SEPTEMBER 1966 TWO SHILLINGS

tape recorder

AKAI X-355 REVIEW TELEVISION ON TAPE THE RIGHT TO COPY
THE HAZARDS OF RECORDING BIRDSONG ASPECTS OF OUTDOOR DRAMA

TO MEET THE STANDARDS OF THE CONNOISSEUR...

Ampex 800 Series of Stereo Tape Recorders for sound perfection

Designed to out-perform all other Tape Recorders in their price range, with *solid state* electronics for maximum reliability. A revelation in pure sound reproduction in 4-track Stereo or Mono. For true fidelity recording or hours of the most satisfying listening pleasure this superb Ampex instrument defies comparison at anything approaching the price. Look at the features that put the Ampex 800 Series years ahead: Versatile 3-speed Operation · Precise Dual Capstan Drive · Interlocked Tape Controls · Lifetime Ampex Deep-Gap Heads · Accurate Record Level VU Meters · Uncomplicated, straight line Threading · Simplified Operation · Die-cast Aluminium Construction · Constant Speed, High-efficiency Motor. Additional features are Automatic shut-off switch—turns off tape transport when tension is lost; automatic tape lifters eliminate head wear during fast wind operations; automatic digital counter allows you to return to a selection on your tape quickly.

AMPEX

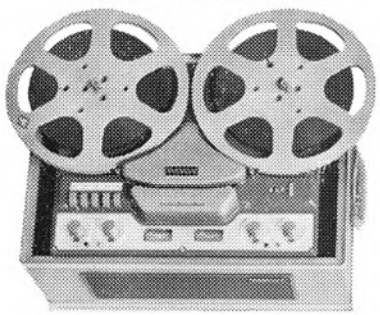
Ampex sales and service facilities are conveniently located throughout Europe and the Middle East. For more information write to: Ampex Great Britain Ltd., Acre Road, Reading, Berkshire, England. Telephone Reading 84411 · Ampex S.A. Via Berna 2, Lugano, Switzerland. Telephone 091/3.81.12 · Ampex Europa G.m.b.H. 6 Frankfurt Main, Düsseldorfer Strasse 24, Germany. Telephone 252001-5 · Ampex, 41 Avenue Bosquet, Paris 7e, France. Telephone 705.38.10.

BRITAIN'S LARGEST SPECIALISTS

As Britain's largest tape recorder specialists we claim to have an unrivalled selection of the most up to date recorders on display in Gt. Britain. The most experienced staff with expert knowledge. Ideal demonstration conditions with every recorder ready for immediate demonstration and comparison. The finest FREE AFTER SALES SERVICING facilities available. The largest, most centrally situated and accessible showrooms in London devoted exclusively to tape recorders. Exaggerated claims? Don't take our word for it, put our claims to the test and visit whichever of our Showrooms is most convenient to you. You won't be disappointed and it's ten to one that if you are interested in buying a tape recorder you'll become one more of our many thousands of satisfied customers.

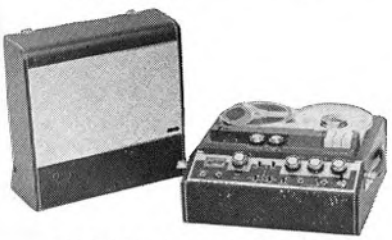
- **HIGHEST PART EXCHANGES**
- **INTEREST FREE TERMS**
- **OVER 100 MODELS ON DISPLAY**
- **UP TO 2 YEARS' FREE SERVICE**

HIGHLY RECOMMENDED



REVOX 736

AKAI 1700



WYNDSOR VANGUARD

AKAI 1700 The latest Akai release. Completely self contained Stereo/Mono recorder. 4 tracks. 3 speeds. 5 watt output. 7" tapes. Automatic tape stop. V.U. meter. Superb quality, amazing value. **79 gns.**

WYNDSOR VANGUARD The newest model to the famous WYNDSOR stable. 3 heads. Before and after record/replay facilities. 3 speeds. 4 tracks. 7" tapes. Freq. 40-15,000. 6 watts output. Detachable 8" Hi-Fi speaker unit giving superb reproduction. A wonderful value for money recorder at **59gns.**

B & O 2000 The most comprehensive fully transistorised stereo recorder available. Its facilities are too numerous to list. Available in 2 or 4 track and suitcase or table model versions. A recorder for those wishing to purchase the finest available. **119 gns.**

BRENELL Mk 5 M The most comprehensive and finest mono recorder made by this famous British company. 3 heads, 4 speeds. Up to 10½" tapes. Bass, treble controls. Mixing. Before and after record comparison facilities. V.U. Meter. 6 watts output. Separate record/replay amplifiers. **93 gns.**

SPECIAL OFFERS !

Philips EL3541 inc. mic. Perfect.	18 gns.
Ferrograph 4AN, as new.	49 gns.
Truvox PD86 Stereo tape unit. Perfect.	32 gns.
Grundig TK6 portable. As new.	42 gns.

SONY TC260 A brilliant new 4 track stereo model. Separate record and playback volume controls. Bass and treble controls. V.U. meters. Automatic tape stops. 7" Tape. 2 speeds. Superb Hi-Fi quality. Complete incl. 2 dynamic microphones, fantastic value at **95 gns.**

TANDBERG 6 One of the most technically perfect record/replay tape units available. Every possible facility provided. Sound on Sound. Freq. 30-20,000. 3 Speeds. 2 or 4 track models. 7" Tapes. Auto tape stops. A perfect unit for use with the best hi-fi equipment. **110 gns.**

GRUNDIG TK6 A handsome high quality battery/mains portable by the world famous company. 2 tracks. 2 speeds. Freq. 50-13,000. 4¼" tapes. Meter for recording and battery level. Includes superb dynamic microphone. A portable recorder with big machine performance and quality. **69 gns.**

REVOX 736 The stereo tape recorder that sells by reputation alone. One of Switzerland's finest products. Full professional record/replay facilities. 4 Preamplifiers. 3 heads. 2 V.U. Meters. Track to track facilities. Freq. 30-18,000. For the perfectionist. **127 gns.**

AKAI M8 Japan's finest. Complete stereo. 4 speeds. Unique Akai Cross Field recording. Freq. 30-25,000. 2 V.U. Meters. 10 watts output. Auto tape stops. Bass, treble controls. 4 tracks. 7" tapes, etc. Fantastic Hi-Fi, performance. **136 gns.**

UHER 4000 L A superb 4 track all transistorised battery/mains portable. Unbelievable performance. Freq. 40-20,000. 1 watt output, 4 speeds. 5" tapes. Ultra lightweight only 6 lbs. Capable of recording to the highest standards and used extensively by professionals. **103 gns.**

AKAI X4 Completely fully transistorised battery/mains portable. Superb performance. 3 speeds. 5" tapes. V.U. meters. 4 tracks. Operates from mains or rechargeable batteries. Has own power amplifiers. Freq. 40-20,000. Excluding microphones. **99 gns.**

SPECIAL OFFERS !

Sony TC500 inc. mics. Brand new.	89 gns.
Grundig TK60 Stereo. Perfect order.	59 gns.
Telefunken Stereo 77. As new.	45 gns.
Sony 777A Professional model. Perfect order.	85 gns.

VORTEXION WVB One of the most tried and tested models available. This latest model has the new Wright & Weaire 3 speed deck. 3 motors. 3 heads. Separate record/replay amplifiers. Before and after record. Monitoring facilities. 4 watts. Variable bias. 8½" tapes, etc. **£115.10.0.**

SONY TC200 This is the lowest priced hi-fidelity complete stereo recorder available. 2 separate speakers. 2 speeds. 4 tracks. Meters. 2 microphones inc. 7" tapes. Track to track facilities. We have yet to see a recorder offering so much at such a price. **72 gns.**

TELEFUNKEN 300 A truly remarkable battery/mains portable tape recorder. Available in both 2 or 4 track models. Extremely portable and a delight to use. Easy to operate push buttons and controls. High quality dynamic microphone incl. Freq. 40-14,000. Wonderful quality. **49 gns.**

TRAVEL FREE TO NUSOUND

To all customers residing outside the Greater London Area we offer a unique Free Travel facility. For full details by return, write to our Head Office: 191 Plashet Road, London, E.13.

