFORMATION

Without obligation please send me TICK HERE

★ **HEATHKIT FREE BRITISH CATALOGUE . . .** ☐

FULL DETAILS OF MODEL(S) ☐

Kindly write below in BLOCK CAPITALS

NAME .....

ADDRESS .....

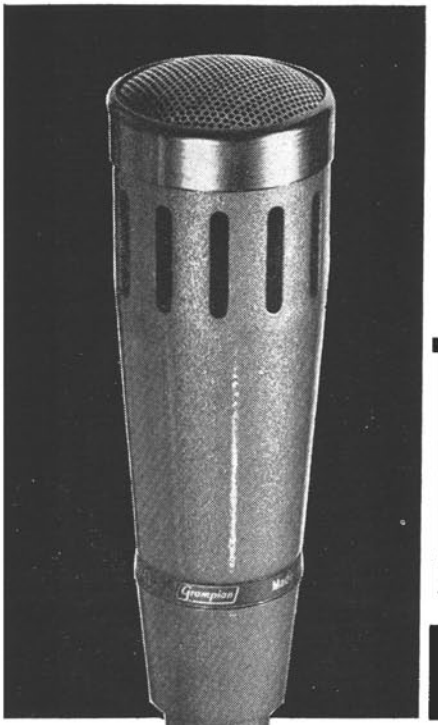
..... HT8..

WE SHALL BE EXHIBITING at the TELEVISION AND RADIO SHOW, Earls Court, LONDON, August 26th—September 5th, 1964, STAND 32, 11 a.m.—9 p.m. AND LOOK FORWARD TO SEEING YOU.

DAYSTROM LTD. DEPT. H8 GLOUCESTER, ENGLAND

(A subsidiary of Weston Instruments Group) manufacturers of

THE LARGEST-SELLING ELECTRONIC KITS IN THE WORLD



NEW FROM

Grampian

CARDIOID MICROPHONE!

After years of research, Grampian proudly present a microphone with a really good frequency response, high sensitivity and a genuine cardioid pick-up pattern.

More—it is rugged enough to withstand hard usage—and is still in the medium price range.

Especially useful under difficult conditions, the Grampian Cardioid is fully up to the highest Grampian standards of workmanship, reliability and *integrity*.

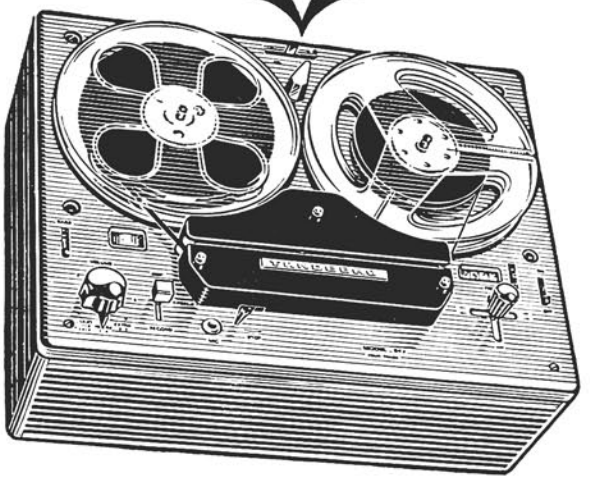
Frequency response 40 c/s to 12 kc/s. Available in 4 impedances —Low Impedance **£14**, other Impedances **£15**. Obtainable *now* from your Grampian dealer. Fullest details from—

GRAMPIAN SOUND EQUIPMENT

INTEGRITY THAT YOU HEAR

GRAMPIAN REPRODUCERS LTD
Hanworth Trading Estate, Feltham, Middlesex. Feltham 2657

NEW FROM NORWAY



Tandberg

MODEL 8

A complete portable monaural tape recorder in the true Tandberg tradition, by the manufacturers of the famous Tandberg Stereo Series 6 & 7.

Tandberg Series 8 in teak cabinets.

2 speed 3¾ & 1.7/8 I.P.S.

Model 823 2 track, 50 gns.
Model 843 4 track, 54 gns.

Model 921 2 track, (3 speed) 69 gns.

For further information on any Tandberg Models please write to Elstone Electronics (address below).

Tandberg

ELSTONE ELECTRONICS LIMITED
Edward Street, Templar Street, Leeds 2. Tel: Leeds 35111 (7 lines)

GRAM TURNTABLES & PICK-UPS

Mono Stereo Battery TAPE RECORDERS

LOUDSPEAKERS & ENCLOSURES

Pre-Recorded Tapes

IF....

RECORD PLAYERS

IF *you want to buy the best in sound equipment, we stock and sell the lot.*

IF *you want the best at the lowest prices, buy from us on INTEREST FREE H.P.*

IF *you buy from us and live anywhere in Gt. Britain, we deliver free.*

IF *it goes wrong, we cover you with 12 months completely free servicing.*

NO *"IF"s — OUR TERMS, SERVICE AND STOCK ARE THE BEST YOU CAN FIND ANYWHERE.*

IF *you want brochures, details of all our terms, and free advice — write, phone or call:*

Portable RADIOS

TUNERS & AMPLIFIERS

Second-hand & Part-exchanges

ALL TAPES & TAPE ACCESSORIES

Please tick your interests:

TAPE RECORDERS

Mono under £50 ☐
Mono over £50 ☐
Stereo ☐
Battery ☐

HI-FI

Tuners & Amplifiers ☐
Loudspeakers & Enclosures ☐
Gram Turntables, Arms, & Cartridges ☐
Portable Radios ☐
Record Players ☐

HOWARD

TAPE RECORDERS · HI-FI

218 HIGH ST. BROMLEY. KENT. RAV. 4000

THE RECORDER CO.

for best machines on advantageous terms

	Deposit	12 Monthly Payments	Cash Price
	£ s. d.	£ s. d.	Gns.
4-TRACK STEREO/MONAURAL			
Ferrograph 424 ...	11 12 0	8 13 2	110
Sony TC 500	11 9 0	8 11 8	109
B. & O. Stereomaster	11 5 0	8 5 0	105
Grundig TK46 ...	10 12 0	7 15 7	99
Siemens Mod. 12 ...	8 0 0	5 17 11	75
Philips EL3534 ...	9 16 0	7 4 8	92
Sony TC 200	8 19 0	6 3 4	79
Elizabethan LZ507 ...	5 9 0	3 16 8	49
2-TRACK STEREO/MONAURAL			
Revox Model 736 ...	13 4 0	10 11 8	124
Brenell STB 1	12 0 0	9 0 0	120
Ferrograph 422 ...	11 12 0	8 13 2	110
B. & O. Stereomaster	11 5 0	8 5 0	105
Telefunken 98 ...	10 0 0	7 9 7	95
MAINS 2-TRACK			
Brenell 5 Type "M" ...	9 5 0	6 18 7	88
Ferrograph 5A/N ...	8 19 0	6 13 10	85
Telefunken 85 ...	8 15 0	6 10 8	83
Brenell 5/2 (Meter) ...	7 15 6	5 16 7	74
Brenell 5/2	7 5 0	5 8 8	69
Truvox 92	7 5 0	5 8 8	69
Reps R10 Mk. 2 ...	6 4 0	4 12 11	59
Grundig TK18 ...	4 2 0	3 1 5	39
Grundig TK14 ...	3 13 6	2 15 2	35
Wyndsor Trident ...	3 10 0	2 11 11	33
Wyndsor 707-11 ...	3 9 0	2 5 0	29
Elizabethan Auto 2 ...	2 16 6	2 0 10	26
Ferguson 3206 ...	2 16 6	2 0 10	26

H.P. also over 18 and 24 months

	Deposit	12 Monthly Payments	Cash Price
	£ s. d.	£ s. d.	Gns.
MAINS 4-TRACK			
Grundig TK40 ...	8 19 0	6 3 4	79
Reps R10 Mk. 2 ...	7 5 0	5 8 8	69
Truvox R94	7 5 0	5 8 8	69
Philips EL3549 ...	6 12 0	4 17 6	62
Grundig TK23 ...	4 15 0	3 10 10	45
Philips EL3541/H ...	4 12 0	3 5 10	42
Elizabethan LZ29 ...	4 2 0	3 1 5	39
Philips EL3541 ...	3 15 8	2 16 9	36
Elizabethan LZ24 ...	3 14 0	2 13 4	34
Ferguson 3204 ...	3 10 0	2 11 11	33
Elizabethan Auto 2 ..	2 19 0	2 4 1	28
Philips "Star Maker"	2 16 9	2 2 7	27
BATTERY			

"THIS IS IT!"
PHILIPS EL3300
POCKET TAPE RECORDER

'Snap-in' Cartridge Loading, Twin-Track, playing time 30 mins. per track. Remote control switch on microphone (detaches for separate use). Modulation Meter and Battery strength Indicator. Size 7⅞" x 4½" x 2½". Complete with grained leather carrying case **25 gns**
Deposit £2.15.0, 12 Monthly payments £1.19.2

Uher 4000S	9 16 0	7 6 5	93
Ficord 202	7 0 0	5 3 10	66
Grundig TK6 ...	6 17 0	5 2 4	65
Butoba MTS	6 4 0	4 12 11	59
Telefunken 300 ...	6 4 0	4 12 11	59
Stuzzi Magnette ...	6 4 0	4 12 11	59
Optacord 414 Bat/Mains	4 19 0	3 14 0	47
Philips EL3586 ...	2 12 6	1 19 5	25

Open Saturday 6 p.m.—Friday 6.30 p.m.

If unable to call, write for free brochure, or send deposit now for quick delivery or telephone SWI 4977 for FREE HOME DEMONSTRATION

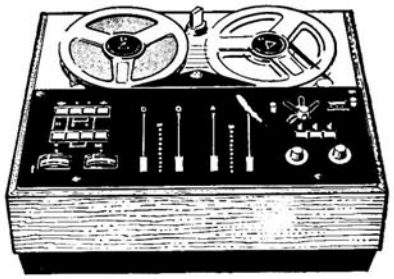
FREE DELIVERY
PART EXCHANGE

THE RECORDER CO.

(DEPT. T) 188, WEST END LANE, WEST HAMPSTEAD, LONDON, N.W.6
Telephone: **SWI 4977**

H.P. INTEREST FREE

B. & O. STEREOMASTER



Price 105 gns.

Deposit £11.5.0
12 payments of £8.5.0

Separate record and replay amplifier. 3 separate mixing controls. 3 speeds : 7½, 3¾, 1⅞ i.p.s. Fully transistorized. 8 watts output per channel. Echo multi-play and synchronising facilities. Synchorous motor. Housed in attractive, contemporary Danish designed teak cabinet. Available in 2- or 4-track versions.

Agents for : **Ferrograph, Vortexion, Reflectograph, Tandberg, Sony, Goodmans, etc.**

We will be pleased to demonstrate these fine models or send full details.

YOU OWN A GOOD TAPE RECORDER

So insist on obtaining the best sound reproduction from it, and to do this is by getting a Lustraphone Microphone.

A wide range of models both ribbon and dynamic is available.

For full details contact

LUSTRAPHONE LIMITED (Dept. TR 12)

St. George's Works, Regent's Park Road, London, N.W.1.
Telephone : PRImrose 8844/5/6

TAPE RECORDER COVERS

Smart waterproof cover to give complete protection to your tape recorder. Made from rubberised canvas in navy, wine, tan, grey and bottle green with white contrasting pipings, reinforced base, handy zip microphone pocket and name panel.

Grundig TK.1	49/6
,, TK.5	55/-
,, TK.6	67/6
,, TK.8	63/-
,, TK14 & 23 & 18	59/6
,, TK.20	52/6
,, TK.24	55/-
,, TK.25	55/-
,, TK.30	60/-
,, TK.35	63/-
,, TK.40 & 41 ...	66/-
,, TK.46	82/-
,, TK.55	63/-*
,, TK.60	75/-*
,, TK.830/3D ...	63/-
,, Cub	35/-*
Telefunken 85	65/-
,, 75/15 & 76K...	55/-
,, 95	69/6
Philips 8108	57/6
,, 3548 ...	No Price
,, 3534	87/-
,, 3459	79/6

Philips EL3538	63/-
,, EL3542	63/-
,, EL3536	70/-
,, EL3515	57/6
,, EL3541/15... ...	57/6
,, 3541/H	72/-
,, Starmaker... ...	66/-
Cossor 1602	57/6
,, 1602	63/-
,, 1604	79/-
,, 1605	84/-
Stella ST455	63/-
,, ST454	57/6
,, ST458	79/-
,, ST459	84/-
Saba	63/-
Elizabethan FT.1 ...	66/-
,, FT.3	75/-
,, LZ29	75/-
Fi-Cord 1A	52/6
Fidelity Argyle	55/-*
Clarion (with strap) ...	52/6
Brenell Mk. 5	77/-
,, 3 star	69/-
Truvox R92 and 94 ...	99/-
Robuk RK.3	67/6
Ferrograph	88/-
Sony 521	90/-
Revox	84/-
Optacord 414—412 ...	63/-

* Without pocket

A. BROWN & SONS LTD.
24-28 GEORGE STREET, HULL. TEL. : 25413, 25422

33 GNS BUYS FINGER-TIP CONTROL- AND 15 LUXURY FEATURES!

■ 4 tracks—12 hours playing ■ 2 speeds—$1\frac{7}{8}$ and $3\frac{3}{4}$ ■ Superimpose button ■ Auto-stop ■ Push button programme indicator ■ Pause control ■ Microphone and lead included ■ Straight through amplifier ■ External speaker socket ■ Finger-tip piano key control ■ Tape inching either way at a touch ■ High quality amplifier, 3 watts output ■ Two-tone finish ■ Free reel of BASF tape ■ Free BASF booklet of tape recording hints.

ULTRA
Features the most

TO: ULTRA RADIO & TELEVISION LTD.
TELEVISION HOUSE, EASTCOTE, RUISLIP, MIDDLESEX

Please send me free colour leaflet on the Ultra tape recorder

Name.....

Address.....

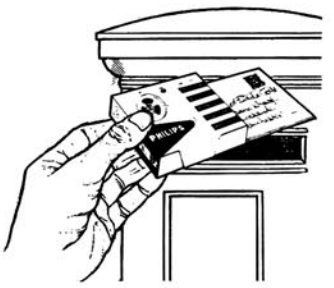
TR31

Gift-problem solver!

Philips magnetic tape

—give it to every tape recorder owner you know!

You solve a lot of gift problems when you give Philips Tape to tape recorder owners—and you give a lot of pleasure! For Philips Tape, sensitive, long-lasting and easy to identify in colour-coded packs, makes every tape recorder sound better than ever. It's easy to give, too—the 5″, 5¾″ and 7″ reel sizes come in colourful Christmas wrappers. Buy Philips Tape from your local dealer now. Ask your friends to give it to *you* too!



Helpful tape recording hint. Send *spoken* Christmas greetings on Philips Audio Letters. They're only 5/6 each, complete in 'ready-to-post' packs.

A Happy Christmas Idea from PHILIPS—the friend of the family

PHILIPS ELECTRICAL LTD., ELECTRO ACOUSTICS DIVISION, CENTURY HOUSE, SHAFTESBURY AVENUE, LONDON, W.C. 2

Always in stock—

an unrivalled selection of

- **Tape Recorders**
- **Hi-Fi Equipment**
- **Tapes**
- **Microphones**

Free demonstrations—Honest opinion

COMPLETE STEREO TAPE RECORDERS (Four Track)

The New Elizabethan, 7½, 3¾, 1⅞ i.p.s.	£68 5 0
*The New Saba, 3¾, 7½ i.p.s.	92 8 0
The New Cossor, 3¾, 1⅞ i.p.s.	59 17 0
Sony TC.200, 7½, 3¾ i.p.s.	82 19 0
Philips EL3534, 7½, 3¾, 1⅞, 15/16 i.p.s.	96 12 0
*Outstanding Two-Track Stereo Recorder, Vortexion CBL. Separate Record/Replay Heads, Semi-Professional. All facilities ...	160 0 0

STEREO TAPE UNITS

*Ferrograph 422.U. 2 Track. 7½, 3¾ i.p.s. ...	£115 10 0
*Ferrograph 424.U. ¼ Track Playback. 7½, 3¾ i.p.s.	115 10 0
Sony 464 (one replay Amplifier), 7½, 3¾ i.p.s.	67 4 0
*Truvox PD 90. Series 2 or 4 Track, 7½, 3¾ i.p.s.	82 19 0
*Tandberg Series 6. 2 or 4 Track. 7½, 3¾, 1⅞ i.p.s.	115 10 0

FOUR TRACK MONO TAPE RECORDERS

Philips EL3549, 7½, 3¾, 1⅞, 15/16 i.p.s.	£65 2 0
Philips EL3548, 3¾, 1⅞ i.p.s	40 19 0
Elizabethan L.Z. 29 (illustrated) 7½, 3¾, 1⅞ i.p.s.	40 19 0
Elizabethan Automatic, 3¾ i.p.s.	29 8 0
Grundig TK23, 3¾ i.p.s.	47 5 0
Truvox R94, 7½, 3¾, 1⅞ i.p.s.	72 19 0

TWO TRACK MONO TAPE RECORDERS

*Vortexion WVB (3 head system), 7½, 3¾ i.p.s.	£110 3 0
*Vortexion WVA Standard System, 7½, 3¾ i.p.s.	93 13 0
*Ferrograph 5A/N, 7½, 3¾ i.p.s.	89 5 0
*Telefunken 85 De Luxe (The Classic) 7½, 3¾ i.p.s....	87 3 0
Grundig TK.41, 7½, 3¾, 1⅞ i.p.s.	78 15 0
Grundig Automatic, 3¾ i.p.s.	40 19 0
Elizabethan Automatic 200, 3¾ i.p.s.	27 6 0
Philips EL3552 Automatic/Manual 3¾ i.p.s. ...	25 4 0
Truvox R92, 7½, 3¾, 1⅞ i.p.s.	72 19 0

LATEST BATTERY RECORDERS

Optacord 414 (inc. Mains), 3¾ i.p.s.	£49 7 0
Philips EL3300, cartridge loaded, 1⅞ i.p.s. ...	26 5 0
Philips EL3586, 1⅞ i.p.s....	26 5 0
Grundig TK6, 3¾, 1⅞ i.p.s. Mains/Battery ...	68 5 0
Uher 4000S. Remote Control. 4 Speeds ...	97 13 0
Telefunken M300, 3¾ i.p.s.	61 19 0

*Microphones EXTRA

HI-FI IN STOCK	TAPES
● Quad	● BASF
● Leak	● Telefunken
● SME	● Philips
● Garrard	● Scotch
● Rogers, etc., etc.	● EMI, etc., etc.

All types of Microphones.

For free delivery, competent demonstrations, good after sales service, and the best of Hire Purchase terms call at :

THE TAPE RECORDER CENTRE

THE TAPE RECORDER CENTRE LIMITED
82 High Holborn, London, W.C.1

Open from 9 to 5.30 weekdays
Close 12.30 Saturdays

Telephone: CHAncery 7401

FRANCIS OF STREATHAM

MAINS OPERATED TAPE RECORDERS

B & O Stereomaster ...	105 gns.
*Brenell Stereo STB 1 ...	£120
*Brenell Mk. V Model M ...	88 gns.
*Brenell Mk. V Series 2 ...	69 gns.
Cossor 4 Tr. 1604 2 sp. ...	39 gns.
Cossor 4 Tr. 1605 4 sp. ...	62 gns.
Elizabethan LZ29	38 gns.
Elizabethan LZ24	34 gns.
*Ferrograph 422 or 424 ...	110 gns.
*Ferrograph Series 5 ...	85 gns.
Fidelity Major	35 gns.
Fidelity Playmaster 2 Tr....	20 gns.
Fidelity Playmaster 4 Tr....	23 gns.
Grundig TK14	35 gns.
Grundig TK18 "Magic Ear"	39 gns.
Grundig TK23 4 Tr.... ...	45 gns.
Grundig TK40 4 Tr.... ...	75 gns.
Grundig TK41 2 Tr.... ...	75 gns.
*Grundig TK46 4 Tr. St. ...	99 gns.
Philips 4 Tr. 3541/H ...	42 gns.
Philips 4 Tr. 3549	62 gns.
Philips 4 Tr. Stereo 3534 ...	92 gns.
Philips 3548 4 Tr. 2 sp. ...	39 gns.
*Reflectograph "A" ¼ Tr....	105 gns.
*Revox T36	124 gns.
Robuk	36 gns.
*Saba Stereo...	95 gns.
Siemens Stereo 14 4 Tr. ...	69 gns.
*Simon SP5	93 gns.
Sony 200	79 gns.
Sony 500	106 gns.
Stella 458 4 Tr.	39 gns.
Stella 459 4 Tr.	62 gns.
*Tandberg Mono 92 ...	69 gns.
*Tandberg Series 6 ...	110 gns.
*Tandberg Series 7... ...	93 gns.
Telefunken 55	43 gns.
*Telefunken 85 de luxe ...	83 gns.
*Telefunken 96 4 Tr. ...	69 gns.
*Telefunken 97 ¼ Tr. Stereo	95 gns.
*Telefunken 98 ¼ Tr. Stereo	95 gns.
*Vortexion WVA	£93.13.0
*Vortexion WVB	£110.3.0
*Vortexion CBL Stereo ...	£160.0.0
Wyndsor Trident	33 gns.
Wyndsor Sabre	—

TRUVOX

R.92 2 Tr. Recorder... ...	69 gns.
R.94 4 Tr. Recorder... ...	69 gns.
*PD.93 (2 Tr.) or PD.95 (4 Tr.) Deck and Pre-Amp	59 gns.
*PD.97 (2 Tr.) or PD.99 (4 Tr.) Stereo (Deck and Pre-Amp)	79 gns.

