APRIL 1968 2s 6d

tape recorder

TESLA-A TALE OF NEW BOHEMIA

DROPOUT-CAUSE AND CURE

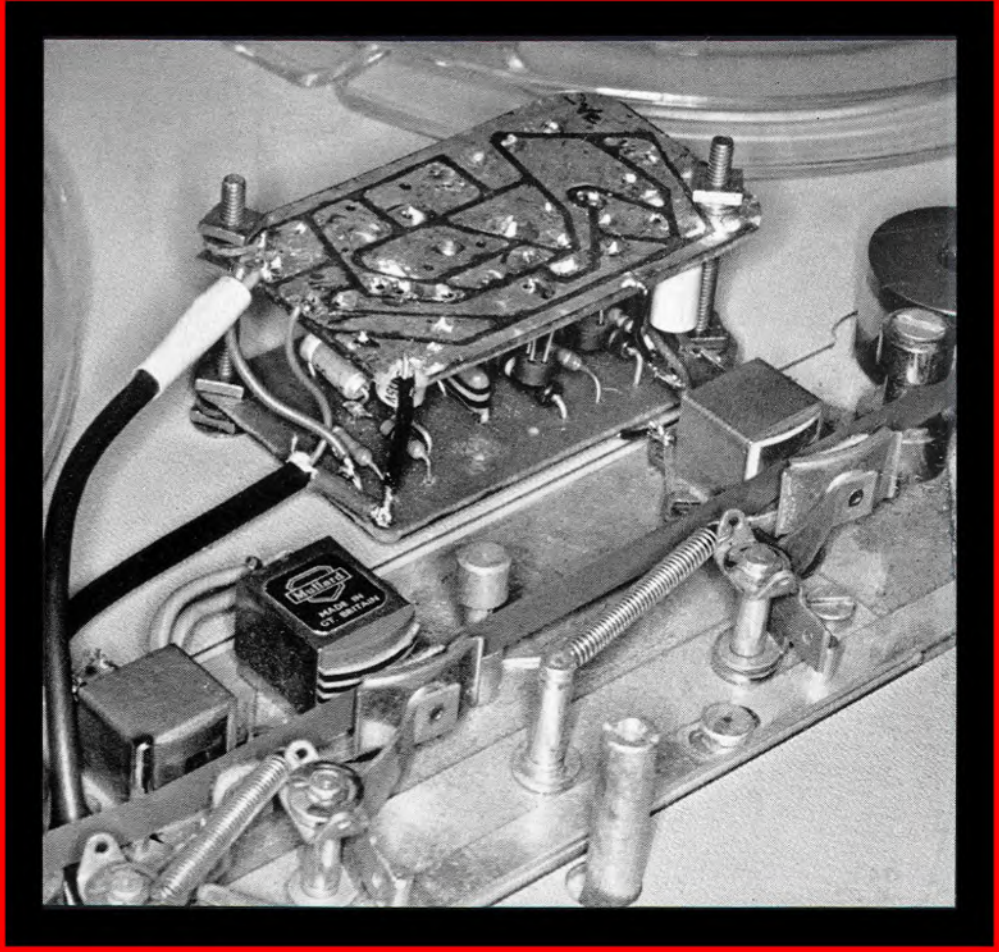
EVOLUTION OF A TAPE SYSTEM

SONY TC-530 REVIEW

SERVICING THE VAN DER MOLEN VR7

PETER BASTIN ON THE MOVE

TAPE TRANSPORT MECHANISMS



Slow slow quiet quiet slow

Quite.

'Scotch' Low-Noise 'Dynarange' tapes reduce background noise.

They also increase your dynamic range.

And improve your frequency response.

So you can reduce recording speeds if you want.

In fact you can *halve* them. Without losing quality.

So you save money, even though you pay a bit more.

Or you can exploit that increased dynamic range and improved frequency response.

And make the best recordings you've ever heard in your life.

202 STANDARD PLAY
sizes: 5″, 5¾″ and 7″
203 LONG PLAY
sizes: 5″, 5¾″, 7″ and 8¼″

For Price List of the full 'Scotch' range with technical details, write to: G. C. Wride, Magnetic Products Division, 3M Company, 3M House, Wigmore Street, P.O. Box 1.E.T., London, W.1.

Scotch 3M DYNARANGE

3M, 'Scotch' and 'Dynarange' are trademarks of Minnesota Mining and Manufacturing Company.

HEATHKIT EXHIBITION OF HI-FI
(Concurrent with the 1968 Audio Festival)
GRAND HOTEL,
SOUTHAMPTON ROW, LONDON.

Thursday, Friday, Saturday and Sunday, April 18th-21st, 11 a.m.-9 p.m. (Sun. 8 p.m.). See what's new on the audio scene.

HEATHKIT offer wonderful value in their Latest Stereo Portable Tape Recorder, STR-1

Send for full leaflet.

only £45/18/0 kit

Ready-to-use £59/15/0

FOR THIS SPECIFICATION

● ¼ track stereo or mono record and playback at 7½, 3¾ and 1⅞ ips ● Sound-on-sound and sound-with-sound capabilities. ● Stereo record, stereo playback, mono record on either channel. ● 18 transistor circuit for cool, instant and dependable operation. ● Moving coil record level indicator. ● Digital counter with thumbwheel zero reset. ● Stereo microphone and auxiliary inputs and speaker/headphone outputs . . . front panel mounted for easy access. ● Push-button controls for operational modes. ● Built-in audio power amplifiers giving 4 watts rms per channel. ● Two high efficiency 8" x 5" speakers. ● Operates on 230V AC supply.

STR-1 SPECIFICATION: Tape Speeds: 7½, 3¾ and 1⅞ **ips. Wow and Flutter:** Better than 0.15% rms on 7½ ips; 0.25% rms on 3¾ ips; 0.35% rms on 1⅞ ips. **Tape Size:** ¼" wide, Long or Standard play. **Reel Size:** Standard, up to 7"/5¾" spools and tape supplied. **Digital Counter:** 3 digit counter with zero reset. **Heads:** ¼ track erase record and playback. **Microphone:** Moving coil hand microphone (mono) supplied. **Semi-Conductor complement:** 18 transistor, 1 silicon bridge rectifier. **Frequency response:** 3 dB, 40 c/s to 18 Kc/s at 7½ ips. 3 dB, 40 c/s to 12 Kc/s at 3¾ ips. 3 dB, 40 c/s to 7½ Kc/s at 1⅞ ips. **Signal to noise ratio (unweighted):** Better than 40dB. **Inputs per channel:** Microphone 0.35 mV. Auxiliary 50 mV. **Outputs per channel:** 4 watts rms into 15 ohms. 1 volt rms (1,000 ohm source). **Speakers:** Two, high efficiency 8" x 5" pm 15 ohms. **Power requirements:** 200-250V AC, 50 c/s, 60 watts. **Cabinet:** Materials, 9mm. plywood covered with two tone Rexine with chrome fittings. **Dimensions:** 19½" wide x 7⅞" high x 15½" deep.

Latest 12 + 12 watt Stereo Amplifier

TSA-12 (Fully transistorised)

Kit £30.10.0 Ready to use £42 10 0

Optional extras: Walnut veneered cabinet, Part No. 91-508 ... £2 5 0
Trim and mounting Brackets for panel mounting GMK-1 ... ... £1 18 0

● 17 transistors, 6 diode circuit ● ± 1dB, 16 to 50,000 c/s at 12 watts per channel into 8 ohms ● Output suitable for 8 or 15 ohm loudspeakers ● 3 stereo inputs for Gram, Radio and Aux. ● Modern low silhouette styling ● Attractive aluminium, golden anodised front panel ● Handsome assembled and finished walnut veneered cabinet available ● Matches Heathkit models TFM-1 and AFM-2 transistor tuners.

TSA-12 SPECIFICATION: Recommended speaker systems: Cotswold MFS, Berkeley, Avon, SSU-1. **Power Output:** 12 watts rms per channel, 8 ohm loads, 8 watts rms per channel, 15 ohm loads. **Hum and Noise:** Gram.—500 dB. Radio—60 dB Aux.—60 dB. **Power Response:** 16 c/s to 50 Kc/s, ± 1 dB, 8 c/s to 85 Kc/s, ± 3 dB. **Input sensitivity and Impedance:** Gram. 5 mV rms. 47 K ohm, Radio 300 mV rms, 180 K ohm. Aux. 300 mV rms, 180 K ohm. **Channel separation:** 45 dB or better. **Harmonic distortion:** (at rated output) 1% or less, 20 c/s to 20 Kc/s. 0.5% or less at 1 Kc/s. **Semi-conductor complement:** 17 transistors, 6 diodes. **Outputs:** 8 and 15 ohm. **Controls:** 6-position source switch, balance control, volume control with switch, bass and treble controls, input level controls. **Power requirements:** 100-125, 200-250 volts, 50-60 c/s, 60 watts at full output. **Dimensions:** 15 5/16" wide x 3¾" high x 10" deep.

Attractive low silhouette styling, compact size 3¾" high x 15¾" wide x 10" deep, looks sleek and modern. Use free standing or house in a cabinet.

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Demonstrations of Hi-Fi by arrangement

Please send me **FREE CATALOGUE** (Yes/No).....
Details of models.....
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ADDRESS: .....
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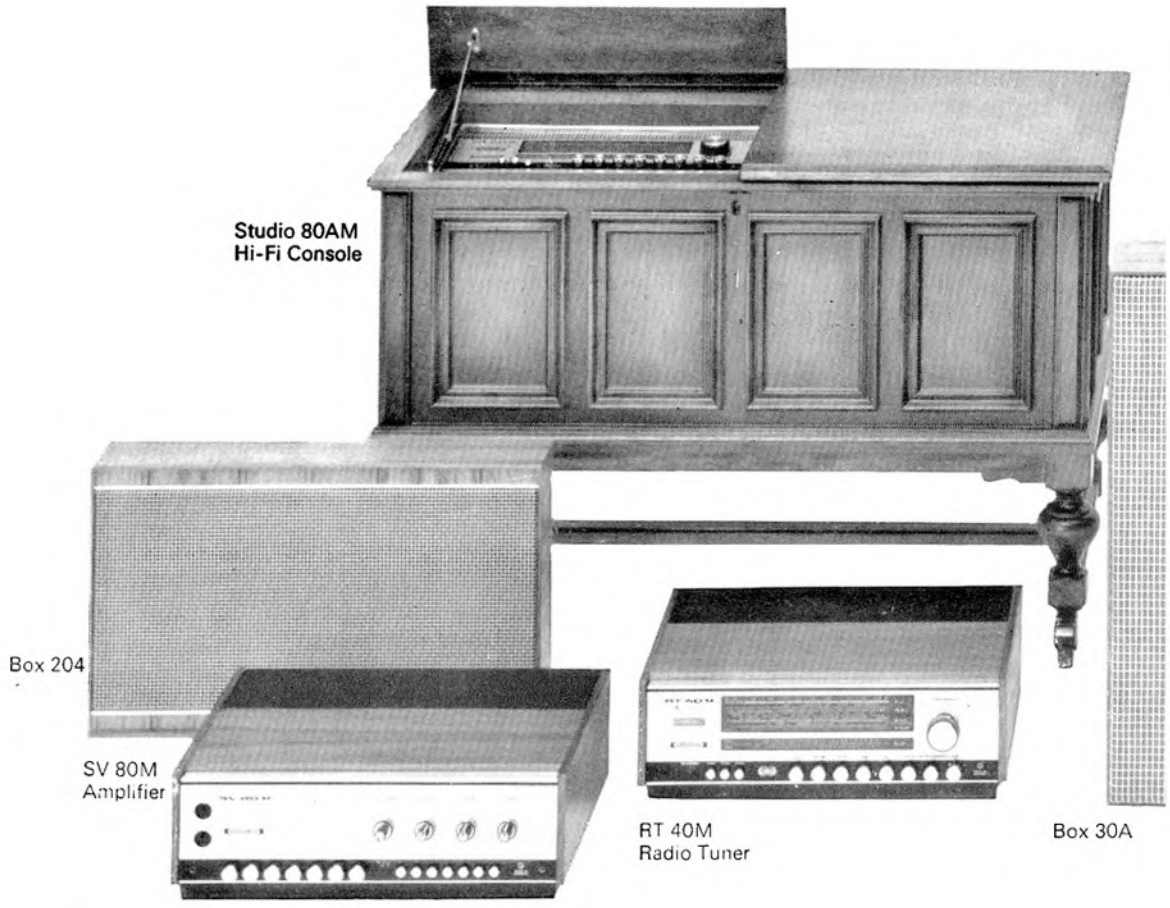

This year, at the Audio Fair, you'll see a lot of Grundig...

...if you can get through the crowds!

April 18-21, at the Hotel Russell, London... your chance to see the full exciting range of Grundig Hi-Fi equipment, at the 1968 Audio Fair. There'll be a Grundig Booth on the ground floor (Booth No. 69), and you'll *hear* Grundig in action in our Demonstration Room on the sixth floor (Room 634). Feel free to browse around, taking a close look at what must surely be the most comprehensive range of precision sound equipment ever offered by one manufacturer.

Our experts will be on hand to answer all your questions, so come along, we've a lot to show you.

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GRUNDIG, London, S.E.26

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BRITAIN'S PREMIER MAIL-ORDER RECORDING TAPE SPECIALISTS

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20% OFF

BASF - EMI - GRUNDIG PHILIPS - SCOTCH AGFA - KODAK

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

	LIST PRICE	OUR PRICE
STANDARD PLAY		
5" 600' }	21/-	16/10
5¾" 900' } Except Agfa	28/-	22/6
7" 1200' }	35/-	28/-
LONG PLAY		
3" 210' Not Scotch or Kodak	9/-	7/3
3" 300' Scotch only	9/6	7/6
3½" 300' Kodak only	12/-	9/6
4" 450' Except Kodak	14/6	11/8
4½" 600' BASF, Agfa only	21/-	16/10
*5" 900'	28/-	22/6
*5¾" 1200'	35/-	28/-
*7" 1800'	50/-	35/-
8½" 2400' BASF, Scotch only	72/6	58/-
10" 3280' Agfa only	85/-	68/-
10" 3600' BASF only	95/-	76/-
10½" 4200' Agfa, BASF only	112/-	90/-
SCOTCH DYNARANGE (L/P)		
5" 900'	32/3	25/10
5¾" 1200'	40/6	32/6
7" 1800'	57/6	46/-
8½" 2400'	83/6	66/10
COMPACT CASSETTES		
C. 60	17/6	14/-
C. 90	25/-	20/-
C. 120	33/6	27/-

	LIST PRICE	OUR PRICE
DOUBLE PLAY		
3" 300' Not Kodak or Scotch	14/-	11/3
3" 400' Scotch only	16/6	13/2
3½" 400' Kodak only	18/9	15/-
4" 600' Not Kodak	25/-	20/-
4½" 900' Agfa, BASF only	30/-	24/-
5" 1200'	42/-	33/8
5¾"1650' Kodak only	57/6	46/-
*5¾"1800' Not Kodak	55/6	44/6
*7" 2400'	77/6	62/-
10" 4600' Agfa only	140/-	112/-
TRIPLE PLAY		
3" 450' Not Scotch	22/-	17/8
3" 600' Scotch only	24/9	19/6
3½" 600' Kodak only	30/-	24/-
4" 900'	39/-	31/3
*4½"1200' Agfa, BASF only	49/-	39/3
5" 1800' Not Scotch	66/-	52/10
5¾"2400' Agfa, BASF,	90/-	72/-
7" 3600' Kodak only	115/-	92/-
QUADRUPLE PLAY		
3" 600' }	36/6	29/6
3½" 800' } Kodak only	46/-	37/-
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GRUNDIG TAPE AVAILABLE ONLY WHERE MARKED WITH ASTERISK

Postage and Packing 2/- ORDERS OVER £3 POST FREE

FERROGRAPH TAPE—20% OFF!

Brand New. Fully guaranteed and in normal manufacturer's pack.

	LIST PRICE	ONE	THREE	SIX
BN7 1,200' on 7" reel (Dynarange)	50/-	40/-	117/6	230/-
BN8 1,800' on 8½" reel (Dynarange)	71/-	57/-	168/-	330/-
BL7 1,800' on 7" reel (Dynarange)	70/-	56/-	165/-	324/-
BL8 2,400' on 8½" reel (Dynarange)	90/-	72/-	213/-	420/-

7" metal reels 9/-, 8½" metal reels 10/6

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ILFORD TAPE near HALF PRICE

A bulk purchase of premium grade, top quality POLYESTER MAGNETIC TAPE from one of the world's foremost experts in film coating technology. With FULL LEADER stop foil, Polythene wrapping, and in original manufacturer's boxes. Available in long-play base only at these BARGAIN PRICES.

	ONE	THREE	SIX
900' on 5" reel. List price 28/-	16/6	48/-	90/-
1,800' on 7" reel. List price 50/-	32/6	95/-	180/-

Please add 2/- P. & P. ORDERS OVER £3 POST FREE

SENSATIONAL NEW HALF-PRICE OFFER!

A bulk purchase of top quality Recording Tape manufactured by one of the Country's leading makers. A polyester based tape with superlife black coating. Polythene wrapped, boxed, and fully guaranteed. Available while stocks last in one size only.

		NORMAL VALUE	ONE	THREE	SIX
1,800' on 7" reel.	Long Play	50/-	26/6	78/-	150/-

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AMPEX TAPE

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

'500' SERIES AUDIO TAPE (MYLAR BASE)

TYPE	DESCRIPTION	LIST PRICE	ONE	THREE	SIX
541-9	900' Long Play on 5" reel	28/-	21/-	61/6	120/-
541-12	1,150' Long Play on 5¾" reel	35/-	28/-	82/6	162/-
541-18	1,800' Long Play on 7" reel	50/-	32/6	96/-	189/-
551-12	1,200' Double Play on 5" reel	42/-	35/-	103/6	204/-
551-16	1,650' Double Play on 5¾" reel	56/-	45/-	133/6	264/-
551-24	2,400' Double Play on 7" reel	72/6	55/-	163/6	324/-

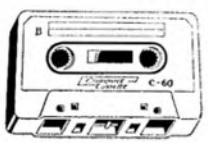
'600' SERIES PROFESSIONAL AUDIO TAPE (MYLAR BASE)

641-9	900' Long Play on 5" reel	30/6	23/-	66/6	127/6
641-18	1,800' Long Play on 7" reel	52/6	39/6	116/-	226/-
651-12	1,200' Double Play on 5" reel	46/-	34/6	101/-	197/-
651-24	2,400' Double Play on 7" reel	80/-	60/-	177/-	348/-

Post and Packing 2/-. ORDERS OVER £3 POST FREE.

N.B. Other types and sizes available including the inexpensive "White Box" series

SPECIAL OFFER COMPACT CASSETTES



"MC 60" & "MC 90"

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

OUR PRICES

"MC 60"	"MC 90"
1 for 13/-	1 for 18/6
3 ,, 38/3	3 ,, 54/-
6 ,, 75/-	6 ,, 105/-
12 ,, 144/-	12 ,, 204/-

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

Post and Packing 2/-. *ORDERS OVER £3 POST FREE*

BASF TAPE — 30% REDUCTION

A Special Offer of the famous Premium Grade BASF Tape. Brand new, boxed with Full Leader, stop foil and "Polythene sealed". Multiples of three 4" D/P 600' size can be supplied in the BASF 3 compartment plastic library cassettes at no extra cost.

TYPE	DESCRIPTION	LIST PRICE	ONE	THREE	SIX
LGS26	600' D/P 4" reel	25/-	17/-	49/-	93/-
LGS26	1200' D/P 5" reel	42/-	29/6	86/-	166/-
LGS26	1800' D/P 5¾" reel	55/-	38/6	112/6	219/-
LGS26	2400' D/P 7" reel	77/6	49/6	145/6	285/-
LGS35	1,800' L/P 7" reel	50/-	35/-	102/-	198/-

Post and Packing 2/-. ORDERS OVER £3 POST FREE.

TRIPLE PLAY TAPE — 40% OFF

A large purchase from two world renowned manufacturers enables us to make this unique near half-price offer. Brand new, fully guaranteed, premium grade Polyester Base Tape with FULL LEADER and stop foil. In original maker's boxes and polythene wrapped at these EXCEPTIONALLY LOW PRICES.

	LIST PRICE	ONE	THREE	SIX
450' on 3" reel Gevasonor	22/-	14/-	40/6	78/-
600' on 3" reel Gevasonor	27/6	17/6	51/-	99/-
900' on 4" reel Gevasonor	39/-	24/6	72/-	140/-
2,400' on 5¾" reel Zonal	90/-	55/6	165/-	324/-

Post and Packing 2/-. ORDERS OVER £3 POST FREE.

20% off all Grundig & Philips Equipment

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Our New Illustrated catalogue sent entirely free on request. Britain's most specialized comprehensive range of recording tape and accessories. 20,000 reels always in stock with reductions ranging up to 50%.

MORE FANTASTIC BARGAINS FROM K.J. ENTERPRISES

WE SAVE YOU MONEY!

SPEAKERS GALORE!

SAVE £6.10.0 on the SONOTONE SOLENT

The fabulous bookshelf speaker system designed and manufactured by PLESSEY, one of the country's largest electronics groups. An acoustically designed two-speaker system with crossover network.

ORIGINALLY SOLD FOR £18.0.0

NOW OFFERED AT £11-10-0d

CARRIAGE 10/- EXTRA PER UNIT

THIS OFFER REMAINS OPEN ONLY WHILE STOCKS LAST!

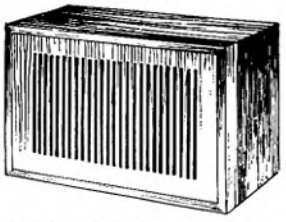
WHAT THE REVIEWERS SAID:

"Recommended without reservation for this category of loudspeaker." *David Philips and Donald W. Aldous.*

"Sonotone 'Solent' deserves to reach a wide public." *John Borwick.*

"A worthy member of the Hi-fi family." *R. L. West.*

TECHNICAL SPECIFICATION
CABINET SIZE 14" x 9" x 8½"
WOOFER 6½" 10,000 *gauss*, 1" *pole*
FREQUENCY RESPONSE 40-20,000 *cps.*
FINISH TEAK.
TWEETER 3½" *Acoustically loaded.*
POWER HANDLING 12 *watts.*
IMPEDANCE 8-15 *ohms*



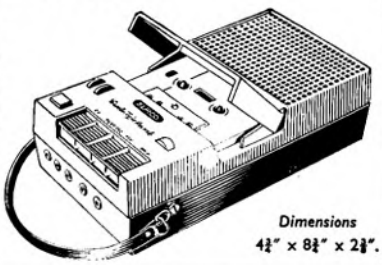
Guaranteed Brand
New in maker's carton

ALSO ANOTHER FANTASTIC PURCHASE

Compact Cassette TAPE RECORDER ONLY 17GNS.