HOURS OF BUSINESS

HIGH HOLBORN:
Monday to Friday 9 a.m. to 6 p.m. Saturday 9 a.m. to 1 p.m.

BISHOPSGATE:
Monday to Friday 9 a.m. to 6 p.m. Closed all day Saturday.
Open Sunday 10 a.m. to 2 p.m.

KING'S CROSS, STRATFORD, LEWISHAM, EAST HAM:
Monday to Saturday 9 a.m. to 6 p.m. Halfday Thursday.

82 HIGH HOLBORN, W.C.1 (1 minute Holborn Underground)	**CHAncery 7401**
242/4 PENTONVILLE ROAD, N.1. (3 minutes from King's Cross Station)	**TERminus 8200**
228 BISHOPSGATE, E.C.2 (1 minute Liverpool Street Station)	**BIShopsgate 2609**
36 LEWISHAM HIGH STREET, S.E.13 (1 minute Lewisham Station)	**LEE Green 2399**
2 MARYLAND STATION, STRATFORD, E.15 (adj't Maryland Station)	**MARyland 5879**
205 HIGH STREET NORTH, E.6 (opposite East Ham Station)	**GRAngewood 6543**

NUSOUND TAPE RECORDER CENTRES

Greatest pre-recorded tape offer ever made!

Take one for 6/11

(just a fraction of basic cost)

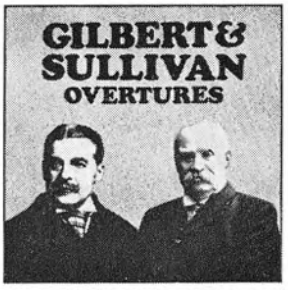
a 3¾ ips tape

(OR 12" LP IF YOU PREFER)

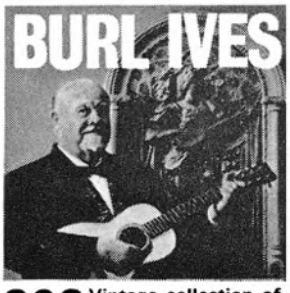
70 Band of the Royal Scots Greys plays regimental music. 12 items include Colonel Bogey; Semper Fidelis; El Capitan.

449 Unforgettable songs from the Continent! Romantica; Volare; La Mer; Never on Sunday; Quando, Quando; plus 7.

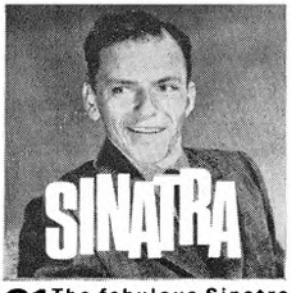
285 Ideal party disc! Swinging dance arrangements of Z Cars; Maigret; Coronation St.; Kildare; other famous themes.



292 Kenneth Alwyn and R.P.O. play famous G. & S. overtures—Mikado; Iolanthe; The Gondoliers; Yeomen; Pirates; Patience and Pinafore.



302 Vintage collection of ballads by the Big Daddy of folk-singers. Tracks inc. Early One Morning, The Irish Rover.



81 The fabulous Sinatra swings and sings 12 top songs. Don't Worry About Me; Melody of Love; Look over your Shoulder; White Christmas; etc.*

Here's why:– We want to prove to you that the quality of World Record Club pre-recorded tapes is unbeatable. But we believe that all the words in the world won't be as convincing as one actual WRC tape, played on your own equipment in your own home.

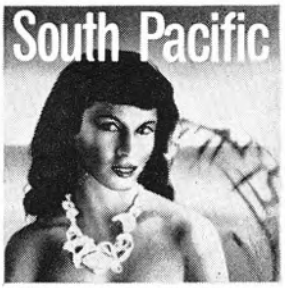
So now, we freely invite you to choose any one of these WRC recordings — actually worth 29/– — and to KEEP IT WITHOUT ANY OBLIGATION, for a purely token payment of only 6/11 (plus p & p). All we ask is that you listen to it, compare its quality with any other recording and then seriously consider the merits of joining Britain's liveliest record club. That's all. Because whilst we will certainly send you lots of interesting information about WRC, you are not obliged to join the Club, or to buy any other tapes, unless you really wish to do so.

This is the greatest offer ever made by any Club in this country, and we will be inundated with applications. So please — if you want to accept this amazing no-risk invitation — POST THE COUPON NOW!

This offer MUST be limited–closes first post 26/9/66!

202 One of Nat's greatest discs! Walkin'; Because You're Mine; You'll Never Grow Old and nine others.*

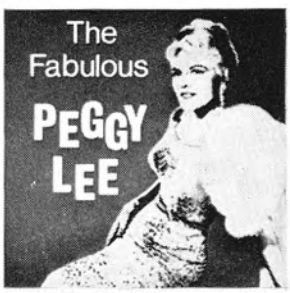
31 John Hollingsworth conducts the Sinfonia of London in a thrilling performance of this famous ballet music.



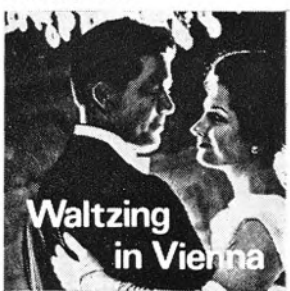
1 The *complete* score from this great musical. With Ian Wallace, Joyce Blair and Chorus.

443 Chart topping Australian folk group the Seekers sing Ox Driving Song; Blowing in the Wind; Chilly Winds; plus 9.

14 Sinfonia of London under Muir Mathieson give scintillating performances of Bizet's two delightful suites.



352 The Luscious Lee-way with Stormy Weather; Sweet Chariot; Somebody Loves Me; Birmingham Jail; plus 8.

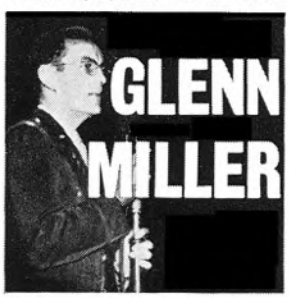


362 Blue Danube; Emperor; Vienna Woods; Voices of Spring; Roses from South—glittering waltzes by Vienna Symphony Orch./Rudel.

239 Virtuoso performance by Yuri Boukoff with L'Orchestre des Concerts de Colonne under maestro Pierre Dervaux.

89 Star cast singing all the greats like Climb Ev'ry Mountain; Do-Re-Mi; Lonely Goat-herd; Favourite Things etc.

✳ Indicates Mono LP's—reprocessed for stereo reproduction.



***223** In the Mood; Bugle-Call Rag; Chattanooga Choo-Choo; Serenade in Blue—9 original tracks that are classics.

Send NO MONEY claim your choice NOW!

TO WORLD RECORD CLUB · P O BOX 16 · HAYES · MIDDLESEX

I want to accept your remarkable invitation, and to know all about Britain's brightest Record Club. Please send me, without any further obligation whatsoever, the recording I have indicated below, together with free illustrated brochures about WRC and details of your special Introductory Offer. I understand that even if I decide to take no further interest in the Club, I may still keep my tape and owe you only 6/11 (plus 2/- p & p) which I will pay when asked.

IMPORTANT! THIS IS YOUR ADDRESS LABEL - PLEASE PRINT CLEARLY

MR
MRS
MISS .....

STREET .....

TOWN .....