BATTERY PORTABLES

Grundig TK6	65 gns.
Cossor 1621	26 gns.
Philips 3586	25 gns.
Lowe Opta 414 (Mains/Battery/Car)	47 gns.
*Butoba	59 gns.
*Fi-Cord 202	66 gns.
Philips Battery Portable EL3300	25 gns.
Stella 471	26 gns.
Uher 4000S	93 gns.
Telefunken 300	59 gns.

*Microphone extra

MAINS POWER PACKS

Philips, Stella or Cossor	£5.12.0
Butoba	11 gns.
Fi-Cord	£7.10.0
Uher 4000	16 gns.

Tape Decks by Brenell, Wright & Wearite

Tape to disc and copy service.

OPEN ALL DAY SATURDAY
EARLY CLOSING—WEDS.

LEADING STOCKISTS OF EQUIPMENT FOR

TAPE and HI-FI

. . . and NO EXTRA FOR CREDIT TERMS

★ **Minimum Deposit**
★ **No Interest or Service Charges on H.P. up to 18 months**
★ **Free Service during Guarantee Period**

● MICROPHONES, MIXERS, ETC.

Grampian Reflector ...	£6.15.0
Grampian Ribbon	£11.10.0
Grampian DP/4 Dynamic...	£8.0.0
Simon "Cadenza" Ribbon	£10.10.0
Reslo Pencil Dynamic ...	£11.0.0
Reslo Ribbon	£10.12.6
AKG Stereo D.77A	£15.10.0
AKG D.19C	£17.10.0
TSL 3 Channel Mixer ...	£2.17.6
TSL 3ch. Transistor Mixer Eagle Mixer	£2.19.6
Grundig Mixer Stereo ...	18 gns.
AKG K 50 Headphones ...	£7.10.0
Philips Pre-amp	£6.10.0

Also in stock microphones by ACOS, FILM INDUSTRIES, TELEFUNKEN, BEYER, etc.

All WALGAIN PRODUCTS

● TAPES & ACCESSORIES

Standard, Long, Double, Triple Play in all sizes by all leading makers.

● **DELUXERS BY WEARITE, WALGAIN**

● *Pre-recorded Tapes by Columbia, H.M.V. and all E.M.I. Labels, Saga, Tutor-tape, etc.*

Bib, Bond and E.M.I. splicers. Matching transformers. Plugs, sockets, etc.

Prices subject to alteration as announced by manufacturers.

● **STANDS OF ALL TYPES**

HI-FI DEPT.

● **STEREO AND MONO AMPLIFIERS—**
Quad HMV Pye Rogers
Lead Armstrong Tripletone
Scott B & O C.S.L. Piccolo Box

● **TUNERS**
Quad Rogers Pye Leak
Armstrong B & O Tripletone

● **LOUDSPEAKERS**
Quad Pye Rogers W.B. Kef
WharfedaleGoodmansTannoy
Lowther Leak Elac Eagle Kelly

● **MOTORS, PICKUPS**

GARRARD incl.	Acos
AT6, 301, etc.	Thorens
Goldring	Tannoy EMI
Connoisseur	Lenco Shure
DECCA incl.	Ronette
ffss Mk. III lat-	Sonotone
est Deram, etc.	B & O
Philips	SME Mk. II
Ortofon	ADC BSR

All types of Diamond and Sapphire styli, stereo and mono. Microlifts, Garrard, Goldring, and Acos Pressure Gauges. Disc Preener. Acos Dust Bug. Cabinets by Record Housing and G.K D.

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

Between St. Leonard's Church and Streatham Station

STReatham 0466/0192

Please note this is our only address

"NEW TAPE" SPECIAL

An exciting recording of percussion instruments. Fascinating arrangements of Easter Parade; Sleigh Ride and five others.
Mono only.
TAPE No. 103

A Mighty Wurlitzer played by Jackie Brown. Lovely arrangements of Far Away Places ; Slow Boat to China ; April in Paris and many more.
Mono only.
TAPE No. 210

Harry Mortimer and the "All Star" Brass Band. Intro Act 3 Lohengrin, Hindu Song, Music for Royal Fireworks, Trumpet Tune and Air and nine others.
Mono only.
TAPE No. 204

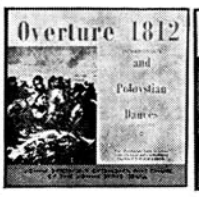
Recapture childhood memories while the Fair organ plays Moulin Rouge Waltz, When I Dance With You ; Wonderful Copenhagen and many more.
Mono only.
TAPE No. 203

Fabulous pianist George Feyer brings La Vie en Rose ; Trois Cloches ; April in Portugal ; La Mer, Domino and many others.
Mono only.
TAPE No. 200

Dixieland Jazz played by dedicated men and bringing Livery Stable Blues; Tiger Rag; Skeleton Jangle; Sensation Rag and five others.
Mono and Stereo.
TAPE No. 102

Morens Ellegaard, one of the world's leading Accordionists plays Ritual Fire Dance, Toccata & Fugue in D minor; Finlandia and five others.
Mono only.
TAPE No. 201

A Steam Caliope—unique—playing March Militaire, McNamaras Band; There's a Tavern in the Town; When Irish Eyes are Smilin' and many others.
Mono only.
TAPE No. 205



Overture 1812 and Polevetsian Dances, recognised as the finest tape of this work so far issued. Vienna Symphony Orchestra and Chorus of Vienna State Opera.
Mono and Stereo.
TAPE No. 208

Authentic Hungarian Gipsy interpretations of Liszt's Hungarian Rhapsody No. 2, and Brahms' Hungarian Dances, all played in most exciting manner.
Mono and Stereo.
TAPE No. 209

YOU GET THIS 5" REEL OF 1 mil POLYESTER TAPE AND ANY 2 OF THESE 3¾ i.p.s. MONO TAPES FOR 40/-

2 TRACK STEREO - 5/- EXTRA
4 TRACK STEREO - 2/6 EXTRA

RECOTAPE make this special offer to enable you to sample, at a huge reduction, the outstanding quality of this new Polyester base tape and at the same time enjoy any two of these fascinating music tapes.

The usual retail price of the 900ft. 5" reel of POLYESTER tape is **28/-** and the music tapes sell from **27/6** to **35/-**, giving you up to **73/-** value for **40/-** (plus 1/6 postage and packing).

All tapes offered are at 3¾ i.p.s., Mono or Stereo.

You can purchase any two, or all of the tapes offered, with each two purchased you will receive a **900ft.** reel of 1 mil **POLYESTER** tape.

TWO TAPES FOR THE PRICE OF ONE

TAPECRAFT brings you examples of recording techniques ; cycles per second ; frequency response ; equalisation; balance; distortion and a host of other information which cannot be learned in any other way. All there is to know about tape—on tape.
Mono only 35/-

SOUND ADVENTURE provides a unique glance into the way sound is put to work for the benefit and pleasure of mankind. It deals with frequency, pitch, Intensity, Doppler effect, Echo, Reverberation Fundamentals and Overtones and a host of other things of interest to the amateur recordist.
Mono only 27/6

YOU GET 62/6 VALUE FOR 30/-

POST THIS ORDER FORM TODAY

To order, just write the NUMBER of the tapes selected in the appropriate box below. Enclose an additional 5/- for every 2 Track Stereo and 2/6 for every 4 Track Stereo ordered.

Insert
Tape No. here

RML ☐ **MONO**

2RSL ☐ **2 TRACK STEREO**

4RSL ☐ **4 TRACK STEREO**

Put an X in the square if you require

TAPECRAFT & SOUND ADVENTURE ☐

To : Esoteric Productions Limited
10 Wells Avenue, Southend on Sea, Essex

Please send to me, at the address given below, the tapes noted in the box at the side of this order. I enclose £..... which includes 1/6 postage and packing for each set ordered.

NAME .....

ADDRESS.....

.....

.....

EVERY TAPE UNCONDITIONALLY GUARANTEED

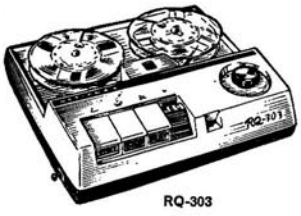
YOU SAID IT! (played it, sang it!) NATIONAL HAVE IT TAPED SUPERBLY!

Just say the word – and it starts! You stop, and the recording stops, too! The **National RQ-150** is the first completely automatic **Voice-operated** portable tape recorder in the world.

And this is only the beginning—the incomparably versatile RQ-150 also provides automatic slide and film synchronisation, automatic threading and remote control. If you really want to spread the word, there's a Public Address System that permits accurate monitoring through a built-in loudspeaker while recording. All this and *immaculate* reproduction—for precisely 44 gns!

SPECIFICATION

Power Source:	**6 unit cells (U.2.), 9 V.**
Output:	**500mW (700mW max.)**
Transistors:	**9 Transistors, 1 Thermistor, 1 Diode.**
Tape Speed:	**3¾ i.p.s., 1⅞ i.p.s.**
Frequency Response:	**100-7,000 c/s at 3¾ i.p.s., 100-4,000 c/s at 1⅞ i.p.s.**
Recording Level Indicator:	**VU meter.**
Speaker:	**3½" Permanent Dynamic Speaker.**
Dimensions:	**3¾" x 9" x 12¾".**
Weight:	**5 lb. 14½ oz.**
Accessories:	**Dynamic microphone with remote control switch; 5" recording tape (600 ft.); 5" empty reel; radio cord; leather case for accessories; hand belt; splicing tape; sensing tape; plug for slide sync.; magnetic earphone.**



RQ-303

Also from NATIONAL:

RQ-303, Mains, 2 track, single speed, 15 gns.

RQ-115, Battery*, 2 track, 2 speed, 35 gns.

RQ-116, Battery*, 4 track, 2 speed, 39 gns.

RS-753, Mains, Full stereo, 4 track, 2 speed, 76 gns.

**With optional mains adaptor available*


RQ-115 & RQ-116

National

TAPE IT EASY—

with **NATIONAL,** naturally!

UME 5-7658-100

tape recorder

INCORPORATING 'SOUND AND CINE'

EDITOR **MILES HENSLOW**

TECHNICAL EDITOR **JOHN CRABBE**

NEWS EDITOR **DAVID KIRK**

ADVERTISEMENT MANAGER **ROBIN WELLS**

Editorial and Advertising offices

LINK HOUSE, DINGWALL AVENUE, CROYDON, SURREY

Telephone MUNicipal 2599 (14 lines)

editorial

"IF I SPEND MONEY on a hobby I am an enthusiast." What truth is to be found in this statement? The answer is—very little. The tape recordist has more to *give* to his hobby than has his brother hi-fi enthusiast. He may have unlimited funds, like his brother, to pour into top quality equipment and accessories. He may have a multitude of recorders, shelves brimming with tapes, microphone cable by the mile, and a host of echo units, home-built mixers and acoustically treated walls. He may think of himself as being the last person to whom the label "I keep my recorder under the bed" could be attached. But how many tape recorder owners—the self-styled fanatics—in fact allow their talents and their equipment to progress further than the tape-correspondent's three-inch reel?

In the history of the various tape magazines, a considerable number of competitions have been launched for the recordist to enter. Far from setting the pattern for the latest competition—organised recently by a well-known tape manufacturer—of using the gimmicky "What is the baby saying?", they required genuine skill in the arts of making tape recordings. Some years ago this magazine used money and valuable space to entice the 'enthusiast' to 'enthuse', by offering substantial prizes in a recording competition. The few who entered could have had no idea how little genuine competition they were in fact to meet, and a ridiculously high percentage of entrants carried off the tape recorders, decks, battery portables and accessories offered.

As things stand, and they are no better now than they were in 1959, entrants to an amateur recording contest (if they have any creative ability at all) are using their recorders to 'print money'—or at any rate to win other tape recorders. Such is the apathy of even the most astute and well equipped recordist, recording contests receive very little support indeed. We recently heard the results of a contest held in the confines of an international tape exchange. Members were asked to submit a tape entitled "My Home Town", the most creative, in the opinion of the exchange organisers, winning a few spools of tape. The idea seemed a good one. No great prizes were at stake and opportunity for a little fireside fun or complex technical production was offered. Out of a membership of some 500 enthusiasts, made up from all nations of the world, *only one person bothered to enter*. These were not common-or-garden recorder owners, but genuine addicts, readers of technical literature, lovers of hi-fi music reproduction, and fireside sound builders—a more typical cross-section of the recording world it would be difficult to find.

The keenest of recordists is often that rare bird—the future enthusiast. At present he or she has nothing other than a single domestic tape recorder, a microphone and a recording lead. One day this person, unless the recorder vanishes under the bed in the generally approved manner, will become the keen reader of magazines, speaker of technical phrases and wielder of soldering irons—everything *except* a creative recordist. Those who have played with a recorder, taping plays from a magazine or drama publication, will know the pleasure to be had from hearing one's own creative efforts and those of others. These are the people who, if they tried, could beat the tired 'old hands' at their own game. What they lack in expensive equipment, they could more than make up in creative talent This, combined with some commonsense ability to handle a recorder, is the sole requirement for success in sound. Remember, when filling in the form entitled: *List of Equipment Used*, the more expensive and complex that equipment, the more points will be taken from your final total. Obviously, if **A** can make a tape with his £25 machine to the same standards as **B** with £90 worth of equipment, **A** will be considered, quite rightly, the better recordist of the two.

We are not, in this Editorial, trying to intimidate the much respected recordists who have been in the game since it began. Neither are we indulging in 'sour grapes' because of the *apparent* success achieved by a recent national competition with which we were not concerned. Like all other such events, its entrants were pathetically small in number, despite the grossly inflated press and radio hullabaloo. Our object here is simply to shake the cobwebs of apathy from the beaten brows of tape recording's founding fathers. This apathy, which is strangling the first generation of tape enthusiasts, must not be passed on to the second—remember the total of nearly two million recorders sold in this country; it is surely reasonable to hope that 20,000 owners (a mere 1%) might become creative users of their machines. This would be much more encouraging than the trifling 0.007% who seem to bother at present.

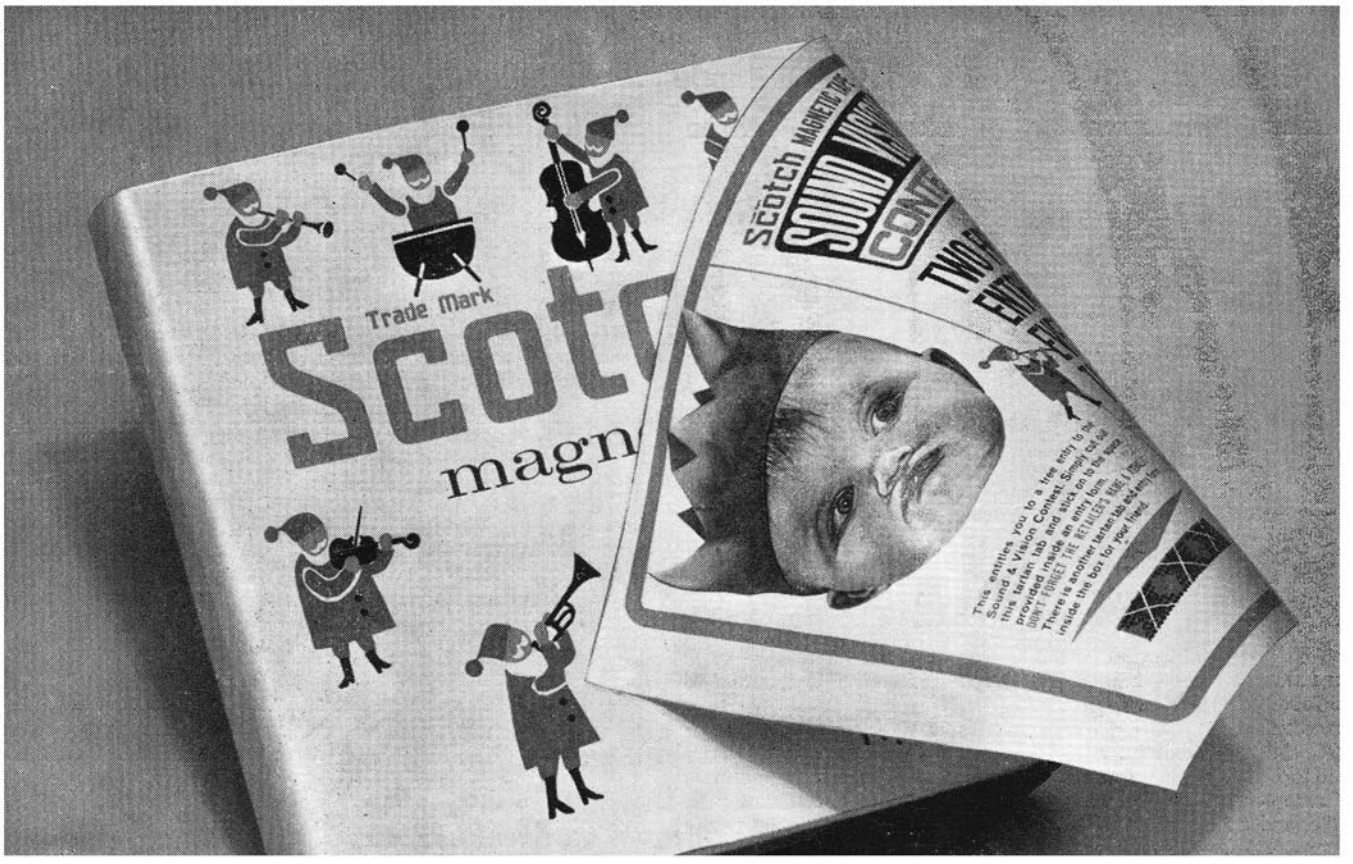
DECEMBER 1964 . VOLUME 6 . NUMBER 11

COVER PICTURE

Head alignment on the Thorn tape deck is accomplished by adjustment of two screws. This is just one of the many processes involved in the manufacture of a tape recorder. Details of the Thorn approach to mass production are given on page 450.

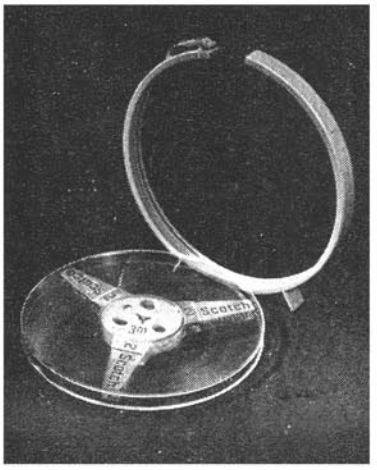
SUBSCRIPTION RATES

Annual subscription rates to *Tape Recorder* and its associated magazine *Hi-Fi News* are each 30s. in the U.K. and 32s. 6d. overseas (U.S.A. $4.50) from Link House Publications Ltd., Dingwall Avenue, Croydon, Surrey.



CHRISTMAS EXTRA

Gay gift-wraps with TWO FREE ENTRIES in the SCOTCH Magnetic Tape SOUND & VISION Contest



SELF-THREADING REEL AT COST PRICE

It's new. It's unique. It saves fumbling and ruined leaders. This SCOTCH Self-Threading Reel holds tape firmly but gently: threads up automatically when recorder starts. And it's yours for the bare cost of production when you buy a 7" Reel of SCOTCH *Superlife* Long Play Tape. Ask your dealer for full details.

They're in the shops now. Gay, gift-wrapped reels of SCOTCH Magnetic Tape. Each with two FREE entries for the exciting SCOTCH Magnetic Tape Sound and Vision Contest. Prizes include a £200 Hi-Fi outfit or set of photographic equipment, a Ferrograph Stereo Tape Recorder worth over £100 and 100 £5 gift vouchers. There's a valuable ***free gift*** too for *every* entrant. It's all a Christmas Present for you and your friends from 3M — makers of SCOTCH Magnetic Tape. Hurry along to your dealer while stocks last!