THE ELPICO CTR 600 BATTERY CASSETTE TAPE RECORDER

Beautifully styled, pocket size recorder with "snap-in" cassette loading. Press button operation with separate volume and tone controls. Up to 120 minutes playing time on a single cassette. Weighs only 3lb. 5 oz. Supplied complete with C.60 Cassette, remote control microphone, earphone and batteries.



Dimensions
4½" x 8½" x 2½".

ORIGINAL PRICE 24 gns. Now offered to you, brand new and fully guaranteed for the sum of **£17.17.0**

plus 7/6 postage and packing.

OTHER OUTSTANDING BARGAINS IN "COMPACT CASSETTE" RECORDERS AVAILABLE FROM K.J.

Description	*List Price*	*Our Price*	*Postage & Packing*
PHILIPS 3302 Battery Tape Recorder ...	25-14-6	20-9-6	7/6
PHILIPS 3303 Battery Tape Recorder ...	30-9-0	24-7-6	7/6
PHILIPS 3312 Stereo Mains Tape Recorder ...	50-8-0	35-0-0	10/-
(With two X GL559 loudspeakers) ...	57-15-0	47-0-0	15/-
GRUNDIG C.200 (new model) Battery Tape Recorder	38-17-0	31-7-6	7/6
AIWA TP1004 Mains/Battery Stereo Tape Recorder	50-18-6	39-10-0	10/-
SANYO M.18 Battery Tape Recorder ...	24-3-0	20-12-6	7/6

A few only PHILIPS 3301 at **£18-18-0** plus 7/6 post and packing.

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A Winner

The DP4 microphone is another winner—by performance alone it has achieved world wide acclaim. It is used regularly by P.A. engineers, broadcasting and television companies, film studios, etc., as well as by many professional and amateur tape recordists. Its winning qualities have been designed and produced by Grampian—specialists for over thirty years in the field of sound equipment. We shall be pleased to send you full technical details of the DP4 and other microphones, together with descriptions of various accessories.

Specially designed to use with the DP4, in order to cut down wind noise is the Windshield — as illustrated here.

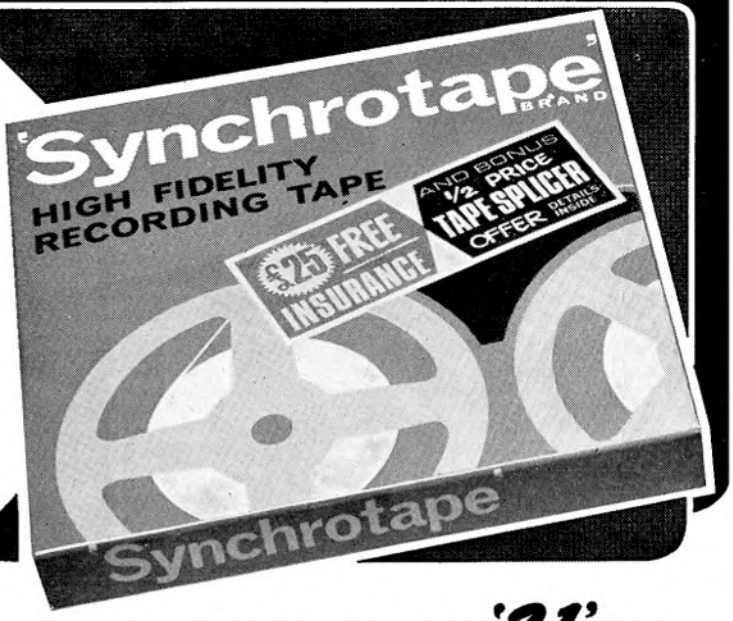
There is also the "Grampian" Parabolic Reflector. Where it is not possible to place a microphone close to the source of sound such as when making recordings of bird songs, weddings, car and train noises etc. the Parabolic Reflector has been proved over and over again to be of enormous value.

Grampian

Grampian Reproducers Ltd.,
Hanworth Trading Estate, Feltham, Middlesex.

This box contains the best value-for-money Recording-Tape you can buy . . .

Heres why . . .



*** Synchrotape costs less.**
A British-made high-fidelity Recording Tape incorporating so many "plus" features and at the most competitive price.

*** Synchrotape's quality specification.**
Only the finest quality PVC and Polyester base materials are used. No stretching, no snapping, no deterioration of recordings in storage.

*** Synchrotape is so easy to use.**
Practically all sizes have coloured leaders, trailers and metallic stop-foils. Perfect for 2 or 4 track, mono or stereo.

*** Synchrotape is unconditionally guaranteed**—against *any* defect whatsoever.

*** Synchrotape has all the extras built in.**
Film-sealed rigid boxes, colour-coded and clearly labelled . . . a 12-page booklet containing useful tape recording data and the Synchrotape Recording Log.

The Synchrotape '21' range

SIZE	STANDARD	LONG	DOUBLE	TRIPLE
BASE	P.V.C.		POLYESTER/P.V.C.	
2⅜"		200'– 5/9d.	300'– 8/9d.	
3"	150'– 4/9d.	225'– 6/3d.	300'– 8/9d.	450'– 13/9d.
4"		450'– 12/–	600'– 18/–	900'– 27/–
5"	600'– 15/–	900'– 18/6d.	1200'– 28/6d.	1800'– 45/–
5¾"	900'– 18/6d.	1200'– 22/6d.	1800'– 36/–	2400'– 57/6d.
7"	1200'– 22/6d.	1800'– 28/6d.	2400'– 48/–	3600'– 75/–

NEW Synchrotape BRAND Editing Kit . . . ONLY 29/6

NEW Synchrotape Editing Kit only 29/6. Here's big value for every tape enthusiast . . . a "must" for editing and library compiling.

Packed in a see-through, crush-proof box, the Synchrotape Editing Kit comprises: ● The Adastra "Instant Cut & Trim" tape splicer. ● 4 reels of coloured leader tapes (each reel 45 ft.) ● 1 reel of metallic stop-foil (approx. 22 ft.) ● 1 reel self-adhesive jointing tape (18 ft.) ● 6 coloured tape securing clips. ● 24 self-adhesive labels. ● Synchrotape 12-page booklet with instructions, tape recording information, technical data and recording log.

PLUS

Up to £25 Free Insurance on your tape recorder against loss by fire or theft.

Special Tape Splicer offer. Collect three coupons from Synchrotape packs and for 7/6 get a superb Adastra "Instant Cut & Trim" tape splicer.

BRITISH MADE

Synchrotape

ADASTRA ELECTRONICS LIMITED 167, Finchley Rd, London, N.W.3. (Tel: MAI: 8164/5)

Sanyo puts you in the world class

This is the Superb new MR990 stereo tape recorder

- Full fidelity
- Vertical operation
- 4 track
- Sound with sound

Tape speeds
7½ in/sec (19cm/sec)
3¾ in/sec (9.5cm/sec)
1⅞ in/sec (4.8cm/sec)

Playing time
96 min x 2 at 7½ ips
(stereo 7″ 1,200 ft. tape)
192 min x 2 at 3¾ ips
(stereo 7″ 1,200 ft. tape)
384 min at 1⅞ ips
(stereo 7″ 1,200 ft. tape)

Frequency response
7½ ips : 20–21,000 c/s
(–3db 30–16,000 c/s)
3¾ ips : 30–13,000 c/s
1⅞ ips : 30–9,000 c/s

Wow & Flutter
7½ ips : 0.15% R.M.S.
3¾ ips : 0.20% R.M.S.
1⅞ ips : 0.30% R.M.S.

Output Power
Music: 10W x 2
Undistorted : 5W x 2

Erase rate
Less than 65db

Weight
35.2 lbs (17kg)

Accessories
Microphone x 2,
Recording tape 7″,
Empty reel 7″,
Patch cord x 2,
Reel stopper x 2,
Splicing tape,
Capstan sleeve,
Microphone stand x 2.

Price to be announced

SANYO

RELIABILITY IS BUILT IN

See Sanyo at any authorised dealer. For further information write to: J. W. Cowley, Sales Manager, Electronic Equipment Division. Marubeni-Iida Co. Ltd., 164 Clapham Park Road, London, S.W.4.

We planned a SALE!

And, in fact, budget or no budget, we're having one. But stocks are moving so fast that we can't give you all the information on available bargains which we'd like. What we can do is to invite you to either of our two showrooms (come soon and come early) and tell you that if you're looking for BARGAINS, by golly you'll find 'em. We have a vast range of top quality hi-fi and tape equipment—only two or three items left of some—which simply must be cleared at "squeeze" prices. Everything on interest free terms, of course. Or if you're paying cash we could be persuaded to offer something really special by way of discount. Try us and see. We can promise real opportunities for callers.

● *TERRIFIC STOCKS!* ●

at

PRE-DEVALUATION AND
PRE-BUDGET PRICES
while stocks last

. . . but hurry!

★ Akai ★ Sony ★
★ Sanyo ★ Sansui
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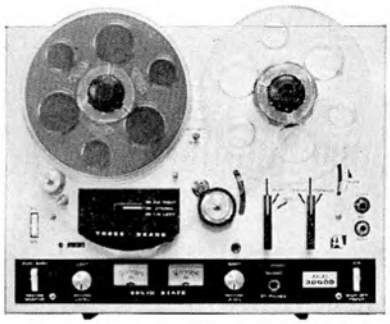

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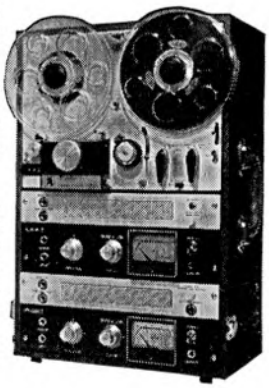

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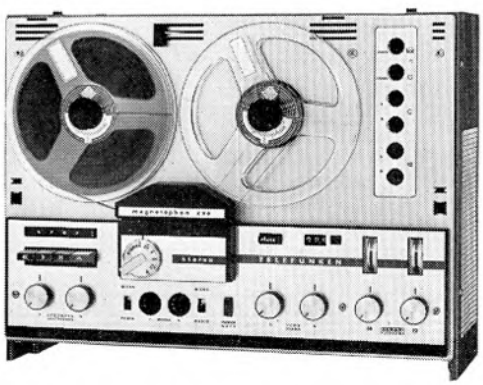

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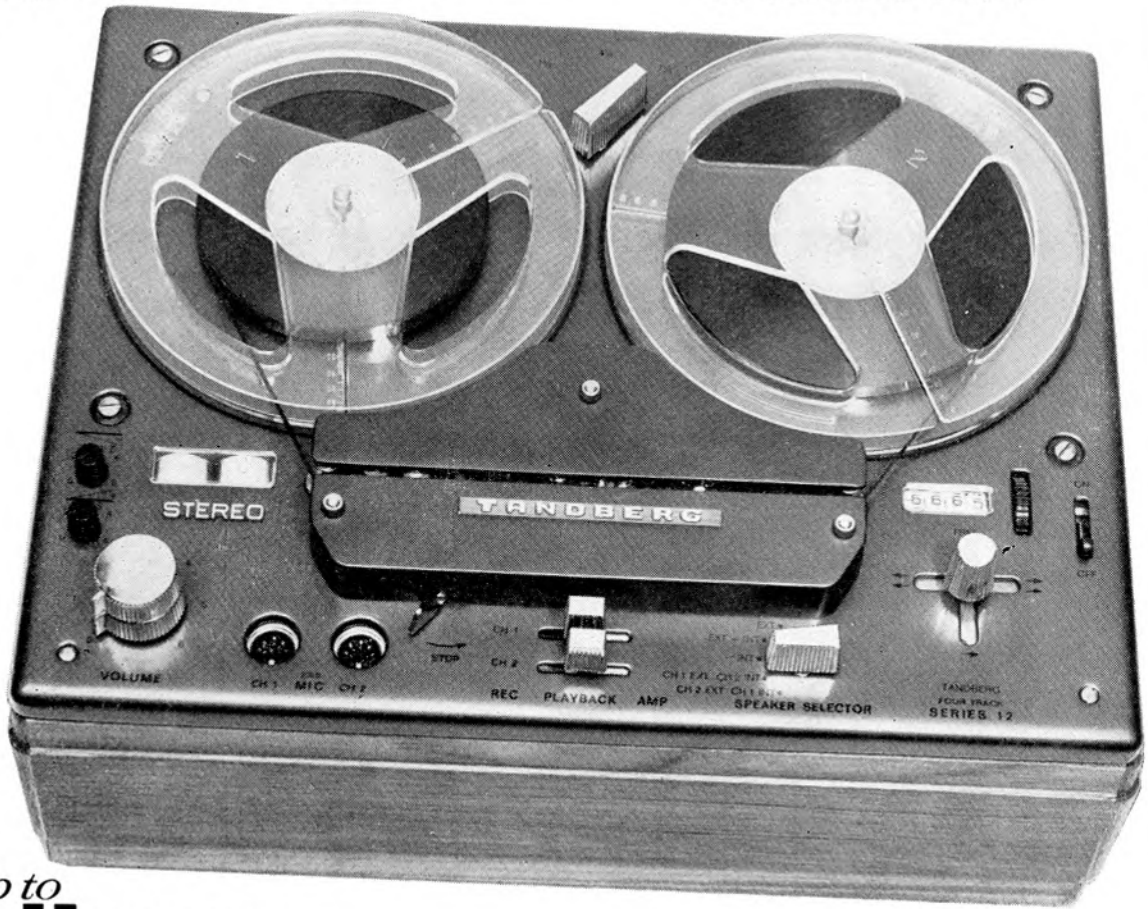

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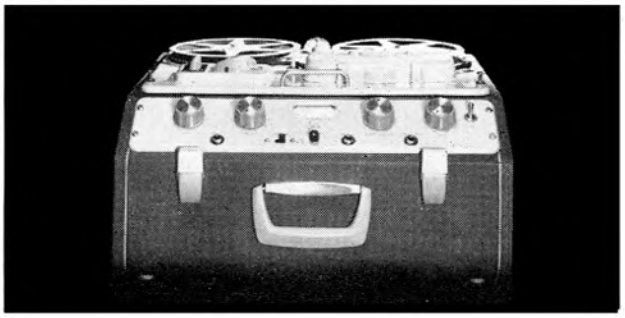

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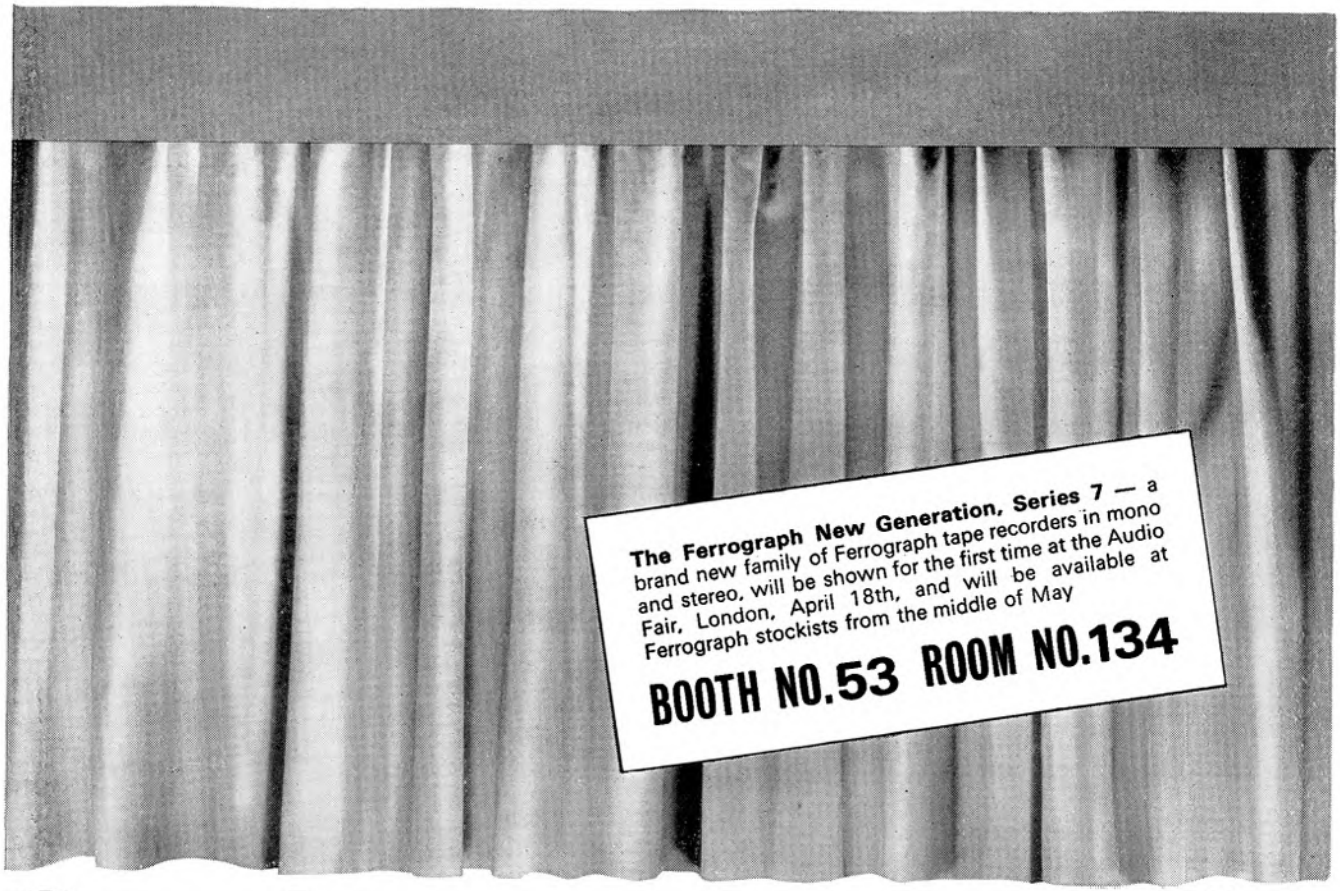

See the new Ferrographs unveiled at the Audio Fair

tape recorder

APRIL 1968 VOLUME 10 NUMBER 4

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COVER PICTURE

No prizes for identifying the deck shown in part on this month's cover. Few mechanisms lend themselves so well to modification as the *Brenell*, seen here with a stereo head preamplifier constructed by an Australian contributor, Geoffrey Nutting. A detailed account of his endeavours appears on page 164.

SUBSCRIPTION RATES

Annual subscription rates to *Tape Recorder* and its associated journal *Hi-Fi News* are 36s. and 41s. respectively. Overseas subscriptions are 38s. 6d. (U.S.A. $4.60) for *Tape Recorder* and 42s. 6d. (U.S.A. $5.10) for *Hi-Fi News*, from Link House Publications Ltd., Dingwall Avenue, Croydon, CR9 2TA.

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

IN A QUIET DOMESTIC sitting room a few friends are gathered for a musical evening. They take their music seriously, listening intently without chatter or clatter except between pieces. The host keeps his records in good condition, making consistent use of Preener and Dust Bug to minimise dust-induced background noise. Some discs have a touch of recorded hiss and others suffer from odd low frequency rumbles, and of course the occasional plop or click impairs listening pleasure; but on the whole unwanted noises do not obtrude unduly, even if they are seldom conspicuous through total absence.

One item in the programme is a tape recording of a stereo broadcast, which everyone is particularly anxious to hear as this is their first experience of two-channel radio from a London studio. The problem of tape hiss when recording music of wide dynamic range does not arise, for while the signals on some discs will these days exceed the S/N capacity of tape at domestic speeds and track widths, the more limited volume range offered by the EEC is easily accommodated. In short, there is every prospect of some excellent reproduction, with genuine silences when the conductor or the score so designate. But here is the snag, for that silence is shattered by the whine and swish of a tape recorder mechanism.

This is a true story, giving us an opportunity to comment on a rarely mentioned aspect of tape recorder design. It is true that tapists are warned from time to time about the dire consequences of using a microphone where it can pick up noises from the transport mechanism, and of course we all know that tape scrape is obviated by avoiding warped spools like the plague. It is also true that the better class gramophone turntables are practically silent in operation and would be the subject of bitter complaint if they were not. Because tape recorders have been evolved, in the main, for the active business of recording, little attention has been paid to making them operate silently: one is not particularly aware of a modest mechanical background noise while busily adjusting recording level with attention on meter or magic-eye. However, tape machines are also used for replay, frequently in relaxed, quiet, home conditions as part of a hi-fi set-up, and here the lack of silence is often (nearly always !) very obvious and irritating.

In the quest for wobble-free reproduction designers draw upon a whole panoply of pulleys, belts, clutches, bearings, motors, pads and brakes, and we applaud the results achieved on the best machines. But these 'best' models are frequently no better than their cheapest and nastiest brethren when it comes to mechanical noise, some costly units designed specially for hi-fi replay being noticeably more offensive in this respect than many battery portables. The tale at the beginning of these notes arose from use of such a tape unit, a machine with separate record and replay heads permitting direct A-B comparison of signal and recording and chosen by its purchaser because of an impressive performance in this respect. The rest of his hi-fi system was totally silent as judged from any normal listening position, but the motor hum and pulley purrings from the tape unit were immediately apparent on entering the room and could be heard whenever the music descended to pianissimo level.

This is typical of domestic and semi-professional tape recorders, and while there are honourable exceptions it must be emphasised that however good the electrical signal-to-noise ratio achieved by a machine, the radiated acoustic noise is generally far worse than that heard from a turntable. Manufacturers with an eye on the hi-fi side of tape recording should listen to some of their machines in a quiet domestic sitting room; this may be rather revealing compared with the laboratory bench.

FEATURE ARTICLES

REGULAR ITEMS

EQUIPMENT REVIEWS

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WORLD OF TAPE

ELECTRET MICROPHONE

NORTHERN Electric Laboratories of Ottawa, Canada, claim to have produced a microphone transducer based on electret phenomena, using a diaphragm that stores a more-or-less permanent electrostatic charge. Although confined at present to experimental telephone transducers, the principle is said to lend itself to high quality audio applications, particularly where long microphone leads are required. A semi-conductor amplifier giving 20 dB gain is located in the transducer unit to match the high microphone impedance to the line impedance.

BATRC JUDGING

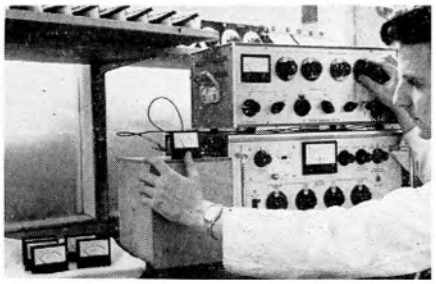
'TAPE of the Year' will be selected by British Amateur Tape Recording Contest judges in London on 20th March. A presentation party will take place at the Hotel Russell during the Audio Fair weekend.

NORTH-WEST TAPE GATHERING

"A SORT of north-west clubs get-together" has been proposed by tape recordists in the Lancashire region who are circulating questionnaires among local individuals and recording societies. Likely venues are Blackpool, Preston, Liverpool or Manchester, the actual form of the gathering remaining open to suggestion. Individuals, groups and manufacturers interested in supporting the venture are invited to contact *Mr. T. Brown, 67 Sherbourne Road, Middleton, Manchester, Lancashire.*

DC TO 40 kHz

THE first British instrumentation recorder to offer an FM bandwidth of DC to 40 kHz has been introduced by *Elliott-Automation*. A general-purpose system, the *TIR-3* has already been ordered for flight data recording, medical research and engine assessment.