For office use only

3/

COUNTY .....

309

MY CHOICE IS NO.

Enter choice number only in box.

□ Tick for mono 12" LPs

△ Tick for stereo 12" LPs

○ Tick for 3¾ ips mono tapes

This offer applies to G.B. and N. Ireland only.

Outstanding Quality

The compact TC200 stereophonic tape recorder

FEATURES ■ **Complete 4 track stereophonic and monophonic tape recording system** ■ **Compact and light weight** ■ **2 full range balanced satellite speaker systems** ■ **Public address** ■ **Sound-on-sound recording** ■ **Variable tone control** ■ **2 VU meters** ■ **Instant stop, individual track selection** ■ **Individual level controls on each channel** ■ **2 SONY F-96 dynamic microphones with other accessories** ■ **Price 72 gns.**

SPECIFICATIONS

Power requirements	100, 110, 117, 125, 220, 240 volts 70 watts, 50/60 c/s
Tape speeds	Instantaneous selection 3¾ ips or 7½ ips
Frequency Response	50-14,000 cps at 7½ ips ±3dB 50-10,000 cps at 3¾ ips
Signal-to-Noise Ratio (per channel)	46 dB
Wow and Flutter	Less than 0.19% at 7½ ips Less than 0.25% at 3¾ ips
Erase Head	In-line quarter track
Record/Playback Head	In-line quarter track
Bias Frequency	Approx. 55 Kc/s
Level Indication	Two Level Meters
Level Controls	Individual Controls on each channel for playback and record
Tone control	1 Tone Control for treble boost or roll-off operates both channels simultaneously
Editing Facilities	Instant Stop Lever, Automatic Tape Lifters, Fast Forward and Rewind, Manual Cueing and Digital Tape Counter
Reels	7" or smaller
Outputs	8 ohm Speaker outputs or high impedance line outputs selectable by switch (2)
Inputs	Low impedance Microphone inputs (2) High Impedance Auxiliary inputs (2)
Power Output	Max. 1.5 watts
Tube Complement	6267 (2), 30MP23 (3)
Transistor	2SD64 (2)
Diodes	1T22G (2), 1S125 (1)
Weight	Approx. 27 lbs.
Dimensions	15" W x 8 13/16" H x 15 7/8" D

SONY®

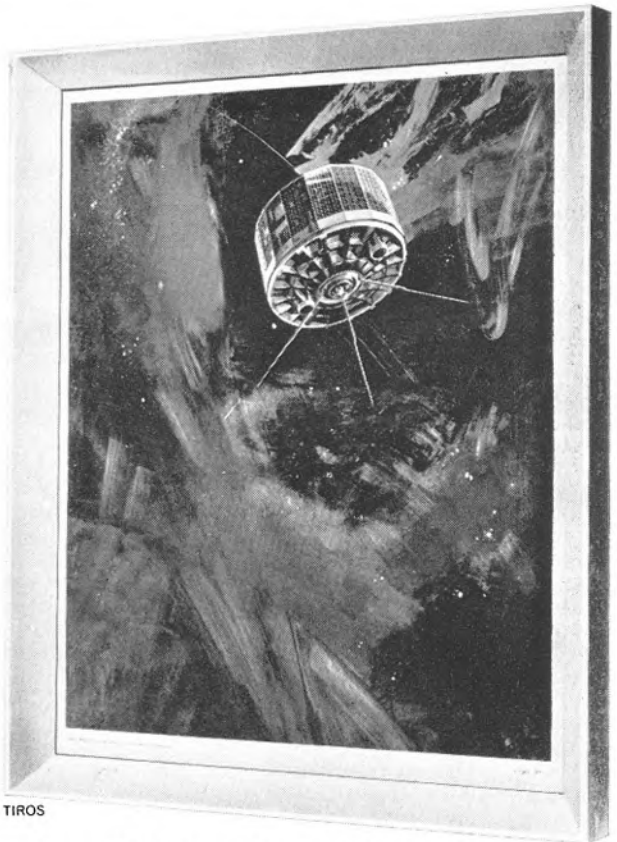
RESEARCH MAKES THE DIFFERENCE

For full details write to

Geoffrey Smith, Sony U.K. Sales Division, Mercia Road, Gloucester.
Tel: Gloucester 26841. London Showroom. 70-71 Welbeck St, London W.1.

These authentic, framed space pictures. Yours for only 9/6

(Each worth 19/6 at least!)



TIROS

MARINER

POLARIS

Actual size of all pictures 16½" x 14½"

3M Company commissioned these beautiful coloured prints of Tiros, Mariner and Polaris from Oleg Stravrowsky, internationally famous painter. Each one is authentic in every detail, each one could be yours for a mere 9/6 and the tartan tab from a reel of 'SCOTCH' Magnetic Tape.

Framed in white painted wood in contemporary style, either individually or as a set, they make fascinating and educational decoration for a study, a boy's bedroom or, because the colours and designs are so good, for your living room.

The research that leads the way in space

3M Company research has provided communications systems for much of the space programme. The same research developed 'SCOTCH' Magnetic Tape with Superlife, used by tape enthusiasts all over the world. The most stringent precautions and meticulous standards are essential for all equipment used in space — the same standards are applied to the recording equipment sold to you.

You can get your Tartan Tab from any reel of 'SCOTCH' Magnetic Tape, 4" size or over.

Scotch
MAGNETIC TAPE
first with the new ideas

To: 3M Company, SPACE, 3M House, Wigmore Street, London, W.1.

Please send me — tick which
Tiros ☐ Mariner ☐ Polaris ☐
I enclose ..... tabs — one for each
and cheque/P.O. for .....
(9/6 each)

NAME .....
(BLOCK CAPITALS)

ADDRESS .....

.....

..... TRI

STICK YOUR TARTAN TABS HERE

Offer closes 31st Jan. 1967

3M COMPANY **Minnesota Mining & Manufacturing Co. Ltd., 3M House, Wigmore St., W.1. HUNter 5522**

Bang & Olufsen –
for those who value design
and quality

This new Beocord 2000 de luxe has everything!

■ Split mixer controls ■ Two track record and playback plus four track playback
■ High/low input impedance selectors ■ Three channel interchangeable mixer unit
■ Variable echo facility

Plus all the highly developed and proved mechanical and electronic specifications featured in the Beocord 2000. Price: 135 gns. Portable version 139 gns.

For comprehensive information and the name of your nearest Bang & Olufsen Dealer, write to Geoffrey Smith, Bang & Olufsen U.K. Sales Division, Mercia Road, Gloucester. Tel: Gloucester 26841, or see the 2000 De Luxe at our London Showroom, 70-71 Welbeck Street, London, W.1. Tel: HUNter 2143.

tape recorder

SEPTEMBER 1966 VOLUME 8 NUMBER 8

INCORPORATING
SOUND AND CINE

EDITOR
JOHN CRABBE

NEWS EDITOR
DAVID KIRK

ADVERTISEMENT MANAGER
ROBIN WELLS

Editorial and Advertising Offices:
LINK HOUSE,
DINGWALL AVENUE,
CROYDON, SURREY
Telephone: MUNicipal 2599 (12 lines)

COVER PICTURE

The delicate greens, reds, yellows and blues of a colour television picture are portrayed in vivid black and white on this month's cover. Taken in Paris by CSF, it shows an *Ampex VR-650* being used to record SECAM signals.

SUBSCRIPTION RATES

Annual subscription rates to *Tape Recorder* and its associated journal *Hi-Fi News* are 30s. and 38s. respectively. Overseas subscriptions are 32s. 6d. (U.S.A. $4.50) for *Tape Recorder* and 38s. (U.S.A. $5.40) for *Hi-Fi News*, from Link House Publications Ltd., Dingwall Avenue, Croydon, Surrey.
Tape Recorder is published on the 14th of the preceding month unless that date falls on a Sunday, when it appears on the Saturday.