First with the new ideas

Scotch
MAGNETIC TAPES

3M

3M MINNESOTA MINING & MANUFACTURING CO. LTD., 3M HOUSE, WIGMORE ST., LONDON, W.1. HUNter 5522

world of tape

THE LONGEST LIST

CLOSE on 2,000 members are listed in the latest directory to be issued by *Voicespondence*. The organisation, which specialises in international tape correspondence, claims to be the largest recording club in the world. Names of ex-members are automatically dropped from the publication, despite which it is assuming the proportions of "a local telephone book". Annual membership fee is 17s. 6d. Further details are available from the U.K. Publicity Chairman : **Robert Coote, 27 Royal Oak Road, Bexleyheath, Kent.**

PORTABLE LANGUAGE LABORATORY

UNTIL recently importers of Bang & Olufson audio equipment, Aveley Electric, have developed a language laboratory using the B & O *Belcanto* recorder. The main object of a laboratory, namely independent development of each pupil according to his own speed of

learning, has apparently been lost in the process of reducing price, which is just over £320 but the system is still claimed to have advantages over normal classroom teaching.

Instead of a partitioned booth equipped with a twin channel recorder, microphone and headset, each pupil has a *Voice Flector*. This is a combined microphone and headphone device which overcomes the disadvantages inherent in the standard headphone, namely disregard of female hairstyles and the possible transmission of ear infections. The Voice Flector provides each student with an efficient acoustic screen from extraneous noise, without giving the complete isolation of earphones. Students can be connected, one at a time, to record on the Belcanto, or together to the output.

Manufacturer: Aveley Electric Ltd., South Ockendon, Essex.

AUDITION BY TAPE

AN attractive 22-year-old oboe player, Miss Mary Oliver, of Mount Vale Drive, York, has secured an appointment as principal oboe player of the Gaevle County Orchestra in Sweden, following a successful audition by tape recorder.

A former pupil of the Mill Mount Grammar School, York, Miss Oliver saw the post advertised in a newspaper. She sent a tape recording of her playing—and got the job, which began on September 1st. The Swedes are arranging accommodation for Miss Oliver and with the help of a friend from Hull University she has been studying the Swedish language.

"I think it is only right that one should try to learn the language although the conductor does speak English," she told our reporter. "Fortunately," Miss Oliver added with a smile, "music is international, so I have no fears on that score!"

After leaving Mill Mount School, Miss Oliver attended the Royal Academy of Music in London. More recently she was a specialist teacher of the oboe with the West Riding (Yorkshire) Education authority. She has played with the York Symphony Orchestra and has performed at lunchtime concerts at the Leeds Art Gallery.

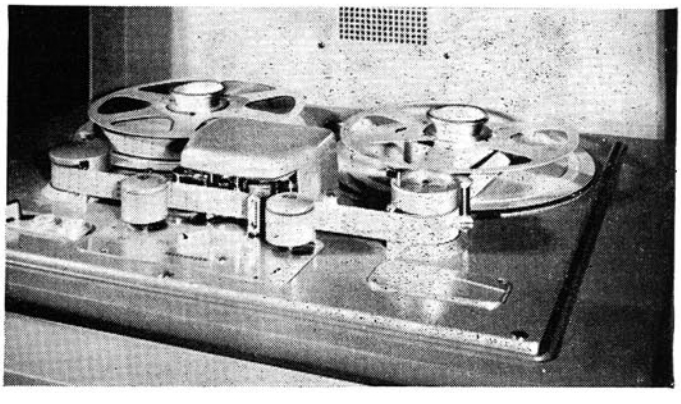
"Watch it do a ton!"

Most of the players in the Swedish Gaevle County Orchestra are young people and there are about 60 similar orchestras in Sweden. They have a very large repertoire and occasionally link up with other orchestras and choirs.

This may not be the first time that an attractive appointment has been secured on the strength of a tape recorded "interview" but for Miss Oliver the medium has certainly opened up an exciting and adventurous avenue of opportunity.

TAPING THE GAMES

TELEFUNKEN *Type M* 10 audio tape recorders became links between East and West during the recent Olympic games in Tokyo. Video recordings of the day's activities were produced and edited by the Japanese Television Service and flown overnight to the Eurovision Centre at Hamburg, via the North Pole. Recorded com-



mentaries accompanied the tapes, using ten of the M 10's twelve channels for each of the various European languages. The other two tracks contained the producer's instructions and signals for synchronising sound with video.

NEXT MONTH

THE January issue, to be published on December 15th, will include an article by A. Foord on the construction of an inexpensive, versatile eight-channel transistor mixer. Advice on how to produce 35mm. tape-slide programmes and reviews of the *Siemens Stereo* 14 and *Valradio* 12/80*B DC-AC* convertor will be given, together with the index to Vol. 6.

EVER READY HIGH POWER MEANS 4 TIMES MORE RECORDING PER BATTERY

This is the Ever Ready HP2 battery, one of the revolutionary new range of High Power batteries. At current drains of 300 mA in tape-recorders the HP2 has a working life over 4 times as long as that of the standard U2. HP batteries are extending the life and so the use of many types of battery-powered equipment from toys to photo-flash in the same way. Get full details from The Ever Ready Co (GB) Ltd., Hercules Place, Holloway, London N7. Telephone: ARChway 3030

EVER READY

for longer life!

THIS NEW SERIES is intended for the enthusiast who enjoys producing plays on tape.

Each instalment comprises an acting script with appended technical notes. Suggested voice-positions are indicated in square brackets. All the plays can be produced on any tape recorder and in any sitting-room.

The series is written for adults, but the first play is essentially for the novice. It takes place in a simple, easily-visualised location—with straightforward sound-effects. Although primarily a solo for one talented actor, the play contains no less than twenty-four additional voices. This apparently enormous cast is a deliberate feature: it demonstrates the basic voice-positions.

As few as two persons (even one person) can create all these crowd-voices; they (or he) merely moves from one position to another for each line of dialogue.

Naturally, this latter method tends to create an impression of one-voice-one-bid—an unlikely situation at an auction. This academic point is of no immediate interest to the novice; he can achieve a crowd by quite haphazard means. But experienced producers should group their available cast into units of three, allotting a voice-number to each actor. During the recording, the tape is halted to allow any necessary re-grouping. The crowd is thus built stage-by-stage, ensuring a scale of repetitive and isolated voices. Indeed, a unit of three actors can form any-sized crowd; results are comparable to using the "cast of thousands" from a Hollywood epic.

Future plays will progressively exploit the technical elements of the medium. Any amateur wishing to study a simple explanation of theory should consult the Focal Press *Dramatape Guide*.

The First of a Series of Short Plays for Tape Recording

THE AUCTIONEER

BY DAVID HAINES

TECHNICAL NOTES

Perspective

Note that the auctioneer is 'nearest' the listener (i.e., closest to the microphone). The public should call their bids from sharply-contrasted positions.

Acoustics

The auction-room acoustic is achieved by recording in any medium-sized (preferably empty) room.

Sound-effects

The rustle of catalogues, shuffling of feet, isolated coughing—these assist 'atmosphere' but should not be overdone.

The shattering jug should be emphatic. It can be produced by snapping a brittle piece of wood and instantly tossing a handful of old crockery into a wooden box. Note that it is a 'distant' sound.

The production can be rounded off by fading in suitable music (e.g., baroque). Alternatively, an indignant murmur from the crowd can be introduced—followed by a fade-out.

ANNOUNCER: We present a short play entitled *The Auctioneer*. (Fade in. Scene: auction-room.)

AUCTIONEER: [*close-mike*] . . . and now, ladies and gentlemen—lot number sixteen. Let's look at the catalogue. (*Quoting rapidly*) "An eighteenth century Toby jug, eleven inches in height, representing a corpulent English gentleman. Blue coat, yellow breeches, white stockings, buckled shoes and tri-corn hat . . . " Hold it up high, Stanley—let everyone see it. No, give it to me—I can display it better. Pass it up to the rostrum . . . (*as if reaching with effort*). That's it . . . Here we are, then—one Toby jug. Let's start at a realistic figure. Will anyone bid fifteen shillings? (*pause*) Don't all look so shocked. Surely it's worth fifteen bob? Come on, someone . . .

1st VOICE: [*very distant*] I bid one hundred pounds!

AUCTIONEER: (*astonished*) As much as that? I'd no idea. (*hastily*) One hundred pounds I am bid by the gentleman at the back. Let's try another fifty out of sheer audacity. Are you bidding, Madam—or just having a good scratch? You *are* bidding? Good; that's one-fifty from the lady on my left. Anyone like to try two-hundred?

2nd VOICE: [*near*] Two-fifty!

3rd VOICE: [*distant*] Two-seventy!

4th VOICE: [*very distant*] Three hundred!

AUCTIONEER: Well, well, well . . . It's surprising what people do pay for antiques. Three hundred pounds I am bid.

5th VOICE: [*distant*] Guineas! I bid guineas!

AUCTIONEER: Listen to that—three hundred guineas for one jug. Let's try three-twenty-five.

6th VOICE: [*near*] Three-thirty.

7th VOICE: [*distant*] Three-thirty-five.

AUCTIONEER: Three-thirty-five from the gentleman on my right. It beats me how people can afford so much money. Let's try three-forty.

8th VOICE: [*near*] Three-forty-five.

9th VOICE: [*very distant*] Three-fifty!

AUCTIONEER: Do you know how much I earn per week? Next to nothing compared with you, I bet. Who wants to try three-seventy?

10th VOICE: [*distant*] Three-eighty.

11th VOICE: [*very distant*] Four hundred!

AUCTIONEER: Four hundred guineas? For a piece of second-hand crockery? I haven't managed to save that much money in my whole life.

12th VOICE: [*near*] Four-twenty-five.

AUCTIONEER: [*musingly*] Do you know what I'd do if I had that much money?

13th VOICE: [*very distant*] Four-thirty-five.

AUCTIONEER: I wouldn't waste it on a thing like this. I could go on a cruise . . .

14th VOICE: [*distant*] Four-fifty!

AUCTIONEER: I could have my house decorated while I was away . . .

15th VOICE: [*very distant*] Five hundred!

AUCTIONEER: (*coming-to, sighing*) All right, five hundred guineas I am bid. (*angrily*) Which is just a drop in the bucket as far as you're concerned! You come driving up to the auction in your swagger motor-cars . . .

16th VOICE: [*near*] Five-twenty-five.

AUCTIONEER: Money no object! All you've got to do is to write a cheque with your gold-topped fountain-pens.

17th VOICE: [*distant*] Five-fifty.

AUCTIONEER: I haven't even *got* a bank account . . .

18th VOICE: [*very distant*] Five-seventy-five.

AUCTIONEER: Just a post-office savings book. And hardly anything in it—after a lifetime of hard work!

19th VOICE: [*distant*] Five-ninety-five.

(*continued on page* 457)

the heart of a very good, very reliable tape recorder

THORN Mk.II TAPE DECK

Only the Thorn Mk.II tape deck gives you all these many extra features!

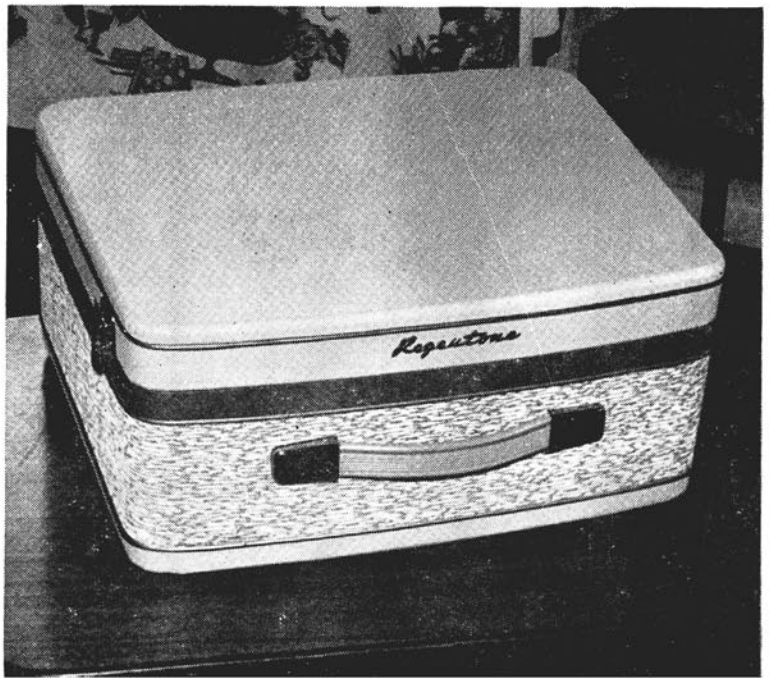
The Thorn Mark II tape deck is an all-British built and designed piece of equipment *incorporating more exclusive recording features than are to be found in any other similarly priced tape deck.*

✔ Piano key controls	✔ Pause control	✔ Reel diameter 5¾"
✔ Tape 'inching' facilities	✔ Track selector push buttons	✔ Audio output power: 3 watts
✔ Fast spooling in both directions	✔ 'Playthrough'/superimpose button	✔ Remote control button microphone
✔ Four track, two speeds:— 3¾" per sec; 1⅞" per sec	✔ Press-button reset for tape position indicator	✔ Automatic stop operates at both ends of tape
✔ Electron beam recording interlocked with tape motion keys	✔ Microphone input (on deck cover), radio input, pickup input. Output to radio, amplifier or external loudspeaker (internal loudspeaker automatically muted)	

Thorn Mark II tape deck now incorporated in all tape recorders under the brand names

FERGUSON "HIS MASTER'S VOICE" Marconiphone ULTRA

THORN ELECTRICAL INDUSTRIES LIMITED, THORN HOUSE UPPER SAINT MARTIN'S LANE, LONDON, W.C.2



A CHEAP FACE-LIFTING TECHNIQUE FOR THE AMATEUR

new attire for tawdry tape recorders

BY E. CORNWELL

A WIDENING field of popularity has resulted in the 'novelty-worn' and 'cover-torn' tape-recorder being taken down from its place on the shelf and viewed with renewed interest.

Torn and dirty covers, just like renewed interest, can be quickly and easily revived with a minimum of financial outlay. It was the delapidated condition of my own tape-recorder that sponsored the successful attempt that resulted in the 'spanking new' appearance of my *Regentone T.R.* 51 (see photo.)

Such a proposition was sponsored by my accidental discovery that the gold plastic beading lifted quite easily. My enquiring mind was rewarded with the discovery that the beading was held in the rebated slot around the tape-recorder by its own pressure. I also noticed that the rather shoddy cover of my recorder had its termination in the same slot. Closer examination revealed that it would be quite easy to strip it, section by section.

IRONED FLAT

Having been freed and spread out, and ironed flat, it was pinned at its edges with drawing-pins over a piece of the new material (two yards of pale blue *Rexine* was purchased for the purpose—it costs 6s. to 10s. per yard) and its outline transferred with a ball-point pen. As the corners were of a rounded shape I realised that tucking would be a problem if the corners were not copied and cut faithfully. A *Stanley* knife and a pair of sharp scissors ensured the clean cut (see diagram).

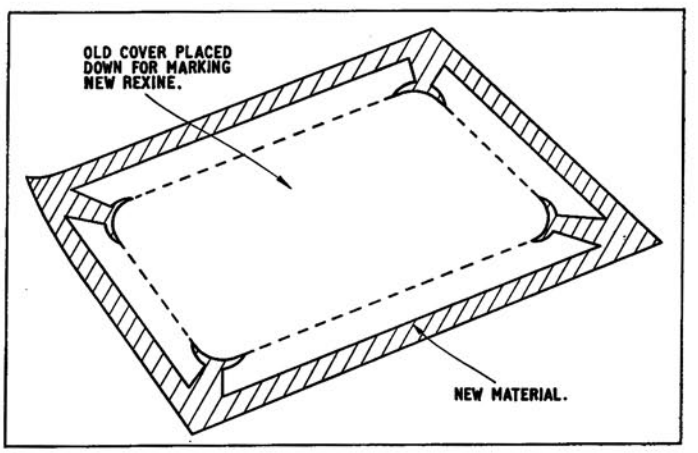
The exposed woodwork of the recorder was sanded, to clean off the remnants of the adhesive previously used to stick the cover to the casing, and dusted. Sanding also served to key the surface for the *Evo-stik* that was subsequently spread thinly over the surface. Only the woodwork was thus coated ; the Rexine was placed on after five minutes, in its correct position—equal overlap all round—and smoothed into position with a large duster.

The remainder of the cabinet was covered in the same way, with careful stripping, ironing, pinning, tracing and cutting. However, some of the fittings, such as hasps and hinges on the lid, and plastic feet from the bottom, were removed first.

The overlap, after tucking, was glued into the beading rebate and trimmed clean inside the groove with a Stanley knife. Modern adhesives allow for this immediate treatment.

When all areas had been covered and trimmed the gold beading was replaced and pressed firmly into position, it tightened the rexine's loose edges as it found its depth.

I was both surprised and pleased with the results of my amateur handiwork when, finally, the brass fittings had been replaced. The whole job had taken little time indeed, some confidence and about 15s. outlay. The professional-looking change appeared as good—to myself, better—as a brand new tape-recorder.



newhaven tape saga

A VISIT TO THE THORN RECORDER FACTORY

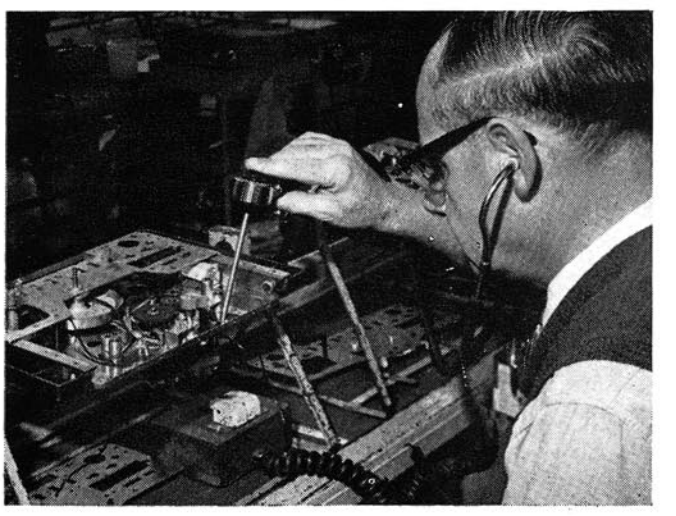
FOLLOWING an invitation to visit the newly-built *Thorn* factory, we found ourselves, in the company of other journalists, travelling on the 9.45 from Victoria to Newhaven.

Ferguson, HMV, Marconiphone and *Ultra* brands are in production at what is claimed to be the largest works of its kind in the Commonwealth. Several thousand recorders are manufactured each week, many of which are exported to Europe and other parts of the world.

It is estimated that some 500,000 tape recorders were sold in Britain during 1963 (excluding very cheap imported 'toy' recorders), and a considerable proportion of these were made on the continent. Thorn are the *only* British firm to have challenged, by means of a home-designed integrated domestic tape recorder, the Dutch, German and Danish manufacturers in their efforts to dominate the market in this country.

The difference between an integrated recorder and straightforward tape deck/amplifier combination was found to be superior finish, freedom from design inhibitions, and lower production costs. Prior to August 1961, when development of the Thorn tape deck first began, some 18,000 BSR be-decked recorders were sold under the Group names. This was small indeed compared with their sales of television receivers, which they claim are higher than those of any other British manufacturer. In accordance with the policy of manufacturing as many components as possible for use in Thorn products, the new deck was seen as an ideal advancement into the recording field.

Right: *The Thorn works, largest tape recorder production plant in the Commonwealth.*



Below : *A tuned industrial stethoscope is used to check for mechanical vibration.*

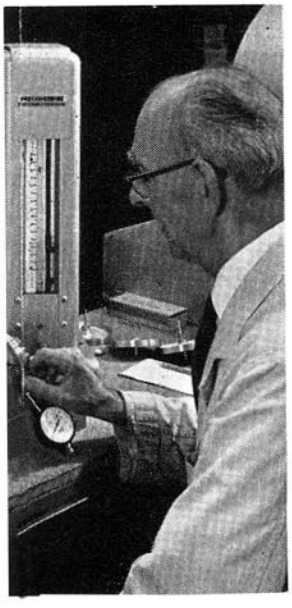
It took Dave Charlesworth (chief engineer of the Newhaven plant) and his colleagues 18 months to design and perfect the original deck. Mechanical facilities were predetermined as being : piano key operation for simplicity ; foolproof straight-line tape threading ; pause control ; fast-acting automatic stop ; and a push-button revolution counter. The *FTD*4 deck incorporated all these features and was the basis of all recorders produced by the group during 1963. Later came the *DB*21 and *DB*42 versions which are used in all current Thorn models. The three decks were mechanically similar, but the *DB*42 left the 3¾ i/s ½-track specification to give a choice of 1⅞ i/s and ¼-track scanning.

Many problems were experienced in designing the prototype. A motor was developed in collaboration with *EMI* which would work efficiently without generating excessive heat. A compromise was made between high efficiency (which meant low temperature but strong hum fields) and low efficiency (with consequent high temperature but little magnetic dissipation).