SIFAM SUPPLY AMPEX METERS

THE Sifam Electrical Company of Torquay, manufacturers of *Ferrograph* peak programme meters, are now producing VU-meters for *Ampex*. They are being incorporated on the *AG-20* battery recorder developed by the Reading branch of the American corporation.

AUDAC APPOINT DISTRIBUTOR

MARKETING of *Audac* microphones and audio equipment is now being undertaken in Britain by *Audio & Design Ltd., 40 Queen Street, Maidenhead, Berkshire.* The Dorset manufacturer will continue to be responsible for Northern Ireland, Eire and other overseas markets. Audac will also still handle sales of custom made microphone equipment and specialised accessories.

PUNCHED TAPE GOES PLASTIC

AN unusual tape programmer developed by *Tenor* of Wisconsin provides a simple and economical way of programming very long or intricate sequences.

The Tenor tape programmer uses an endless belt of punched 0.6 mm. wide *Mylar* encased in a transparent plastic cartridge. The tape is advanced by a sprocket around which the tape belt is wound. Down the centre of the tape is a series of drive perforations. Programming consists merely of enlarging these perforations into a rectangular programme slot.

An integral switch with tape-follower performs NO and NC switching action according to the programme slots punched into the tape.

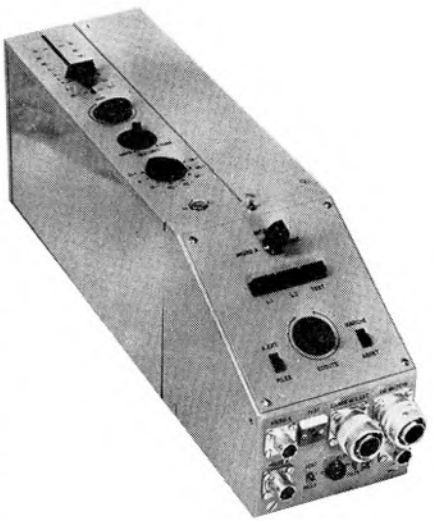
Up to 100 ft. of tape can be wound into one cartridge, for a total of 10,080 programmable bits. Thus, when driven by a $\frac{1}{12}$ r.p.m. motor, the programmer can control an event at every minute of a full week's time cycle. A wide range of synchronizing problems can be overcome by stacking the cartridges as needed and using a single drive mechanism.

The drive motor can be synchronous, stepping, or non-synchronous. Drive speed, number of tape cartridges, and tape length can be specified individually for each application.

Although the tape may be programmed before it is installed in the cartridge, a small hand punch is available for manual programming or corrections after installation. Deprogramming—reducing the size of the hole from a programme slot to a drive perforation—is easily accomplished with perforated pressure-sensitive tabs.

Due to the large number of sequencing requirements which can be met with the Tenor tape programmer, a wide variety of applications is possible. These include such diverse uses as light and motion control in displays, signs and exhibits; industrial controls for various automatic fabrication operations, chemical processing, and automatic testing; and building controls for programming lights, fans, ventilation and air conditioning; and many others.

Drive mechanisms may be added by the user or supplied by Tenor. The drive shaft hole is 0.6 mm. square. The cartridge itself measures 11.5 x 9.9 x 1.1 cm.



OUT IN THE COLD

MALLORY *MN1300* cells were selected by the French Broadcasting and Television service to power recording equipment at the Winter Olympic Games in Grenoble. Swiss *Magna* and *Perfectone* recorders were deployed in addition to *S.A.F.* recording units (see above) in temperatures between —10° and —20°C. The MN1300 is equivalent to the standard *U2* cell in size and gives a nominal 1.5 V with a 10 Amp-hour capacity. The similar *MN1400* cell has been supplied to the British Trans-Arctic Expedition this year.

NEXT MONTH

APPEARING ON SATURDAY 13th April, our May issue will contain a detailed floor by floor preview of the 1968 Audio Fair with first pictures of the new *Chilton* and *Ferrograph* recorders. David Kirk reports on a visit to *Tandberg*, while Alec Tutchings reviews their controversial *64X*.

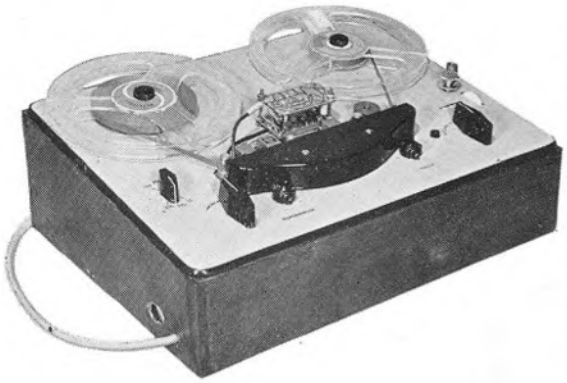


Fig. 1. Plinth-mounted Brenell deck showing replay preamplifiers mounted behind heads.

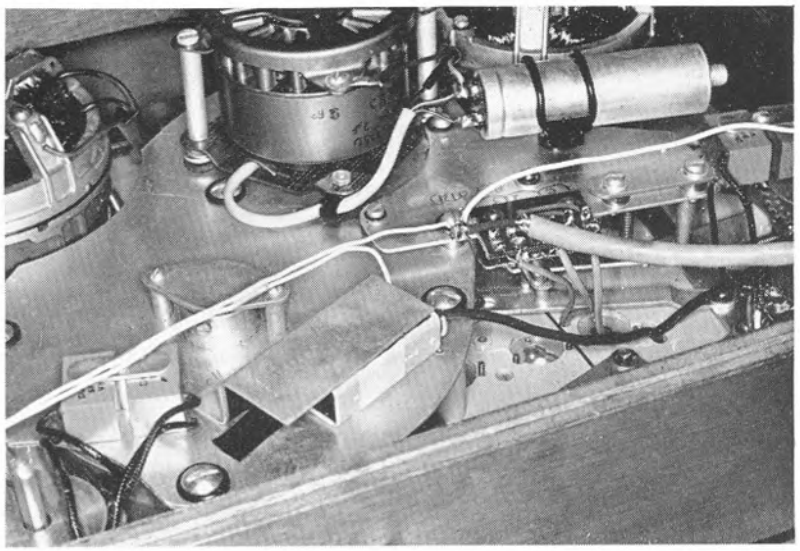


Fig. 3. Battery mounting beneath deck.

EVOLUTION OF A TAPE SYSTEM

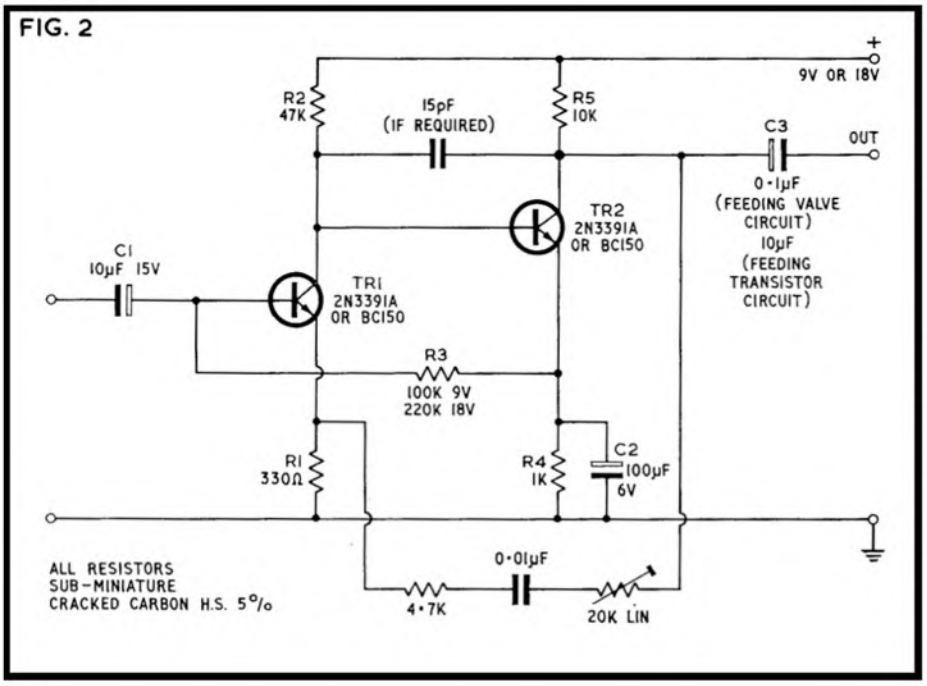
OF all conventional audio equipment, the tape recorder must surely offer the most interesting possibilities to the musician. But in practice it is apt also to cause him the most frustration, since there are so many things which can go wrong—both in the equipment and in its operation. Furthermore, it is widely believed in high fidelity circles that tape reproduction at normal domestic speeds and track widths cannot compete with good gramophone systems in sound quality. Over a period of seven years I have evolved my own response to these disadvantages, with professional advice and help. The cost in cash has not been very great; but the expense in time has been formidable, and often I have wished I had never begun the do-it-yourself game, and had instead purchased a really good stock commercial machine. However, I seem at last to have reached a resting-place where I can enjoy a tape system superior in performance to anything money can buy from 'off the shelf'; a system which minimizes the possibility of error in operation, and which will be uncommonly easy to service if the need should arise. My pilgrim's progress may be of interest to readers of *Tape Recorder* and I feel that the end-product should be of serious interest to the designers of new commercial equipment.

My pilgrimage began, like that of many others, with the *Gramdeck*, and in some ways I look back to that stage as a golden age of simplicity and quality. The Gramdeck record/play preamplifier seems blessedly free from all diseases of the inner parts: it has travelled with me many thousands of miles from England to Africa and Australia without elaborate packing; a number of them have been used for several years in a difficult tropical climate with never a murmur of malfunction. The design-specification is to professional rather than amateur standards: up to a modest 10 kHz at 7½ i/s (19 cm/s)—which sounds so nice after those machines which torture themselves (and us) to produce 16 kHz at half that speed! Readers may care to know that this inexpensive unit will produce satisfactory recordings with a number of other decks: in Nigeria our students used them for field-recordings with *Garrard* battery tape-decks, which had as their standard fitting a more recent version of the original *Marriott* head used in the Gramdeck. They are also fairly well matched to the typical modern ¼-track medium-impedance head: we used them often for convenience with the Marriott *X-18* which is available as a standard fitting on the current *Magnavox* deck. Recordings are also possible with the standard *Bogen* head of current *Truvox* decks, though more bias might be desirable in this case. With these more recent heads, of course, the original play-back equalisation will not be correct; but a fairly close approximation is obtained by cutting 1½ dB/octave above 1 kHz for 19 cm/s tape recordings, or boosting the same amount for 3¾ i/s (9.5 cm/s), a matter which most amplifiers can take care of. I should make it clear that I am not recommending this sort of combination for strict high fidelity, although surprisingly good results can be obtained if one monitors the recording on a second head; but it has been invaluable as a faithful stand-by when all else failed, and was entirely adequate for many purposes.

I learned one useful lesson in my earliest recording days: that the average provincial retailer of audio equipment cannot necessarily be relied on for even the simplest technical advice. I did not buy the recommended 600-ohm microphone with the Gramdeck, but sought it later at the local shop. I was sold the high-impedance version instead. When I complained that results were not satisfactory, I was assured that my troubles would be solved by "shorting out the transformer", which was duly done for me free of charge, since they had no 600-ohm version to offer in exchange. It took me a long, long time to discover why I was getting such feeble microphone recordings with my Lustraphone 'corrected' to 30 ohms!

Another lesson which I ought to have learnt from the Gramdeck is that no tape system can be better than its transport mechanism—in the case of the Gramdeck, no better than the turntable you put it on. Unfortunately I failed to apply this lesson stringently when I decided to 'go stereo'. The excellent *Stern-Clyne* stereo switched record/play preamplifier was purchased along with a tape deck which was reckoned a budget priced bargain. I was not long in discovering that you get what you pay for: a wow appeared which was not susceptible to cure by attention to all the normal causes. I

FIG. 2



BY GEOFFREY NUTTING

(Lecturer in the Music Department of Monarsh University, Victoria.)

decided to get a *Brenell* deck, which had the attraction of the same range of four speeds up to 15 i/s (38 cm/s) as my recording amplifier, and would accommodate 8¼ in. (21 cm.) reels, thus making the top speed practical for recording live concerts. It also gave one plenty of scope (four positions) for playing around with various heads of one's own choice. For replay purposes my experiments were profitable, but I was no doubt unwise to attempt matching new record and erase heads myself without adequate facilities.

Thus far I had learnt enough about the innards of tape-recorders to become the local 'expert', often consulted for first-aid on commercial machines; but I was not obtaining from my own equipment results significantly better than a good 'off the peg' product could offer. I was, however, forming a clear idea of what I expected of a tape recorder, and a determination to seek whatever professional assistance might be needed to secure optimum results. Several preliminary decisions had to be made:

Physical layout: an integrated semi-professional tape-recorder tends to be heavy and bulky. It would not be welcomed on the sideboard, nor would I enjoy dragging it around frequently for location recording. On the other hand, the Brenell deck lends itself to a very slimline mounting if the electronics are housed in a separate unit. This arrangement has proved most satisfactory: a plinth only 9 cm. deep at the front is reasonably unobtrusive in the living room (**fig. 1**), and all the recording gear can be banished to my study, where in any case it is normally used. (This also has the distinct advantage of making it impossible for the family accidentally to erase a precious recording!)

Speeds: I had flirted with the lower speeds, but concluded they were not for serious use since they can introduce wobble problems, and also substantially increase distortion and noise unless a restricted HF response is accepted. It was decided to use 15 i/s 38 cm/s for live recordings that would be especially valued, and 19 cm/s for most other purposes. The latter speed seems to me eminently convenient for classical recordings: using LP tape, most 19th Century works will fit nicely on a 7 in. (18 cm.) spool, and most others on a 5 in. (13 cm.) or 5¾ in. (14.5 cm.) The fascination of logging half a dozen different works per track on the rev counter wears very thin when one has to play one's tapes on different machines to illustrate lectures, and 'one work per track' has proved a good rule.

Tracks: I like the machines I use to be capable of playing any tape to its best advantage, and happily this was not difficult to arrange with the ample 'head-room' of the Brenell. However, a choice had to be made as far as recording is concerned, and I opted for the standard which has long been established in the U.S.A. and is increasingly prevailing elsewhere—quarter-track stereo. This is admittedly a compromise in the interests of tape-economy but, at the speeds I use and with reputable tape, it does not seem to present drop-out problems. The loss of 3 dB in signal-to-noise ratio remains to my mind a material disadvantage for wide-range recordings with machines commercially available; but, in the system described below, noise has been reduced virtually to vanishing point.

Recording System: It has long been known that what is good for a playback head (narrow gap) is not advantageous for a recording head. (It is curious that this principle is seldom taken seriously: all too many machines which have separate heads for the two functions use narrow-gap types for both.) I decided to upgrade my recording system by getting a wide-gap head designed specifically for recording. The *Mullard* ferrite heads, with their promise of very long life, particularly attracted me, and I was pleased to learn that existing equipment could be adapted to match one of these.

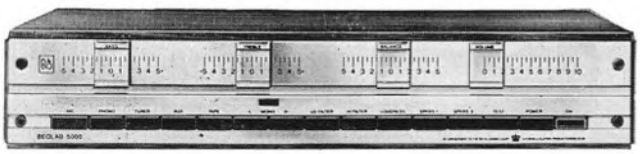
Adapting a recording amplifier to a new head of totally different specification is certainly a job for a professional, and I put the matter in the hands of John Latham of *Deimos Ltd.* A track-switch and matching transformers were fitted to the *Stern/Clyne STP.1*, a Mullard head to the Brenell, and balanced-to-earth interconnections made. So much for externals—a number of internal components of course needed to be changed also. I am most grateful to Mr. Latham for a very successful conversion. To appraise the performance of the system, I have compared it as closely as possible with a highly-regarded semi-professional machine which is widely used in broadcasting and recording studios, recording the same signal on the same tape with both machines at similar modulation-levels. The commercial machine was given every marginal advantage: the inner track; a specifically recommended brand of tape; replay over its own equalisation network. Nevertheless, on a variety of programme-material, its recording was judged inferior in respect of both distortion *and* noise to the outer-track recording of the machine described here.

It could well be that the difference is mainly the result of dis-similar pre-emphasis arrangements: the commercial machine reckons to preserve some sort of response up to 20 kHz, whereas mine is 'peaked' for a limit of 16 kHz, above which the response of present-day tape heads falls drastically at 19 cm/s. If so, it would appear that engineers are still too much under the thumb of sales-managers. Apart from the issue of recording noise and distortion, programme-sources rarely contain anything worth preserving above 16 kHz, and very few reproduction systems can handle such HF content without a sense of strain.

Playback System: Even with optimum recording techniques, playback-noise can still be obtrusive on wide-range recordings. This is commonly written off as 'tape hiss', a supposedly incurable fault inherent in the system. My investigations have convinced me that a large part of such noise in most systems is in fact amplifier noise. It must be remembered that, whereas gramphone pickups typically deliver many times the nominal sensitivity of their associated amplifier input from a wide-range modern recording, tape-heads are hard put to meet the rated input requirement of the equivalent circuit. We can accept a nominal 52 dB as a reasonable

(continued on page 190)

The most advanced High Fidelity equipment ever built for the home



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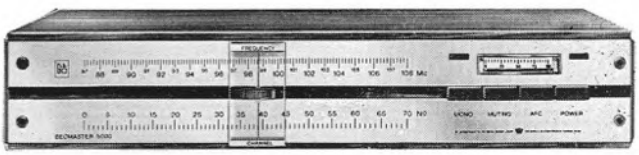

BEOMASTER 5000. Stereo F.M. Tuner with usable sensitivity of 1.5μV. Automatic Mono/stereo switching, 4 stage gang tuned R.F. section, 5 I.F. stages and A.F.C. Large radicator calibrated relative to signal strength. Cursor type tuning control with vernier adjustment. Variable muting and stereo levels. Aerial inputs for 75 ohm, 300 ohm and local. Identical in size and cabinet finish to match Beolab 5000.

Also in the Beolab System range is the Beogram 3000 transcription turntable fitted with the world famous B & O STL/15° tone arm, lowering device and stereo magnetic cartridge; Beovox 2500 high frequency sound diffuser units incorporating six speakers in a small and elegant cube, and a choice of Beovox 3000 or 5000 pressure chamber loudspeakers.

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BEOVOX 2400 – High Fidelity wall or bookshelf speaker to DIN standard, with one bass, one mid-range speaker and one tweeter. Complete details will be available at '68 Audio.

Beolab—together with a new range of loudspeakers will be demonstrated at 68 Audio.

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CLOSED CIRCUIT

No 6 THE GOLFER'S EYE
BY RICHARD GOLDING

IN response to some new readers I begin this month's article with a simple statement on closed-circuit television.

The simplest form of CCTV consists of a single TV camera in a fixed position, linked to a single television monitor. This system is used mainly for observation by police, security in factories and shops, highways, hospitals, railways, mines and even in homes, mounted above a baby's cot. It can be installed for less than £200—significantly less if bought in bulk. For security, one operator could watch a large number of monitors fed from cameras in different departments, and the size of these monitors could be small enough to allow the use of a very small room. On the other hand, the monitor could be very large for use in a board-room or for any group viewing.

The single system can be linked to a video tape recorder for the purpose of recording simple demonstrations for playing back at any time in any place. The cheapest, complete, system of this type on the market at this moment can be had for less than £500 and several other manufacturers plan to market similar packages at a competitive price fairly soon.

CCTV, however, can comprise many TV cameras and microphones with their signals fed through a control point, amplified and transmitted over miles of cable to many monitors. The cameras may be basic models fitted with a single standard lens or they may be high-precision instruments costing thousands of pounds. Special turrets or zoom lenses may be used and, as with the underwater camera, they may be controlled from a distance.

Complete systems may be bought outright from any of the many suppliers all over the country or hired for short or long periods.

The hire service can be of great convenience to businessmen. Radio Rentaset Services Ltd., of Shrivenham Road, Swindon, for instance, offer a great variety of equipment for hire. The charges are: short-term, £12 10s. per cent of the value of the equipment hired for the first week and £2 10s. per cent for the next week, and the subsequent nine to 16 weeks £2 per cent. These charges include all maintenance, depreciation and interest. Among the vast range of apparatus on offer is the very interesting *Duke and Bridges* underwater camera. This is a lightweight model with a wide angle lens. It is 41 cm. long by 15 cm. wide and is operational down to 600 ft. The camera carries iodine-quartz underwater floodlights which are stated to be so powerful that it is unwise to use them above the surface.

The *Rite-Line Portable Studio* is another interesting item of equipment that may be leased, for example, by a golf club. All the electronics, including a videotape recorder, are housed in a free-standing 6 x 3 x 2 ft. cabinet and external controls are reduced to two press-buttons set into a command pedestal. The cabinet is equipped with castors and is relatively mobile. The vidicon camera, incorporated into the device, is equipped with a fixed-focus, wide angle lens, giving an optimum target area of 12 sq. ft. at a distance of 9 ft. from the lens. Lighting is automatically operated when the device is set to record. Viewing is on a 25 in. screen.

Standing on the tee mat, 9 ft. in front of the cabinet, the golfer can record his swing or series of swings. Then, with a short delay, he can replay them from the recording, either at normal speed, slow motion, or frozen into a still picture. This last 'freeze frame' facility enables the golfer to study in detail the position of his hands and body at a single point of the swing.

The VTR used in the Rite-Line is the *Optacord* manufactured by the West German *Loewe Opta* company who have recently introduced new models to the market.

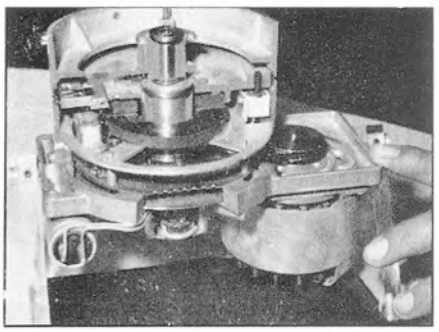
These new models are improved versions of the *600* and *600S* with higher frequency response and full compatibility. Both models use 25 mm. tape with a single head system, the tape being wound round the drum in a helical loop of 360°. The video head revolves at a speed of 3000 r.p.m. and records one half-frame per revolution on a slanting track 0.15 mm. wide. Picture content is recorded by a frequency modulated carrier signal and definition on play-back is up to 3 MHz. Starting time is within three seconds.