A NEW STYLE OF LAYOUT is adopted with the introduction, this month, of three-column printing. This step has been taken, following the recent example of our sister publication *Hi-Fi News*, with a view to improving the general appearance of the magazine. The narrower columns should also be easier to read.

We retain the original type-face and (much more important!) the same general editorial policies. Despite the illusion of giving more words per page, three-column-measure provides effectively the same page wordage as two-column. In fact, we shall continue to offer more sensible words per penny than may be found in other places!

An important point that might easily have been overlooked is the scaling of wow and flutter pen recordings in our review columns. For the past few years, these have been published at precisely half their original size, thus simplifying visual comparison of the speed-fluctuation characteristics exhibited by different tape mechanisms. We shall continue to publish these traces at a two-to-one reduction, allowing comparison of machines reviewed before and after this date.

Frequency response curves, however, are being stretched to a new horizontal scale, conforming with that in *Hi-Fi News*. We mention this point in case regular readers imagine a sudden improvement in the general quality of recording amplifiers over the next few months!

From which preamble, we turn to the topic of dictaphones. In the angry chaos of the recent seamen's strike, a national newspaper was prompted to twist Churchill's wartime words into an ironic comment on life in modern Britain. We would twist them still further in describing the office-recording-equipment industry: never before has so much been paid by so many for so little.

We can call to mind three manufacturers—known and respected on all sides of the audio industry for the value and quality of their domestic recording equipment — who are currently marketing office recorders of a quality inferior to £20 Japanese battery portables—*at three times the price.*

How do they get away with it? Has the dictaphone, perhaps, a limited potential market? Must it be unusually robust, or simple to operate? The market for a moderately priced pocket dictaphone of good (GPO Telephone *plus*) quality and solid construction is immense.

When *Grundig* introduced their *EN3* they were on the right road. At £20, it was within reach of the petty-cash box, it was small and used a single control for record, play and rewind. It lacked only quality and gain.

Though widely used as a dictaphone, the *Philips EL3300/1* was conceived for home and outdoor entertainment and represents probably the ultimate in low-price battery portables. Its single disadvantage is size. The EL3300/1 bulges even from an overcoat pocket—no drawback for the tape enthusiast, but an inconvenience for the pampered executive or the secretive market-research man.

Would it really cost £60 to compromise between the quality of the Philips and the size of the Grundig? Apparently it does, though we really cannot see why.

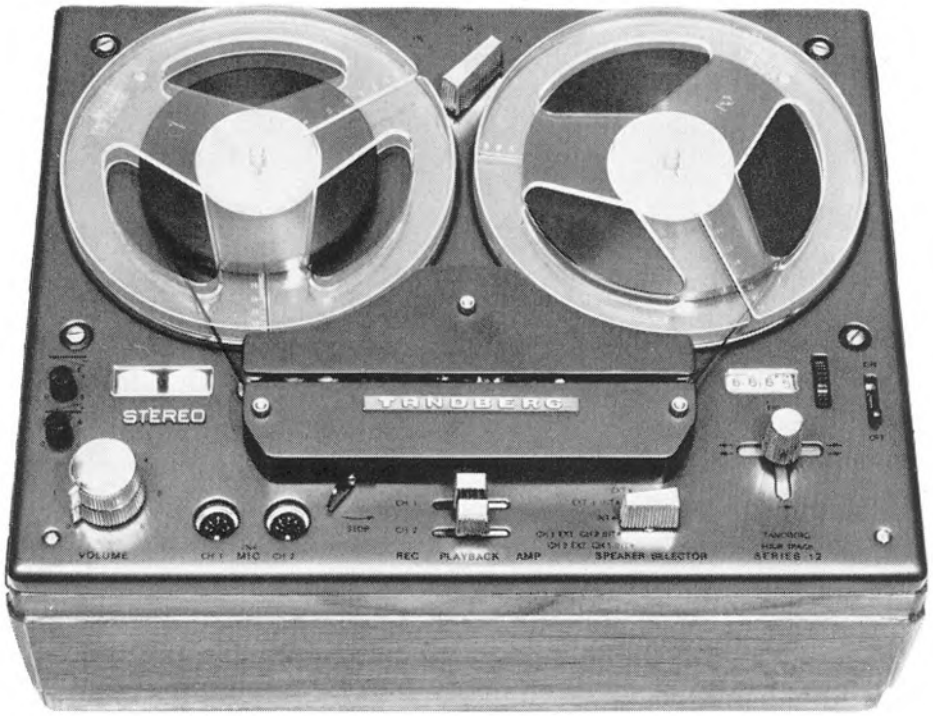
While in the realm of portable tape recorders, it is worthwhile clarifying what appears to be a widespread misunderstanding regarding rechargeable batteries. These are often purchased with a view to economising on conventional cells, an outlay of £10 for a charger, plus £3 or more for the battery, being assumed capable of providing 'portable power' for at least a few months. Rechargeable batteries do not have an indefinite lifetime and in some cases quickly lose their ability to accept sufficient power for more than a few minutes' operation. High power batteries, particularly following recent price reductions, are more economical than some users may believe.

FEATURE ARTICLES

REGULAR ITEMS

EQUIPMENT REVIEWS

Tandberg announce the new 3 speed, 4 track, totally transistorised series 12 stereo record & playback Hi-Fi system



★ 20 WATTS OUTPUT (10 watts per channel) makes additional Hi-Fi unnecessary.
★ BASS & TREBLE Tone Controls.
★ F.M. MULTIPLEX filters fitted (a *MUST* for recording Stereo Radio).
★ INTERNATIONAL CONNECTORS i.e. Phono and DIN and Standard Jack Sockets.
★ CENTRE CHANNEL OUTPUT.
★ PRE-AMP OUTPUTS.
★ LOW IMPEDANCE MICS ★ PLUG-IN PRINTED CIRCUIT PANELS.
★ INTERNAL SPEAKERS, etc. etc.

Tandberg

ELSTONE ELECTRONICS LTD.
81 Kirkstall Road, Leeds 3. Telephone 35111

Please send details and price of model 12 and/or other models in the range to:—
(BLOCK LETTERS PLEASE)

NAME .....

ADDRESS .....

..... TR.1

WORLD OF TAPE

30 I/S VIDEO ARRIVES

DIRECT from Japan comes news of a breakthrough in video tape recording techniques. It has been known for some time that research was being carried out on the cross-field bias system, both in Japan and the USA, and this has produced some incredible results. *Akai* hope shortly to be marketing a television recorder using good quality audio tape to achieve a video frequency response of 60 Kc/s—1 Mc/s ±6dB at 30 i/s. Fixed heads are employed, audio and video information being recorded on separate tracks. Each track occupies, in effect, one quarter the tape width. Thus two complete television programmes may be recorded on a single stretch of tape. The *VX-1100* video recorder is similar in appearance to the *X-300* audio model shown at the 1966 Audio Fair and employs almost the same mechanism. Main difference, oddly enough, is the greater simplicity of controls on the video unit, a single gain control and VU-meter being incorporated on each channel. Both machines accept spools of up to 10½in. diameter, giving a total of 1 hour 36 minutes recording time on two passes of a 7,200ft. triple-play reel.

A signal-to-noise ratio of 34dB is claimed for the video channel, input and output being 1.4V p-p sync-negative at 75 ohms (video) and 600 ohms line (audio). Audio bandwidth is 50 c/s—10Kc/s, with 40dB signal-to-noise ratio. Separate inputs for microphone and line are featured, being 20K –50dBm and 600 ohms 0dBm respectively. The VX-1100 is transistorised and weighs 45lb. Operation is from 50 or 60 c/s mains at 100-240V. It is expected to be shown at the Radio Show (trade only) and will ultimately sell for some £300.