Tape heads, made to their own design, were produced for Thorn by an outside company. The high standards required could not, however, be maintained, so it was reluctantly decided to incorporate an outside manufacturer's design. Eventually the initial difficulties

Left : *General view of factory floor. Note production lines in the background.*

Below : *One of the latest Marconiphone recorders incorporating the Thorn deck.*



Left : *Testing the flywheel for cutting accuracy and balance.*

Below : *Speed fluctuations being measured on a Gaumont Kalee flutter-meter.*

were overcome and a hundred 'pilot' decks were made. These were subjected to many tests for reliability and performance.

An original feature of the deck was remote on-off switching. This did not follow the pattern—adopted by several other firms—of merely cutting off the motor current, but allowed for complete retraction of the idler and pinch mechanism. By using a switch on the microphone the operator could therefore turn his machine on and off without ruining the speed consistency.

Improvements in the motor windings and auto-stop solenoid were made in the *Phase Two* deck, introduced in October 1963. The solenoid is surprisingly small for the task it performs (operating an entire deck mechanism) but a large force is provided without risk of burned coils by giving a high current 'kick' from a charged capacitor and retaining the solenoid in an 'on' position with a much lower current.

It is sad to note that, although the deck provided facilities for add-on slide synchronising devices, voice relays, stereo pre-amplifiers and time switches, no interest was shown in them by the public. Developments in this field were therefore halted, though provision was made for the connection of other manufacturers' accessories, and leaflets advising buyers of their existence included with every recorder sold.

We were informed that some 40% of the output from Newhaven is exported. Not a little difficulty is being experienced in conforming to the stringent (possibly *over*-stringent) safety standards required by some countries. Canada and Scandinavia rate as the most difficult markets to enter, the former demanding that only certain brands of wire may be used to connect components. Thorn are thus forced to import Canadian wire for use in equipment sold to that country! The Scandinavians are even more 'safety-minded', requiring a multitude of fuses in various parts of the circuit and complete freedom from danger to searching fingers.

Certain countries will not permit the import of *any* complete foreign recorder, making it necessary to sell separately assembled decks, amplifiers and cabinets. The Thorn group are particularly proud of the sales figures of decks to Germany, though we know of no German recorders yet using them. Being literally within a stone's throw of Newhaven Docks, the factory is as conveniently situated as many Continental works, when it comes to transporting equipment to Europe.

Mass production techniques are far from being a new innovation, but they can hardly be perfected further than has been done at Newhaven. Automation of printed-circuit soldering is one of the fascinating processes that must be seen to be believed. Before its short journey along the assembly line, the recorder consists of several boxes of mechanical components, and a selection of printed-circuit boards. The record-playback amplifier components (less valves) are assembled on a board which is passed through heated flux (sprayed from below) and skimmed across a flowing bath of molten solder. The vertical distance between board and solder is so arranged that only the component wires poking through the bottom of the board are coated. Dry joints are said to be reduced to one in ten thousand.

Bushes of connecting wires sprout from one of the many component containers situated around the production line. These cables are strung together as a unit on a wooden board on which are painted the wire positions and lengths. Almost every electrical connection between switches, motor, printed circuit boards and transformers is made through this array of cables.

Mechanical assembly begins with the fitting of brackets to the deck. Elsewhere the pressure-pad assembly is being glued and pressed into existence. This comprises a small felt rectangle which is stuck on to a metal 'horse-shoe' spring. The spring is pushed through two apertures in a mu-metal plate which is locked against the front of the head, immediately behind the tape, and effectively eliminates hum pick-up through the head gap during recording and playback. The heads themselves are made of mild steel, but the noise-level is estimated as only 1dB worse than when the entire head casing is of mu-metal.

Another part of the mechanical preparation stage is the grinding of idler wheels, which is done on a special lathe. The capstan, too, is subjected to much careful grinding, and is measured around the flywheel rim to within 0.1 thou. tolerance. Should an idler or capstan appear defective, it is destroyed. The deck will be submitted to a wow and flutter test at a later stage and should it not measure up to standard, it will be stripped down and repaired. Due to the high quality of the casting, the flywheel has a tendency to ring, which would prove disastrous in an otherwise silent tape transport. For this

(continued overleaf)

reason, a *fungus resistant* cardboard wheel is glued to the lower surface to provide acoustic damping.

While the capstan is subjected to careful measurement, the idler requires a more subtle test. Due to the variable density of some rubber materials, imperfections in the idler composition can lead to vibration and noisy drive transmission from motor to flywheel. Each idler is tested for silent running in a special drive system which is acoustically insulated, to some extent, by a head-and-shoulders listening booth.

At this point, the various sub-assembled components begin their journey along the production line, transported by a slow-moving endless belt. Each assembler has one specific task to do, starting with the mounting of a chassis plate on to a rotating rack. This rack is shown fairly clearly in our cover picture and supports the recorder until it is ready for mounting in a wooden cabinet.

Creeping along to the next assembler, the chassis is fitted with a tape drive wheel and pulley, and, at the next stage, with a motor. Steadily and methodically the transport system is born, culminating with the insertion of a flywheel. This section of the assembly line is deliberately adjacent to the flywheel testing bench, so minimising risk of damage to the wheels during their transition to the line.

With the deck complete down to its tough plastic press-tabs, a head unit is fitted and the track selector wired. This selector is a concrete example of the thought put into designing the deck: it is deliberately located close to the heads to avoid long connecting leads which might lower the signal-to-noise ratio.

Horizontal and vertical head alignment is the next stage, carried out with external amplifiers and test equipment. A ¼-track test tape is played from the heads to produce an audible tone in two loudspeakers positioned to give a 'stereo' effect, with each speaker relaying one of two tracks scanned by the head. The tracks on the tape being recorded at a standard azimuth, it is necessary only to set for maximum volume through each speaker for correct positioning.

Passing further along the line, each deck is subjected to a simple test of the various functions. This means threading a tape and operating every function of each deck. Never have we seen such dexterity as was shown by a female inspector whose lightning fingers threaded the tape and operated the machines so quickly that we were put to shame!

Now comes the wow and flutter test, carried out on a *Gaumont-Kalee* flutter-meter. Every machine must meet a certain standard, inclusive of vibration caused by the moving belt. Should a fault show up on this or the previous test, the recorder is removed from the production line and overhauled. Having now travelled the full length of the first assembly line, the completed decks are moved to a second line to be fitted with pre-wired circuit boards. Some of the decks, however, will be sold as they are, and are removed from their metal 'cradles' and stored in racks.

With the record-playback amplifier and sub-circuitry already wired, the assembly procedure becomes the simple one of clipping circuit-boards to the deck and soldering them in position. In the space of a few minutes the completed recorder, less cabinet, vanishes through a short tunnel into a small sound-proofed booth where it is tested carefully on all its functions, free from the noise of the factory floor, before rolling into the cabinet section.

The Thorn cabinet is rather more than a wooden box. It is coated internally with graphite which is subsequently connected to the earthed chassis to give a fairly efficient screen from stray electric hum fields. Several styles of cabinet and deck cover are used, one for each brand.

One by one, the completed recorders roll towards the packing department, the racks on which they were made returning to the beginning of the assembly line. One machine in twenty, however, has still to face further close examination, while 1% of all recorders manufactured are given exhaustive tests for amplifier characteristics and mechanical performance in yet another well-equipped sound-proofed booth. Should any unsatisfactory machine be found, as they occasionally are, the entire line is halted until the fault has been located and corrected.

The designers and assemblers at the Thorn plant have every reason to be proud of their products, and have much to teach their British rivals in the arts of efficient working in a friendly atmosphere. Continental methods have been adapted to suit home needs, resulting in one of the most competently-built British tape recorders ever to adorn the domestic market.

some thoughts on guarantees

BY MARTIN YORK

SAM Goldwyn is reported to have said, "A verbal agreement is not worth the paper it's written on". This is possibly the reason why a manufacturer's guarantee became a feature of our daily life. The document itself, however, while protecting a buyer from major losses, falls far short of the ideal in the case of minor inconveniences.

Much has been written in these pages about the customer/dealer relationship. Customers complain of indifference ; dealers wave the flag of "legal responsibility"—and, in the background, stands the manufacturer. Shielded from the rude buffeting of commerce, he righteously proclaims that his goods are *guaranteed* and that he is willing—nay, eager—to demonstrate his integrity by backing up that guarantee to the hilt. A very satisfactory state of affairs—for the manufacturer.

I take the old-fashioned view that if a man pays fifty or a hundred pounds for a machine he is entitled to expect that it will perform like "the picture on the packet", and will do so at the time he wants it to.

Any device which is imperfect is a reflection on its manufacturer. To forestall the storm of protest which that statement will bring forth, let it be admitted right away that there are bound to be genuine faults of material, errors in construction and weaknesses in test schedules ; it would indeed be naive to pretend otherwise. But, as I hope to show, there are too many avoidable defects, and whatever the legal rights, the sufferer is always the customer—the very person who, having paid good money, is entitled to expect something in return.

Let us examine the case of Adam Bryant—true in all except names —who paid something approaching sixty pounds in cash to a reputable dealer for a *P*...., a model which had been long enough established to have had any design faults ironed out. Very highly spoken of by the enthusiasts, it looked good, sounded good and appeared to be a very satisfactory tape recorder. It transpired, however, that somewhere in the input side was a defect which caused a considerable 'crackle' in the recording. Playback was perfect—crackle included ! So, back to the dealer went Adam. A five-mile bus journey.

The dealer was very nice about it. After a few days delay, during which his service department was unable to trace the fault, he provided Adam with a *Q*.... machine, costing four guineas more, without extra charge. This one made perfect recordings, but the tapes had to be played back on another machine, since the *Q*.... had a fault in the output stage. Back to the dealer again !

The dealer tut-tutted, sympathised, but had just received the newest model in the *P*.... range—straight from the Audio Fair. Ten guineas more than the first one, but let's keep the customer happy. Write off the extra as compensation for the five-mile 'bus journeys, and for the couple of weeks' delay.

So they all lived happily ever after ? Alas, no.

The latter *P*.... had an excessively tight nut on the brake to the left-hand spool, with the inevitable result on fast-wind (triple-play tape, too !). However, Adam wasn't going to complain over such an easily rectified fault. Let's try a recording. Oh, dear ! It's that crackle again. Adam thinks of buying a season ticket on the bus.

Try an entirely different make—the *R*.... Lovely machine—performed perfectly for nearly two hours before the magic eye went on strike.

Try a new *R*...., still sealed in the maker's carton. Excellent, except that after ten minutes recording the sound fades to zero. True, it comes back after a few seconds, but it plays havoc with classical music.

Adam now has a machine of yet another make, the *S*...., and is thoroughly satisfied at last. Still ten guineas more than the original, but at no extra cost to him.

The manufacturers of the faulty machines will doubtless reply with perfect truth that if they had been returned under guarantee, they would have been corrected at no cost to either the dealer or the customer—provided that *somebody* paid the cost of carriage, and that the customer did not mind waiting a few weeks (and let's be honest, some manufacturers' service departments are less than prompt—no doubt for the very best of reasons).

There may be objections, although they escape me, to the simple solution which suggests itself. Is it too much to ask that manufacturers should indemnify authorised dealers against service work necessary to rectify faults in new machines, or to authorise the replacement of a faulty machine with a new item from stock ? Surely this would relieve the customer of inconvenience, expense and delay, and put the onus where it belongs—on the shoulders of those whose poor work (or genuine error, or sloppy testing) allowed the machine to be delivered in an imperfect state. This might have the effect of ensuring a more thorough system of factory testing.

Finally, a thinking point : what would happen to the dealer's good-will if he had sold all those five machines to the members of one group ?

our readers write . . .

. . . about active recording

From : John Hone, 10 Aldbourne Road, London, W.12.

DEAR SIR, I feel I must write and defend contributor Mr. Finlayson after reading the sarcastic letter from Gordon Rimmer.

I wonder if Mr. Rimmer is an *active* recording enthusiast and if he has, in fact, ever bothered to try the difficult task of recording a piano backwards—or even forwards, for that matter.

I recorded a backward piano accompaniment to my forward solo piano playing and obtained a quite realistic *organ* and piano duet.

I also used the pseudo-organ effect as a background to a humorous feature tape. I certainly hope that Mr. Rimmer never visits the BBC Radiophonic Workshop ; he would most certainly consider them a collection of idiots performing a useless job!

Yours faithfully.

. . . about carets and hats

From : J. G. D. Pratt, 4 Branstone Road, Kew Gardens, Richmond, Surrey.

DEAR SIR, I have just noticed that Mr. Robinson is in need of a succinct mark for the peak programme meter on his mixer, to show that the reading refers to the greater of A and B. The *caret*, or "exlusive or" A∧B means either A or B but not both ; this, however, does not explain that the signal chosen is the greater of the two. An added "hat" (which means "the greatest value of") nearly puts things right—A∧B.

Probably the caret alone is good enough. Unfortunately, if anyone is determined to misunderstand the marking, they can point out that a caret also symbolises vector multiplication in vector algebra—and vector multiplication is a far worse howler than a mere + ! The hat also has a variety of meanings in other branches of mathematics, but none is quite so devastatingly wrong as vector multiplication.

Yours faithfully.

Agfa tape is specially made to take all the knocks and wear of constant playing. The magnetic emulsion is *bonded* to the polyester base – for good. Heads stay clean and free from iron oxide deposits. That's why you'll get the most consistently perfect reproduction you've ever heard. Agfa tape is *really* special (yet it's the same price as ordinary tape).

One thing Sir Lancelot can't resist is Magneton Illustrated – our colour magazine, all about recording – and you don't have to enter the lists to get a copy – they're free. Write to Agfa Ltd. 27 Regent Street, London, S.W.1. (REGent 8581). *Agfa PE Recording Tapes, Long-play, Double-play, Triple-play are available in shatter-proof plastic cassettes (5", 5¾" and 7" spools).*

Agfa tape
is
extra tough

Agfa®

Products of Agfa-Gevaert AG

TOWARDS BETTER TAPING

PART 9 - MIXER MATCHING AND EQUALISING

BY GORDON J. KING

LAST month we saw that a good signal/noise ratio is obtained by keeping the wanted signal at the highest possible level at the input of the recorder and arranging for the circuits themselves to produce the smallest possible noise signal. From the mixer angle, this means arranging for each low-level channel to be fed straight into an amplifier and then mixing *after* initial amplification in some kind of passive fader network, depending upon the actual requirements.

After the mixing process has been accomplished, network-wise, the composite signal is usually fed into a buffer amplifier, the output of which may be at medium impedance to allow the use of reasonably long inter-connecting cables. Low and medium impedance signal-carrying cables are less susceptible to hum and noise pick-up than similar cables operating into high impedance circuits. Hence the desirability of converting to medium or low impedance when the cable run is likely to be greater than a couple of yards or so.

A medium impedance circuit can usually be applied to a high impedance microphone or RADIO tape recorder input (**fig. 1 (a)**) without undue ill effect to the frequency response of the signal on that circuit. From this angle, the major trouble occurs when a high impedance crystal microphone is fed *into* a medium or low impedance circuit, for then serious attenuation of the lower frequencies arises. The only solution to this problem is to step up the impedance of the input circuit as seen by the microphone, but, unfortunately, this action introduces a loss between the microphone and the input circuit due to the necessary attenuator network, and the *overall* gain of a simple amplifier may be converted into a loss (**fig. 1 (c)**). Indeed, many impedance-converting circuits, even though employing valves or transistors, rarely themselves provide gain. Some may have what is called 'unity gain', which means neither gain nor loss! The gain of the valve or transistor employed is neutralised by the insertion loss of the impedance matching network.

Many mixers directed to the enthusiast feature unbalanced input and output circuits. These have been known to bewilder the beginner, especially so far as the microphone connections are concerned. Low impedance ribbon and moving-coil microphones often incorporate a screened (braided) cable having *two* inner conductors, one coloured white or red and the other black. When connecting these to an unbalanced circuit, the red or white wire should be connected to the tip of the jack plug while the black wire, along with the braided outer conductor, should be connected to the body of the plug.

If, for reasons of hum or other interference pick-up, a balanced input circuit is essential, a special balanced-to-unbalanced matching transformer should be employed. Such a device is often called a *balun*, for short (**fig. 1 (d)**). The same reasoning applies to the mixer output circuit.

While the low-level channels of a mixer may each feature an input amplifier, the high-level channel may feed direct to the fader control network, without pre-amplification. This is possible, of course, because at high-level the signal/noise ratio problem is greatly minimised, as we saw last month, and the loss the signal undergoes in the mixer network is restored after the faders, when the composite signal is amplified (and impedance converted) in the buffer amplifier section.

Moreover, a high-level signal applied to a low-level amplifier could result in overloading and consequent distortion, for remember there may be no gain control or attenuator in the input circuit (a gain control here would, of course, detract from the signal/noise ratio), so even by decreasing the setting of the appropriate fader control the overload condition would remain, in spite of the mixer output on that channel being reduced.

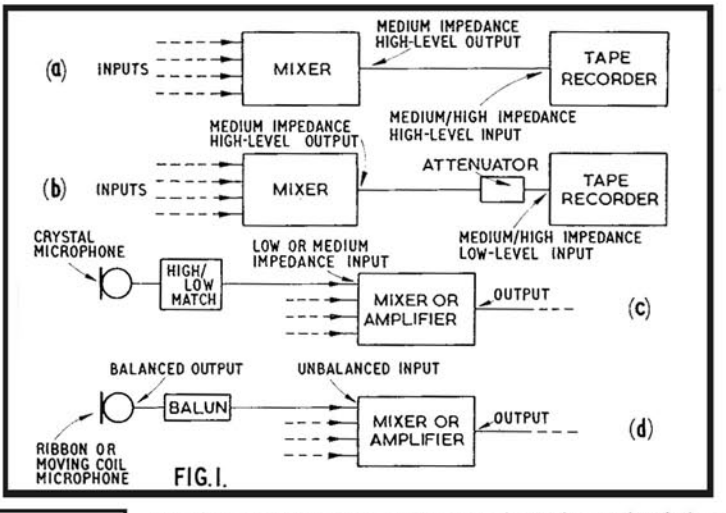


FIG. 1.

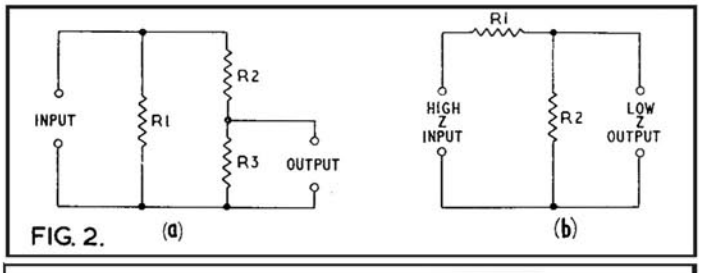


FIG. 2.

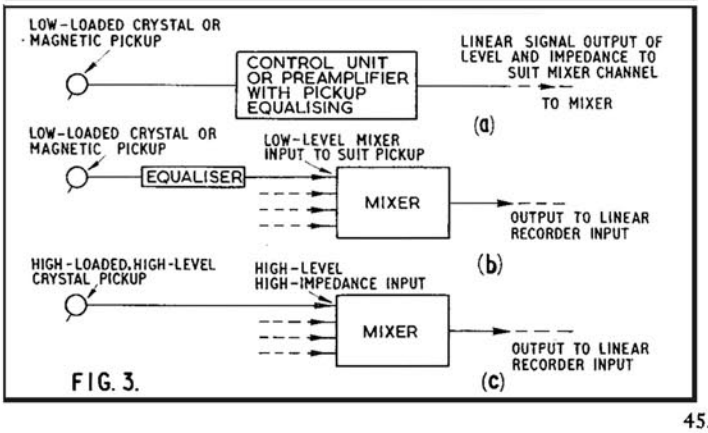


FIG. 3.

Recorders with a high-level input circuit can accommodate the mixer signal without any trouble, but those without such an input must employ an attenuator between the mixer output and the microphone input socket on the recorder, if this happens to be the only input available—which is unlikely (**fig. 1 (b)**).

On no account, however should the output signal from a mixer be fed direct into a *low impedance* microphone tape recorder input, whether through an attenuator or not. This is mainly because the microphone transformer used in the recorder and the associated circuits are tailored to suit a signal direct from a microphone and not normally from an electronic circuit or amplifier.

However, if the tape recorder has a 600-ohm impedance input socket, then it is permissible for a mixer signal to be applied direct to this, provided, of course, that the mixer output is of medium impedance.

The points detailed above are illustrated in **fig. 1**, while **fig. 2** shows at (**a**) an attenuator for condition **1** (**b**) and at (**b**) a high/low matching arrangement for condition **1** (**c**).

There is one further point, and that is the mixer signal should always be applied to an input circuit whose frequency characteristics are linear. The mixer output is, of course, linear.