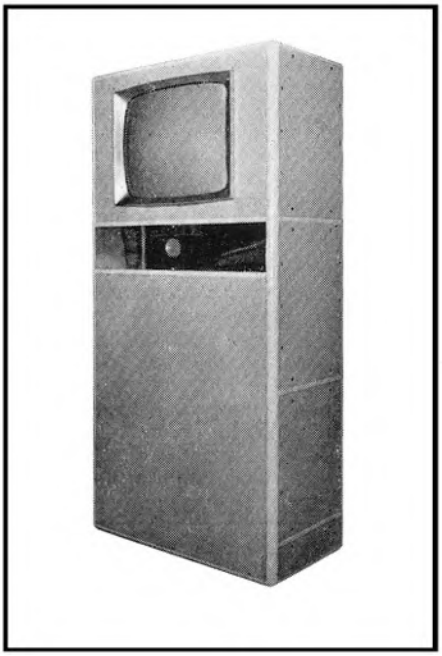
Tape speed is variable. A lower speed of 15.22 cm/s allows for a recording time of up to 100 mins on a single spool of tape, but a recording made at this speed must be replayed on the same machine. The higher speed of 21.15 cm/s gives a shorter recording time of 72 minutes but is fully compatible and can be played back on any other Loewe Opta VTR. The rewind velocity is also continuously adjustable from zero to 60 times the recording speed, giving a rewind time for the complete tape-run of less than 60 seconds. During rewind, the tape can be slowed down and the picture content monitored in order to find the exact sequence required.

For recording and play-back the Optacord operates on a video signal, but provision is made for a special connection and small modification whereby the VTR can be used with a domestic TV receiver, the RF signal being modified to a video signal and vice-versa.

On the *602* the rewind button can be used to slow and stop the tape. By careful manipulation of the spools, a single frame can be selected and scanned to give a still picture. The spools can then be rotated by hand to give

(continued overleaf)





Top: Cutaway model of the Loewe Opta helical-scan mechanism.

Middle: Rite-Line Portable Studio.

Bottom: Shibaden HV-14 tripod camera and, just visible at bottom left, HV-50 pistol camera.

a slow-motion effect. The *603S*, on the other hand, has a remote control panel which allows these two latter viewing modes to be effected automatically. On the panel there are four buttons, including start and stop. The third button selects a slow motion drive by which the repetition frequency of each half-frame of recording is slowed down from 50 to one per second. The fourth button halts the tape and automatically adjusts the resulting still picture. Each frame thus scanned is automatically replaced by the succeeding frame at intervals of 1, 30, 60, 90, or 120 seconds, depending on the setting on the control panel.

Both models are available now with a special conversion unit and monitor for colour recording and, from June onwards, both the 602 and the 603S will be available with a frequency range of up to 4 MHz. Further details of Rite-Line and Optacord equipment may be obtained from *Nugent & Partners Ltd., 1 Princess Street, Manchester 2*, although I can say now that the colour conversion unit costs almost as much as the VTR itself.

Where one single factor such as the analysis of a golfer's swing is concerned, then, quite obviously, the less equipment to worry about the better. The busy golf club would certainly not want to be bothered with the setting-up of the various items, their control, and their packing-away afterwards if only for staffing reasons, and the self-contained system seems ideal for them. Another thing is that the cabinet can be provided with a slot-meter so that periods of time can be paid for on the spot, thus simplifying the system even more.

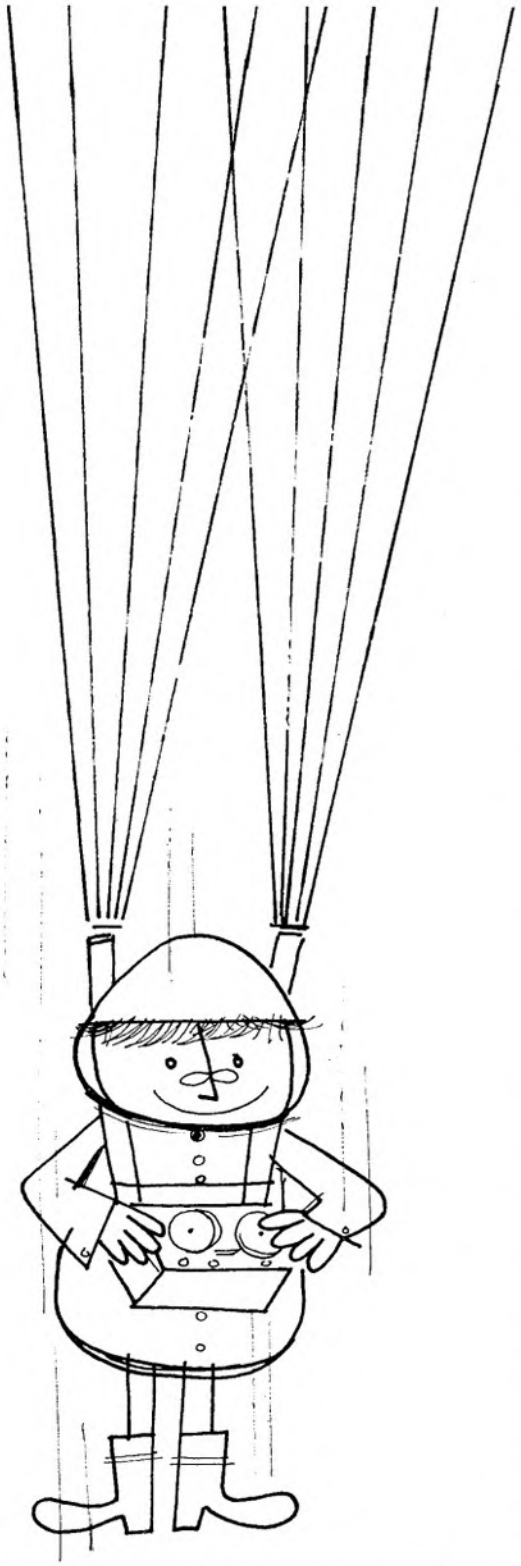
Where versatility is required, however, the VTR is much better in a less rigidly controlled system such as that shown in our photograph of the *Shibaden* VTR and associated equipment. In this picture the heavier *HV-14* camera on the right is the taking agent but the smaller *HV-50* camera in the left foreground would do well for this type of recording. It weighs only 2½ lb. and can be operated by a single hand, though the pistol-grip holder may be removed for mounting the camera on a tripod. The scene is viewed through a built-in optical viewfinder, but if this camera is to be used in a hand-held position and moved about over the scene, then it would be advisable to have the monitor in such a place that it could be seen by the camera operator in order not to lose focus.

Of course, the most satisfactory way of relating a camera to the scene is to have a viewfinder monitor built in to the camera. This will more accurately show the scene to the operator, particularly if the camera is used at some distance from the control unit. But once you start thinking in these terms you are no longer interested in a cheap CCTV system.

Whatever system you are using, however, you owe it to your audience to select the best camera angles and distances from the scene that will appear most satisfactory to the story development. In the hands of an experienced and imaginative cameraman the camera can become a truly creative instrument; but it should never be obtrusive, it should be used so smoothly that the audience is never conscious of it. The technique of handling a camera efficiently does not come included in the package deal—it has to be learnt. I have seen too many Sales Directors who fondly believe that they were born holding a camera, that they have a natural flair for setting-up long shots, medium shots and close-ups, and that all they have to do is point a spot at a subject and it will be lit to perfection; and I have seen too many results of this in those CCTV recordings that resemble only too well the hit and miss assembly of the 'baby on the lawn' type of amateur cine film.

The correct techniques can be applied to CCTV production however small the system, and adequate staff training should be one of the first considerations of the department responsible.

"It wants the first two weeks in August"



on the move, they said, the BBC

PETER BASTIN DESCRIBES THE ART OF WINNING COMPETITIONS

FROM their lofty perch in the fastness of Manchester the BBC announced the closing date and the subject for their second amateur tape-recording contest. *On the Move* was the command and little tape recording soldiers all over the country jumped to attention and scuttled away to obey Colonel Aunty's orders.

This is not disrespect; I applaud and admire the North Region for, at very long last, recognising the tape recorder and those who manipulate it. More power to their elbow and let us all hope that their endeavours bear considerable fruit in the future.

On the Move? How should I illustrate this intriguing problem? What do the BBC expect—a monophonic David Frost, a Third Programme Heavy, a disc-jockey Trite? No, I decided, they expect us to tell them. And so be it. I chewed the matter over at considerable length. Shaving and periodic visits to the bathroom were the enlightening moments and eventually, after much thought and wastage of paper, the idea took shape.

A funny set of rhymes, tracing the history of transport through the ages seemed to be a reasonable solution. More paper, more reading out of my screamingly funny rhymes to my wife. Couldn't somehow get any decent reaction to the Regency period, so I cut it out and I hope that history forgives me. And so, a sheet of rhymes which seemed to read all right and appeared to be vaguely humorous. But that wasn't enough; no one really likes poetry, especially funny poetry and very especially amateur poetry. So I decided to put little bits of rubbish in between each verse, bearing some resemblance to the text.

The first verse dealt with Adam and Eve in the Garden of Eden. I made Adam eat an apple, whereupon Eve, in true feminine form said that the apple would make Adam move. And it did. He thundered away into the distance and there was a slight interlude while the flush toilet spent itself. This was criticised a little when the tape was broadcast but, after all, it made its point! Other 'inserts' were of knights making a horse (hammering a bit of wood on the front doorstep), a ship creaking in a storm (blowing into the sink through a straw and making a disgusting mouth noise to simulate creaking), a Victorian railway engine (a shaken hand-drill and a multitude of other bits and pieces) and others equally ridiculous. The most successful, possibly, was the Austin Seven, made by blowing out so that the cheek flaps about and playing it back at half speed. The klaxon horn was a bit of a problem but I got over it by recording my car horn and playing back at half speed.

The idea was to record the dialogue first. This is never quite as easy as it sounds, for one stumbled word, one wrong inflection and back to the beginning again. However, I made it. I then recorded, separately, the 'inserts' track, cued it in at the beginning with the spoken track and tried it out. It worked. Right, okay, two tracks. Beginning to sound interesting, but it needed something to knit it together. Music. Right, this is where I could enjoy myself.

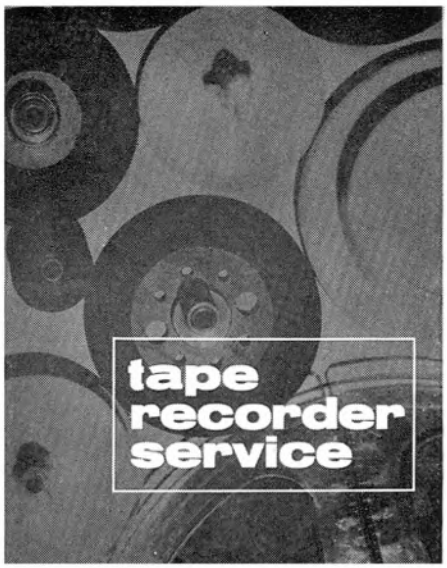
A lot of my time is spent producing execrable multi-track music which some people are foolish enough to like. Some have even used it for films and my wife would like to use it to tie up parcels. I use about six instruments—electric guitar, glockenspiel, trumpet, drums, ocarina and mini electronic organ. I can't play them all at once, so I multi-track on two Ferrographs and possibly my other two machines as well. It's all great fun, especially disentangling the 79 leads scattered all round my studio. Anyway, I produced some of this stuff, with a common theme. I used guitar, glockenspiel and drums and recorded it all on another track.

All that remained was to cue it all in and let it roll, picking up the noises on the master tape. Eventually I got it right. I say eventually because there are always small difficulties in doing this sort of thing. For example, two hands and one foot on the controls, three eyes on the meters, all ready to go. Studio door opens and a large blur says "Dad, can I borrow . . . ?"

The tape went off. My wife said she didn't think it was one of my best. I said no, but that's the way the cookie crumbles, etc. About ten weeks later, the BBC rang me up asking if they could have a bit of the music "for the programme". I sent it and asked if they had now judged the tapes. They said ha-ha, you listen on 20 December. So, on 20 December, I sat down to look at the *Radio Times* and discovered that the first prize was £50. My wife and son, optimists to the last, spent it in two minutes flat. I sweated my way through nearly twenty minutes of that programme, before they announced that I had won the contest. Everyone cheered and went over the business of spending my £50 again.

I think the thing which impressed me most was the fact that within two minutes of the programme closing I had three telephone calls of congratulations. Two of these were from recording colleagues, one of them in London, and I really felt most touched that people were so kind. One thing which I feel very strongly about is the negative attitude adopted by the technical press to this contest. Only *Tape Recorder* made any reference to the result of the Contest. I think it a very great pity indeed that after making so much fuss for so many years about the indifference of the BBC to amateurs, the technical magazines did not give it the great big boost it deserved. I can only hope that in the future they will encourage and even intimidate amateurs to have a go. In my opinion, there are far too many people with recorders who say "just listen to that quality" instead of trying to do something with them. My experience with radio, TV and films seems to emphasise that it is the content of the material which is important.

Anyway, all their glorious plans for spending *my* £50 didn't come off. I wanted a new guitar and a new microphone.



VAN DER MOLEN VR7

BY H. W. HELLYER

EVENTS have a nasty habit of creeping up on one and administering a painful pinch in the rear; but at the time of writing I do not recall having seen this machine reviewed or being given a field-trial for the benefit of *Tape Recorder* readers. Which may seem surprising as it was described in the 'New Products' column in October 1966 and has continued to hold a place as one of the cheapest three-speed, ¼-track, 7 in. (18 cm.) spool capacity vertical play machines on sale anywhere. The newest version of it, with the suffix *T*, retains its main advantages and adds a couple of things that were originally left off to keep the machine competitive. We shall come to these later.

There must be several reasons, not all of them sinister, why a machine should not have been reviewed. Chief among them, the fact that the maker has not sent one to Link House for the honours to be done.

Most production models submitted turn out to be pretty typical but as may have been gathered from occasional footnotes, contretemps sometimes happen. And there have been—whisper it—odd times when the machine submitted was frankly so bad as to seem faulty, being returned to the makers for replacement. I hardly believe *Van Der Molen* falls into this category. Speaking only from my own experience, which is of a service engineer, not a salesman, this range of models, starting with the more expensive *VR4*, should have been a winning line. They are neat, easily stripped, need the minimum of fiddling adjustments and sound good. (Sounds vaguely like a pop singer I once knew but that's another story.) (*Several Van Der Molen recorders have been requested for review in recent years but the manufacturer has never chosen to submit equipment. Two battery machines—the Fi-Cord 202A and National RQ-150—appeared faulty when submitted and were returned for replacement. Since they were not replaced, we were obliged to assume that the faults were common to all models. Endeavouring to overcome this difficulty, we chose to hold faulty recorders in ransom for their replacement, and even this questionable practice does not work. An apparently faulty Robuk Statesman has been sitting in our office awaiting replacement for nearly two years!*—Ed.)

Mention of the *VR4* makes it necessary to mention that this model, though earlier by a short head, is almost a development of the *VR7* in design; and so we proceed backwards. If we can find space to look at the *Sonic-8* as well, with its adaptation of the *Philips* cassette deck, so much the better.

Fig. 1 shows the circuit of the VR7. It is unashamedly hybrid. "Getting the best of both worlds" as Michael Van Der Molen told me with a grin; but when we take a look at the VR4 circuit, next month, we shall probably see that there was some cost-consciousness in the design as well. The whole of the circuitry, apart from the small mains transformer, is mounted on a panel attached to the main deck behind the right-hand spool. Thus the panel sits just above and behind the controls and sockets, allowing direct connections between components by the 'old-fashioned' method of tag boards. No printed circuits to worry about (or, as some makers have it, to take your worries from you! Examples of each case should be sent in a plain envelope to HWH, *Tape Recorder*).

To show what I mean more adequately than clumsy language, **fig. 2** is reproduced. Not only does it demonstrate the method of mounting and wiring but so also does it illustrate very clearly one of the minor irritations that beset a few users. In a row across the bottom we can see the forked ends of the levers to which the press-tab keys are fitted. Operation of a key depresses the forward end of the lever and the rear end (also in **fig. 2**) rises. Note the second from the right, the only one that does any work at this side of the main deck plate. This operates the record switch, (S1 in **fig. 1**) by pressing the white nylon block upwards. Return action is by the compression spring that should be visible if our friends in the art department have not compressed my precious picture too much. (Can't repress these lads, you know, since they showed a Japanese portable wrong way up one month and *nobody noticed*!)

The point about the previous paragraph is that the described operation sometimes misfires, and this, we found, was possible either when the panel worked loose from the main deck—an unlikely contingency—or had received sufficient mechanical shock to bend just a little at its flange . . . much more likely, knowing our friends of British Rail and British Road Services. On one or two earlier models we improved matters by fitting a staybar from the screwhead holding the lower end of the tag strip to a convenient spot on the raised wooden abutment at the base of the cabinet. But if everything is fairly rigid, and not likely to bend again, there can be no objection simply to bending the upper part of the fork to ensure a more central pressure on the nylon block.

At the top left of **fig. 2** can be seen the track switches, and these are of the type with the straight-through pins. Quite good, and not so prone to intermittent contact as one or two other track switch conformations, but with a possibility of jammed buttons because of the mounting method, those small springs and usually—it must be admitted—some blighter's clumsiness.

Giving credit where due, the controls very seldom require any cleaning. On some models (yes, even some acclaimed transistor models) let me hasten to say before someone trots out the old tale about stress voltages—hardly one of a group lasts a twelvemonth without at the least a squirt of *2A-X* aerosol or at most, a hasty replacement. On the Van Der Molen, despite the large number of all types I have handled, I cannot recall a single instance of its having been necessary to clean, let alone replace any of the potentiometers.

What I have had to change, more than once, has been the extension loudspeaker socket. This little joker is right in the defocused foreground of **fig. 2** and is a conventional type, mounted with 6 B.A. screws and nuts. The usual trouble is that the blades of the muting switch, which should be 'made' (see **fig. 1**) with no plug inserted, relax and give intermittent output. (This is a similar sort of trouble readers may remember with the Ferguson microphone socket and the Philips remote control socket.) We can get over it the same way as before, by omitting a facility that may not be needed, i.e. muting, and simply changing the 'outer' connections to the four tags of the socket. But these sockets are so cheap that it is hardly worth fiddling about.

So while you have the toolbox open and the

(*continued on page 175*)

FIG. 2

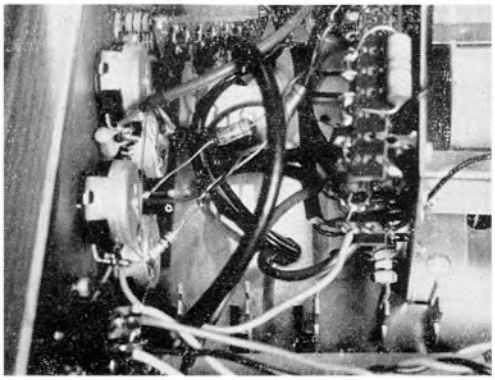
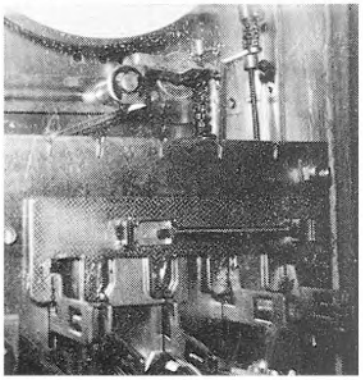


FIG. 3



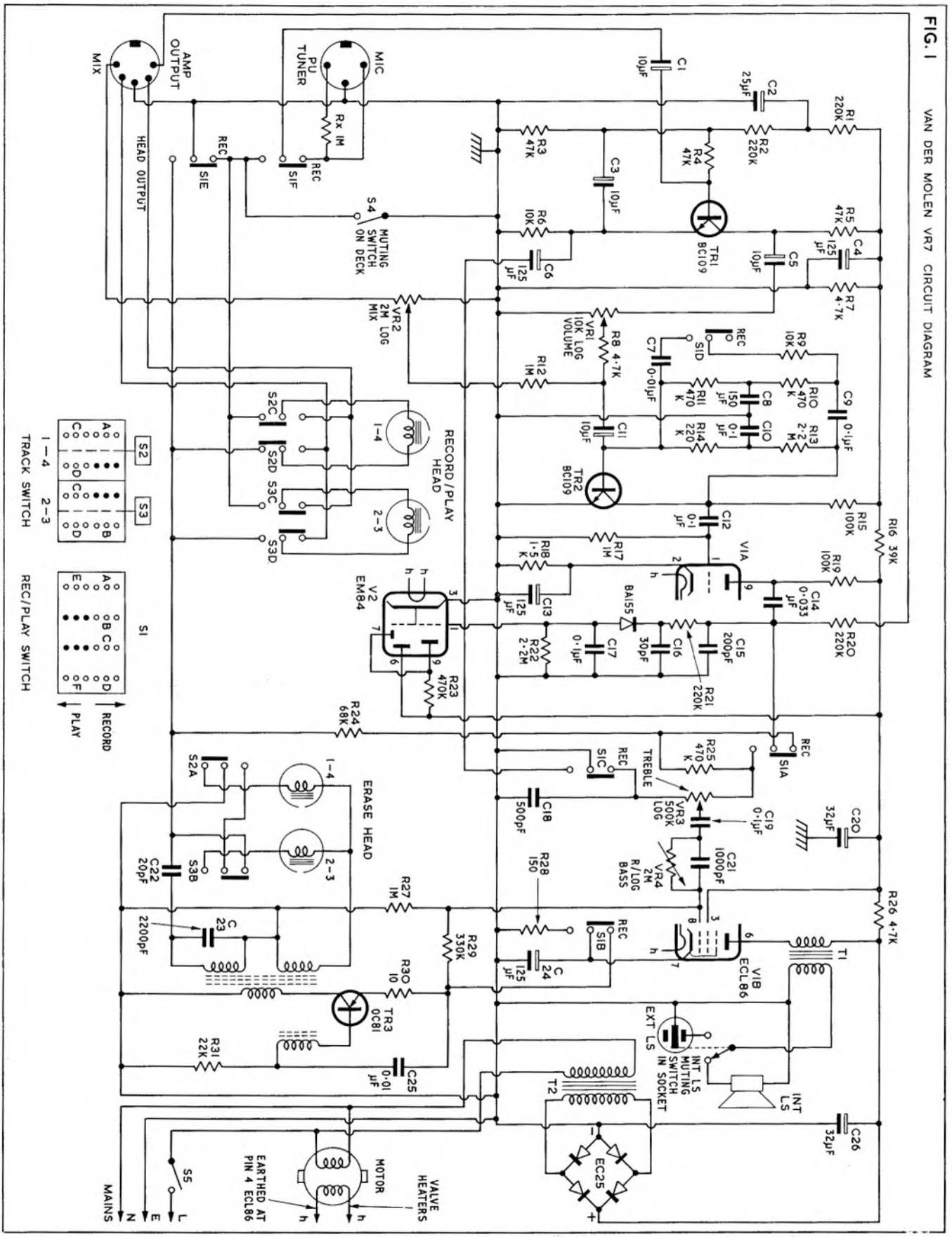


FIG. 1 VAN DER MOLEN VR7 CIRCUIT DIAGRAM

TESLA a tale of new bohemia

OTTO MUSIL DESCRIBES THE CZECH APPROACH TO TAPE RECORDER PRODUCTION

SITUATED in the heart of Europe, Bohemia is a region of picturesque lowlands. Several ancient towns in this area have long been centres of prosperous industry and yielding agriculture. In the course of the last two decades the good pre-war tradition of Czech products has received a new impulse of development towards both quantity and quality.