BBC 'INTRODUCE' STEREO RADIO

STEREOPHONIC radio broadcasts finally left the 'experimental' stage with the commencement, on 30th July, of daily pilot-tone programmes on the FM Third Network. Two or three stereo transmissions are taking place *each day* from Wrotham and Dover, and will be extended to Sutton Coldfield (Midlands) and Holme Moss (Northern England) in the next twelve to fifteen months. Pilot-tone broadcasts are fully compatible with mono receivers, on which they will be heard as normal single-channel signals. The system used has been standardised for services in the USA, Germany, France, Italy and Holland.

Stereo gramophone records, live and specially recorded material will be broadcast in the Music Programme, and it is hoped to relay the Promenade Concerts on the Third Network during the forthcoming season. All stereo broadcasts will be indicated by a special sign in the *Radio Times*.

Further extensions of the service will depend on public reaction and available finance.

STEREO TAPE LIBRARY

SINCE the *Teletape* hire service was discontinued there has been, to our knowledge, no commercial tape library in Britain. This state of affairs has been halted, however, by the *Wilson Stereo Library*, a company formed some years ago to supply stereo gramophone records on a rental basis to owners of hi-fi equipment.

Whereas specific limits were placed on the type of equipment to be used for reproducing discs, tape records may be hired by owners of somewhat loosely defined 'high-grade equipment'. (One of the highest *priced* recorders we have lately used was exceptionally fond of snapping tapes.) Equipment must be maintained with *WSL Tape Cleaner* (4s. 6d. per bottle) and heads degaussed with a *Wearite Defluxer*. Tapes may not be fast-wound.

All tapes are 7½ i/s ¼-track stereo. Annual subscription is 3 gns., plus 9d. per day hire-fee for each tape requested. Minimum hire period is six days. A charge of 3s. 6d. is made for postage and packing, irrespective of the number of tape records despatched.

Further details may be obtained from: **WSL Stereo Tape Library, 104 Norwood High Street, London, S.E.27.**

AUDIO FAIR AGM

SUMMING up for 1966 and looking forward to 1967, the AGM of the *International Audio Festival and Fair* took place on June 29th at the Hotel Russell—venue chosen to preserve the audio atmosphere. Exhibitors heard reports from Festival Director Cyril Rex-Hassan and Committee Chairman Donald Chave (*Lowther*): as usual, the previous event was generally felt to be highly successful, and already the Russell was fully booked for 1967, with 72 exhibitors on next year's list.

There was some discussion about possible reconstitution of the Committee in a manner designed to ensure that each major *equipment* category is represented, though this suggestion, made by tape recorder exhibitors who felt the need for better representation, was defeated by a show of hands. Also, the perennially controversial topic of the manner in which 'foreign' manufacturers are represented at this 'International' event was the subject of some comment, though no change was envisaged. The Festival Director announced that the Board of Trade Export Promotion Division had been invited to help on export matters next year, and also confirmed that the Hotel Russell would again be used.

The latter decision was in keeping with the findings of a survey conducted during the 1966 Fair by *Group Marketing Research Ltd.*, a firm within the Rank Organisation working on behalf of exhibitors in its own group of companies (*Wharfedale* and *Akai*). A representative sample of male visitors were asked a comprehensive set of questions about many aspects of the Fair, and two-thirds preferred the Show to be held in a hotel. Of 1966 visitors, 42% were making their first visit; 44% of those coming for the first time had heard of the Fair through specialist magazines; 39% had also been in 1965—with those who had been before making, on average, three previous visits; 45% of all visitors obtained their tickets from dealers; 40% of previous visitors had purchased equipment as the result of a visit (18% tape recorders and/or decks); 80% came from London or within 50 miles of London; and half the male visitors were unmarried, with 64% under 34 and 27% in the AB income groups.

Following the various reports and discussions, exhibitors elected a new Committee for the 1967 Fair. This body in turn re-elected Mr. Chave as its Chairman, with Mr. Hawkins of *Leak* as vice-Chairman. Mr. Maunder of *Shure* was also re-elected by importers to represent overseas manufacturers on the Committee.

LANGUAGE RESEARCH AT QUEENSLAND

FIVE thousand six hundred tape recordings of pre-war German dialects have been presented by the *Deutsches Spracharchiv* to Queensland University. The presentation marked another step in a programme to create a world centre for language research and was enthusiastically received by Dr. G. M. Bonnin, Reader in German at the University, who has been appointed Chief Research Officer. The co-operation of five Australian universities, the *Hapag-Lloyd Joint Service* shipping line, and the German authorities, made possible the copying of Spracharchiv stock. Card indexes of the catalogue are being held by the universities involved to simplify the borrowing and use of recorded copies.

NAGRA PORTABLES ON HIRE

NAGRA battery tape recorders are now available on short-term hire from the U.K. agents, *Livingston Laboratories*. The charge is comparatively low at £18 per week and is reduced by a further £18 for each consecutive period of two months. Models hired are the PH lip-sync versions, which come complete with microphone. A three-channel mixer for use with the recorder is also expected to be available on hire shortly.

Distributor: Livingston Laboratories Ltd., Greycaines Estate, Bushey Mill Lane, Nr. Watford, Hertfordshire.

NEXT MONTH

THE PROBLEMS OF recording multiplex stereo radio broadcasts will be examined by John Earl in the October issue, to be published on Thursday, 14th September. A survey of stereo tape recorders will also appear, special note being taken of their suitability for pilot-tone recording. The *Telefunken M.401* will be field-tested.

TAPE RECORDER SERVICE

NUMBER 57 PHILIPS EL3586 BY H. W. HELLYER

THIS machine has had plenty of coverage in past issues of *Tape Recorder*. Many comments have been made—most of them favourable. Since October 1963 it has been steadily gaining ground and, despite the challenge of the cassette models, continues to hold its own with many devotees. A colleague whose parish extends from the tropics to the polar regions has toted the *3586* with him, amidst a welter of photographic equipment, and brought back excellent sound-effect tapes to augment his lectures to schools. Although he possesses much more expensive machines, the little *Philips* is his regular standby and has never given trouble.

Then why add to the extensive coverage, and why discuss a machine that does not give much bother? carps the critic at my elbow. My answer is much as before: a number of these machines are on the second-hand market, and readers would like to know a little more about their prospective bargain. Moreover, as David Kirk said during his 'Field Trial' of the 3586 (May 1965), most owners like to see just what they have bought by peering at least once 'below deck'. The publication of the circuit should help them know a little more about the 'innards', once they have overcome the primary obstacle of dismantling. Although, in fact, a copy of the circuit is usually pasted on the inside of the cabinet, when the machine is new.

The first barrier is the pair of large circlips that encircle the plastic studs through which the metal lugs that locate the keyways of the carrying handle protrude. These require the correct tool to be sprung off without damage to circlip or case. This special pair of reverse action pliers (i.e., opening when the handles are squeezed) with round points is not the sort of tool that the average handyman will carry around in his back pocket, so recourse to a pair of small screwdrivers will be the favourite expedient. It is so easy to slip and scar the case, or one's-self, that a word of warning is needed. If it is possible to use a steel blade with a point small enough to locate in the hole of the circlip, such as a ground screwdriver, even a gimlet or the domestic corkscrew, a much better leverage will be obtained. Two such tools, levered against each other until the clip begins to spring, then insertion of a fine blade in the resultant gap is a slower but more practical method than digging away beneath the lip of the plastic ring.