If this linear output were applied, say, to an equalised input, then

(continued overleaf)

the overall response of the system would be badly affected. This would happen if the mixer output were applied to, say, an equalised pick-up or tape head input circuit.

It often happens, of course, that signals in addition to those from microphones need to be applied to one of the mixer input channels. This is demanded when music and sound-effects (probably from tape or from a sound-effects disc) need to be mixed with speech to create a composite signal for recording on to tape.

Thus, eventually, the enthusiast finds a need to apply to the mixer the output from either a second tape recorder or a gramophone pick-up, along with the signals applied to the other channels.

There are two ways of handling this requirement. One is that the pick-up signal can be extracted from a point in a gramophone amplifier or hi-fi control unit *after* the signal has undergone an equalising process, and where the level of the signal is suitable for direct application to the mixer. The other is to connect the pick-up direct to the mixer without any amplification.

THE SECOND METHOD

Let us look initially at the second method. Suppose that the mixer we are using has a high impedance, high-level, feature on one of its channels. We could then apply to this input the signal direct from a *crystal* pick-up, and provided the mixer input impedance is sufficiently high to avoid bass attenuation and the pick-up output sufficiently high to give full modulation within the range of the fader control, all will be well and a reasonable recording (mixed as required) would be obtained from the pick-up signal (**fig. 3 (c)**).

Unfortunately, however, the high impedance mixer input may not be sufficiently sensitive to accept a pick-up signal direct, in which case some form of pre-amplification would be required, such as given by the first stages of a control unit (the first method, **fig. 3 (a)**).

There is another angle on this, and that is *equalisation* of the pick-up signal. If the output is taken from a pre-amplifier or hi-fi control unit designed with pick-up equalisation, then the output signal, as applied to the mixer channel, would be linear, and all would be well. However, if a pick-up signal is applied direct to one of the mixer channels, there would be no equalisation, and since the mixer output would be connected to a linear input on the tape recorder the pick-up material would be recorded with excessive treble and very little bass! This troubles many enthusiasts endeavouring to tape gramophone records for the first time.

Some pick-ups, such as the crystal and ceramic variety, require no equalisation, provided they are coupled into a suitably high impedance circuit—see **fig. 3 (c)**. Such a pick-up, then, could be fed straight into the mixer, provided the other requirements as already mentioned are satisfied.

CRYSTAL AND LOW IMPEDANCE

A crystal or ceramic pick-up fed into a medium impedance (50,000 ohms or thereabouts) input circuit gives an output which resembles that from an electromagnetic type of pick-up, and thus requires equalising. Equalising for a 'low-loaded' crystal or magnetic type of pick-up, therefore, must be accommodated between the pick-up and the mixer should it be decided to feed the pick-up signal direct to the mixer (**fig. 3 (b)**).

Normally, though, the output from low-loaded crystals and quality magnetic pick-ups is insufficient for applying direct to a mixer input, and this is further aggravated by the employment of an equaliser directly following such a pick-up, since such an equaliser has an insertion loss.

The first method of feeding a pick-up signal into a mixer is thus usually adopted. That is, first apply the pick-up signal to an equalised pre-amplifier or hi-fi type control unit, and feed the equalised output from this to a mixer input channel (**fig. 3 (a)**.) The other two conditions discussed are revealed in **(b)** and **(c)**.

Where an equalised pre-amplifier is adopted, equalisation to the RIAA characteristics is preferred. The amplifier output will then be linear and suitable, at least, for the response characteristics of the mixer (or, indeed, of the AUXILIARY, RADIO or CRYSTAL MIC inputs of the tape recorder proper, where a recording of a gramophone record is desired *without* the help of a mixer).

FIELD TRIALS

OF BATTERY PORTABLES

NO. 6 TRANSICORDER TR 100

BY DAVID KIRK

MANUFACTURER'S SPECIFICATION

Tape Speeds: 3¾ and 1⅞ i/s. **Spool Capacity:** 3in. **Battery Complement:** Six 1.5V cells (motor) and one 9V battery (amplifier). **Frequency Range:** 150 c/s—7 Kc/s. **Level Indicator:** VU-meter. **Wow and Flutter:** 0.3%. **Dimensions:** 7¾ x 7¾ x 3⅝in. **Weight:** 4lb. **Price:** £51 9s. **Distributor: Fonadek (Branson) Ltd., Vivian Road, Harborne, Birmingham 17.**

JAPANESE products constitute a large fraction of battery recorder sales in Britain. The £5 'toy' models have been selling particularly well, according to various reports. Most expensive of the non-professional range is the *Transicorder TR*100, which sells for £51 9s. It is light and compact, of pleasing appearance, and uses a single switch to control the mechanical functions. This has four positions which are, rotating in a clockwise direction: FAST REWIND, STOP, PLAY and RECORD. No erase interlock is incorporated, thus care must be exercised, when switching to PLAY, not to turn the control too far. A single low-level miniature jack socket is fitted, to the right of which is a pre-amplifier output socket for connection to an external amplifier. The earpiece can be fed from here during recording or playback, so allowing a tape to be monitored as it is made. Plugging in the earpiece automatically cuts out the VU-meter, which is rather unfortunate, as over-modulation is not easily detectable through the monitor circuit alone. The meter is one of the most 'truthful' VUs I have yet found on a domestic mains or battery recorder, but the microphone amplifier was so sensitive that the gain control, calibrated in tenths, never required setting to more than the 2 mark during recording. It had one small defect as, when used horizontally, the needle would sometimes jam in the 'maximum' position during sudden peaks. Battery life is indicated by operating a switch during RECORD or REPLAY. A further switch cuts off the battery supply and connects a power socket for use with a mains adaptor. The moving-coil microphone houses yet another battery switch, this one serving the purpose of 'remote-control'. Although this system of control leaves the capstan and pinch wheel locked together, a note mentioning the detrimental result of using it is given on the inside lid.

A push-button clip gives easy access to the battery compartment. Outworn cells are easily replaceable and are sufficiently small for a spare set to be carried in a convenient coat pocket. Such a step would be advisable, as the motor batteries gave out during the trial almost without warning, showing no sign of slow deterioration in speed as they wore down. Battery consumption is relatively high in the motor circuit and operating cost is in the order of 1s. per running hour.

The leather case is sturdily made with a rubber shoulder pad to prevent the strap from slipping. A separate microphone case is also threaded on this strap. All connection sockets and the main controls are accessible through the case.

Simplicity of operation proved very marked during an outdoor sound hunt. "The world's longest pleasure pier" provided an admirable source of effects, but subsequent playback on the miniature internal speaker proved unimpressive, motor noise (electrical) and hiss being very prominent. Transferring the tapes to a larger recorder showed faults not noticed through the small speaker. High frequencies were completely lacking, with recordings sounding 'woolly'. Some sounds were almost unrecognisable and were generally distorted. Motor interference proved rather less noticeable on the mains machine, but the overall background noise level remained high. Just why the interference is so strong in a design using independent motor-amplifier batteries is something of a mystery. Background hiss can certainly be put down to the DC bias system and is a fault prevalent on many Japanese portables.

Orchestral music from an FM tuner, relayed through an external amplifier and speaker, showed a fairly strong flutter which I had not noticed on speech. But apart from this fault, the unit is, mechanically, very robust and strongly built, and deliberate shaking or swinging caused no perceptible change in speed.

A removable hub sleeve is used to change the speed from 3¾ to 1⅞ i/s. This was found to be rather loose fitting. Tape guidance was not entirely satisfactory as more than once the tape slipped down from between capstan and pinch-wheel to be wrinkled against the deck base.

Mechanical noise from the tape transport was of a fairly high order and was overcome indoors by placing the machine under a cushion. Fast rewind really *was* fast and, with the amplifier connected to the playback head, the loud screech emitted by the speaker simplified the problem of finding particular recorded sequences. No forward wind is fitted.

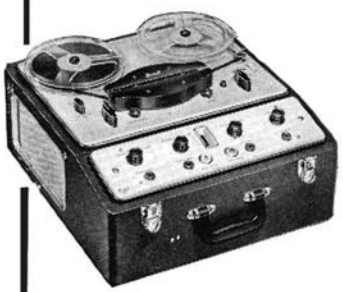
I conclude with the sad comment that the TR100 gives rather poor value for money when compared with the performance of battery portables in the £25 to £35 price range. Quality is very little better at 3¾ i/s than it is at 1⅞ i/s due to the very restricted frequency range and high noise level. The deck, which is itself far from faultless, is badly let down by a recording amplifier that does not do justice to superior playback equipment.

THE AUCTIONEER CONTINUED

AUCTIONEER: I haven't even got a fountain-pen. Just a shilling ball-point.
20th VOICE: [*very distant*] Six hundred!
AUCTIONEER: I have to cycle to work—no car for *me*.
21st VOICE: [*distant*] Six-twenty-five.
AUCTIONEER: Even my bicycle-clips are rusty.
22nd VOICE: [*very distant*] Six-fifty.
AUCTIONEER: All right, all right! Six hundred and fifty guineas I am bid. But what's the attraction? Look at it . . . look at its ugly, leering face!
23rd VOICE: [*near*] Six-fifty-five.
AUCTIONEER: Look at its fat stomach.
24th VOICE: [*very distant*] Six-eighty!
AUCTIONEER: (*through clenched teeth*) All right, six hundred and eighty guineas I am bid. Any further offers? (*pause*) No? (*tap of hammer*) Sold, then, to the gentleman at the back for six hundred and eighty guineas. Here you are, Sir—catch . . .
(*A slight pause, followed by a distant shattering of the jug.*)
AUCTIONEER: (*scornfully*) Butter-fingers.

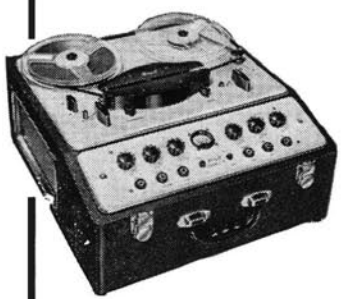
For a REALLY high standard of performance . . .

. . . buy a Brenell tape recorder. Whether you choose the basic MARK 5 Series 2, the more advanced MARK 5 Type M or the STB1, with its many features and facilities, all are capable of giving magnificent results combined with the famous Brenell reliability.
Compare these specifications with any other tape recorder on the market :—



Mk. 5 Series 2

4 tape speeds 1⅞, 3¾, 7½ and 15 ips • frequency correction at all speeds • 3 motors (capstan drive - hysteresis synchronous) • low wow and flutter content - .05% at 15 ips, ·1% at 7½ ips, ·15% at 3¾ ips, ·25% at 1⅞ ips • 4 watts power output • monitoring and superimpose facilities • 8½" dia. reels • Mk 510 for 10½" dia. N.A.B. reels • fast rewind (1,200ft. in 45 secs) • digital revolution counter.



Mk. 5 Type M

as Mk. 5 Series 2 PLUS:-

Separate record and playback heads and amplifiers • recording level meter • tape monitoring while recording • separate bass and treble controls • superb finish.

STB 1

Especially designed for use with external High Fidelity amplifiers • Mono/stereo record/playback facilities with twin recording and twin playback pre-amplifiers • immediate comparison of original and recorded signals • adjustable bias level • playback facilities for ½ and ¼ track mono/stereo tapes • sound-on-sound facilities • 2 edgewise meters for recording level, tape output level and bias level.

For full details of these recorders write to the sole manufacturers :—

BRENELL ENGINEERING CO. LTD.
231/5Liverpool Rd., London, N.1
Telephone: NORth 8271 (5 lines)

Please note our new address

'Synchrotape' BRAND
HIGH FIDELITY RECORDING TAPE

BRITAIN'S FINEST VALUE IN P.V.C. RECORDING TAPE
STANDARD, LONG, DOUBLE & TRIPLE PLAY

Adastra Electronics Ltd 167 Finchley Rd. London NW3

UNIVERSAL (EXTENDIBLE) STAND

FOR TAPE RECORDERS, RECORD PLAYERS, HI-FI GRAMS, AMPLIFIERS, ETC.

With Optional SPOOL/DISC RACK

ONLY £3 · 3 · 0
(Inc. P.Tax) + 3/6 P. & P.

In bright chromed square steel tube and rod. Will fit any unit 12" to 22" in width (larger version available on request—22" to 33"). Height 17½". Rack takes any spools and E.P's. Stand alone £2 10 0 (inc. P.T.) plus 3/- P. and P. Rack alone 15/- inc. 2/- P. and P. M/O or P/O to :

P. L. TUBEWARE CO.
31 CHURCH ROAD · PARKSTONE · DORSET

STEREO or MONO ?

The Choice Is Yours

For helpful advice on the most suitable equipment, with personal attention to your requirements, Mr. J. H. Liley of Southern Audio Services, invites you to consult him at 3 Lower Church Street, Croydon Surrey. CRO 9134. *Evenings by arrangement.*

SPECIAL DEMONSTRATIONS DURING DECEMBER

Agent for : **Ferrograph, Truvox, Trio**

We are situated opposite Car Park, Reeves Corner

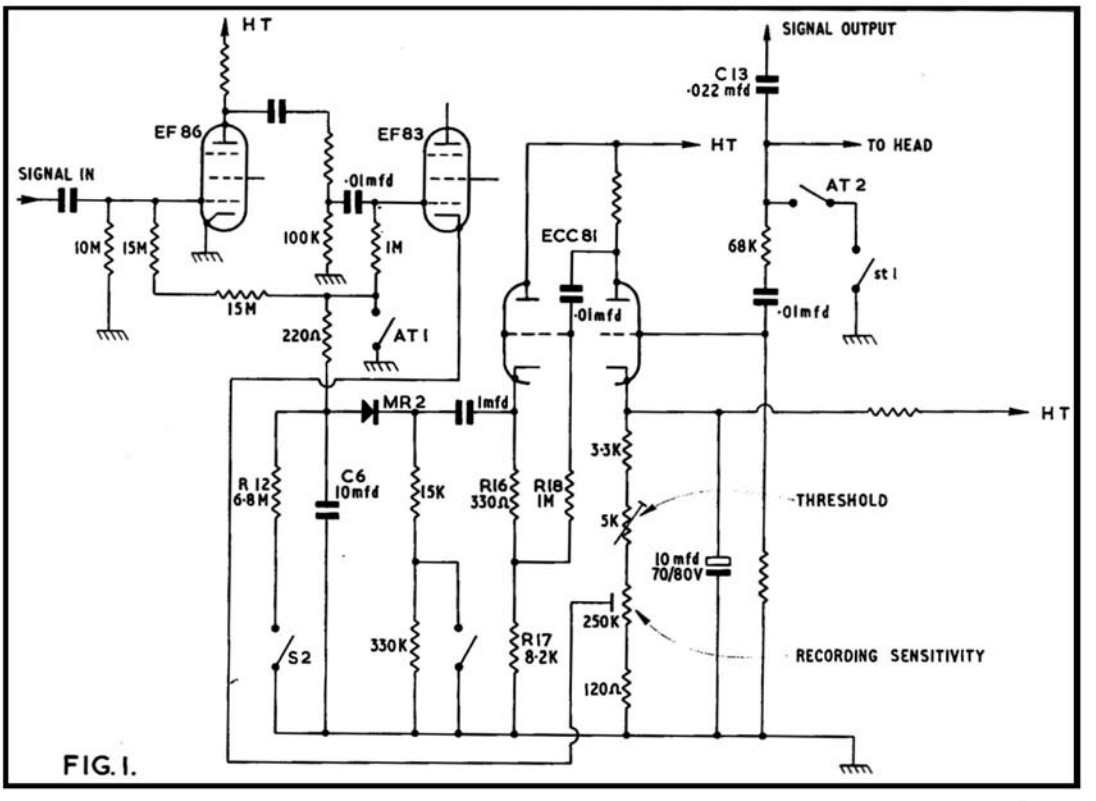


FIG. 1.

By H. W. Hellyer

tape recorder service

NO. 36 - GRUNDIG TK18

MY purpose this month is to warm up the bleakness of the winter season by mentioning AUTOMATIC RECORDING LEVEL. To the enthusiast, this is almost blasphemy, and this article should generate the sort of heat that automatic transmission causes in the automobile fraternity, clinging lovingly to their gear-levers.

Automatic Gain Control (AGC) is, basically, a form of circuitry well known to the radio and television engineer. In radio equipment the purpose of an automatic gain control circuit is to combat signal fading, and, incidentally, to reduce the effect of a sudden increase of signal level when the receiver is tuned through a strong station. The principle is to sample the modulated signal, usually at the detector stage, converting to a varying DC, and feeding this back as bias to earlier amplifier stages which employ vari-mu valves. These valves are designed to have a gain characteristic which alters as the bias changes. A control of volume is thus effected by the level of the signal.

The problems with this kind of circuitry arise partly from the damping effect of the necessary components on the amplifier and, to some extent, the detector. This can give rise to harmonic distortion, but does not concern us here, except to note that the time-constant of the auto-detector circuit is often a compromise between complete smoothing of the audio signal variations and the loading on the circuit. The time-constant is chosen to give a bias that is an average of the incoming signal level, while more rapid variations are smoothed out. In television work, another complication (which has aroused a good deal of erudite controversy) is the source from which the AGC voltage is derived—again, this does not concern us.

What *does* concern us is this time-constant problem, and the question of delay. In applying a bias, some reference must be determined. It is not enough to sample the strength of the incoming signal, rectify it, and apply the resultant bias to a controlled stage of amplification. This would mean that a whisper would produce only the tiniest bias and thus be fully amplified, while a shout would give a savage reduction of gain. Successive pianissimo and fortissimo passages of music would tend to come out at the same overall level—hardly what the composer intended! Also, the method of rough control outlined above would result in distortion.

As a guide to the kind of level control at which we must aim, consider the action of the tape recorder operator who is adjusting his recording gain knob manually. He watches his meter or magic eye, mentally averages the incoming sound and adjusts for a level which does not quite allow the meter or magic eye to indicate overload on peaks. So long as the dynamic range is not too wildly varied, this hit-or-miss method is quite satisfactory. The level control is set to a determined amount and, unless the programme level changes drastically, left at this setting. This is what the auto-level designer tries to do.

The only effective way of doing this is to allow the circuit to adjust itself to a level pre-set either in the factory or on the test bench, for a

(*continued on page* 461)

REPS R10 MkII VERSION

AN IMPROVED MODEL IS NOW AVAILABLE MAINTAINING A HIGH STANDARD OF PERFORMANCE

Exclusive professional type idler wheel for reliability and reduced wow.

D.C heating on pre-amp valves.

Modified Magnavox Studio deck with improved wow/flutter.

Bogen micro-gap two or four track heads fitted.

10 watts nominal R.M.S. Rating.

Calibrated Bass and Treble controls

Mic. Gram/radio inputs, separate controls for mixing.

7½ i.p.s. 40—15,000 C.P.S. ± 1dB 100μS
3¾ i.p.s. 40—10,000 C.P.S. ± 2dB 200μS } to C.C.I.R.
1⅞ i.p.s. 50— 5,000 C.P.S. ± 3dB 400μS

5 ECC83. 2 EL84. 1 ECC82. 2 Contact Rectifiers.

Pre-amp Signal/Noise > --55dB at all speeds.

Fully illustrated literature available on request to—

2 Track **59 gns.**
4 Track **69 gns.**

REPS (TAPE RECORDERS) LTD.
118 Park Road North, South Acton, London, W.3
Phone: Acorn 4141

PERFECTED AUDITORY LEARNING MACHINE
THE COMPLETE PORTABLE SLEEPOMATIC UNIT

Comprising transistorised tape machine, microphone, auto time-switch, under-pillow speaker, batteries, FROM £26. 0. 0.

SLEEPOMATIC UNITS ARE PROFESSIONALLY ADAPTED FOR AUTOCONDITIONED STUDY, CALLED SLEEP-LEARNING

Details of equipment, tapes and discs gladly sent on receipt of postcard

EDUCATIONAL RECORDINGS LTD.,
(Dept. TR) 21 Bishops Close, Church Lane, London, E.17

BRAND NEW 100% TESTED RECORDING TAPES
MANUFACTURED BY FAMOUS BRITISH FIRM
Fitted Leaders and Stop fails. All boxed and suitable for 2 or 4 track recorders at any speed.
Our guarantee is in writing with all orders (it has never ever been requested)

	Size	Length	P.V.C. Crayterm	P.V.C. Poltroy
STANDARD PLAY ...	3″	250′	2/6	2/3
	5″	600′	9/-	8/-
	5¾″	900′	11/6	10/-
	7″	1200′	16/-	12/-
LONG PLAY	3″	225′	3/-	2/9
	4″	450′	6/-	5/6
	5″	900′	11/6	10/-
	5¾″	1200′	16/-	12/-
	7″	1800′	23/-	15/6
DOUBLE PLAY	3″	400′	6/-	5/-
	4″	600′	8/6	8/-
	5″	1200′	21/-	14/6
	5¾″	1800′	24/-	19/-
	7″	2400′	39/-	24/-
EMPTY SPOOLS ...	3″ 9d	5″ 2/-	5¾″ 2/3	7″ 2/6

Post and Packing 1/- per spool, 4 or more post free.
The above tapes are only available at theses prices from :
N. Walker, 28 Linkscroft Ave., Ashford, Middx. Tel: Ashford 53020

---

magnetic tape recording

H. G. M. SPRATT. Completely revised and up-to-date second edition containing valuable chapters on tape materials manufacture and testing. Other chapter headings include Principles of Magnetism ; Sound Reproduction and Electro-Acoustics ; Principles of Magnetic Recording ; Tape Recording Machines ; Recording and Reproducing Machines for Music and Speech ; Testing of Machines ; Applications of Magnetic Recording ; Present Trends and New Developments.