A team of several hundred skilled workers and experienced technicians in the 700 year old town of Prelouc (do not try to pronounce so typical a Czech name !) laid the foundations for the manufacture of tape recorders which, under existing conditions, has achieved really interesting results. And here I invite you today—into the works which, as a branch of the gigantic state-owned *Tesla* company, produce more than half of all Czech tape recorders and yet still meet the demands of larger quantities of machines required by foreign customers.

Mr. Hurych, the chief of the Technical Inspection Department accompanies us during during our visit. He is unusually competent for this task as his life has been joined with the enterprise for many years. He knows all its problems and has participated decisively in its development.

Having had several years experience in the production of valve tape recorders, Tesla moved to transistors two years ago. At the same time, a solenoid mechanism was developed for the modern *B4* series, providing an elegant semi-automatic control. Preparations for the production of specialised models within the series then commenced, including a simple version for schools and a luxurious stereo recorder.

Readers had a chance to meet some of the earlier Tesla range, and also the first of the new series, in the June 1965 *Tape Recorder*. Now we are able to see how these machines originate.

The new recorders have changed their appearance considerably to meet modern demands. The cabinets are flatter and their material is either natural wood or coloured polystyrene. But the rigidity remains, provided by a die-cast frame which holds all mechanical and electrical components. The new low shape contributes greater portability and also ensures easier access in case of repair. Mechanical stability is, of course, the main advantage, overcoming any fear the company might have felt of the fall tests prescribed by the State Standards Office for all forms of packed produce. In such a test, a packed tape recorder must operate normally after falling on all six sides of the carton from a height of 50 cm.

We are now at the beginning of the production line. First of all we watch the assembly of the most important mechanical parts : motor with outer rotor, flywheel, idler wheels and both couplings. At the edge of the frame we observe the solenoid which controls the pinch-wheel and brakes through its draw rods.

1 New Tesla premises.
2 General view of production line.
3 Air-pressure measurement of flywheel spindle.
4 Dexterous women's hands are the best tools for assembly work.
5 Preliminary measurement of wobble.
6 Measurement of frequency response by 'charactergraph'.
7 Final chassis check before removal of frame.
8 Final soldering before placing in cabinet.
9 Hinged amplifier board permits easy servicing.
10 Mechanism of a Tesla mains recorder.
11 The ¼-track Tesla B44.

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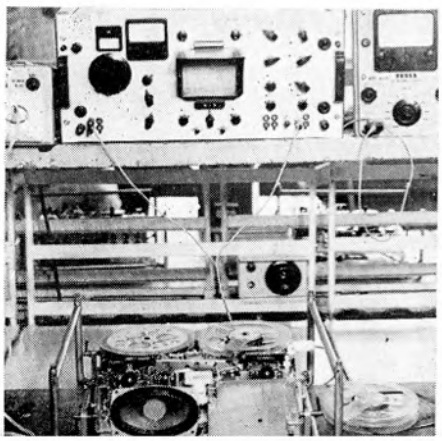

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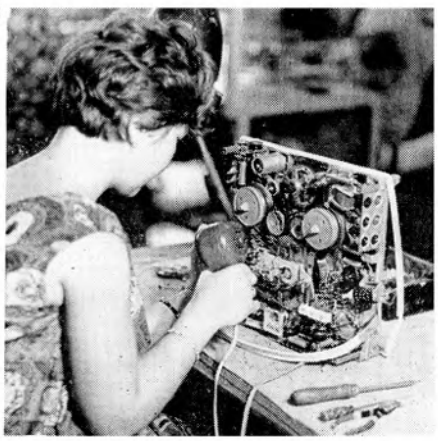

All the fundamental electrical units are assembled on printed circuit boards, mutually interconnected by cable forms. The boards are also made in the factory. I was surprised to find that, in this particular department, the well-known acid etching method has been completely abandoned. Heavy automatic presses cut out the required pattern of copper foil and glue it to cuprextite boards, into which they punch the necessary holes. This is done in one operation at remarkably high speed.

Tesla produce printed circuit boards for nearly all electronics manufacturers in Czechoslovakia. This covers a wide range, from miniature printed coils up to large boards for television receivers.

Most Tesla tape recorders need four different plates bearing the preamplifier, equalisation elements, output amplifier and oscillator.

Printed circuits are assembled semi-automatically, using a 'machine-gun' device which shoots resistors and capacitors into the boards directly from paper belts which are loaded with components like cartridge-belts. Every plate then passes across a bath of melted tin and, after initial inspection, is ready for measurements of its basic electrical parameters. Shortly after, the circuit becomes part of the innards of a tape recorder.

The printed circuit system has great advantages for the serviceman, since to check a circuit or to replace a component, he has only to tilt out the plate to gain access to both sides of the board.

To keep wobble below the agreed limit of 0.2% under all circumstances, Tesla designers consider that the capstan run-out should not exceed 0.002 mm. When asked if it was possible to measure such a dimension on a turning spindle and, moreover, on several hundred pieces daily, they answered by designing the measuring device illustrated.

Each capstan spindle is inserted into a turning holder and its run-out measured in a non-contact manner—with the aid of pressurised air. Any irregularity is then enlarged twenty thousand times on a dial. A spindle displacement of 0.001 mm. causes a shift in the mercury column of 2 cm. from rest.

And what about the repair of spindles failing to comply with the given limits? Repair would mean regrinding, new electroplating, polishing, and still an uncertain result. For that reason, it appears more economical to throw it away. After all, we know that any fight for good quality costs money. This is also proved, for instance, by the problem of acoustic noise in tape mechanisms. Absolute silence is unattainable in practice but the customer nevertheless expects as silent a machine as possible. Tesla agreed upon a certain subjective limit and tried to reach it.

Since motor noise proved negligible, Tesla focused their attention on the transmission system. Considerable improvement was achieved by introduction of a more suitable

(*continued on page 175*)

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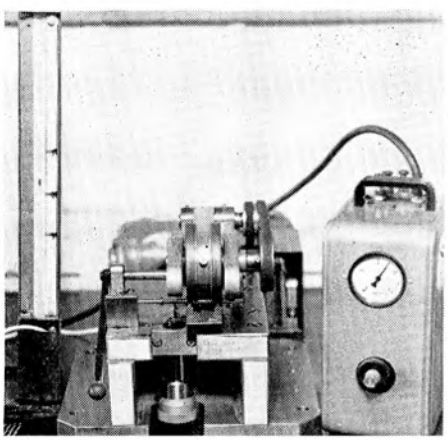

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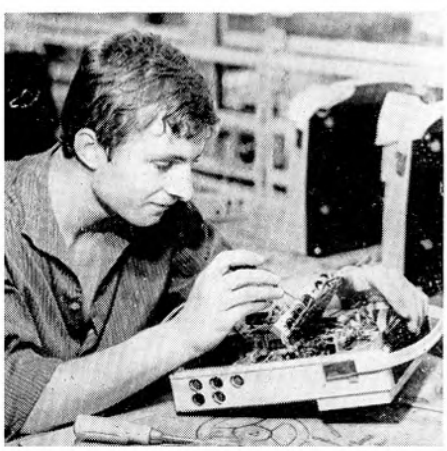

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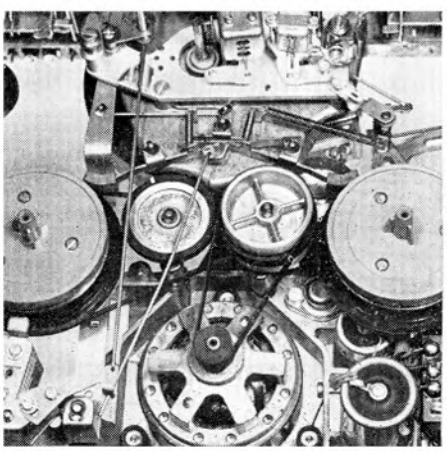


11

EMITAPE is not just the finest recording tape backed by the world's largest recording company....

EMITAPE is also *completely* British manufactured.

EMI's exacting quality control ensures that you get perfect, clean recording results every time – there are four grades of Emitape in five reel sizes to suit all recording requirements.
And you have the satisfaction of knowing you're backing Britain by buying an all-British manufactured recording tape.
Don't buy any tape – buy EMITAPE

EMI

An EMI group product
EMI TAPE LIMITED, HAYES, MIDDLESEX, ENGLAND

lubricant but still the ideal had not been reached. The belt transmission was then thoroughly analysed. High rubber adhesion of the flat belt to the pulley was found to cause a noise within the particularly offensive range of highest human ear sensitivity. Application of new belts of different material —several thousand of the original belts being discarded—was the solution and another step towards higher quality.

The recorders are produced in assembly frames—giving easy access from all sides of the unfinished deck. After assembly, the machines are almost ready for testing. First, however, they have to pass a kind of running-in operation. Several hundred recorders are run simultaneously, individual steps of the procedure being noted on attached labels. This involved four hours of recording while the pinch-wheel is turning, two hours of rewind and two hours of fast-forward. No tape is used during these tests since the tests themselves are considered of prime importance. This view has been confirmed by differing results in measurements made before running-in and after it. The test is also useful from the inspector's viewpoint as it may reveal most of the assembly faults or an occasional unreliable electrical component. Any tape recorder that appeared to be faulty would need to be repaired and run-in again.

I noticed a similar sort of running-in when we called on the construction office. The Tesla company is naturally interested in the durability of its products. The terms of guarantee and production of spare parts depend on durability. Several recorders of each type are kept in continuous operation for hundred of hours and any defect is carefully studied. These tests often result in new production methods.

And at last we see the workplace at which magnetic tape can be inserted into a brand new tape recorder. The operation carried on here is particularly delicate—an experienced technician adjusts the height and azimuth of the heads. The checking measurement which immediately follows is so objective that I venture to describe it myself. It concerns the measurement of a tape recorder's frequency response. Instead of recording individual frequencies and measuring their successive output levels, the whole process is carried out automatically with the aid of an instrument called a 'charactergraph', a combination of sweep frequency generator and oscilloscope. In addition to other measurements, a rapid succession of rising signals—from 40 Hz to 18 kHz—is recorded on a test-tape. Then the tested machine is stopped by the end foil of the tape and, after rewinding, the signal is played back and displayed on a cathode ray tube from which it is immediately apparent whether or not the recorder reaches the desired standards.

All major parameters of completed recorders are measured and noted on an attached record card. Only some less important qualities are measured at random: oscillator frequency, for example, or output power at reduced mains voltage.

Every machine has to pass a so-called customer inspection which involves a check of all control elements under practical conditions. The result of this last test is decisive and if more than 10% of all pieces produced on any one day prove unsatisfactory, production is stopped. A faulty recorder means a lower bonus for whoever is responsible, and more work since he has to repair the defect himself.

We now leave the production section and pass to the packing and distribution departments. The store here contains various types of equipment based on the recording principle, including echo units for electric guitars. The number of mutations seems to be great but it is not so difficult to produce variants of basic models. For example, a different speed or series of speeds can be achieved if the original flywheel is replaced by another one of different spindle diameter. Also, from the electrical point of view, the printed circuit building brick system simplifies change. Not all models are produced simultaneously: some recorders are stored simply as samples, to be introduced if and when in demand.

At the moment, Tesla produce about ten thousand tape recorders monthly. Owing to the fact that the market in Czechoslovakia is nearly oversaturated, it is necessary to seek outlets abroad. Between 60 and 90% of their production is exported, according to circumstances. Export to other East European countries has been relatively well established. Some of them even stopped their own production to import from Tesla because they could not achieve the same parameters economically. Tesla's biggest commercial success so far has been exporting to the German Federal Republic. In spite of this, Tesla do not overestimate their chances. For instance, they find it impossible to offer a new range of recorders at the beginning of every season—as is done by some manufacturers. Tesla concentrate on the most popular models of their range and produce as many of them as possible. At the moment, their main worry is that they cannot cope with all orders, though the factory has lately been expanded to accommodate greater production facilities.

And so we say goodbye to Mr. Hurych and the Tesla works. British readers may have difficulty in understanding the conditions under which enterprises are operating in Eastern Europe. But when we go deeper into the subject, there are points for comparison. Like Britain, Czechoslovakia builds up her national income primarily by exporting products manufactured from imported raw materials. Hard competition in foreign trade creates the stimulus that asserts itself even in the heart of Europe.

soldering iron in your hand, what about that other job you have been meaning to do? I am referring, Sir, to your loose microphone socket.

Ah, methinks I detect a guilty look!

On the VR4 and VR7, the inputs and outputs are arranged between two adjacent sockets, beside the loudspeaker socket and just below the controls. The sockets are, unfortunately, retained by a species of grip-ring. In the manner of these abominations, with time they loosen, one or two stabs at insertion of the microphone or other plug may aggravate matters and even, in worse cases, snap off portions of the bakelite between the pin holes. Tightening the socket by pushing the grip-ring up tight to the control plate is a waste of time. It will swiftly work free again. Change the socket—which means, fitting a better type, with flanges and screwed security. It will mean drilling through the mounting plate and one of the screw-heads is going to obscure part of the legend—but if you don't know where to insert your microphone by now, George, you never will!

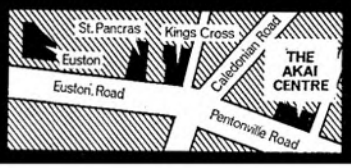
While you are active, it might also be a good idea to scrape a bit off the black stove enamel, or whatever it is, from the rear side of the main control panel and make a good, solid earth return line. Very often, these machines will work merrily without this precaution, but on just one or two, used in fairly docile acoustic conditions, we have detected a slight low frequency burble and cured it with this extra chunk of screening. On the VR4 model it is especially important and always worth a five minute modification.

Reference was made above to the use of two sockets for all inputs and outputs. This non-standard method of connection needs to be watched carefully, when one makes up dubbing leads, etc. **Fig. 1** shows the two sockets as a three and a five-pin, which is cheating a little because they are both fives. But the forward socket is for inputs alone, microphone between pins 1 and 2, per international standards, and pick-up, tuner, or other source, through pins 3 and 2, which is not standard. Input sensitivity, microphone, is 2 mV into an effective megohm, and a crystal microphone is supplied. At this price (only £40 19s. when first released) one could hardly expect more, and readers will have their own ideas for bettering this state of affairs. Up to date, I have not been called upon to perform any input modifications, but am always glad to discuss them—why should the manufacturers have all the fun?

The middle socket is a combined input-output. The input, between pins 3 and 2, is labelled MIX, and taken via its own control to a later stage, affording a very useful 200 mV at 1 M. It must be stressed that this input is still active during playback—forget to pull that plug out and you can be bothered with a tantalising hum, at least, or some completely superfluous programme material, at most. (As I write this, *Today in Parliament* is announcing that Lord Boothby is rumbling sententiously about the recording and replay of proceedings in the House of Lords A bit late, as usual, for this is already agreed upon. But his antediluvian crotchetings remind one

(*continued on page 177*)

THE AKAI CENTRE



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Ferguson 3218 ...	8 18 6	2 4 8	34
Telefunken 201 ...	8 18 6	2 4 8	34
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Ferguson 3214 ...	11 11 0	2 17 9	44
Truvox 44	12 6 9	3 1 9	47
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OUR READERS WRITE . . .

. . . about English English

From : A. G. Watling, 32a Pleasant Valley, Saffron Walden, Essex.

DEAR SIR, I was interested to read, in this remote part of Tokyo, David Kirk's article on *Japanese English* in the January issue. There are undoubtedly many problems to solve in technically advising our esteemed customers how to operate advanced equipment produced.

Some English technical phrases have still much puzzlement for us to make our own leaflets in Japanese—perhaps you can give explanation? In your issue (this in Japan can mean many children) H. W. Hellyer says bedding down of heads can lead to great lengthening of life. This also in Japan can mean many children. But most puzzlement comes from Mr. Hellyer on Page 33 who says of 65 kHz oscillator that "push-bell circuit is very efficient". This we know, but wire-pull circuit better as needs no battery.

Yours faithfully,

If Mr. Hellyer's remark is examined closely, it will be noticed that his sentence "The push-bell circuit is very efficient" does not actually refer to the 65 kHz oscillator. That is the only excuse we can offer without admitting that we made a mistake.—**Ed.**

. . . about meters and metres

From : R. J. Woolford, 46 Lonsdale Square, Islington, London, N.1.

DEAR SIR, I have read with interest Peter Turner's article *A Survey Surveyed* in your February issue and would like to make the following comments.

Firstly, with regard to metering. Mr. Turner prefers good magic-eyes to piffling VU-meters, agreed ; but a properly calibrated PPM is at least equal to the Tandberg's eye and should be easier to set accurately. Praise is given to the single meter circuit reading the higher of two signals on the new *Daystrom* recorder, though greater praise should be given to Messrs. *Tape Recorder Developments*, whose PPM can be switched to perform in a similar manner, using a circuit not unlike that of David Robinson in your October 1967 issue.

As far as speeds are concerned, I too consider 4.75 cm/s virtually useless ; indeed my main machine (a TRD of course) ranges in speed from 76.2 cm/s via 38.1 and 19.05 cm/s to 9.5 cm/s. (Yes, 76.2 cm/s, and it *does* get used, mostly for electronic music working.) Should 4.75 cm/s really be required then my second TRD can be used, or either of two stereo *Brenells*.

As far as editing is concerned, please let Mr. Turner try the TRD—he will find on the solenoid-controlled deck (full remote-control if required) no clutter at all in front of the heads, and a nice flat area on which to mount a *thin* splicing block. There is a black mark to be given for the TRD variable wind mechanical-control deck, though. This ought to be the ideal for editing as it has optional tape lifting to aid one in finding any particular spot while spooling but, alas, the start/stop and spool controls managed to grow right in front of the heads so that the splicing block has to go on the left of the deck. Even so, the tape path is still uncluttered by most people's standards. A further invaluable aid to editing is the tape-driven counter, registering in feet. (Should this be changed to metres? It would be like counting in yards unless we, perhaps, include a decimal point.)

At 38.1 cm/s (let alone the other) NAB reels are essential—or DIN winding plates if one does not object to a kilometre of tape on the floor occasionally.

Finally, a small plea : Please, if we go metric, let us do it correctly : 76.2 cm/s, 38.1 cm/s, *19.05* cm/s, 9.5 and 4.75 cm/s. Alternatively, adopt the Continental 'shorthand'—76, 38, 19, 9.5 and 4.75 cm/s.

Yours faithfully,

. . . and centimetres

From : R. H. Norton-Dawson, 22 Twynham Road, Southbourne, Bournemouth.

DEAR SIR, Surely it should be 19.05?

Yours faithfully,

Several readers have been troubled by our adoption of metric non-multiples (38.1, 19.1, 9.5 and 4.8 cm/s) for the speeds 15, 7½, 3¾ and 1⅞ i/s, and we admit to being unhappy ourselves with these figures. They were chosen, however, to conform with equivalents chosen by the British Standards Institute. Hence our reply to Mr. Norton-Dawson "Yes we think it should, but B.S. 1586:60 got there first".

Since the purpose of this exercise is to abandon British 'standards', we shall in future conform to general European practice with the exact multiples — 76 cm/s (30 i/s), 38 cm/s (15 i/s), 19 cm/s (7½ i/s), 9.5 cm/s (3.75 i/s) and 4.75 cm/s (1.865 i/s).—**Ed.**

. . . about the Revox 736

From : M. Pritchard, 20 Elgar Close, Fairview, Blackwood, Monmouthshire.

DEAR SIR, With regard to the recent correspondence on re-fitting the top deck sheet on a *Revox 736*, I have found the following solution both cheap and effective.

With the top sheet off, take a piece of thin card approximately 2 x 1½ in. and cut two 'V' notches from the 1½ in. edge. The centre of each notch should line up with the push-button holes.

Slipped under the top sheet as it is replaced, this jig will overcome any trouble in locating the button through their apertures.

Yours faithfully,

TAPE RECORDER SERVICE CONTINUED

somewhat of the background noises one gets when forgetting to neutralise this MIX input.)

The amplifier output of this model is taken from pins 1 and 2 of this socket, and the feed from the anode of the triode section of the ECL86, that is, the driver stage, gives over a volt for external amplifier or headset use. Additional facilities are the head replay outputs, giving an average of 1 mV at 1 kHz from the alternative pins on this second socket. Thus, when track 1 is recording, the output from track 3 is switched to pin 4 of the 5-pin socket. Very useful for language learning and so on, and, as the track switch is drawn out at the bottom of the drawing, there should be no trouble in finding one's way around.

Still keeping to the electrical side of things, and leaving most of the mechanics for next month, when more illustrations will be available, we must mention that very simple but most tantalising muting switch. Tantalising, because it has a habit, after servicing and reassembly, of getting tangled up with the levers and either refusing to mute at all which gives the howling Babel on fast wind that some machines regard as normal, or perform a curious trick of bringing up the sound on play, only to choke it off as soon as we remove our finger from the key. Very naughty, but, as I said, simple. The leaf switch can be seen in **fig. 3,** nestling in the bottom right corner. Downward movement of the play key closes the contacts S4 of our drawing, removing the short circuit to deck of either the head or the input, depending on function. All that is needed is a resetting of the switch block and an assurance that its mounting screw is tight.

Fig. 3 also shows clearly the key locking and slide operation and gives us our first look at the rod, spring and lever system that will concern us in the next article.

The oscillator is another section that requires a mention, but is rarely likely to give any bother. Based on the ever-popular OC81 (for which the AC128 is a suitable replacement) it will give a reading of 65 V AC on the 100 V range of an *AVO 8* at the junction of the C23/C22 coupling, and as there is no real adjustment here, signs of failure may require circuit tracing. Voltage checks around the transistor are the first resort, and my own figures (as was the last one) are: Base 22 V, Emitter 17.5 V, Collector 0 V—or, at least, nothing we are likely to be able to read of any significance. If there is some discrepancy in the emitter/base voltage, check the junction of C25/R30/R29, where approximately 18.5 V should be available.

Note that this voltage derives from the current flowing through the pentode section of the ECL86 during record, when the cathode resistor is switched out of circuit. Therefore, before delving too deeply into an oscillator fault, make the simple substitution test of a new valve. Any enthusiast using equipment with this hard-working bottle in it should have a spare or two by his side—or have I said something wrong again?