The two halves of the case are then held by a pair of long bolts at the base and four small screws countersunk in the top. In the earlier models, particularly its predecessor the *3585*, these screws threaded into small plates, which would tinkle away into the mechanism if all four screws were removed. It is best to remove two screws from the one half section, then slacken the other two slightly, noting whether the plate beneath tends to swivel. The right-hand section is a fixed bracket in later models. If it swivels, gently slide the two halves apart, leaving the small plates in place. Some care is needed to fiddle the case over the bottom ridge of the battery container and then up over the push-buttons and recording button, but patience will win the day. If there is no sign of movement of the metal part that has the holes in it, one may safely remove the four countersunk screws. Removal of the case is then much easier.

The next problem is to get the machine working when there is nothing to keep the batteries in position. It is just possible to use lashings of sticky tape, supporting the six U2 cells in their place and the end cap, which has the connecting link on it, firmly against the contacts. But a better method, leaving the operator more free to investigate, is to connect a pair of leads to a PP9 or similar source of supply, clipping them on the battery contacts of the machine. Observe polarity carefully, and place a small piece of card between the positive connection blade and the chassis. Normally, the spring action is overcome by the size of the cells, but without these in place the switch sequence is by-passed by the short-circuit. No damage will be done, but tests may be confusing unless we start in the proper state.

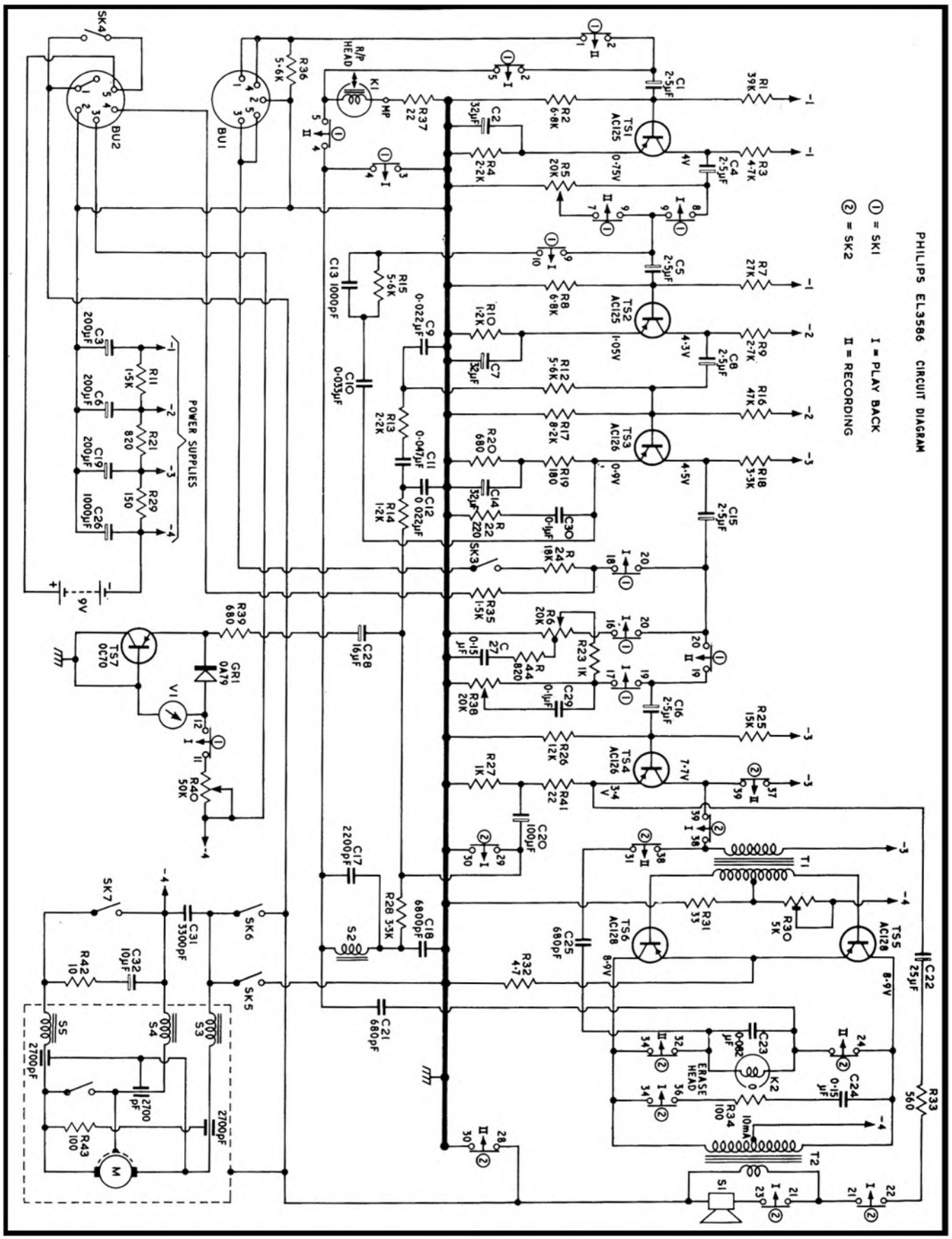
If it is not convenient to clip the positive supply to the appropriate blade and work on the machine, it should be noted that two confusing things will occur. First, the machine will operate on record/play but will not fast-wind, and second, amplifier switching is by-passed and a constant drain is imposed. A secondary factor is that motor noise will increase if the spring blade touches on the chassis.

Apropos this question of motor noise: this machine and its predecessor suffered badly from this complaint after a period of service. Or, to be fair to the makers, after a period of service followed by another period of stagnation. The trouble is often nothing more serious than dirty governor contacts. In the type of motor with a dark grey or black case, an access hole is easily seen, and a spray of Electrolube through this hole should be sufficient. But do let the lubricant carrier evaporate before switching on.

As can be seen from the accompanying diagram, the electrical circuit is fairly straightforward, and only the switching is likely to give trouble. Philips are fond of the Bowden cable slide switch, and adjustment often comes down to bending the support brackets into which the cable nipples seat. Visual inspection of the contacts, with the aid of a strong light, and adjustment for correct contact wiping, should be made with the printed panel in place.

When it is necessary to remove the panel,

(continued on page 336)



Heathkit
DAYSTROM

LOOKING FOR SUPERB Hi-Fi . . .
Choose British Heathkit models

AND SAVE £ £ £'s BY BUILDING ANY MODEL YOURSELF

All models covered by Heathkit guarantee

Compare any Heathkit model for price, performance, quality

Ease of Assembly is guaranteed—even for those without previous experience—by the comprehensive yet simple step-by-step construction manual supplied with every Heathkit model.

Because you build them yourself—Heathkit units cost considerably less than comparable pre-assembled equipment. You cannot buy the parts any other way as cheaply.

Every Heathkit product—assembled in accordance with our instruction manuals is guaranteed to meet published performance specifications, or your money will be cheerfully refunded.

By taking advantage of our convenient credit terms—you can enjoy your model right away and pay for it in easy monthly instalments.

OUR WIDE RANGE INCLUDES :—

AUDIO
Cabinets, Turntable Units, Mono and Stereo Amplifiers, Pickups, Speaker Systems, Mono and Stereo Control Units, Tape Pre-amplifiers, Tape Decks, etc.

RADIO
AM/FM and FM Tuners, Transistor Radios, SW and Communication Receivers.

TEST INSTRUMENTS
A range of Audio Test, Home Workshop, Service and Laboratory instructions.

MISCELLANEOUS
Children's Hobby Kits, Tool Kits, Intercom, Electric Organs and a wide range of Amateur Radio Gear.