368 pages *Demy 8vo* *63s.* *(Postage 1s. 9d. extra)*

"An authoritative, readable text book . . ."
". . . best available value for money . . ."—*Hi-Fi News*

A HEYWOOD BOOK
TEMPLE PRESS BOOKS LIMITED, BOWLING GREEN LANE, LONDON, E.C.1

YOU GET MORE FOR YOUR MONEY with

MASTERTAPE

. . . without doubt the lowest cost high grade tape available today! Full range of Standard, Long, Double and Triple Play available at realistic prices.

NATIONALLY DISTRIBUTED BY VIDOR AND AVAILABLE AT YOUR LOCAL RADIO SHOP

Manufactured in England by
M.S.S. Recording Co. Ltd., Colnbrook, Slough, Bucks.

given bias resulting from a given input. Then, in operation, a similar input produces this bias, and the time-constant of the circuit is arranged so that the bias level is held for a certain length of time. A 'delay' is arranged, so that the recording level remains constant over long periods.

In the machine we are considering this month, the actual delay period is 15 minutes for high level input (radio tuner or pick-up), and three minutes for microphone input. What this means in practice is that the machine runs at maximum recording level until a strong input is injected, when the bias takes over and recording level is reduced to prevent distortion. The delay ensures that the recording level does not reach maximum again until the end of the period stated above. Obviously, the machine has to be used in conditions that allow for this : a whispered commentary carried out in a shunting yard would perhaps be demanding too much.

A further point is that this auto-gain action comes into operation only after a small input level has been attained—the purpose of this being to avoid the recording of hum and noise at high level, in the absence of true signals (equivalent to delayed AGC in a radio.)

PRACTICAL APPLICATION

Having considered what the designer sets out to do, let us take a look at how he goes about it practically, and consider the adjustments we must be prepared to make if the machine breaks down, or in the event of valve or component replacements. **Fig. 1** shows the rudiments of the *Grundig TK*18 AGC circuit. The circuit has been redrawn in isolation to facilitate easier explanation, leaving the manufacturer's circuit numbers.

A portion of the signal is tapped off at the same point as the feed to the recording head. The two-switch contacts, AT2 and AT1, are the RECORD and START button contacts. Reason for two is that this circuit must be opened during both recording and play back, but muted during neutral. The AGC amplifier consists of both triodes of an ECC81 valve. The signal is applied to the grid of one triode, and the cathode of this section has two pre-set and two limiting resistors in series to provide an overall bias such that signals of more than 10V will be amplified, but voltages less than this will give no output. This is ensured by making the cathode bias chain part of a potential divider across the HT. A point worthy of note is that the cathode bias decoupling electrolytic capacitor has a working voltage of 70 to 80V to allow for this high bias. If at any time the component has to be replaced, this rating must be maintained. A small point, but so easily overlooked.

The adjustment of the two pre-sets will be dealt with later. For now, let us follow the signal, amplified by the first (right-hand) triode and passed to the grid of the second triode by the 0.01μF coupling capacitor. Note that the lower end of the grid-leak R18 is returned to the junction of R16, R17, and not to chassis. This is because the latter resistors are actually the output load of this triode, which operates as a cathode-follower. So the necessary cathode bias to bring the operating point to the straight portion of the valve characteristic is obtained across the 330 ohm resistor (R16).

The valve does not amplify, but acts as a buffer and serves to apply the signal of the correct level to the load resistors, the lower one of which (330K) is short-circuited by a contact on the START button switch, and is in circuit during setting-up only.

VARYING DC

The rectifier MR2 converts the audio signal to a varying DC and charges up the 10μF capacitor C6. Note that this is not an electrolytic capacitor but an MKT-type, with a working voltage of 125V. The resultant bias is fed, via high value resistors providing the long time constant in conjunction with C6, to the grids of the EF86 pre-amplifier and the EF83 variable-mu amplifier pentode. The cathode of the latter has a pre-set bias voltage obtained by tapping off a voltage from the divider chain of the cathode of the first half of the ECC81.

Two further switching refinements should be observed. The switch AT1 closes during playback, to short out any control voltage from the grid circuits of the amplifiers, and the switch S2 puts the 6.8M resistor, R12, across the time-constant leak circuit to provide a shorter period during microphone recording.

From the foregoing, it can be seen that the amplifying point, at which signals are converted to bias, is determined by the THRESHOLD pre-set in the cathode chain of the first ECC81 triode, and the recording sensitivity which would normally be adjusted by a manual control, is pre-set by the 250K resistor in the same chain. But because of the time delays, a very definite setting-up procedure must be followed. First, input sensitivity must be checked. An audio generator with measured output and a valve voltmeter are necessary for this, and for the following tests, and certain networks of resistors must be used to obtain correct levels and matching.

The bias oscillator is first 'killed' by shorting the erase head. Volume and tone controls are turned to maximum, and the THRESHOLD pre-set to approximately mid-position. A short-circuit is also applied temporarily across the switch AT1, to remove the control voltage. Then, with the output from the generator across a potential divider consisting of a 1K and a 10-ohm resistor in series, the output taken off the latter via a 100K resistor to pin 1 of the input socket, a signal of 270mV at 1 Kc/s is injected and the RECORDING SENSITIVITY control adjusted until the recording current gives a 5mV reading on the valve-voltmeter, across a 100-ohm resistor connected across the head winding. An alternative point at which to check is the junction of a potential divider made up of a 220K and a 25K resistor from the output side of C13, where there is a convenient anchor tag above the chassis. At this point, the same conditions should give a reading of 1150mV.

Having set the recording sensitivity for correct amplifier levels with an 'average' signal, we can set the bias, first removing the short-circuit across the control voltage circuit. With volume and tone controls again at maximum and the THRESHOLD control turned clockwise, (this adjustment made from the printed circuit side), an input of 44mV at 1 Kc/s should give a reading of about 1700mV across the C13 measuring point, with the same potential divider network as before. The input this time is only via the series 100K resistor.

Now, the ticklish bit follows. The THRESHOLD control must be rotated slowly anti-clockwise until the measured voltage drops from 1700 to

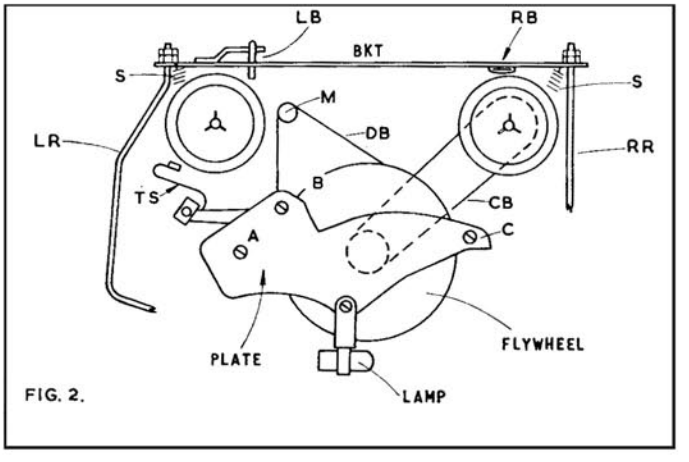


FIG. 2.

1150mV. The catch is that if the voltage is allowed to drop below this figure, one must allow time for the control circuits to recover, and start again. As the THRESHOLD control is turned, there is a slow lag, and a little practice is needed to get the setting right.

Next move is to check the bias on a low signal, and the best way to check the output voltage, again at C13. For an input of 4.4mV the output should be 900mV. If it is not, your first adjustment of sensitivity was wrong, and you must pay the penalty by going through the whole procedure again. Return to neutral before carrying out this last operation, to discharge the control voltage.

If you want to be even more technical, you can check the rise-time of the automatic level circuits. This is the time taken for the bias to drop by a pre-determined amount when the signal is reduced from a high level to a lower level input. With the set-up as before, but with the input via the 100K resistor to the PU socket, pump in a full 2,400mV. This is enough to make the control voltage circuits sit up and take notice. Measure the output voltage, then reduce 10dB (to

(continued overleaf)

760mV) and note that the time-constant of the control circuit should be such that more than 35 seconds should elapse before the measured output rises as much as 3dB.

Already, I hear despairing howls. As several readers have chided before : "It is all right for you chaps with a well-equipped workshop. What if one's signal generator is simply an irregular signal source, and one's valve voltmeter as yet but a hopeful tick in a build-it-yourself catalogue ? "

ALL IS NOT LOST

I shall probably get a rap over the knuckles from Paul Spring of *Grundig* for saying so, but all is not lost ; it is still possible to adjust the machine for good results, given time and patience. These are commodities which readers of *Tape Recorder* have in good measure—after all, look at all the months you have borne with me!

If the control voltage is first shorted, and the sensitivity set for an adequate recorded level on the tape with a *low* input, by making several test recordings and settings of the control, then the THRESHOLD set so that similar inputs give similar outputs with the control voltage short removed—then re-set so that the high inputs (that is, loud sounds) do not overload when played back, quite good results should be obtained.

When making trial-and-error tests of this nature, follow the lead of the laboratory boys. Do not switch from RECORD to PLAYBACK and *vice versa* until the controls are red hot. Begin by marking out a small table on a piece of paper, then make each adjustment during a definite time period, noting the alterations (example, when turning a control mark it "one-o'clock", "two-o'clock", etc., making each alteration at, say, 15 second intervals). Then, when replaying, refer to the table, note the stage which gives optimum results, return to RECORD and adjust as per the instruction for that stage, using this as a starting point for finer plus-or-minus adjustments.

Mechanically, the TK18 is very similar to the TK14. The latter machine was dealt with, albeit briefly, in the previous four-part series on *Grundig* machines, August to November 1962. But as several queries about belt-changing and braking systems have been received, **fig. 2** is given, and the following notes refer to both the TK14 and the machine at present being discussed.

NO GREAT PROBLEM

Belt-changing presents no great problem. After dismantling, remembering first : to remove the top cover by taking out the screws and depressing all six keys simultaneously, then lifting the front lip with the thumbs ; and second, to note that the shortest fixing screw is the front right position—access is obtained to the deck as sketched out roughly in **fig. 2.** In the case of the TK14, next move is to take out the Magic Eye ; the TK18 has an indicator lamp, as no magic eye is required with an automatic machine, and the bracket is released by removing a screw hidden under the pinch-wheel bracket. The dust cover is next removed from the spindle, and the tape position indicator drive belt removed. Then, the three screws, A, B and C are taken out and the whole plate bearing the heads, etc., will be free for lifting. Lift it, tilting toward the rear, slackening off also the fixing bracket under the right side, when the two belts, CB and DB, flywheel-to-clutch and motor-to-flywheel respectively, may be removed and replaced.

The brake adjustment is such that there is 1mm. of play in the operating rods RR and LR when in the neutral position. These act as push rods. The brakes are RB and LB, held inwards by springs S-S, attached to the main bracket, BKT. The action should be such that the left brake impedes the anti-clockwise motion of the left turntable, but has no effect on its clockwise movement, while the right brake, which is a plastic ring on a lug, engaging the periphery of the turntable, so that braking action is applied only to the right-hand side when stopping after fast rewinding. After fast forward winding, only the left brake comes into operation. The clearance is therefore a little less tolerant than with many machines, but quite foolproof in action when correct adjustments have been made.

An auxiliary brake is the TS leaf-spring attached to the temporary stop lever, engaging the rubber tyre of the left-hand turntable.

tape reviews

SYMPHONY FANTASTIQUE (Berlioz) **NIGHT ON A BARE MOUNTAIN** (Moussorgsky), Vienna Symphony Orchestra conducted by Heinrich Hollreiser. **Recotape RML 506.** 3¾ i/s mono. 50s.

"THIS performance is a brilliant interpretation of every nuance of this very emotional music, much beloved of Hi-Fi fans," says the note on the box. Hi-Fi fans, however, must look elsewhere for a recording quality to meet their exacting standards, for on this issue the quality of the recorded sound is such that much of the "brilliant interpretation of every nuance" was not evident to the reviewer. I am referring to Hollreiser's performance of the *Symphony Fantastique* by Berlioz. There are the sounds of a mighty orchestra hard at work, but due to the 'bottom heavy' recording quality and a reverberant acoustic, much of the subtlety of phrasing is lost. True, this is not the case throughout the work. The lovely duet between cor anglais and oboe in the pastoral third movement comes over with genuine atmosphere, though even here the playing could be more refined. The fourth movement, the march to the scaffold, effectively despatches the hero whilst the crowd jeers, but some of the low trombone notes are lost in the muddy bass sounds.

Similar criticism applies to Moussorgsky's *Night on a Bare Mountain* as recorded here. The general impression is that one is prevented from appreciating the orchestra to the full because of the heavy and reverberant recording quality. **G.G.**

GUSTAV HOLST/GERALD FINZI. A Choral Fantasia, Psalm 86/ Dies Natalis. English Chamber Orchestra conducted by Imogen Holst and Christopher Finzi. **World Record Club TCM 50.** 3¾ i/s mono twin-track. 29s.

THE two choral works by Holst recorded here are not amongst his best known, and though both the *Choral Fantasia* and the *Psalm 86* have an ecclesiastical character, they are two completely different types of composition. The Choral Fantasia is a setting—for soprano solo, chorus, strings, brass, percussion and organ—of Robert Bridges's *Ode to Music*. The words have no definite religious implication, being a commemoration to those men who have obtained immortality by having done something to be remembered by, but Holst's treatment of them has a church-music-like quality. The harmonies, vocal lines and instrumentation are characteristically Holst's and in places are vaguely reminiscent of the Planets Suite. The setting of Psalm 86 sounds, naturally enough, more like orthodox church music. The tenor almost chants his lines and there are answering responses from the choir. There is more to the music than this, of course ; the string orchestra plays its part and the choir develops the harmonies suggested by the vocal line. Both the Fantasia and the Psalm are performed with a simplicity of style that appealed to me, neither mannerisms nor over-emphasis interfering with the presentation of the music.

Finzi's *Dies Natalis* is an extended composition for strings and tenor voice, the theme of the words being, as suggested by the title, a retrospection into the thoughts of an infant's mind on first coming into the world. The work is divided into five sections, an Intrada for strings alone, the Rhapsody, Rapture, Wonder and the Salutation being written for tenor solo with string accompaniment. The work was new to me, but after a few hearings I found myself enjoying the first three sections very much, Wilfred Brown's truly English tenor voice expressively following the long phrases of the Rhapsody, and the rhythm of the Rapture contrasting with the preceding sections. However the music of the final two sections I found rather monotonous, adding little to the words themselves.

It is interesting to note that the performances of the Holst and the Finzi works are here conducted by the daughter and the son respectively of the two composers. They also write the biographical notes on Holst and Finzi in the leaflet supplied with the issue. The text of the words is also printed in the leaflet and there are one or two minor misprints : the first two lines of the Rapture in the Dies Natalis are printed in reverse order, for example.

The quality of the recording is very good. A cathedral-like reverberation increases the musical effect of the two Holst items. The voices are clear and well balanced with the orchestra. On the whole a good issue of less frequently heard music.—**G.G.**

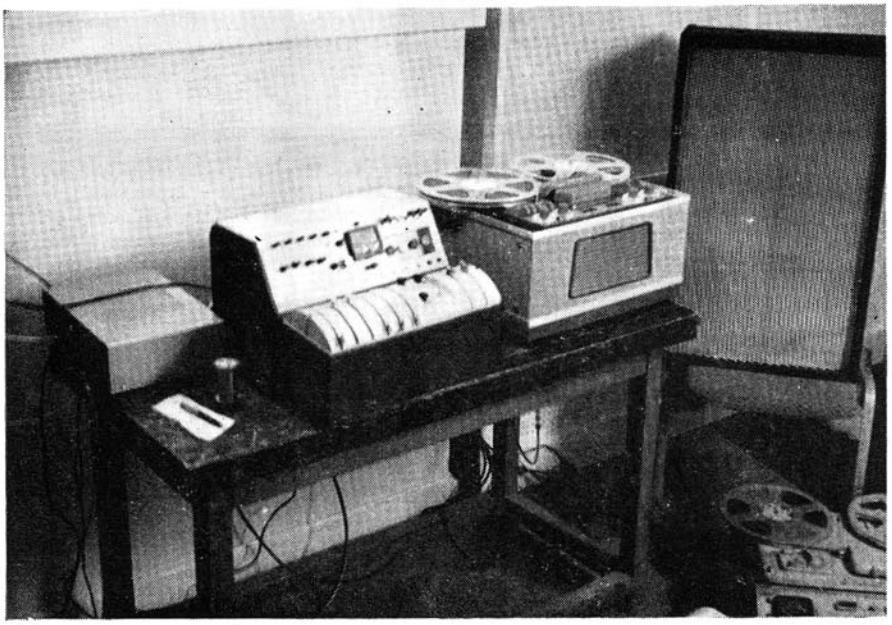
SIBELIUS (SIX HUMOURESQUES) Aaron Rosand (violin) with the Suidwesfunk Orchestra of Baden Baden. Conducted by Tibor Szoke. **Recotape 2 RSL 241.** 3¾ i/s stereo twin - track. 32s. 6d.

THE six *Humouresques* for violin and orchestra that Sibelius composed some seven years after his violin concerto are not, as their title suggests, amongst his more serious compositions. The last of the set is probably the best known, but all of them are lyrical melodies with orchestral accompaniment. Aaron Rosand here displays a high degree of technical ability in their performance, and his warm, firm tone makes pleasant listening throughout. This issue is recorded in stereo, and on the review copy the soloist sounded well forward and vaguely central, but the orchestral parts sounded distant and muddy. Here and there were patches of drop-out too, switching from track to track, more towards the end of the tape. **G.G.**

CONCERT MASTERPIECES (Number 2). Russian Easter Overture (Rimsky Korsakov). Zeiguinerweisen (Sarasate). Blue Danube Waltz (Strauss). 1812 Overture (Tchaikovsky). Vienna Symphony Orchestra conducted by Heinrich Hollreiser. **Recotape 2 RSL 508.** 3¾ i/s stereo twin-track. 55s.

NONE of the music on this record is at all profound, depending largely for its effect on the conductor and orchestra performing with a high degree of dynamic control and virtuosity. These factors seem to me to be lacking in the versions recorded here. Rimsky Korsakov's *Russian Easter Overture* does not receive enough of the careful build-up of forces that it needs and sounds rather dull in consequence. Strauss's popular *Blue Danube Waltz* lacks the sparkle that it needs to become a really successful concert item. The violin playing in the gipsy-like themes of the Sarasete work has great skill and verve, yet the orchestra gives it rather ill-defined accompaniment. I liked the playing of Tchaikovsky's 1812 *Overture* more than anything else on this tape, even though the roaring of the 'cannons' swamped the other things going on at the same time.