DROPOUT

CAUSE AND CURE

BY VIVIAN CAPEL

FIG. 1 HALF TRACK LAYOUT

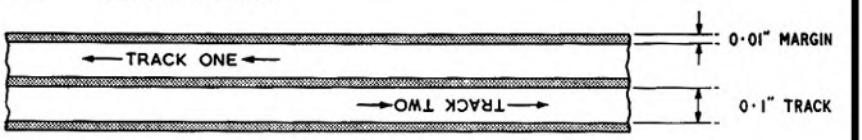


FIG. 2 EDGE-SCANNING QUARTER-TRACK DISPOSITION

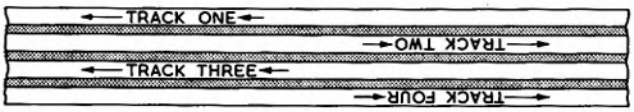


FIG. 3 DISPLACED PRESSURE PAD EXPOSES UPPER EDGE (SEEN FROM UNCOATED SIDE)

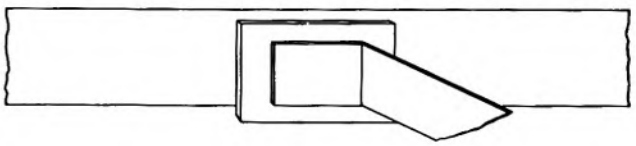
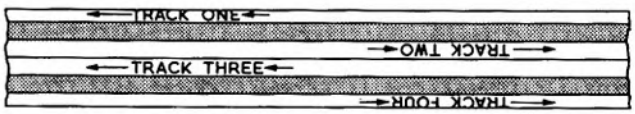


FIG. 4 OUTER TRACK FADING AND INNER TRACK CROSSTALK DUE TO HEAD MISALIGNMENT



THE expression 'dropout' does not reflect the inclinations an exasperated owner of a mal-functioning tape recorder may feel when eyeing his instrument in the vicinity of his seventh storey flat window. Appropriate though the term may be in this connection, it actually describes momentary disappearance or reduction of level in a recording. For reasons that we shall see, this phenomenon is most troublesome on the outer tracks of ¼-track machines. While the first cause of dropout is a flaking tape coating, a similarly troublesome effect is obtained from faulty tracking and slipshod tape slitting. In **figs. 1** and **2** we have the track disposition for half and ¼-track machines respectively. It should be noted here that while the dimensions of the ½-track system is standardised, that of the ¼-track is not, the dimensions shown in **fig. 2**, though, are those commonly found on most British recorders.

With the ½-track recording it can be seen that there is a margin of 0.01 in. from the edge of the tape to the outer edge of the 0.1 in track. Thus from the edge of the tape to the inner edge of the track is a distance of 0.11 in. There is practically no outer margin on the ¼-track recording, however. The maximum width from the edge of the tape to the inner edge of the first track with this system can be no more than 0.044 in. If there should be any curling or indentation of the tape at the edges of a ¼-track recording, a major part of the outer track may lose contact with the recording head. Also, the narrower the *effective* track width, the greater the likelihood of any particular oxide irregularity causing trouble. The tape does not have to part company with the head by a large amount in order to cause a major drop in signal level. A distance of only one thousandth of an inch between the tape and the head will cause loss of signal on either record or play, although matters are far more critical on record because of the way in which high frequencies are influenced.

The fact can lead to a phenomenon that some readers may have experienced. A tape recorded on machine A and then played back on machine B may exhibit little or no signs of dropout, yet a tape recorded and played back on machine B may be found to have a large amount of dropout. This is because machine B has a badly designed guide and pressure system, or misaligned heads, while machine A has not; as we have seen, it is during recording that these problems are most troublesome.

Having looked at dropout due to poor tape coating and *fading* due to track width problems, we will now consider some of the actual defects in a tape recorder that can cause them and how they can be cured. As may be gathered from the foregoing, freedom from dropout will only be attained if a 'perfect' tape is kept in perfect contact with the recording head. Most of the recorder faults giving rise to dropout are ones that prevent such contact being attained. The component which is supposed to ensure good tape/head contact is the pressure pad. Usually made of felt, it is mounted in such a way so that it can be sprung against the back of the tape, thereby pressing it against the head.

There are numerous defects that can occur here. The pad can become displaced so that it is too low, which condition is shown in **fig. 3**. In such cases the top part of the tape is exposed and therefore will not have any pressure exerted upon it. As the pad mounting is often rather delicate, any excessive downward pressure when the tape is threaded may be enough to displace it sufficiently to give rise to dropout. The obvious remedy is to re-position the pad.

Being made of felt, the pad is not particularly durable. The edges can become rounded and, though it may appear to cover the whole width of the tape, the outer edges receive no pressure.

A concave pad gives comparable trouble. Here, due to pressure, the felt may spread and although the edge of the pad may be covering the edge of the tape and even making contact with the head, no pressure is exerted at this point because there is no solid backing.

Felt is preferred for this function because it is firm enough to exert the pressure required and yet it is soft enough also to be able to mould itself to the contours of the head and thus ensure that the tape is similarly moulded. If the felt becomes hard, however, this facility for moulding itself to the head is impaired. Again this is quite a common condition as loose oxide from the tape is deposited on the felt pad and builds up into a hard cake. Often the pad can be cleaned with spirit, roughened up with a nail file (but mind the head !), and the edges squared off; but if there is any doubt it is better to replace the pad completely.

In some cases it may be found that the pad pressure is inadequate. Especially in cases where leaf springs are used the arms may lose their tension or become bent. Before indiscriminately increasing the tension, however, remember that too much tension will cause greater head wear and also increase the tendency for the pad to grip the tape, momentarily arresting its motion. This would

mean that the tape would proceed past the head with a succession of jerks which would give rise to flutter. Excessive pressure will do more harm than good; what is really needed is sufficient pressure *in the right place.*

Another plausible cause of signal dropout is bad head or guide alignment. Any vertical stress on the tape may result in less tension along the top edge of the tape than at the bottom and will increase any tendency for this edge to leave its contact with the recording head.

A similar effect will be obtained if the pinch-wheel is not exactly vertical, even though all the tape guides may be in line. If inclined it will cause the tape to travel upwards and therefore introduce a slack area in the top edge just preceding the pinch-wheel. Make sure, then, that the tape path is straight and that the pinch-wheel is perfectly vertical.

Some manufacturers have overcome fading and dropout effects, to a degree, by arranging the tape to wrap round the face of the head. One method of doing this is by positioning a pin mounted on an arm mechanically linked with the pressure pad assembly so that it pushes the tape backward between the two heads. *Philips*, who were at one time getting dropout troubles on the *3536* model, issued a kit for the modification of the recorder on these lines. Readers with some mechanical aptitude may be able to modify their own recorders in this way if deemed necessary.

Any tendency for slack to develop between the pinch-wheel and the supply spool will increase the possibility of dropout, particularly on models without pressure pads. Some models arrange for the supply spool to be driven by a slipping clutch arrangement dragging against the spool turntable which it is actually turning, thus maintaining tension. Another method that has been used is for a further pressure pad to bear against the tape guide on the supply side of the tape path. Here again, the object is to keep the tape taut and to straighten kinks or creases.

Thickness of tape plays quite an important part in this matter of dropout. A thin tape will respond to the pressure pad and conform to the contours of the recording head more readily than a thick one. For this reason many manufacturers of ¼-track tape recorders recommend the use of double-play or at the least long-play tapes in place of standard play. Experience has proved in many cases where users have complained of dropout that when a change was made to thinner tapes the performance was then completely satisfactory.

There is just one further cause of dropout which must be mentioned. The vertical location of the tape relative to the recording head is normally fixed by means of a tape guide which in many cases is associated with the head itself. In such cases replacement heads come complete with the guide and these have been preset by the makers to give the correct tape position, which is quite critical for a ¼-track machine. These can become misplaced however, and cases have been known where even new ones direct from the makers have not been correctly positioned.

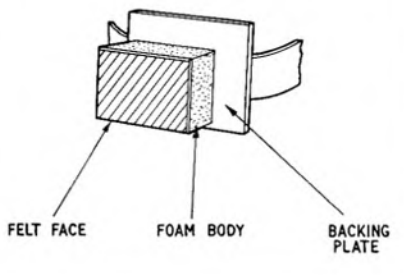
Should the guide be set so that the tape rides too low across the head, then the track disposition will be as shown in **fig. 4**. Here it can be seen that the space between the two centre tracks is much less than normal and, in fact, if the displacement were too great, the centre tracks could interfere with each other, with Track 3 being heard running backwards while Track 2 was being played, and vice versa. The most important effect, however, is that the outer tracks will be partially off the edge of the tape. This means that they will have an even smaller width than usual. It will be seen from this that any deformation of the tape edge or irregularity in tape coating will be far more serious than usual. Much smaller irregularities, which may have little effect upon the tape when correctly positioned, will now give rise to dropout. If it is suspected that this is taking place, the following test can be tried.

A section of tape should be fully modulated on track number two, preferably on tape that has not previously been used. The tape is now reversed and played back switched to Track 3. If the volume control is now turned to maximum a careful listening will reveal any trace of the outer track breaking through. If there is, this could indicate that the middle tracks are indeed too close together and so the tape guide or head are incorrectly positioned. The test is not completely conclusive as there may be other factors influencing the result, but some indication may be obtained from it. However, should suspicion be increased, professional advice should be sought. The height adjustment of a ¼-track head needs special materials and equipment and should only be undertaken by a qualified engineer. Alternatively, there is a special alignment kit available from *Tutchings Electronics Ltd.*, 14 *Rook Hill Road, Friars Cliff, Hampshire.*

When dropout is experienced, the thing to do is to locate the cause and put it right. Sometimes, though, obstinate cases arise where dropout persists after every effort has been made to eradicate all the possible causes. In such cases the making up and fitting of a modified form of pressure pad may be worth trying. The pad shown in **fig. 5** has been used on a number of such machines, with a good degree of success.

The main body of the modified pad is made not of felt, but of sponge rubber or foam plastic. There are various grades of this material and some care must be exercised in choosing the most suitable; some are quite hard with very little 'give', but others are rather flabby with poor resilience. Both extremes must be avoided. What is needed is something that will conform readily to the contours of the head with not too much pressure, yet will regain its shape immediately upon release. The sponge with rather large holes or pores tends to be of the flabby type, so a specimen should be chosen with smaller pores.

FIG. 5 MODIFIED PRESSURE PAD



Having chosen the material, the next stage is to cut it to shape. The thickness of the pad will generally be about ⅛ to $\frac{3}{16}$ of an inch. If the material can be obtained in sheet form at around this thickness, this will be ideal and avoids the necessity of cutting the faces. If all that can be obtained is a thick chunk, then a slice will have to be cut from this to the required thickness. The slice must be cut as evenly and smoothly as possible because any irregularity will give rise to uneven pressure over the area and will defeat the object of the pad. The original top surface should be smooth and can be used as the face which makes contact with the head. Even so, the opposite face, which is glued to the backing plate, should be as smooth as possible as irregularities could be transmitted through the whole thickness and cause a hill-and-dale effect on the active face.

We now have a slice of the right thickness and so we cut it to the right size. This is much easier than cutting the slice: we just need to cut to the dimensions of the original pad. If in doubt it is better for the pad to be slightly larger than the original to make sure that the full width of the tape is covered with a slight overlap top and bottom. Take care, though, that the pad does not foul any tape guides which may be fixed to the side of the head. These may lift a section of the pad clear of the head and once again defeat its purpose.

Foam rubber or plastic by itself is not suitable as a pressure pad material as quite a high degree of friction can develop between it and the back of the tape. This is due partly to the rough nature of the material itself, and partly to the suction effect of the open pores. A thin layer of material over the front of the pad will afford a remedy.

On experimenting it has been found that the best material to use is a very thin furnishing felt such as is used to line drawers or instrument cases. This is thin enough not to alter the effect of the foam rubber body, has a relatively low friction, and does not fray. A piece should be cut the same size as the foam rubber or plastic body and then glued on to the smooth surface. A contact adhesive such as *Evo-Stick* will do the job very well, but the two parts must be accurately positioned before they are brought together, because once in contact they cannot be parted. If this type of adhesive is used, there is a lot to be said for cutting the felt too large and then trimming to the right size after it has been glued to the foam. Finally, the old pad is removed from its backing plate—easily done by peeling it away—and the new one fitted. Again, contact adhesive will be suitable for this operation. The replacement pad must be fitted in exactly the same position as the old one, and this is usually quite simple as the outline of the pad will in most cases be left on the backing plate.

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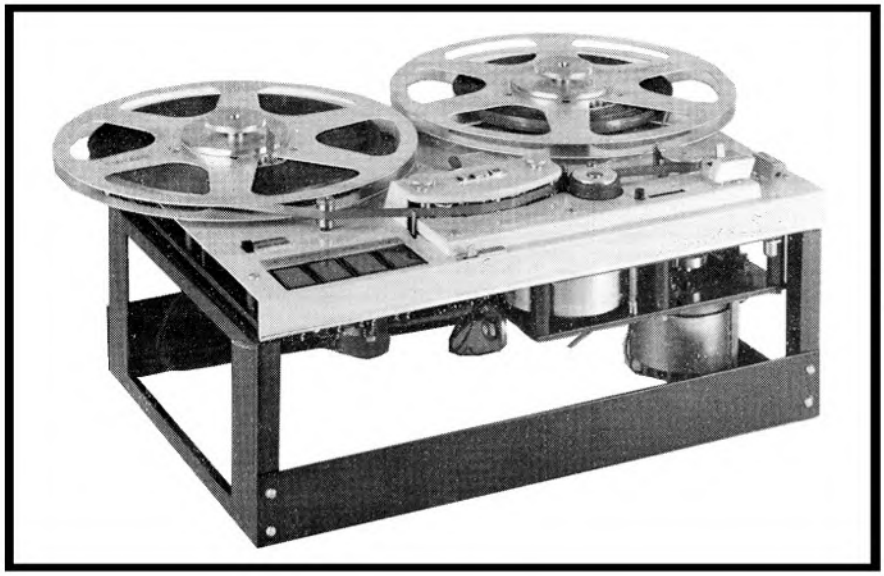

tape transport mechanisms

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A TAPE recorder can be divided into three main sections: the electronic circuits, the head assembly and the tape transport mechanism. The head assembly consists of the erase, record and playback heads and the various adjustable components governing the height and angle of each head. The tape transport on the other hand is the largest and usually the most expensive part of the recorder and comprises the capstan and pinch-wheel, the balanced flywheel, the motors which power the reels and capstan, and any mechanical linkages involved in speed change or the tape drive. Also connected with the tape drive are the brakes and any electrical components which control the power of the motors.

The main function of the tape transport is to enable the tape to pass over the heads at very constant speed and at the same time maintain correct tension on the tape. It is not an easy task for the engineer to design a tape transport with an extremely low speed fluctuation, and success depends on working to exceedingly close tolerances and paying special attention to the capstan and flywheel and the motor that drives them. This is one of the reasons why professional tape recorders are expensive; most of the extra cost in fact goes on the deck, which is made to give negligible speed variation when used continuously for considerable lengths of time.

In the present series we shall be concerned with the various techniques available to the designer of a tape transport and pay special attention to those factors which determine constancy of tape speed.

To bring out the full significance of constant tape speed we shall start by discussing the terms wow, flutter and wobble. In a specification, wow and flutter are often considered together although they are two quite different aspects of tape speed fluctuation as it affects performance. *Wow* is a relatively low rate of speed variation in the order of ten fluctuations per second and the effect is noticed especially on sustained notes such as those produced by a piano or organ. When wow is present the musical note sounds unsteady or wavers in pitch. *Flutter*, on the other hand, is applied to speed variations of higher frequency and again shows up on sustained notes, but this time with a quivering effect. Often when a recording does not sound clean in the higher frequencies, the cause will be flutter—though it may not be diagnosed as such. High frequency flutter is often mistaken for other types of distortion. *Wobble* is a convenient expression for the combined effects of wow and flutter.

Wow and flutter can be measured electronically on instruments designed to express the variations in frequency of a recorded tone as percentage variations of the nominal speed.

Another type of speed problem affecting the performance of a tape recorder is referred to simply as *long-term speed variation*. Although the effects of wow and flutter may be subjectively low, long-term speed variation affects true pitch. If a recording is running slow, the pitch will be low, and this can be very disconcerting to musicians or listeners with a trained ear. This speed variation is also annoying in broadcast work, where it may be imperative for a 30 minute recording to last precisely 30 minutes on playback and not one minute over or under this time. The best studio machines only over-run or under-run a few seconds in 30 minutes, though on a domestic model the speed variation can be as high as one minute for a 30 minute recording.

Fig. 1 shows the layout of a typical tape deck. In this case three motors are employed to simplify the method of operation and make it easier to follow at this stage. In recording and playback the supply tape is stored on the left-hand reel, which is prevented from free-wheeling and hence from spilling tape by a small degree of back tension exerted by the reverse wind motor. The tape then passes over one or more tape guides which help to deflect and align the tape before it passes over the heads. In some machines bobbin guides are mounted on the deck and can be adjusted to prevent tape catching on the reel cheeks.

On many recorders, excellent tape-to-head contact is maintained by the correct tension on the tape as it passes over a head assembly arranged in the form of an arc. Other machines, however, utilise pressure pads which should give just the right amount of pressure on the tape and head to maintain intimate contact. One slight disadvantage of this method is accelerated wear on the heads and, of course, wear on the pads themselves. Pressure pads also obstruct the heads for editing and, if they are not kept clean and at the correct pressure, can cause light sticking resulting in wobble.

The presence of carefully designed tape guides, especially in the vicinity of the head assembly, is very important and is a pointer to the tape tracking accuracy of a deck. Once the heads themselves are properly aligned, it is left to the tape guides, coupled with the tension on the tape, to align the tape correctly against the heads so as to obtain the correct frequency response and freedom from breakthrough from adjacent tracks on the tape. To reduce friction as much as possible, the guides on professional decks are sometimes made of glass which is allowed to rotate freely. This avoids any possibility of the guides becoming magnetised and also allows a much smoother transport of the tape to the head assembly.

The capstan and pinch-wheel are almost invariably situated on the right-hand side of the playback head. When the machine is in the record or playback mode, the pinch-wheel moves into contact with the capstan, pressing the tape between the two. The capstan is made to rotate at a constant rate and so drive the tape by friction at a constant velocity, assuming the drive spindle to be perfectly circular. Slippage of tape can be caused by too much pull or *tension* from either the take-up or supply reel. Slippage gives rise to the long-term speed fluctuation mentioned earlier, though if the driving surfaces of the capstan and pinch-wheel are not kept free from tape oxide deposits, the capstan can also pull the tape intermittently, causing wobble.

Tape guides on the right-hand side of the capstan serve to even out disturbances of tape tension caused, for example, by the tape accidentally catching on the reel check. Some machines have an end-of-tape switch located in this position which automatically springs back and activates a solenoid that closes the

(continued on page 183)

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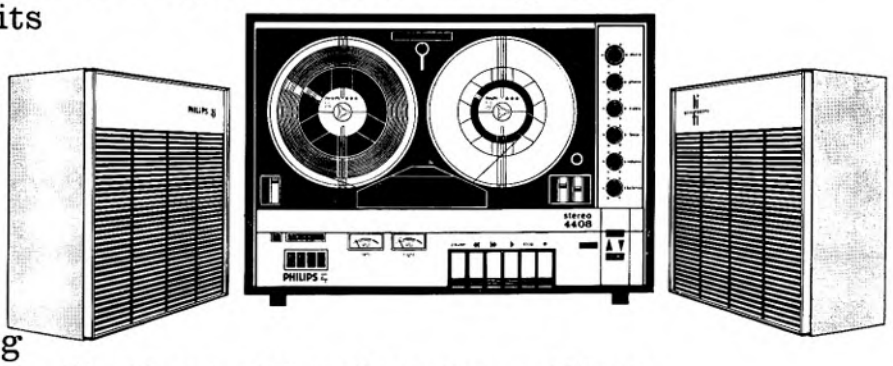

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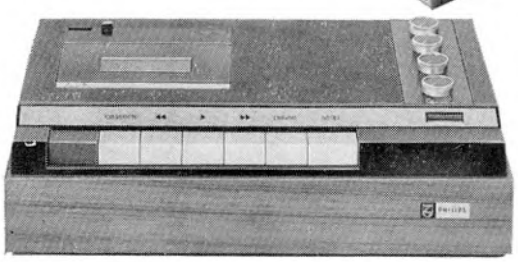

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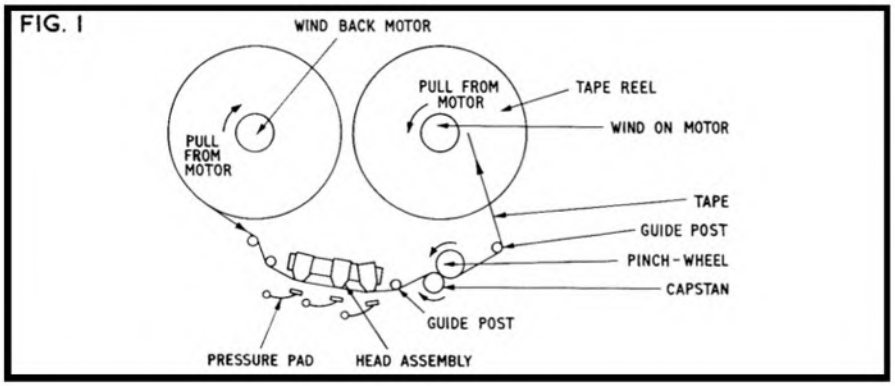

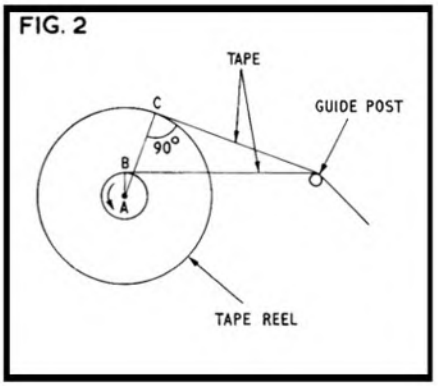

motor switch should the tape break. In the *Revox 736* another type of auto-stop is used. It consists of a small lamp which supplies light through a guide post, along a transparent plastic conductor, to a photo-transistor. When the tape is threaded, the light path is blocked until the tape runs out, breaks or is substituted by a short length of transparent leader, when the photo-transistor operates a solenoid bringing the drive to a halt. Another facility which should always be employed when spools of 8½ in. or over are used, is an automatic tension compensator. On the *Studer* professional recorders, this consists of a movable tape guide linked to a potentiometer which controls an eddy current brake on the feed motor. We will have more to say about tape tension shortly.

The capstan is usually mounted in a bearing which is fixed rigidly to the deck or deck supports with a shaft extended for the attachment of a heavy flywheel. The flywheel has the effect of smoothing out any speed fluctuations transmitted from other parts of the drive since it possesses momentum and resists any tendency to speed it up or slow it down. We shall look at this in more detail when we consider the capstan and flywheel next month.

The power to drive the capstan comes from the capstan motor which should ideally have an extremely constant speed characteristic. Various types of motor can be used for this purpose, but the hysteresis synchronous type is the best since its speed is 'locked' to the supply frequency which is fairly constant. (In *theory at least!*—**Ed.**) Normally this type of motor has an outer fixed part called the stator and an inner part, the rotor, which rotates as a result of a rotating magnetic field set up in the stator. An alternative arrangement is the *Papst* outer rotating cage synchronous motor which has been developed specially for constant speed drives Here the rotor is made to rotate on the outside of the stator coils. This has a distinct advantage as we shall see when we consider the flywheel.