SEE THE COMPLETE HEATHKIT RANGE IN THE FREE CATALOGUE


"MALVERN"


FM TUNER


TAPE PRE-AMPLIFIER TA-1S

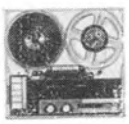

STEREO CONTROL UNIT USC-1


AM/FM TUNER


"COTSWOLD"


MONO AMPLIFIER MA-5

TAPE DECKS


◀ TRUVOX

STUDIOMATIC ▶


STEREO AMPLIFIER S-99

A wide range of models for the Tape and Hi-Fi Enthusiast

	Kit	Assembled
MONO TAPE PRE-AMPLIFIER, TA-1M ...	£19 10 0	£28 18 0
STEREO TAPE PRE-AMPLIFIER, TA-1S ...	£25 10 0	£35 18 0

TAPE DECKS

TRUVOX D93-2 ¼-track	£36 15 0
,, D93-4 ¼-track	£36 15 0
MAGNAVOX '363' ¼-track	£13 10 0

MICROPHONES. A wide range. Please let us know your req.

FOUR CHANNEL TRANSISTOR MIXER, Model TM-1

A must for the tape enthusiast. Four channels allow recording from a wide variety of sources, e.g., dynamic and crystal microphones, tuners, record players. Kit £11 14 6
Send for full spec. Assembled £16 17 6

AUDIO AND HI-FI EQUIPMENT

20 + 20W AMPLIFIER AA-22U (less cabinet)	£39 10 0	£66 11 0
9 + 9W STEREO AMPLIFIER S-99	£28 9 6	£38 9 6
3 + 3W ,, AMPLIFIER S-33H ...	£15 17 6	£21 7 6
3 + 3W ,, AMPLIFIER S-33	£13 7 6	£18 18 0
5W MONO AMPLIFIER, MA-5	£10 19 6	£15 10 0
10W POWER AMPLIFIER, MA-12	£11 18 0	£15 18 0
50W ,, AMPLIFIER, MA-50	£19 18 0	£27 18 0
STEREO CONTROL UNIT, USC-1	£19 10 0	£26 10 0
MONO CONTROL UNIT, UMC-1 ...	£8 12 6	£13 12 6

PICK UPS

DECCA ffss **£18 18 0.** DECCA DERAM **£9 19 6** | Inc. P.T.

	Kit	Assembled
SPEAKER SYSTEMS		
COTSWOLD or MFS	£25 12 0	£33 17 0
SSU-1 less legs	£11 17 6	—

NEW ! BERKELEY SLIM-LINE HI-FI SPEAKER SYSTEM

A new concept in Heathkit Loudspeaker kit design. Completely finished, walnut veneered cabinet shell facilitates, faster, easier assembly, 2 speakers or 12″ Bass unit and a 4″ mid/high frequency unit plus a L/C cross-over network give a smooth 30-17000 c/s response. Power handling 15 watts. 15 Ω nominal impedance.
Kit **£18 10 0.** *Assembled* **£23 0 0.**

EQUIPMENT CABINETS

MALVERN	£18 1 0	£23 6 0
GLOUCESTER...	£18 10 0	£23 15 0
CHEPSTOW	£11 12 6	£16 17 6
PLAYBOX (by Record Housing)	—	£10 10 0

Other 'Record Housing' models to order.

RECORD PLAYERS

GARRARD AT-60 without Cartridge	£13 1 7
,, AT-60 ,, Deram	£17 16 1
,, SP-25 ,, GC8	£13 10 8
,, SP-25 ,, R105	£16 4 8
MOTOR UNIT. GARRARD 401	£32 10 0
,, ,, CONNOISSEUR, 2-speed	£17 2 11

REMEMBER 'PACKAGED DEALS' SAVE YOU MONEY. All purchases of associated Hi-fi equipment totalling over £40 at one time qualify for inclusion.
ALL prices quoted above are Mail Order prices.

WELCOME TO OUR LONDON HEATHKIT CENTRE

In response to the request of many customers we have opened a showroom and retail stores at 233 Tottenham Court Road.

WHEN YOU ARE IN TOWN WE HOPE THAT YOU WILL VISIT US THERE.

To **DAYSTROM LTD.** DEPT. HT-2 GLOUCESTER, ENGLAND

Without obligation, please send me TICK HERE

FREE BRITISH HEATHKIT CATALOGUE .....

FULL DETAILS OF MODELS .....
Kindly write below in BLOCK CAPITALS

NAME .....

ADDRESS .....

..... HT-2

BATTERY POWERED TAPE RECORDERS

BY MICHAEL GORDON

PART 10: A PORTABLE MAINS SUPPLY

LAST month's article finished with a brief reference to two devices suitable for working a recorder designed specifically for AC mains operation from a battery, namely, the *rotary converter* and the *vibrator converter*. These devices translate the DC of the battery to AC and step up the voltage to a value matching that required by the mains-operated recorder. Thus, a 12 or 24V DC supply is stepped up to 240V AC. The frequency of the supply is usually in the order of 50 c/s (or 60 c/s in the States) to correspond to the mains supply frequency.

This is rather important so far as tape recorders are concerned, since the speed of the drive motor is often related to the frequency of the supply. Moreover, the power supply input circuits and components are designed for a 50-60 c/s input, and any substantial deviation from this can impair the power conversion efficiency in the recorder proper and result in overheating of the mains transformer and, possibly, under or over-running of the valve heaters, coupled with a decrease or increase of HT line voltage, depending on whether the frequency is up or down.

Another kind of DC/AC translating device consists of transistors arranged in an oscillator circuit. A low-voltage DC supply operates the transistors in push-pull to provide a 50 or 60 c/s sine-wave, and this signal drives higher powered transistors feeding into a step-up transformer to give 240V output at the required power.

Although very efficient, units of this nature are at present rather expensive, especially the kind capable of delivering 100W or more. High-power silicon transistors are used in the latest units, and it would not be very economical to obtain such a unit solely for running a mains-powered recorder from a battery. Indeed, it would be less costly to purchase a new complete recorder designed specifically for battery-powering.

At this juncture it would not be amiss to mention the method used in some of the *Telefunken* battery-powered recorders for motor powering. An ordinary synchronous motor is used and this is energised from a transistor 'chopper' in the recorder. This is something like the generator referred to above, but since it is called upon only to deliver just a few watts for the motor alone (not for the amplifier, of course), the circuit is nowhere near as costly to produce as one that can deliver 100W of power.

This method of motor control, incidentally, lends itself to speed control, in that any drift in speed could be arranged to send back to the chopper a correction signal which would alter the chopper frequency and thus correct the motor speed automatically!

A similar arrangement is employed in the *Nagra III* professional recorder. Here a 400-tooth phonic wheel on the capstan shaft produces a signal of frequency related to the capstan speed. This signal is compared with the frequency of a reference signal in a frequency or phase discriminator and, should there be a tendency toward drift, the discriminator delivers a correction voltage. This is fed back to the motor speed-controlling system, thereby slightly speeding or slowing the motor as required for correction.

Operating a mains-powered recorder from batteries via a converter cannot be compared with the operation of a model designed specifically for batteries. A great deal more battery power is needed by a mains-powered recorder than by a comparable battery-powered counterpart, and while a battery-powered model will work happily from a battery of dry cells, a mains-powered model demands large secondary calls, such as in the form of a car accumulator, to quench its thirst for power.

Indeed, connecting a dry battery to a DC/AC converter would barely cause any response, and the battery would go flat in minutes! A rotary converter is probably the least efficient of the range of converters mentioned earlier. Quite a lot of power is needed just to get the converter turning as an electric motor driving an alternator (see last month's article). Then, of course, as soon as power is taken from the alternator, up goes the DC to even greater values.

The most popular type of rotary converter is the 12V model, rated at 60-100W. This is ideal for running any ordinary mains-operated tape recorder from a car battery. Indeed, for many months (prior to the advent of good battery-powered recorders) the author was running a *Grundig* mobile from his car battery. The converter was located in a screened and padded box (the latter to reduce the noise and the former to reduce the interference) on a spare space beneath the bonnet. This location reduced the length of cable from the DC input to the car battery, since the high current soon pulls down the voltage if the battery cable is too long and has appreciable resistance.