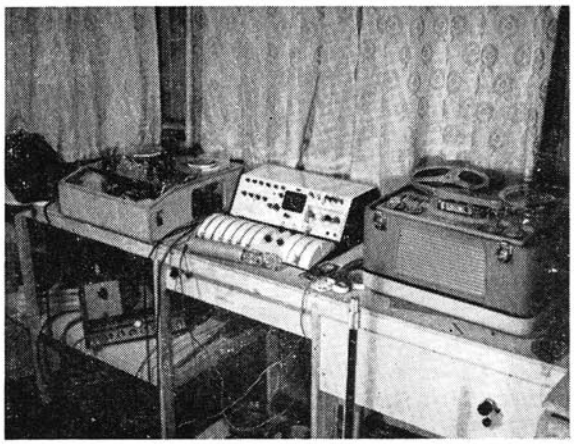
The balance of the recording favours the bass end of the sound spectrum, so the texture sounds thick and resonant. This is a stereo recording and there is a fair spread of sound, but no sharply defined positioning of sections of the orchestra, except perhaps for occasional moments in the 1812 *Overture*, when martial trumpetings have a misty morning atmosphere. Even so, this is not a tape I would like to live with for very long. **G.G.**

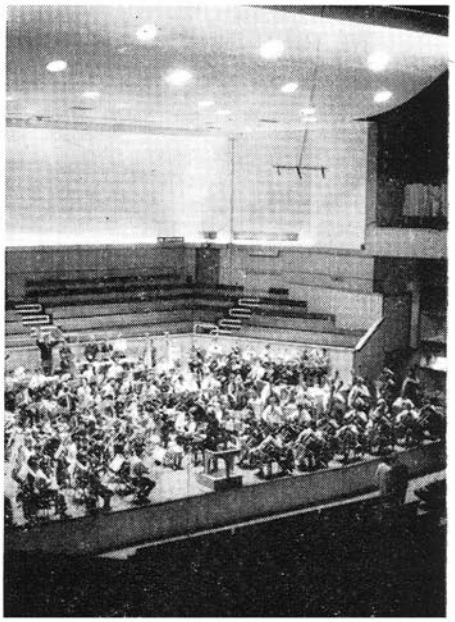


A STUDIO QUALITY MIXER

By D. P. ROBINSON

Fig. 4 (above) : *The mixer and associated equipment ready for action at the Fairfield Halls.*
Fig. 2 (right) : *Recessing into a wooden base-board allows connecting cables to be placed out of sight.*
Fig. 3 (far right) : *Three microphones positioned on boom to record the National Youth Orchestra of Great Britain.*





PART 7—Some Readers' Queries & General Notes

AS an introduction to this final article, some of the queries sent in by readers will be mentioned, but first some of the more obvious errors in the text should be corrected. The first of these concerns the power supply, which was described in Part 2 (July). The next issue (page 272) described the mains transformer as an MTA3, while in fact it should be an MT3AT. This is made by the *Douglas Transformer Co. Ltd.*, and is stocked by many shops in the London area. It is a multi-tapped transformer intended as a model maker's power unit, or as a 2A battery charger, and is very well suited for this power supply.

In the September issue, fig. 1 showed the circuitry of the mixer amplifier, and unfortunately the stereo-mono switch (S5 in the block diagram) was drawn in the wrong state. In stereo operation the switch is open so that there is no connection at all between the left and right channels, but for monophonic use it is closed. Then any signal appearing in the left mixer at the base of TR3 can pass through C.10 to the base of a corresponding TR3 in the right-hand mixer ; of course the reverse applies. Thus all signals will appear at both outputs, although independent control of the level at each output is still retained by the two master gain controls on the main fader deck. TR3 is an emitter-follower, so that the input impedance is high, which means that the joining capacitor can be small in value. However, it must not be an electrolytic since its two ends are at the same potential —so there is no polarising voltage. A 1.μF capacitor will give a 3dB point at 14 c/s, which is more than adequately low.

An error appeared in Part 5 of the series (page 363, October) under the heading *Simple Alignment*. Both references to R.11 in the first paragraph should read R.8.

One reader wrote to ask about the suitability of the mixer as a monophonic device with many more channels than described in the text. To check on the figures obtained in the early stages of the development of the stereo version, a further series of tests were performed on the mixing stage. An ideal mixer is one in which the alteration of the gain on any one channel has no effect on any of the others. In practice the most stringent test is to feed a sine-wave or other test signal to one channel and nothing to the inputs to the remaining channels. Then fading these latter from maximum to minimum should have no effect on the first channel and in turn no effect on the mixer output.

With eleven channels in use, tone was fed to one channel and the gain set to maximum. Fading the remaining ten channels from one

extreme to the other altered the output level by 1dB at 1 Kc/s, which is barely audible to a well trained ear and for all practical purposes is not noticeable. It should be noted that this test represents a situation most unlikely to occur in practice but is a very useful measure of the circuit performance. When the mixer has sixteen sources attached, the output changes by 2.5dB when the same test is applied, and this would probably pass unnoticed by the majority of listeners. The test was also repeated at 100 c/s and 10 Kc/s with identical results.

Several readers have enquired about printed circuits for the mixer, in particular for the plug-in main pre-amplifiers. **Fig. 1 (a)** shows a suitable layout for the microphone amplifier, described in fig. 6, August, and **fig. 1 (b)** shows the reverse side of the board for the copper wiring. Enquiries have been made with a view to producing small quantities of all the printed boards needed for the mixer, both the front panel plug-in units, and also the smaller boards used in the body on the mixer. The price of such cards has proved to be extremely economic, ranging from 4s. for the interior cards to up to 6s. 6d. for the larger units. It is hoped to keep a small supply in stock, and readers who are interested in fully printed cards are invited to write to the author for more details.

Another reader asked about circuits to provide bass and treble lift and cut with 'presence' facilities, all of which are used so much in the manufacture of pop recordings. If these are required the best place for them is after the individual plug-in unit, and a very suitable unit can be found in the BBC monograph mentioned previously on transistors in sound broadcasting, omitting the transformers at both ends since these are not required. With the 600-ohm output impedance the mixer is very suitable for feeding into other pieces of standard broadcast or recording gear, such as frequency shaping circuits and limiters.

Assuming the mixer is now completed, there are only a few minor adjustments to make before the unit is ready for use. Each unit block should have been tested before putting it into the mixer so that the checks are confined to the proper functioning of the monitoring circuits and the balancing of the two halves of the stereo system.

Inject a signal into one of the pre-amplifiers, or use the internal oscillator if fitted, and check that, with the mixer switched to mono, there is an output on each channel and the two main gain controls function on the correct outputs. None of the keys on the front panel should have any effect on the output except the stereo-mono switch, which should remove the signal on one channel and raise the other by 6dB. The outputs should then be set to 0dB each, or whatever signal loads the tape recorder in use to full modulation, and the meter sensitivity controls on the front panel adjusted to read 6 on the ppm. In this adjustment the left sensitivity control should only be changed when the meter selection key, S 10, is in the 'L' position, and vice-versa. Finally, switching to 'L + R', the meter reading should not decrease by more than ¼ division. If the outputs cannot be made exactly equal, then the two pre-set controls on the front panel should be adjusted until they are so. This has balanced the two channels, and at this point the two main gain controls should be faded together. With two good quality potentiometers in the circuit there should be no more than 1dB between the two outputs at any setting of the controls. If there is, the controls should be replaced with better versions, since otherwise the stereo image will wander badly during any fades.

The monitoring channels are then checked to see if they are working correctly, preferably with a test signal such as tone, although a music signal is almost as good. The monitor output is affected by nearly all of the front panel keys, and will be on input signal, tape playback or talkback. The gains of each of these functions are controlled by the various potentiometers in the recessed panel. If no snags have been encountered here, the mixer is now ready for serious use, either as a portable unit or as a fixed installation.

Fig. 2 shows how these two functions can be integrated in a small studio. The mixer is recessed into the baseboard which also holds gramophone units and tape recorders. By recessing the unit the cables can be led neatly away under the board ; the quadrant faders fall naturally under the hands, yet the unit can easily be taken out for recordings on location. The photograph also shows sundry other electronic gear, amongst which is a stereo capacitor microphone for which the line amplifier was designed (see *Hi-Fi News*, September and October 1963).

Finally, a few words about setting-up for a stereo recording session. The most important operation in a coincident-microphone recording is to ensure that the phase of the two units is the same. It is a good idea to check that the leads normally in use are all wired so there is never any doubt about the phasing once it has been established. Occasionally microphones other than the usual ones will have to be used, and it is best to phase them on the ground rather than wait until they are strung many feet into the air. This is very easily done using the mixer. The two microphones, or two outputs in the case of a stereo microphone, are plugged into adjacent channels on the mixer. The microphone is then placed with the two elements facing the same direction as close as possible to a signal source. Here again the best is a loudspeaker with tone, although very good results can be achieved with a voice. The meter is switched to the left channel and the left microphone input faded up to give a reading on the meter, then faded down. The right input is then switched on the rear to the left channel as well, and faded up. The gain is then adjusted by the pre-set on the plug in unit to read the same on the meter as the left channel. This has balanced the two microphones and the pre-amplifiers to the same sensitivity. With this channel still reading on the meter, the left channel is slowly faded up. This is adding the outputs of the two microphones since both have been switched to the same channel, and if the outputs are *in phase* the reading will rise by about 1½ divisions. If *out of phase*, with identical microphones there will be a dramatic fall in the meter reading as the majority of the out-of-phase signals are cancelled. The output should consist mainly of harmonics of the signal, and these can be listened to with the earphones. The phasing switch of one of the channels, situated on the rear panel, should be adjusted to give in-phase, or adding, signals. Finally, the right input is switched back from the left channel to the right.

Microphone placing is, if anything, a little easier in stereo than it is in mono. For a large scale monophonic recording, multi-microphone techniques are usually used to provide a balanced sound, whereas in stereo this same microphone placing sounds 'forced' and will accentuate parts of the orchestra in a way which is not necessary with the added directional properties of stereo. It is usually better to use one stereo

(*continued overleaf*)

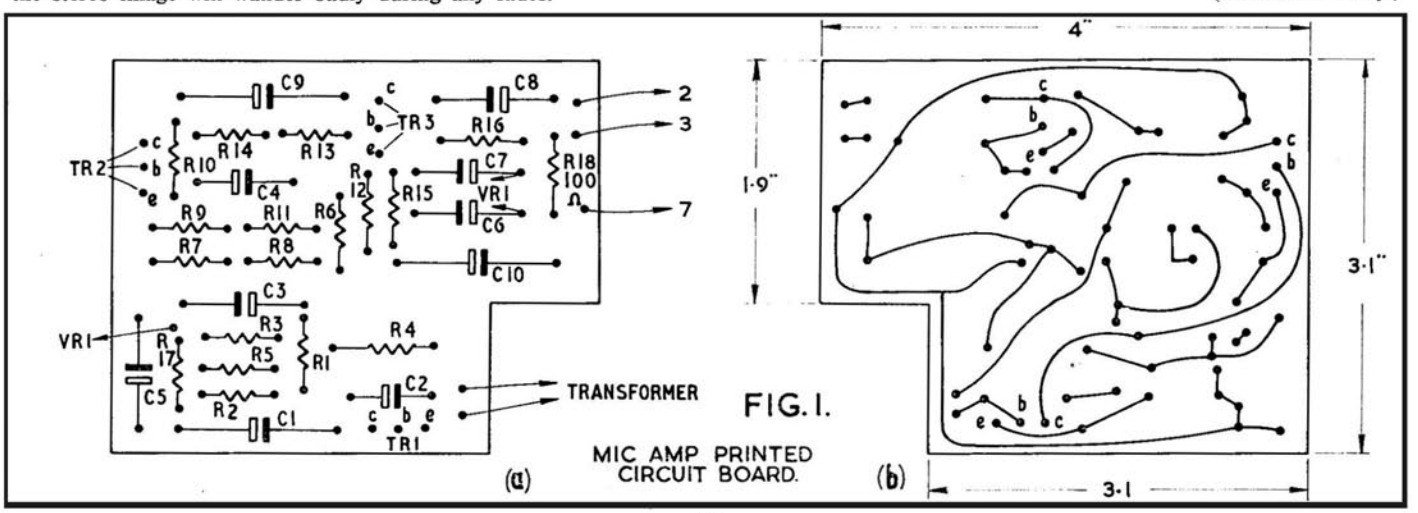


FIG. 1.

pair ; if more than one is used great care must be taken to ensure that the sound picked up by the subsidiary microphone appears in the same position as indicated by the main microphone. A single injection microphone can often be used for soloists in a concerto, for example, when the pan-pots are used to place the image in the correct position.

Figs. 3 and **4** show the recording arrangements for a recent concert given by the National Youth Orchestra of Great Britain, performed in the concert hall at the Fairfield Halls, Croydon, where the photographs were taken during a rehearsal.

In the first photograph the microphone placing is shown, with three microphones on a boom. The centre instrument is the main stereo capacitor, with variable polar characteristics in this case switched to the cardioid response, suspended above the sixth row of the stalls and about 25ft. up. This was angled towards the orchestra so that the acceptance angle included the complete stage. The two other microphones visible at either end of the boom, one a *Reslo* ribbon and the other a monophonic condenser in the figure-of-eight mode, were used only in the rehearsal for a monophonic recording of certain items, and while giving an acceptable sound this would not be the preferable place for a completely mono recording. However, experiments were also made using these two as a spaced pair for stereo, but as with most recordings of this type the directional images were not so precise. In the limit there can be hardly any information recorded from the centre of the stage, producing 'hole in the middle' effects.

The other technique of recording, using sum (L + R, or M) and difference (L — R, or S) was not investigated, since it is more difficult to set up, usually requiring special matricing transformers. There are no special advantages to be gained from this system except that by manipulating the M and S signals separately, both stereo width and reverberation can be controlled independently. In the author's opinion, coincident microphones give the best and most easily made recordings, and this was the system adopted here.

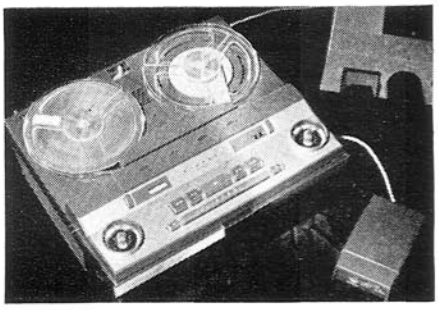
The recorders and the mixer were in a small room to one side of the stage, just visible by the light spilling through the double-glazed window on the right-hand side of the stage. Thus the stage was quite visible from the room, but being isolated from the platform, the loudspeakers could be run at a high level for monitoring. **Fig. 4** shows a small part of the room, with the left-hand speaker just out of the picture. On the table is a valved 10W + 10W amplifier which drives the monitor loudspeakers, then the mixer, and finally the main tape recorder. This latter is the new Revox 736, and is shown using the 10½in. NAB large centre spools, for which there is an adaptor to fit the Revox. The remote facility provided in the tape recorder was used, and the mixer controlled the recorder during recording, stopping and starting between items. On the floor is a home-built machine using a *Wearite 4A* deck, converted to three-speed operation and the large NAB spools, now relegated to stand-by and dubbing work.

A very reasonable tape was made of this concert on the Revox, and it was hard to find fault with the recorder ; with the tape/signal key on the mixer being used to compare the incoming signal with the recorded tape, the only noticeable difference was the small increase in background hiss audible in the very quiet passages, with the volume control rather higher than would normally be used in the home. The operator sat forming an equilateral triangle with the speakers, which gave a good aural perspective ; nearly all the facilities of the mixer were used in this session, and it proved to be very quick in setting-up, which is of great importance for mobile use.

It is hoped that this series of articles has provided information on the planning and construction of a high quality studio audio mixer, in which all the facilities of a small studio are present, but which is still compact for portable use. By the extensive use of transistors this has been possible, and it is hoped that the result is a mixer whose technical performance compares favourably with any other commercially available mixer.

In conclusion, grateful thanks must be made to R. A. J. W. Gibson, who took and processed the majority of the photographs used throughout the series. The excellence of these meant that a difficult point in the design could be illustrated in a way which, without a photograph, would have meant long, involved descriptions. It should also be mentioned that the author is always willing to discuss any problems that readers may have arising from the theory and construction of the mixer—but please enclose a stamp for the reply!

equipment reviews



SABA TK230S STEREO

Manufacturer's Specification : ¼-track stereo tape recorder. **Power Supply :** AC 50 c/s convertible to 60 c/s, at 220/127V. **Power Consumption :** 65W. **Fuses :** 220V 0.4A delayed/127V 0.8A delayed. **Valves :** 3 ECC83, ELL80, EM84a. **Transistors :** 2 AC107. **Rectifiers :** B250C100, B30C600, 2 E25C5. **Tape Speeds :** 7½ and 3¾ i/s. **Spool Capacity :** 7in. **Frequency Range :** 40 c/s to 20 Kc/s at 7½ i/s. ; 40 c/s to 16 Kc/s at 3¾ i/s. **Erase Attenuation :** 65dB. **Fast wind :** 5 min. for 2,400ft. **Wow and Flutter :** 0.15% at 7½ i/s, 0.25% at 3¾ i/s. **Position Indicator :** Revolution counter with zero button. **Inputs :** Microphone : 0.1mV at 200 ohms ; Radio : 10mV at 100K. Phone : 200mV at 1 Meg. **Recording Level Indicator :** Magic Eye EM84a. **Dynamic Range :** 60dB with aural filter. **Signal-to-Noise Ratio :** 48dB. **Radio Output :** approx. 1V. **Output Power :** 5W. **Loudspeakers :** Two 6 x 3½in. elliptical. **Speaker Impedance :** 4-6 ohms. **Headphone Output :** 1,000 ohms. **Additional Connection :** for F Sch 3 pedal switch, Saba slide synchroniser and Regie-Mixer. **Weight :** 28½lb. **Dimensions :** 16½ x 15 x 7½in. **Price :** £99 15s. **Distributor : Saba Electronics Ltd., Eden Grove, Holloway, London, N.7.**

THIS is a complete stereo recording and reproducing system contained in a case not much bigger than an orthodox mono recorder. Most of the space economy has been effected in the electronics section by using transistors for the input stages, double triodes for the intermediate amplifiers and no less than three valve electrode systems in one glass envelope in each of the push-pull output stages.

When the dress cover is removed to disclose the deck mechanism, it is obvious that nothing has been spared in the way of mechanical complexity to offer every possible facility in the way of tape handling. A single, heavy, fixed-speed motor is used for forward wind, rewind and normal transport at 7½ and 3¾ i/s. A flat belt drives two idler wheels and these are rocked laterally to bring one or other into contact with the capstan flywheel. A heavy triangular section belt drives the fast wind and rewind drums and an array of stiff wire rods, rather like bicycle wheel spokes, radiates from the press keys to all parts of the mechanism, sometimes via right-angle levers which allow the motion to be turned around corners without loss of efficiency. It all seems to work very well and I look forward with interest to the comments of my colleague, H. W. Hellyer, on servicing notes for this deck. The outer tape guides rotate to reduce friction and certain types of tape flutter. On rewind, a felt pad is brought into contact with the oxide side of the tape so that it is perfectly clean and free of dust particles on its next transport past the heads. The automatic stop operates by a very light lever which touches the tape as it leaves the capstan so that any break or slackening of the tape trips the stop mechanism.

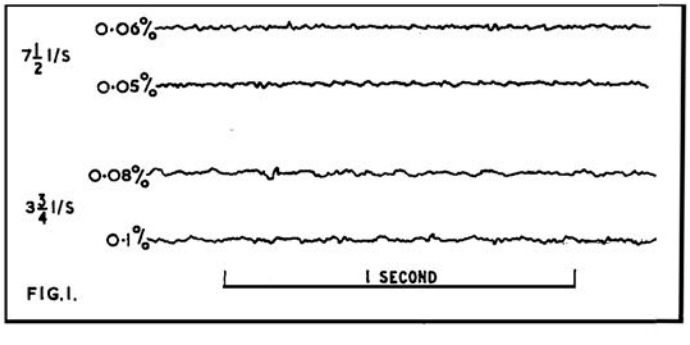


FIG.1.

PRACTICAL ADVANTAGES

It is obvious from the fluttergrams of **fig. 1** that all these refinements pay off. The total RMS wow and flutter at 7½ i/s remains steady at 0.05% to 0.06%, and even at the lower speed of 3¾ i/s the combined record and replay wow and flutter does not exceed 0.1%. Wow is completely non-existent, and flutter is random in character and is probably due to the slight elasticity of the thin double-play tape provided with this machine.

I have just produced test-tapes to the new CCIR standards of 70 and 140μS, and this seemed an ideal chance to try them out on a machine of Continental design which should conform to the DIN standards, which specify these same time constants for speeds of 7½ i/s and 3¾ i/s. **Fig. 2** shows that the playback responses using these tapes are sensibly level with a slight roll off at high frequencies at 7½ i/s, and

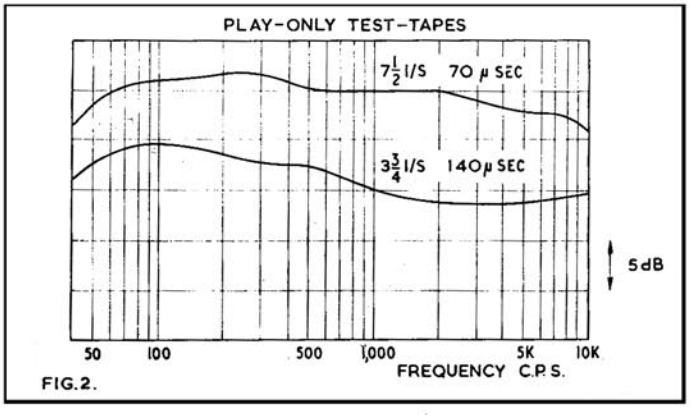


FIG.2.

a small bass rise at 3¾ i/s. The response curves are smooth and free of sharp peaks and dips due to head contour effects.

The test-tape output at the radio socket is fixed at about 0.3V and is not affected by the volume or tone controls. Noise and hum was 32dB below test-tape level at 8-10mV.