Outer rotating cage motors are often employed in machines where a 'direct drive' for the capstan is chosen. An example is, again, the Revox 736, where there are no intermediate wheels or flexible belts to transmit the power from the motor shaft to the capstan. Exact tape speeds can be obtained with this type of drive, but in order to change the tape speed the motor has to be capable of running at two synchronous speeds. We shall come back to this in later articles.

In addition to the direct drive, two other methods of linking the capstan and its motor are the intermediate idler wheel and flexible belt drive. In the former, the motor shaft is usually fitted with a stepped pulley. The appropriate tape speed is then obtained by an idler establishing contact between the flywheel and one of the steps on the pulley. The speed of the capstan then depends on the motor speed, the diameter of the step on the pulley and the diameter of the flywheel—the idler wheelsize does not affect speed. With this mechanism, change of capstan speed can be achieved simply by selecting another step on the motor pulley, in which case another idler springs into action, replacing the existing one which automatically disengages. An intermediate wheel drive can be very reliable and excellent speed stability may be achieved. As we shall see in a later article, an intermediate wheel drive adds greatly to the flexibility of design parameters. There are fewer limitations on the chosen speed of the capstan motor and the speed, and hence size of the capstan itself, and this means less compromise on the part of the engineer when trying to achieve extremely low wow and flutter figures. A belt drive, also, allows less dependence between the speed of the motor and the diameter and or speed of the capstan, although speed change can be a problem here.

Good design aimed at achieving low speed fluctuation and low long-term speed variation will inevitably involve a heavy mechanism and this must be supported by a sturdy main structure or the deck may warp. It is for this reason that many professional and a few semi-professional recorders have heavy diecast plates on which to build the main deck assembly.

The *reel* motors commonly used in tape recorders are conventional non-synchronous induction motors which have good instantaneous speed regulation or smooth drive. This is so that pull on the tape will not be jerky and so contribute to wow and flutter. Ordinary induction motors are inexpensive and give a lot of power for their size, unlike the synchronous type mentioned earlier, although they are subject to long-term speed variation caused by changes in load or line voltage. This, however, is not important for a reel motor because as the tape goes from a smaller diameter—at the beginning of a reel—to a larger diameter at the end, the reel speed must change since the tape speed is constant.

When separate motors are used to drive the reels, the design is such that a nearly constant *tension* is maintained on the tape regardless of how full the tape reel may be. To do this the motor is *stalled* or run at well below maximum voltage so that the torque developed increases with the load. If the take-up reel motor is carefully designed, it develops just the right amount of torque to give the correct tension on the tape and yet not be significantly affected by the varying amount of tape on the reel. The motor operating the feed reel is driven at a still lower torque which is just enough counterforce to keep the tape taut during unwinding so that it does slacken when the tape drive is stopped. With separate reel motors, therefore, there is more or less a balance of forces at each end of the tape, pulling in opposite directions, with the capstan acting as a metering device feeding the tape at a constant rate to the take-up reel. The function of the capstan is to drive the tape by *friction* and it can only do this properly if the tension on the tape is constant.

In many domestic recorders a slipping clutch device is used. Essentially this consists of a rotating disc that is driven at a constant speed, often by the same motor that drives the capstan. Next to this disc is a felt cushion which *slips* on the disc and drives another disc attached to the reel shaft. The slippage between the drive disc and the felt applies a

(*continued on page 190*)

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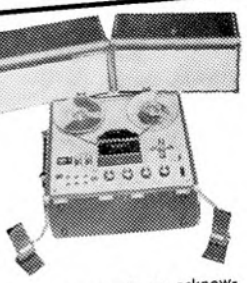

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CHILTON 100S SOLENOID-CONTROLLED RECORDER

A SOLENOID-controlled stereo tape recorder has been developed by a new British company, *Magnetic Tape Mechanisms Ltd.*, under the aegis of T.H. Reps, formerly of *Reps* (*Tape Recorders*) *Ltd.* Twin illuminated peak programme meters, separate record and play heads, and automatic bias adjustment for each of the three tape speeds are among the features of the *Chilton 100S.* The mechanism centres on a *Papst* hysteresis synchronous motor and may be operated in any position from horizontal to 45°. Fast-wind time is within 100 seconds for 1200 ft. in either direction.

The basic 100S operates at 7½, 3¾ and 1⅞ i/s (19, 9.5 and 4.75 cm/s) with no greater than 0.1% RMS total wow and flutter at 19 cm/s from start to finish; spool capacity is 7 in. Two tension rollers prevent bounce wow when the pause control is released and also ensure neat tape wind. A heavy nickel-plated steel flywheel is incorporated, the flywheel shaft being of high chrome steel ground between centres to within 25 millionths of an inch roundness.

A stereo power amplifier supplies 10 W RMS per channel at 8 ohms (or 7 W RMS at 15 ohms) with Baxandall tone controls giving ±10 dB at 50 Hz and 10 kHz. Three input pairs permit connection of low-output ribbon or dynamic microphones (150 μV at 50-200 ohms), radio (5 mV at 47 K adjustable) and gram (5 mV at 47 K RIAA). In addition to the external loudspeaker output, line sockets provide 1 V at 600 ohms for external amplification.

Finished in satin chrome and charcoal grey, the 100S is supplied in an oiled teak cabinet and weighs 32 lb. Dimensions are 40 x 40 x 18 cm. and the price, with ½-track or ¼-track heads. is £120 15s.

Manufacturer: Magnetic Tape Mechanisms Ltd., Chilton Works, Garden Road, Richmond, Surrey.

SENNHEISER CARDIOID MICROPHONE

NOW being produced by *Sennheiser*, the *MD 409* cardioid microphone is intended for amateur tape recordists and the music industry. Bass sensitivity has been reduced to permit close singing without booming effects and a silent on/off switch is built into the microphone base. Finish is in black and gold and the price, complete with gold *Tuchel* connector, is £29 17s.

Distributor: Audio & Design (Sales) Ltd., 40 Queen Street, Maidenhead, Berkshire.

NEW GRUNDIG MODELS

TWO new battery recorders and several updated mains models have been introduced by *Grundig*. Most notable is the *C.200* employing *Philips* cassettes and costing £38 17s. Claimed frequency range is 80 Hz-10 kHz at 1⅞ i/s (4.75 cm/s) with 45 dB dynamic range and 0.4% wow and flutter. Output power is 800 mW through an 11.5 x 7 cm. internal speaker. Overall dimensions are 24 x 15 x 6.5 cm. and weight is 4¾ lb.

A 5 in. (13 cm.) spool capacity, brushless DC motor and twin contra-rotating flywheels are features of the *TK 2200* which supersedes the *TK 6*. Unlike the latter, however, it is designed solely for battery operation and weighs 10 lb. Speeds are 3¾ and 1⅞ i/s (9.5 and 4.75 cm/s) with claimed respective frequency ranges of 40 Hz-15 kHz and 40 Hz -8 kHz. Dynamic range is 47 dB at the higher speed and 46 dB at the lower. Wow and flutter at 9.5 cm/s is ±0.25% and the price is £78 15s.

The *TK 247* offers ¼-track stereo recording and reproducing facilities with two 4 W output stages feeding four internal speakers. Speeds are 7½ and 3¾ i/s (19 and 9.5 cm/s) and the price is £103 19s. A VU-meter is incorporated on each channel.

Distributor: Grundig (Great Britain) Ltd., London, S.E.26.

SELA 2880 PORTABLE MIXER

CARSTON Electronics have been appointed agents for *Svenska Elektronik-Apparater* of Stockholm and are now distributing their *Sela 2880* portable mixer. Though particularly suited to the *Nagra* battery recorder, the unit may be used with any recorder or amplifier, having a frequency response of 40 Hz-16 kHz ± 0.5 dB and less than 0.1% distortion at normal programme level—below 0.2% at maximum output. Average current consumption is 60 mA at 10.5 V. Dimensions are 36 x 32 x 5.5. cm. and the price is £225.

Distributor: Carston Electronics Ltd., Electra House, Wiggenhall Road, Watford, Hertfordshire.

SONY ADD TO THEIR RANGE

THREE speeds, automatic and manual gain control, and silicon transistor circuitry are features of the *Sony TC105*. Retailing at £49 7s. the recorder operates at 7½, 3¾ and 1⅞ i/s (19, 9.5 and 4.75 cm/s) with claimed wobble of 0.17%, 0.3% and 0.4% respectively. Frequency range is 40 Hz-18 kHz at the fastest speed. Maximum output power is 4 W, provision being made

(*continued overleaf*)

for connection of an external 8-ohm speaker. An output is also provided at high impedance for an external amplifier. Separate inputs are incorporated for gram and low impedance microphone. The TC105 accepts spools of up to 7 in. (18 cm.) diameter and weighs 21 lb. Dimensions are 37.5 x 34 x 18.5 cm. A 13 cm. demonstration tape, moving-coil stick microphone, earphone, connecting cord, head-cleaning ribbon and splicing tape comprise the accessories.

The *CV-2000* domestic video recorder is now joined by the *CV-2100CE*, capable of recording 625-line television broadcasts. Price of the new recorder with 19 in. monitor and 625-line camera is £685, some £180 above the complete 405-line system. The new recorder is substantially more versatile than the CV-2000, having facilities for still-frame viewing, tape duplication and automatic or manual audio and video level control. Sound may now be dubbed after the vision has been recorded. Linear tape speed is 11¼ i/s (28.6 cm/s) ±2%,

picture stability being achieved within six seconds of starting.

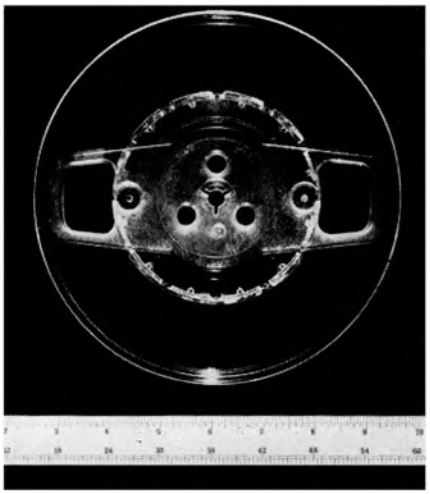
Purchased separately, the CV-2100CE recorder costs £385, while camera and tripod are £175. The monitor, which may also be employed as a 405/625 line broadcast receiver, costs £125.

Distributor : Sony U.K. Division, Eastbrook Road, Gloucester.

WIDE-HUB REELS

RESPONDING to recent references in this journal, *Transatlantic Music Tapes Ltd.* announce that they can supply wide-hub spools without tape. Prices are 6s. 6d., for an 18 cm. spool with 10 cm. hub, boxed, and 4s. 6d. for a boxed 13 cm. spool with 7.5 cm. hub. A sample of the 18 cm. size is illustrated.

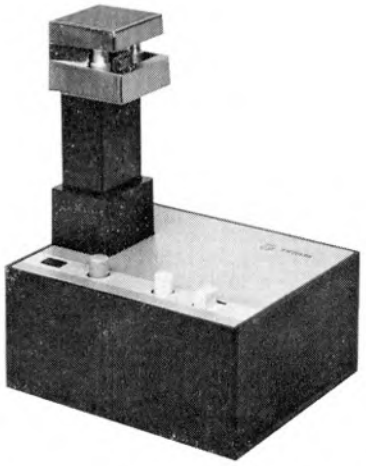
Distributor : Transatlantic Music Tapes Ltd., 36 High Street, Salisbury, Wiltshire.



PHILIPS SLIDE SYNCHRONISER

SUITABLE for almost any combination of tape recorder and automatic slide projector, the *Philips EL1995* slide synchroniser permits automatic activation of the picture-changing mechanism from a pre-recorded control track. The unit is powered by six *U11*-size cells, with a life of approximately 100 hours, or direct from the mains.

The entire head column is telescopic and may be adjusted between 11.5 and 17.5 cm. from the base without need for makeshift supports. The EL1995 is being marketed through

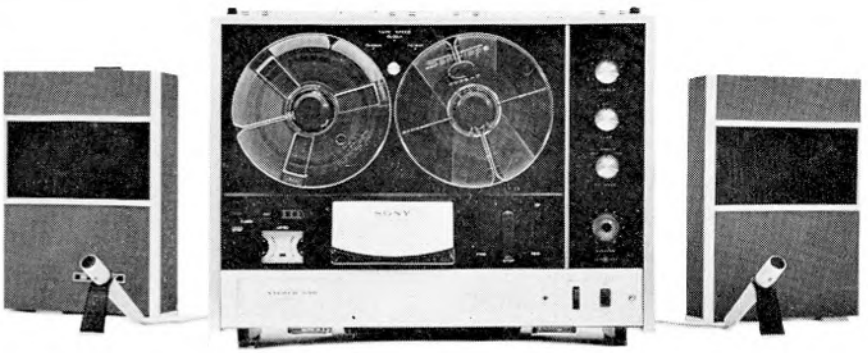


photographic dealers and the electrical retail trade at £12 12s.

Distributor : Philips Electrical Ltd., Century House, Shaftesbury Avenue London, W.C.2.

'Seat in the middle, please"

SONY TC-530 STEREO



THE main feature of this machine is the "Quadradial" (4-way) speaker system where full-range speakers are fitted in the sides of the recorder case, and lid speakers with long connecting leads are spaced out on either side of the recorder to broaden the stereo image.

The machine can be used in either the vertical or horizontal position, and tape threading is made very easy by the "Retractamatic" pinch-roller system which allows the tape to be led across the head block straight to the take-up reel.

All recording controls are hidden under a sliding panel below the twin VU-meter and the playback controls are conveniently laid out on a vertical panel on the right-hand side of the deck.

Tape motion is controlled by a single lever with a push button to select fast forward wind when required. Wind and rewind of a 13 cm. reel of LP tape was completed in 2 minutes 20 seconds in either direction.

The push button reset tape position indicator is driven from the supply reel and 10 reel revolutions give a reading of 9 on the three-digit display.

The rather high wow and flutter specification was comfortably met, as will be seen from the fluttergrams and RMS readings of **fig. 1.** The pen recordings show the combined record and play cumulative wow and flutter, and the panel below shows the play-only readings obtained when playing a special low-wobble test-tape. These readings are of course much steadier, and are a reliable indication of the merit of the machine under test, without long-term adding or cancelling of the record and play speed fluctuations giving optimistic or pessimistic impressions of the recorder's performance.

Coming back to the pen recordings, it will be seen that all traces show evidence of 25 Hz flutter from the 1,500 r.p.m. drive motor, but tape friction high frequency flutter is quite low. Capstan and pressure roller wow is negligible on this particular review sample.

Fig. 2 shows the play-only responses at line output from 70, 140 and 280 μS test-tapes. The 7½ i/s (19 cm/s) response is remarkably level at high frequencies, with a trace of head contour effect below 200 Hz. The lower speed responses are smooth but tilted slightly to cut the bass and raise the top response by 1 or 2 dB.

System noise, with no tape passing the head, was exceedingly low at 46 dB below test-tape level. Bulk erased tape read −44 dB.

MANUFACTURER'S SPECIFICATION

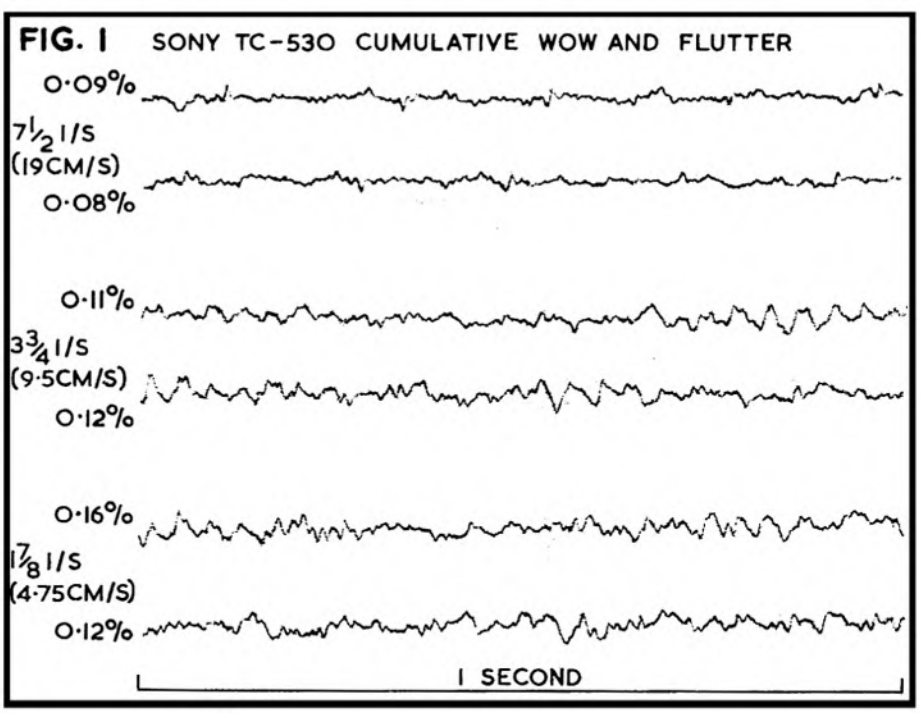
Quarter-track three-speed stereo recorder with internal amplifiers and speakers plus satellite lid speakers. **Frequency response:** 50 Hz-15 kHz at 7½ i/s (19 cm/s), 30 Hz-13 kHz at 3¾ i/s (9.5 cm/s) and 30 Hz-10 kHz at 1⅞ i/s (4.75 cm/s), all ±3 dB. **Output power:** 5 W per channel. Separate bass and treble controls. **Wow and flutter:** 0.17% at 19 cm/s, 0.3% at 9.5 cm/s and 0.4% at 4.75 cm/s. **Inputs:** 0.19 mV at 250 ohms-1 K (microphone). 0.06 V at 100 K (auxiliary). **Line output:** 0 dBm (0.775 V). **Speakers:** 8 ohms. **Dimensions:** 50 x 39.2 x 23.7 cm. **Weight:** 42 lb. **Price:** £126. **Distributor: Sony U.K. Division, Eastbrook Road, Gloucester.**

PLAY-ONLY WOW AND FLUTTER		
7½ i/s (19 cm/s)	W + F	0.08%
	Wow	0.04%
3¾ i/s (9.5 cm/s)	W + F	0.1%
	Wow	0.05%
1⅞ i/s (4.75 cm/s)	W + F	0.18%
	Wow	0.075%

Recording tests at test-tape level gave the curves of **fig. 3.** These are similar to the play-only responses at low frequencies but show a recording treble loss at the two low speeds.

500 Hz overload recording tests showed that a level of 4 dB above test-tape was recorded with the meter needle just entering the red sector of the VU-meter scale. Plus 12 dB on test-tape showed remarkably low distortion figures of 2.1% at 500 Hz, 1.6% at 1 kHz and 1.3% at 3 kHz. 3% distortion at 500 Hz was only reached at a level 14 dB above that of the test-tape, and the normal domestic limit to 5% was nearly 16 dB above test-tape level. This indicates that the Sony tape fitted to the machine has a rather thick oxide layer or an oxide with a higher than usual remanence. This would also account for the roll-off in top response at the lower speeds, and lowering the bias would improve

(*continued on page 189*)



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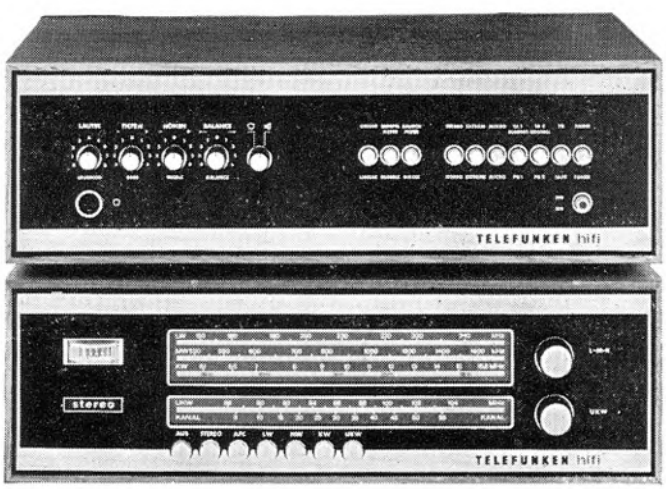

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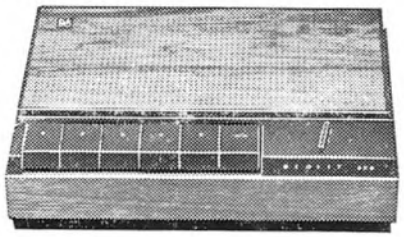

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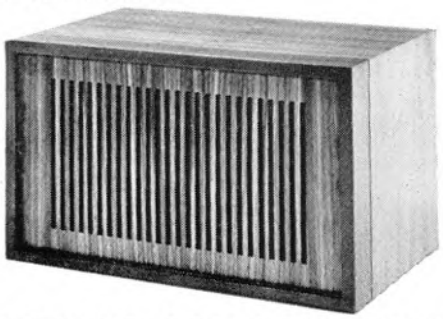

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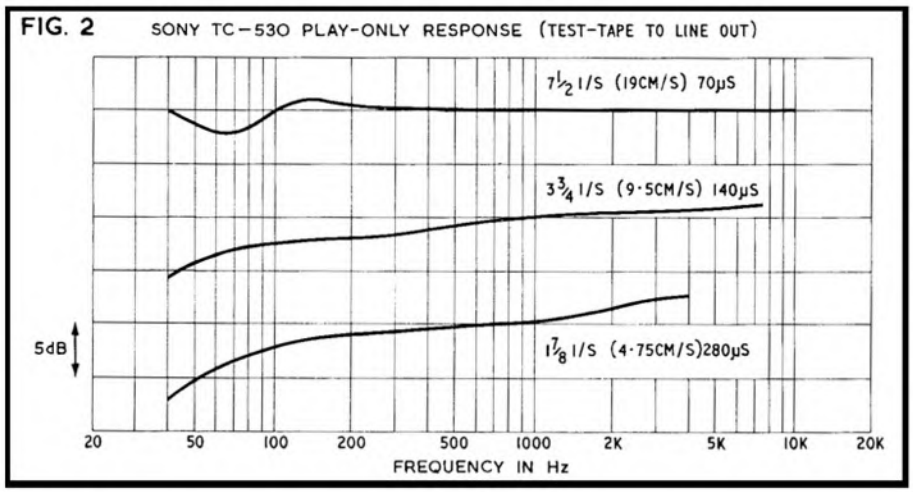

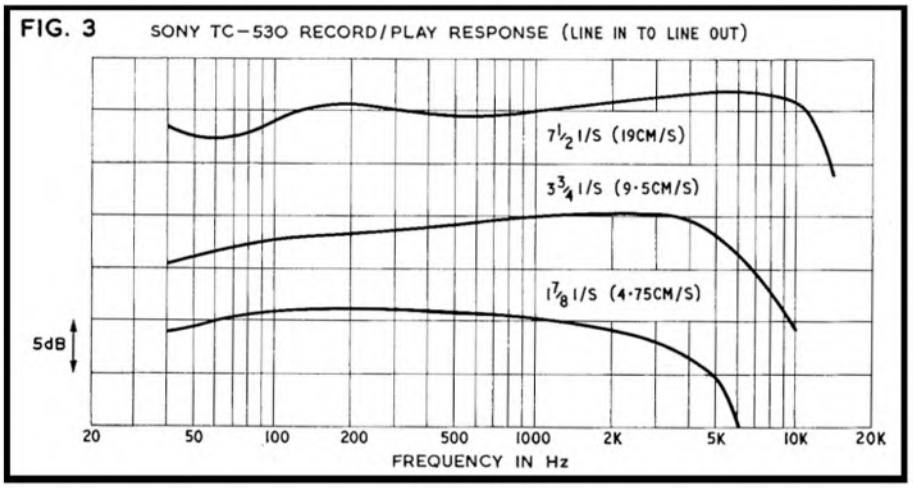

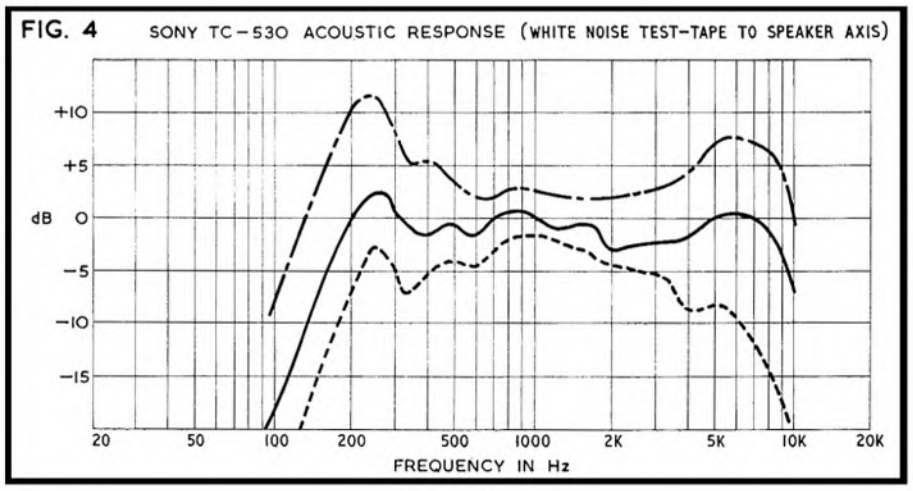

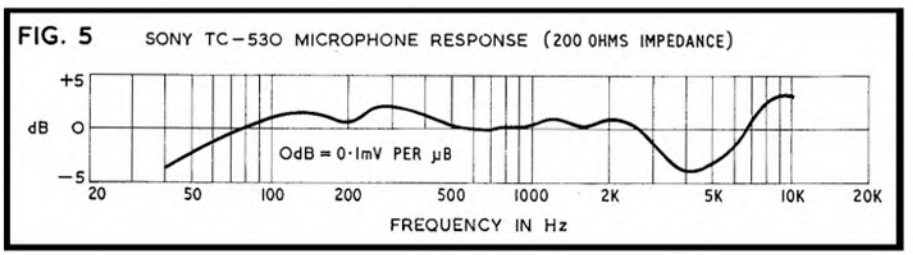

the high note response without raising the harmonic distortion too much. A number of other tapes were tried on this recorder and they all showed a more normal 3% distortion at 12 dB above test-tape and a further octave or so of level high note response at each of the speeds.

All tapes erased on the machine had noise levels better than 40 dB below test-tape level, and unweighted dynamic ranges of better than 52 dB at peak recording level.

The effect of the bass and treble tone controls was measured by playing a white noise test-tape at 19 cm/s and measuring the sound levels on each of the 25 one-third octave bands at a distance of one foot on the axis of one of the internal speakers. The responses obtained at mid and extreme positions of the tone controls are shown in **fig. 4.**

The 250 Hz cabinet resonance rather spoils the effect of the bass tone control, as advancing the control only slightly causes boom on music and exaggeration of chest tones on voice. The high frequency peak is useful for off-axis listening of the side facing internal speakers and proved very useful when using the *TC-530* without the satellite speakers. With the extra speakers, however, distortion was evident whenever the treble control was advanced beyond the mid position. As it was known that tape distortion was low, a further frequency response of one of the lid speakers was checked. This showed a mean sensitivity some 10 dB below that of the internal speakers with two large peaks, one centred on 5 kHz and one at 600 Hz. Waveform distortion was low on the high frequency peak, but violent frequency doubling was occurring on the low frequency peak due to non-linear cone motion at the cone resonance, which had been pushed up to 600 Hz due to the small cavity behind the cone. Removing the backs of the lid-speakers reduced distortion considerably, but advancing the volume control produced further distortion which sounded like amplifier overload.

CRO tests showed that severe waveform clipping commenced at 6 V RMS across the speaker terminals, corresponding to 4.5 W absolute peak (and very distorted) output. Distortion at 3 W was still above 5% with all speakers connected.

COMMENT

The response of one of the stick microphones supplied with the recorder was measured in a white noise sound field to give the response of **fig. 5.**

Nice mechanics and styling, quality excellent up to line output. Sound quality at moderate volume satisfactory with internal speakers only in operation. Lid-speakers are a dead loss under all conditions ! Quality and stereo effect good with high sensitivity, wide-range external speakers connected and internal speakers switched off.

Even a pair of relatively low sensitivity speakers (*Goodmans Maxims*) gave excellent results if amplifier was kept below overload point. **A. Tutchings.**

signal-to-noise ratio for a gramophone-input *only* because we are accustomed to hearing it effectively increased to 60 or 70 dB by overdriving. With most tape playback channels we are lucky to achieve an *actual* 50 dB in the amplification.

The original intention for my dis-integrated system was to connect a *Marriott X-17* head direct to my *Leak* amplifier for playback, using the tape-head input. (The amplifier function-selector provided a convenient track switch.) As an alternative, Mr. Latham had ingeniously arranged for this head to be switched in on the STP 1 when the latter was set to playback. Either arrangement was pretty good by general standards. Nevertheless, amplifier noise was decidedly audible—without tape running—when the gain was turned up to the point necessary for realistic reproduction of choral or orchestral recordings. I was therefore keen to see what could be achieved using Mr. Williamson's silicon-transistor front-end published in *Hi-Fi News* (April 1966) It quickly became clear that in principle his circuit could offer a big improvement, but in practice much depended on screening arrangements, including screening of the battery. Without proper attention to this one was liable to pick up not only hum, but all manner of irregular electrical disturbances. If earthing arrangements were imperfect, the preamp could even turn into an effective AM radio tuner ! The circuit, as adjusted for tape purposes, is given in **fig. 2.**

It has long been known that leads from tape-head to preamplifier should be kept as short as possible to prevent HF losses and problems of resonance between head inductance and lead capacitance This is another ancient truth which has seldom, if ever, been applied with full seriousness. I

more or less constant torque on the take-up reel. However, this does not produce a constant tension on the tape. **Fig. 2** may help to explain this. When the reel is nearly empty the lever arm A-B is short and the constant torque or rotational force at A will produce a high tension at B, which is for practical purposes the tension on the tape as it leaves the capstan. When the reel is full, on the other hand, the lever A-C is long and the tension on the tape at C will be lower. In practice this means that a certain amount of slip through the capstan is inevitable and the long-term speed stability suffers. To help solve the problem one can use tape reels with large hubs, thus reducing the tension differences between the inner and outer diameters. Even with the stalled motor take-up, a larger diameter hub gives closer timing results and should be used in applications demanding close precision programming. Incidentally, because of the variation in back tension of the tape as the *supply* reel gets smaller, it is also good practice to use reels of similar dimensions and weight even if large hubs are not used. In any case this prevents spillage of tape which is liable to occur if the

must confess I had myself taken as God-given the standard Brenell arrangement, whereby the head leads are conducted below the deck to a terminal strip, shielded but close to the motors. I have to thank Arthur Skirving of Berwick, Australia, for the suggestion that the Williamson preamplifier be mounted *above* the deck plate. This is not easy with most decks—I have managed it with a Truvox, but only by considerably pruning the circuit-board and removing the record/play switch. Happily, it was the simplest thing imaginable with the Brenell : a stacked pair of preamp boards could be mounted immediately behind the playback heads, so that leads from the Marriott head were virtually direct connections—no more than an inch long ! (See front cover picture.)

This arrangement has so much to commend it, that it may be as well to give a few practical hints for other Brenell owners. With Series II or later decks, it is not necessary to drill into the main deck-plate. Remove the plastic-coated cover, drill two holes in it and insert 1½ in. bolts from below, locking them with washer and nut on top. Cover bolt-heads with insulating tape to prevent contact with the deck-plate. The preamps can then be rigidly mounted with nuts each side. The holes in the circuit-board should be slightly countersunk on the plated side to prevent electrical contact with the bolts, and insulating washers should be used except at one point, where a good contact through to the aluminium of the cover should be ensured. The screen of the output leads should be soldered to a good chassis earthing point beneath the deck. (Beware : some parts of the deck are 'floating' on anti-vibration rubber washers !) A 9 V battery should be mounted screened, below deck : a *PP3*, with a little packing, will fit under the standard Brenell screen for the terminal-strip, if the latter is removed (**fig. 3**). The positive supply should be connected by a screened lead, but the negative line can be broken at the record/play wafer or elsewhere for switching. I suppose theoretically the two screws retaining the top cover should be replaced with nylon ones for correct double-screening, but this does not seem to make any practical difference.

If the preamp boards are carefully positioned, and their corners rounded off, 8½in. (21 cm.) spools can still be used. With 18 cm. reels there is plenty of room, and a screening cap can be fitted over the whole assembly. In practice this is usually not necessary : thanks to the built-in screening of the deck-plate, it makes no detectable difference at normal maximum volume levels with standard equalisation. But it is clear (if one turns up volume and bass way beyond tolerable limits) that a top cover will greatly reduce residual noise from external sources, so in some circumstances it could be important.

I hope at some future date to make laboratory measurements of noise levels. At present I can only quote the unanimous verdict of friends and acquaintances (including professional musicians and a former recording engineer) who have heard the system : they have never before heard ¼ in. tapes so devoid of distracting background noise ; and tonal balance (with a nominal 68 μS feedback path) seems as accurate as with the best discs. The Williamson 'front-end' is normally fed direct to the Leak volume control (via tape-monitor facility), or via *Quad* amplifiers, to a pair of Leak *Sandwich* speakers. In an averagely-furnished room of 24 x 13 ft., amplifier-noise is inaudible from normal listening positions with gain set to produce realistic orchestral climaxes. Additional white noise with a commercial pre-recorded tape tracking can be detected by a deliberate effort of attention, but passes completely unnoticed in normal listening. (This judgment was volunteered by a gramophone-enthusiast who had previously reckoned all domestic tape systems offensive on this score ; the very same tape, played on freshly degaussed £100-plus machines, produces enough hiss to turn up his nose !)

machine is stopped and reels of different size are in use.

The transport mechanism is also generally required to wind the tape at high speed in forward and reverse directions, so that any part of a recording can be located quickly within a reel of tape. In three-motor machines, this spooling process is achieved by a switching system that connects an overload voltage (which may be full mains voltage) to either the wind-on or wind-back motor. During this function, the pinch-wheel disengages and the pressure pads are released. Under these conditions a large reel of tape can be shuttled in a short time. We have already mentioned that, when the reels are driven directly by motors, a more or less constant tension on the tape is achieved. Although this is desirable to prevent capstan slippage, it invariably winds the tape 'hard'—the constant tension on the tape during the fast wind builds up considerable pressures with each turn of the reel. If a tape wound in such a manner is subjected to sharp changes in temperature or humidity, substantial tape tensions can build up in the inner turns which may stretch the tape beyond its yield point, causing permanent deformation.

Most domestic machines employing a slipping clutch constant torque reel drive achieve a 'soft' wind, especially if very little back tension is used. Here we have a satisfactory situation, so far as spooling is concerned where the tension in the tape wind is reduced as the amount of tape on the reel increases.

Another problem of design arises, with fast rewind and spooling speeds, namely being able to stop the mechanism at any time without risk of breaking or stretching the tape. To overcome this, brakes are fitted to each of the reel drives, which come into action as soon as the stop switch is operated. Normally the feed reel brake comes on momentarily before that of the take-up reel, preventing the feed reel free-wheeling and spilling the tape. In many machines the brakes are self-wrapping in one direction, opposite to the normal rotation of the motor. The action of these brake shoes brings the tape to an almost instantaneous halt when the power is removed from the driving motor. Other recorders employ brakes which are brought into play by levers connected to the stop switch. In many cases the braking torque can be adjusted so that the system can be compensated for any overrun, tape spillage, or wear on the brake shoes.

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5″ 600′	5/6	16/-	5″ 900′	7/6	22/-	5″ 1200′	11/-	32/-	5″ 1/6
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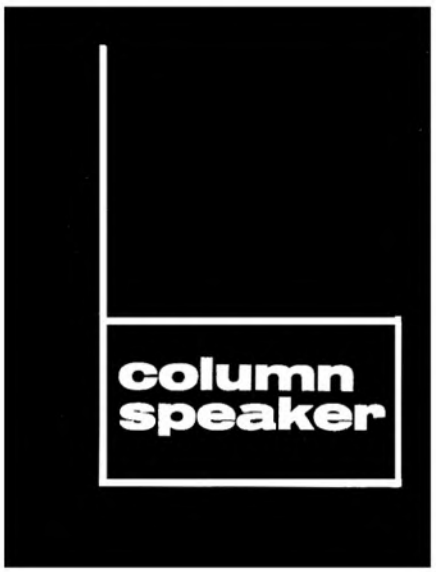

HAVE you ever checked the speed-accuracy of your machine? *Tape Recorder* reviewer Alec Tutchings has pointed out that to do so to fine limits is not easy; but a very good idea can be gained from a measured length of tape and a stop-watch, or even an ordinary watch with a sweep second hand. There is available a type of leader-tape which has graduations of 3¾ and 7½ in. (9.5 and 19 cm.) printed on it, and it is quite easy to splice a different-coloured leader to both ends of a length such as to give the distance which ought to be transported in 100-second periods. An answer in percentage fast or slow can then be obtained.

IN FOR A SHOCK

I warn you that you are in for a shock: I have five machines at this moment, and all are different. That does not matter, of course, so long as one records and replays on the same machine; but one cannot get very far without transferring tape from one machine to another. Variations from nominal speed quite commonly show up when dubbing, and are particularly critical on speech. Quite apart from receiving nasty enquiries from correspondents about the state of one's gonads, there are more serious problems. I help to edit a taped magazine, for which we receive contributions from all over the place, recorded on machines of many makes. When these items are spliced together, variations in speed sometimes become agonisingly apparent. It is bad enough on the master; but on circulation copies, made at a slower speed . . .

It seems to me that manufacturers ought to devote a great deal more attention than they do to this question of speed-accuracy. I can see all the difficulties of mass-production; and I know that those machines which do give something like dead accuracy, not only of nominal speed but of speed-consistency throughout a reel, do so only by adopting sophisticated methods of control. I am not asking for that, which would be out of question on less costly machines; but I do think it ought to be possible to get run-of-the-mill machines accurate to within ±0.5% of nominal.

Magazine production (and indeed any other kind of creative recording) demands the highest possible quality on the original tape, which will in all probability be copied for editing (so as to preserve the original intact) and may then be re-copied more than once before the final product is achieved. Since, inevitably, every copy involves a loss of quality, one can be getting very close to the intolerable at the end of this copying-chain. For that reason, and to permit accurate editing, an original made at at least 7½ i/s (19 cm/s) is essential.

Most mains machines provide 19 cm/s but how many battery machines do? I can think offhand of the Uher, the new Ampex, the Tandberg, the Nagra and the EMI. So, if you are lucky enough to be able to afford a hundred pounds or two you are all right. There are other machines which produce very acceptable quality at 9.5 cm/s; but once the copying process gets under way it is a different story. Why, for heaven's sake, cannot these cheaper machines provide 19 and 9.5 cm/s at least, as a special order, instead of 9.5 and the useless 4.8 cm/s.

A LOT TO BE SAID

Indeed, there is a lot to be said for a battery-operated machine which is a recorder *only*: no erase, no replay, and the single speed of 19 cm/s. It ought to be possible to market such a machine for something between fifty and seventy-five pounds and I for one should be very interested indeed. The cost of too many machines is sent up by the provision of facilities which nobody uses, and when applied to battery-portables that process becomes ludicrous.

A Bexhill reader, Mr. Alan Stuart, has most kindly sent me the answer to the earth-breaking problem mentioned in a previous article. It is a flex-connector type *2901/P*, marketed at 2s. 9d. by *Wellco Electric*, of Knebworth, Herts. Unlike other designs I have seen, the earth connection is made by metal strips on the outside of the plastic plug and socket. Hence, one can simply reverse the two ends, thereby disconnecting the earth. Other similar types of connector I have seen have an offset earth-pin, designed precisely to prevent one from doing that.

CLASSIFIED ADVERTISEMENTS

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

SITUATIONS VACANT

Tape Recorder Servicing Engineer required for central service department (East London) of Britain's largest tape recorder specialists. Telephone Mr. Willis, GRAngewood 2110.

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BBC Television requires fully qualified and experienced technicians as Holiday Relief Film Recordists (£29 14s. per week) and Assistant Film Recordists (£21 18s. per week) for the summer months. Initial appointment for two months. Possibility of extension for further four months.
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Write, giving age and full particulars of relevant experience, to General Manager, Film Operations and Services, Television Film Studios, Ealing Green, London, W.5.

Educational Tape Recordings. An unusual and interesting vacancy exists for a keen tape recording enthusiast who would like to turn his hobby into a full-time job. We are looking for a man having a basic, but not necessarily extensive, knowledge of foreign languages, and having also a certain mechanical aptitude to carry out editing and mass recording of taped educational programmes using novel and specialised equipment. Salary will be in accordance with age and experience. Applicants should write with full details of previous experience to: T. C. Halvorsen, A-V Sales Manager Bell & Howell Ltd., Great West House, Great West Road, Brentford, Middx.

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

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30% off BASF tape, L.P. 7in. reel 1,800ft. 33/-, D.P. 7in. reel 2,400ft. 52/6. P. & P. 5/- per order. W.S.L., 104 Norwood High Street, S.E.27.

Your sole U.K. agent for spares/service of the Saja recorder. C. Braddock Ltd. (Blackpool 45049).

Musicassette Supply Company—library service—part exchange—blank cassettes—catalogue 9d. stamps. 13/4 Angel Street, Worcester.

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

American 4-Track Stereo Tapes covering most famous labels at realistic prices. Why pay more? Imported directly by us, saving distributor's profits. Vast collection at 75/ each —send S.A.E. for free lists or call at London showrooms: Teletape of Marble Arch, 33 Edgware Road, W.2.

Transistorised OSC./Milli-Voltmeter, combined test unit for professional and hi-fi equipment. £39.6.0 plus 8/6 p. and p. Enquiries to Lander Electronics, 24 West Kensington Mansions, Beaumont Crescent, London, W.14. Tel. 01-385-0697.

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

If quality matters consult first our 70-page, photographically illustrated catalogue (5/6) and equipment housing guide (1/6). Members enjoy unbiased advisory service, preferential terms (cash only, no H.P.). Membership 7/6. Our associates also manufacture records from your own tapes, or record the Master at our studios (Steinway Grand). Bulk terms for choirs, fund-raising. Please specify requirements. Audio Supply Association, 18 Blenheim Road, London, W.4.

The Institute of Tape-Learning are pleased to announce a major breakthrough in tape-learning economics. At last we are able to offer a recorder which is not only ideal for Tape-Learning and Therapy and gives excellent results on music, but at the same time at a sensationally low price—**only 25 gns.** Send now for our latest free catalogue of Complete Tape-Learning Kits and accessories, including our special Induction Tapes, Pillow Speakers, Time Switches, etc., etc., together with latest Press Reports on this Vital New Subject. The Institute of Tape-Learning, Dept. TR, 153 Fellows Road, Swiss Cottage, London, N.W.3. Tel. 01-722-3314.

EMI & HMV Sound Effects Records: complete list including new issues now available from record shops or EMI Records, 20 Manchester Square, London, W.1.

Norman Easysplicer makes tape splicing easy and accurate. Only 5/- post paid. Easysplicer, 85 Middleton Ave., Greenford, Middx.

FOR SALE—PRIVATE

15 pre-recorded music tapes, slightly used. Postcard for details. 4 Links Close, Caister-on-Sea, Gt. Yarmouth.

111 copies of Tape Recorder from No. 1 with indices, in spotless condition. Offers to Byrne, 10 Sid Vale Close, Sidford, S. Devon.

E.M.I. professional tape recorders for sale. TR50s and as new RE301s, £25 and £200 o.n.o. Telephone Hall, 01-435-1177, daytime.

PERSONAL

Reviewed favourably in this journal: Sony TC800 mains-battery portable recorder. New. Tested and found satisfactory. £60 with five new tapes. A good buy for the sound hunter. Mike Howell, 7 Park Lane, Greenfield, Oldham.

WANTED

Brief loan of Tippett's "King Priam" or "St. Augustine" mono or stereo, expenses paid. Box No. 532 (London).

Quality stereo recorder required. Perfect Beocord 2000 portable preferred or comparable 4-track Truvox, Tandberg. Box No. 534 (Scotland).

Private collector wishes to contact anyone who taped the opening night of B.B.C.2, urgent! Dowling, 38 Donald Way, Chelmsford, or phone 01-248. 1642.

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

County Recording Service (A.P.R.S.) for tape to disc, master discs and pressings. Suppliers of cutting sapphires for all disc recorders. London Road, Binfield, Berks. Tel. Bracknell 4935.

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

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

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Tape to Disc service. Specialists in location recordings, demos', weddings, sound equipment, etc. Any distance, s.a.e. for leaflet. **Trusound** Recording Services, 4 Hitchin Road, Shefford, Beds. Telephone: Shefford 355.

MISCELLANEOUS

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

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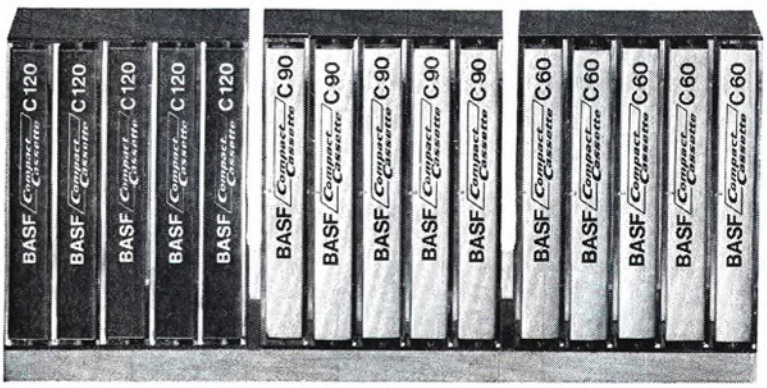

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