DELIBERATE UNDERBIASING

The overall record-play responses were measured by feeding fixed level oscillator tones to the radio input socket, and measuring the output at the same socket on replay. The responses at the two speeds are shown in **fig. 3.** These frequency responses are excellent and meet the maker's range specification—*but* there is some indication that they are obtained by deliberate underbiasing of the tape. The first piece of evidence was obtained immediately when I tried to record at 12dB above test-tape level—the waveform was obviously distorted at this level and had to be reduced by 5-6dB before the waveform of the 500 c/s test tone became even remotely sinusoidal. As double-play tape often has a thinner oxide layer than standard or LP tape, the test was tried again on LP tape which easily recorded +12dB level on another recorder. There was a slight improvement, but waveform distortion commenced at 7-8dB above test-tape level. Also at this level the magic eye beams were half an inch apart, showing that it had not been properly adjusted. The pre-set sensitivity control was turned fully on for maximum sensitivity but the beams were still at

(continued overleaf)

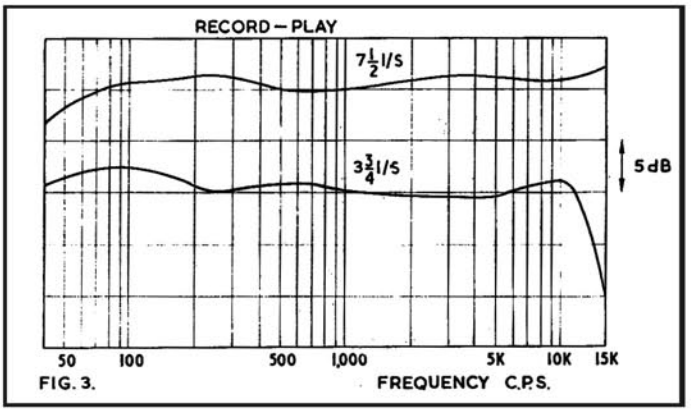


FIG. 3.

least a quarter of an inch apart at +8dB, and clashing the beams resulted in considerable tape overload.

Signal/noise ratio between maximum *undistorted* recorded signal and noise from tape erased on the machine was barely 40dB, 8dB below the specification.

The second clue to low biasing was provided by the sound quality of the high frequency noise bands ; instead of sounding like a thin silky hiss, the noise was thick and muddy, indicating that considerable intermodulation was occurring between the high frequency components of the noise giving unwanted low frequency beat products which were not in the original signal.

Twenty-five one-third octave bands of filtered white noise were recorded on the machine at 7½ i/s and the sound level measured on the axis of the RH speaker. The resultant response is shown in **fig. 4.** The dotted curve was obtained with the tone control switch in the top cut position.

COMMENT

A very interesting machine mechanically, with extremely good tape transport. Electrically, the tests demonstrate once again that there is much more to the design of a recorder than the provision of a very wide frequency response, and that low distortion and intermodulation are the factors which contribute the effortless cleanness which is the hall-mark of the well designed semi-professional recorder. It also explains why professional specifications are so modest in their frequency response claims, and why a wide frequency response is obtained by using a higher tape speed.

The overall acoustic response of **fig. 4** demonstrates very convincingly that there is little point in striving for a very extended electrical response if it cannot be passed on to the listener's ear. The high frequency cut-off was probably arrived at empirically by choosing loudspeakers which made the 'super wide range' sound tolerable by filtering out the harmonic products produced by tape overload and intermodulation. How much better it would have been to have doubled the bias and started with a clean signal from the tape, even if the high note response fell above 7½ Kc/s at 7½ i/s and 3¾ Kc/s at 3¾ i/s!

A. Tutchings.

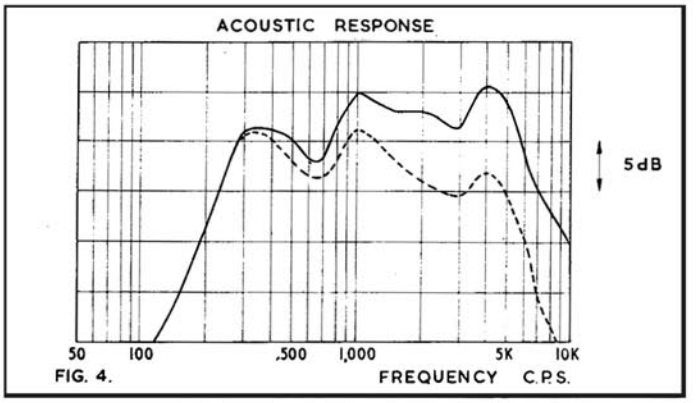


FIG. 4.

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 1965 issue must reach these offices by 27th NOVEMBER addressed to: The Advertisement Manager, Tape Recorder, Link House, Dingwall Avenue, Croydon, Surrey.

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

FOR SALE

Grundig Stereo Model TK46 3 speed, 4 track, with stereo mic. Cost £118/13. Very little used. In showroom condition. Accept £75. Also £90 stereo speaker outfit, snip at £45. Phone Putney 9950 evenings.

Modified three-speed Collaro studio recorder, fitted with ½ and ¼-track heads. Price £25 including accessories. Box No. 373 (Southend). (nc)

Ficord 1A, 2 speed semi pro recorder, batteries, charger, Grampian D.P.4 microphone. £38. CUN 6959 after 6 p.m.

TAPE EXCHANGES

Limited number of Members now admitted to Britain's largest, friendliest Tape Exchange, "WORLDWIDE TAPETALK", 35 The Gardens, Harrow, Middlesex. S.A.E. for particulars.

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 : PADdington 5521.

Highest cash prices offered for good quality Tape Recorders and Hi-Fi. See our ad. page 438 this issue. R.E.W., 266 Upper Tooting Road, London, S.W.17.

STUDIO FACILITIES

Discs cut, all speeds, from your TAPE. REDUCED PRICES. Microgroove 7″ 17/6, 10″ 37/6, 12″ 43/-. SATISFACTION GUARANTEED. West Herts Sound Recording, 9 Tring Road, Northchurch, Berkhamsted, Herts.

TAPE TO DISC

Tape to Disc service, editing, and dubbing, all speeds. Studio available for musical groups. Outside recordings our speciality. Ilford Sound Recording Service, 63 Aintree Crescent, Barkingside, Ilford, Essex. Phone : CRE 8947 and GRA 5107. S.A.E. for list.

Rapid Recording Service, 78s and L.Ps. from your own tapes. (48-hour service.) Master Discs and pressings. Recording studio. Mobile recording van. Manufacturers of the Sleep-o-Matic Unit. Foreign language courses available for sleep-learning. Brochures and price lists on request from : Dept. T.R.21, Bishops Close, London, E.17.

Tape to Disc Recordings. Finest professional quality, 10in. L.P. 42s. (32 min.), 12in. L.P. 48s. (45 min.), 7in. E.P. 21s. 48-hour Postal Service. S.A.E. for leaflet to : Deroy Sound Service, 52 Hest Bank Lane, Hest Bank, Lancaster.

continued on page 470

— YOUR TAPE DEALER —

Staffordshire

Audio Electronics (Midlands) Ltd.
Specialists in Dictation Mcs., Tape Recorders, Inter Com., Tapes and Accessories
Full After Sales Service on all Equipment
PHILIPS, GRUNDIG, TRUVOX, UHER, ETC.
203 STAFFORD STREET, WALSALL Tel. : 21086

Surrey

FARNHAM, SURREY
The finest selection of Tape Recorders, Hi-Fi Equipment and quality Radiograms in the Provinces is awaiting you at:—
LLOYD & KEYWORTH LTD
26-27 Downing Street, Farnham, Surrey. *Telephone:* 5534
Comparative Demonstrations, Large stock of Cabinets and Pre-Recorded Tapes.

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, *ADDiscombe*
CROYDON 1231/2040

Sussex

WORTHING, SUSSEX
Stocking Ferrograph, Revox, Sony, Tandberg, Truvox, Philips, EMI, Luxor, etc., on fully comparative Demonstrations
BOWERS & WILKINS LTD.
1 Becket Bldgs., Littlehampton Road, Worthing 5142

NEW PREMISES
NEW PREMISES
NEW PREMISES 132 montague street telephone 2585
CRAY
CRAY OF WORTHING LTD

WORTHING TAPE RECORDER CENTRE
22 NEW BROADWAY, TARRING ROAD,
WEST WORTHING, SUSSEX
TAPE AND HI-FI SPECIALISTS
Agents for Vortexion, Ferrograph, Fi-Cord, Truvox, Philips, Revox, Butoba, Wyndsor, Elizabethan, Brenell, Loewe-Opta, Grundig, Leak, Quad, Reslo, Armstrong, Shirley, S.T.C., E.M.I., Uher.
REPAIRS . TERMS . EXCHANGES
Telephone : Worthing 9260

Warwickshire

COVENTRY & DISTRICT CO-OPERATIVE SOCIETY LTD.
HIGH FIDELITY SOUND EQUIPMENT TASTEFULLY DISPLAYED FOR YOUR "BROWSE AROUND" ENJOYMENT
All leading makes : Amplifiers, Control Equipment, Loud-speakers, Cabinets, Tuners, Microphones, Tape Recorders and Ancillary Items in stock or quickly obtainable.
Coventry & District Co-operative Society Ltd., High Fidelity Sound Section, Electrical Dept., First Floor, Central Premises, Corporation Street, Coventry. Tel. Coventry 24031-10 lines

BIRMINGHAM Tel. HIG 4182/CAS 3546
COLIN G. TURNER, M.I.P.R.E.
SALES AND SERVICE
Comparison demonstrations daily. Truvox, Brenell, Sony, Grundig, Cossor, Luxor, Tandberg, etc. Also Hi-fi by Quad, Leak, Trio, HMV, Rogers, ADC, KEF, Braun and others.
39 YORK ROAD · KINGS HEATH · BIRMINGHAM
Mail Order · Export · Personal

CLASSIFIED ADVERTISEMENTS

TRADE

Lafayette Tape. Polyester : 7in. 2400ft. 22/6, 5½in. 1800ft. 20/-, 1200ft. 14/-, 7in. 1800ft. 19/-, 7in. 1200ft. 12/-. Acetate : 7in. 1800ft. 14/9, 5in. 900ft. 10/6, 5in. 600ft. 8/-. P. & P. 2/-. Refund guarantee. S.A.E. list. Leda Tapes, 27 Baker Street, W.1. WELbeck 0441/2.

A Unique Buy ! Recording tape, top brand. 7in. 2400ft. D.P. 25/-, 5½in. 1200ft. 19/6, P. & P. 1/6 per spool. Bargains in all sizes. S.a.e. for list. We repair, buy and sell recorders. E. C. Kingsley & Co. Ltd., 132 Tottenham Court Road, London, W.1. EUSton 6500.

Pre-recorded tapes. Unique complete catalogue listing all makes, mono, stereo, 7½ and 3¾ i/s including World Record Club tapes. Call for free copy or send 1s. mailing fee. Dept. T.R.3, Teletape Ltd., 33 Edgware Road, W.2. Phone : PAD 1942.

Speedy and Expert Tape Recorder and Hi-Fi repairs by England's leading Hi-Fi Specialists. Telesonic Ltd., 92 Tottenham Court Road, London, W.1. MUS 8177.

Pre-sleep Study. Learn difficult lessons or parts or improve your mental powers while you sleep ! Send now for price list of materials; including the perfect tape machine, time switch, pillow speaker, endless tape cassettes, pre-recorded tapes for learning or therapy, language courses, etc. Psychology Tapes Ltd. (TR), 16 Kings College Road, London, N.W.3. PRI 3314.

Lees of Dover for all your requirements in Hi-Fi, tape-recorders, components. 6 London Road, Dover.

If quality matters consult Sound News Audio Supply for better terms. 60 page photographically illustrated Hi-Fi catalogue 4s. 6d. Part exchange, servicing. Your precious tapes transferred to unbreakable L.Ps by specialists. Specify requirements. 10 Clifford Street, London, W.1.

Woollett Electrostatic Treble Units for use in your own enclosure 12 gns. and 14 gns. L. G. Woollett & Co. Ltd., 21 Anerley Station Road, S.E.20.

— TAPE TO DISC SERVICES —

The following are members of the Association of Professional Recording Studios who can be relied on to give satisfaction

MJB RECORDING & TRANSCRIPTION SERVICE

specialise in the production of microgroove records from Professional and Amateur recordings (Acetate copies ; Mono and Stereo pressings). Extended playing times achieved by controlled cutting techniques. Studio, Mobile, "Off the Air" and all recording services. Detailed booklet available.

7 HIGH STREET, MAIDENHEAD (Tel: 25630)

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

MAGNEGRAPH

1 Hanway Place, London, W.1. *Tel. : LAN 2156*

— YOUR TAPE DEALER —

Wiltshire

SOUTHERN ENGLAND

HI-FI AND RECORD CENTRES

J. F. SUTTON

SALISBURY — 18 QUEENS STREET

SOUTHAMPTON — 421 SHIRLEY ROAD

Yorkshire

SHEFFIELD HIGH FIDELITY

HI-FI EQUIPMENT AND TAPE RECORDERS

FULL DEMONSTRATION FACILITIES
SPECIALIST REPAIR SERVICE
ALL LEADING MAKES STOCKED

Tel. 20588 — 10 WEST STREET, SHEFFIELD, 1

TAPE RECORDER CENTRE (HALIFAX)

Stock all the best Tape Recorders; Hi-Fi Equipment; Tape; L-P Records, etc.

DEMONSTRATIONS DAILY BY EXPERT STAFF
2 years FREE SERVICE ON NEW RECORDERS over £35

30 King Cross Street, Halifax. 'phone 66832

Scotland

Edinburgh's TAPE RECORDER specialist

Ferrograph—Grundig—Telefunken—Philips, etc.
W. G. Graham, Assoc. Brit. I.R.E.

Tape to Disc Recording Service

Agent for The Famous Heathkits.

Hi-Fi Corner

1 Haddington Place, EDINBURGH.

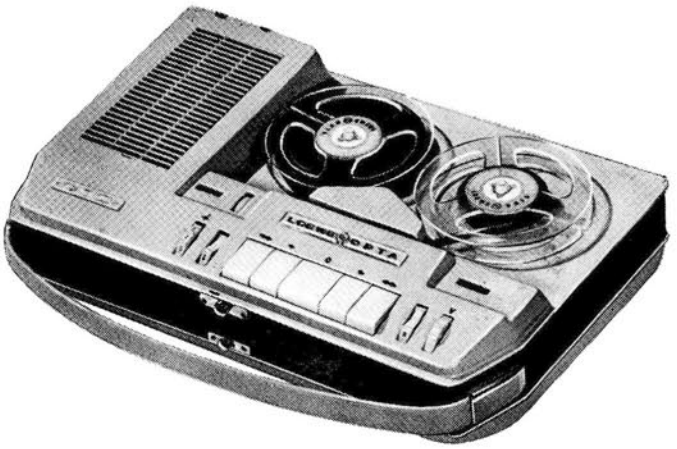
Phone WAV 7901

ADVERTISERS' INDEX

LOEWE OPTA

Hi-Fi Tape Recorders

FOR PERFECTION IN SOUND



OPTACORD 414

With the first-ever high frequency motor ensuring long life and constant speeds. Unsurpassed for a portable tape recorder. Single speed $3\frac{3}{4}$ ips. Twin Track. For use on mains, batteries and car batteries.

47 GNS.

OPTACORD 414 DIA

As the OPTACORD 414, with built-in Synchronisation with Automatic Slide Projector.

57 GNS.

THREE-IN-ONE

MAINS—BATTERIES—CAR BATTERIES

HIGHGATE ACOUSTICS

Telephone: MUSeum 2901/5

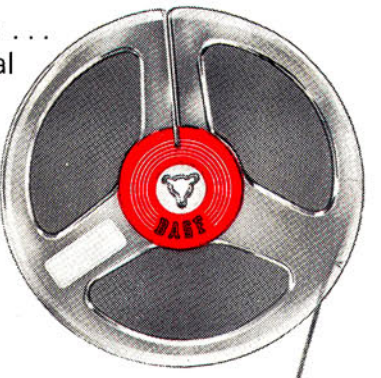
71/73 GT. PORTLAND STREET, LONDON, W.1

Approved Loewe-Opta Stockists

Alexanders, Holburn St., Aberdeen.	Bristol & Cardiff Tape Recorder Centres.	Gilbert Pianos Ltd., 37 Southchurch Road, Southend.	Joplings Ltd., John Street, Sunderland.	Piercy's, 63 Lupus Street, S.W.1.	G. H. Steel, 141 St. Georges Road, Glasgow.
J. J. Allen Ltd., The Quadrant, Bournemouth.	A. Brown & Son Ltd., 24/28 George Street, Hull.	Grimes Ltd., King Street, Wigan, Lancs.	Kendal Milne & Co., Deansgate, Manchester 3.	Rackhams Ltd., Corporation Street, Birmingham 2.	Tape Recorder Centre, 82 High Holborn, W.C.1.
Arding & Hobbs Ltd., Clapham Junction, S.W.11.	*Brown, Muff's* BRADFORD 1	Guildhall Tape Recorders, 33 Guildhall Street, Folkestone.	John King (Films) Ltd., Film House, East Street, Brighton 1.	Recording Machines Ltd., 119 Victoria Street, S.W.1.	Tape Recorder Centre, 30 King Cross Street, Halifax.
Audiocraft, 20 Kettering Road, Northampton.	Camera Thorpe, 6/8 Osmaston Road, Derby.	J. E. Hargreaves Ltd., 1 Railway Road, Blackburn.	R. S. Kitchen Ltd., 22 King Edward Street, Leeds 1.	Tom Reekie Ltd., 10 Bridge Street, Stafford.	J. H. Tate & Co. Ltd., 45 Crowtree Road, Sunderland.
Barkers Ltd., 31 Oxford Road, Worthing.	Campkins Audio, 21 Market Street, Cambridge.	Harveys, High Street, Guildford, Surrey.	Lancashire Hi-Fi Ltd., Tape Centre, 8 Deansgate, Manchester 3.	REW Earlsfield, 266 Upper Tooting Road, S.W.17.	Tele-Sales & Service Ltd., 9 Alexandria Drive, St. Annes, Lancs.
Barretts of Canterbury.	Chelsea Record Centre, 203 Kings Road, S.W.3.	Hamilton Electronics, 35 London Rd., Southampton.	Leech & Haig Ltd., 112 London Road, Oxford.	Ryland Huntley, 15 Old Bond Street, Bath.	Teletape, 33 Edgware Road, W.2.
Battys (Rhyl) Ltd., Rhyl (Tel. 2621).	Chiesmans Ltd., Lewisham, S.E.23.	J. Harris, 231 Baker St., N.W.1.	Massey's, 121/3 High Rd., Chiswick, W.4.	Selfridges Ltd., Oxford Street, W.1.	The Recorder Co., 188 West End Lane, N.W.6.
Wilf Plant, Asfordby, Melton Mowbray, Leics.	City & Essex Tape Recorder Centres, 228 Bishopsgate, E.C.2.	House & Son Ltd., Blake Street, York.	James McKenzie Ltd., Grange Road West, Birkenhead.	Sheen Tape Recorder Centre, 8 Station Parade, Sheen, S.W.14.	Turners Photographic Ltd., 9 The Walk, Ipswich.
Bon Marche, Northgate Street, Gloucester.	Courtney Davies, 12 Station Road, Harpenden.	Howard Tape Recorders, 218 High Street, Bromley, Kent.	Misons, Hi-Fi Specialist, Citadel Row, Carlisle.	Sheffield High Fidelity, 10 West Street, Sheffield 1.	Radio Maintenance (Leicester) Ltd., 111 Queens Road, Leicester.
Leonard Booth, 35 South Street, Eastbourne.	Croasdales (Nelson) Ltd., 41 and 58 Every Street, Nelson, Lancs.	R. H. O. Hills Ltd., Bank Hey Street, Blackpool.	Nicholsons Ltd., High St., Bromley, Kent.	J. Smith & Son, 184 The Rock, Bury, Lancs.	Lloyd & Keyworth, 26 Downing Street, Farnham.
Bourne Radio, 4 Albert Road, Bournemouth.	Dingles, Royal Parade, City Centre, Plymouth.	Imhofs Ltd., New Oxford Street, W.C.2.	Olympic Electronics, 40 Queensway, W.2.	Stanwood Radio Ltd. (All Branches).	Bristol-Hi-Fi, 28 Upper Maudling Street, Bristol.
LOEWE OPTA	Francis of Streatham, 169 Streatham High Road, S.W.16.	Jones & Higgins, 1-41 Rye Lane, Peckham, S.E.15.	Paish & Co., 130 Union Street, Torquay.	Sport & Radio, 26/29 Aldwich Road, Bognor Regis.	J. W. Mansfield, 18 Liverpool Road, Worthing.

BASF

BASF Tapes. Make pleasure permanent . . . faithfully . . . with BASF tapes. Technical perfection in reproduction . . . in fact wherever there is sound, BASF can capture it . . . hold it for all time . . .



— SYMBOL OF AUTHENTIC SOUND

BASF

BASF Chemicals Limited 5a Gillespie Road London N5 Tel: CANonbury 2011