A heavy relay was used to switch the converter on and off, this being located near the converter and the primary circuit terminating at a switch in the car. The converter used was of ex-Government origin and thus featured suppressor components in the battery input circuit; but a little extra capacitor suppression was found desirable in the AC output circuit which, incidentally, terminated at a 13A, three-pin socket on the car dashboard. The general set-up is shown in **fig. 1.**

Twelve-volt 60/100W converters are not cheap, though at one time they could be picked up for a couple of pounds or so from firms dealing in surplus equipment. It is understood that such equipment may still be available, but as time goes on 12V converters become less plentiful and thus their price increases. 24V converters have never been so popular, and are generally less expensive on the surplus market than 12V models.

However, the current input is less with 24V models (approximately half that of 12V models), and these are probably better where a recorder (or other AC-operated equipment) is to be employed at a static site removed from the mains system. Remember that 12V models can pull up to 20A or so from the battery, so quite a substantial battery is needed, along with some means of re-charging. When a 12V converter is used in a car, of course, the charging dynamo supplies most of the power

(continued overleaf)

when the car is in motion or when the engine is running.

So much, then, for the rotary converter. Now let us investigate the vibrator converter. The basic circuit of a 12V vibrator converter is given in **fig. 2.** Here reed **A** is supported at point **B** and the design is such that the period of vibration is related to the required output frequency. Normally, contacts **C** are closed so that when DC is supplied it flows through contacts **C** and through the electro-magnet winding **D.** This causes the reed to be attracted towards armature **E,** breaking contacts **C** and cutting off the current in the winding. The effect, of course, is then to release the hold on the reed, causing it to swing back again. A vibrator action thus results, but this is more sophisticated than the action in an ordinary vibrator or electric bell owing to the accurately tuned and balanced reed.

Now, as the reed vibrates, so current from the battery is passed alternately through sections **G** and **F** of the primary winding of **T1,** via contacts **H** and **I** and the corresponding contact surfaces on the reed itself. This 'looks' like an alternating current to the primary winding, causing to be produced a similar kind of EMF in the secondary winding **J** of **T1.**

The nominal battery voltage is stepped up owing to the primary-to-secondary ratio of **T1,** this ratio being arranged to give an output in the order of 240V AC.

An arrangement which is sometimes used when an input in excess of 12V is used is shown in **fig. 3.** Here are two reeds, **A1** and **A2,** coupled mechanically together and supported at **B1** and **B2.** They are tuned as before and energised by contacts **C** letting through input current to winding **D,** thus magnetising armature **E.** Both reeds are thus caused to vibrate in unison at their tuned frequency.

Input current is, as before, caused to flow alternately through sections **G** and **F** of **T1** primary, via the surface contacts of reed **A1** and also, this time, through resistor **R1.** This resistor limits the initial current. However, immediately following the closure of, say, contact **H** on reed **A1,** contact **K** on reed **A2** closes. This short-circuits **R1** and thus allows the current in **T1** primary to build up to its full value. Similarly, a little after contact **I** on reed **A1** closes, contact **J** on reed **A2** closes, again short-circuiting **R1.**

The effect, then, is that the initial primary current from the supply is limited by **R1,** and then on each half-cycle this shorts out a little afterwards, causing the full current to flow through the primary. Advantages of this technique include the minimisation of contact sparking, leading to smaller suppression problems, longer vibrator life, greater output power and improved efficiency.

A leading firm in vibrator converter design and construction is *Valradio Ltd.* of Browells Lane, Feltham, Middlesex, and the arrangements expounded in the foregoing are, in fact, employed by this firm. The author would wish to acknowledge at this juncture the information supplied to him by Valradio.

A practical vibrator, of course, is somewhat more complex than the basic circuits shown in **figs. 2** and **3.** Optimum efficiencies coupled with minimum contact sparking demand the use of capacitor elements connected to the make-and-break circuits. Some of these are called 'buffer capacitors'.

Radio and television interference is suppressed by the use of appropriate value chokes and capacitor filters.

While the ordinary mains supply gives a waveform closely approaching that of a sine-wave (usually with a little odd-numbered harmonic distortion), the waveform from converters tends to differ somewhat from a sine-wave. Basically, this is of little consequence, provided the output is not too much of a square-wave, as the form factor of this waveform can upset the input loading of equipment designed for a nominal voltage sine-wave supply.

Rotary converters do not present much of a problem in this respect, since a true alternator is used to deliver the AC supply and the waveform is essentially sinusoidal. Thus, a rotary converter with a 240V AC output (assuming the frequency matches that required by the equipment) can be fed direct to any AC equipment within the wattage rating of the supply without much trouble.

The output from some vibrator units, though, is essentially square-wave, meaning that the supply contains an abundance of odd-numbered harmonic components of the fundamental frequency. Indeed, it is the harmonics that give the wave its square form.

This may mean a slight alteration to the input voltage tapping on the recorder if the measured output voltage is equal to that voltage to which the recorder is adjusted. This is because most AC voltmeters respond to the mean of the waveform, the calibration being in RMS based on a sine-wave. Usually, though, the compensation is provided in the converter itself; but it is just as well to have the problem in mind.

Harmonics in the supply voltage can also give rise to curious 'buzzy' hum symptoms when applied to high gain audio equipment, such as the amplifiers of a tape recorder. Electrostatic disturbances created by the vibrator action can also give similar trouble, and for a test report on a Valradio vibrator type converter, reference should be made to the January 1965 issue of *Tape Recorder.*

Without doubt, the best and most efficient way of achieving battery-powering is by the use of a transistor recorder designed specifically for batteries, and next month we will start looking at the circuits of some of these machines.

FIG. 1

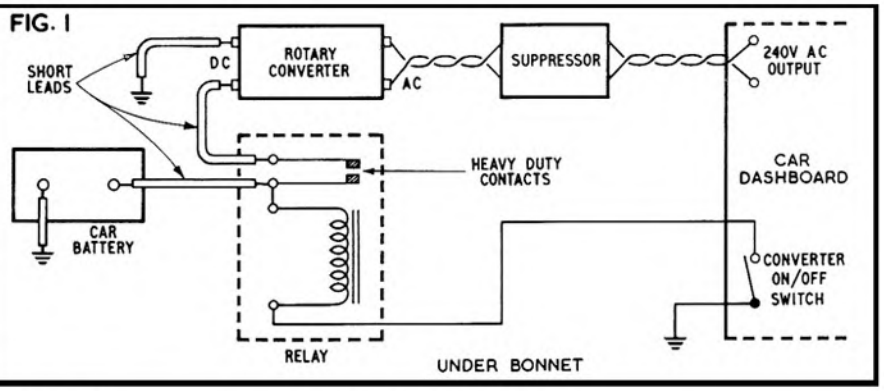


FIG. 2 BASIC LOW-POWER VIBRATOR

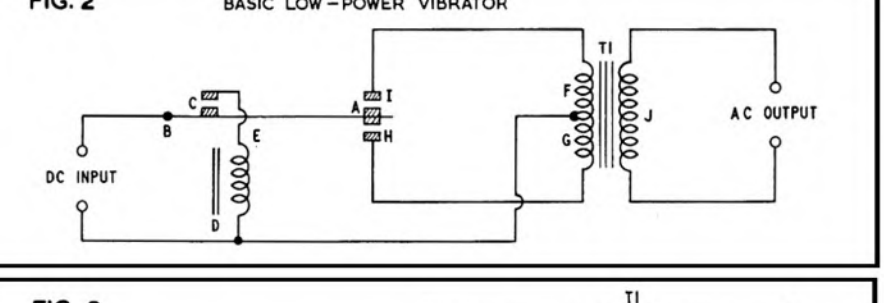
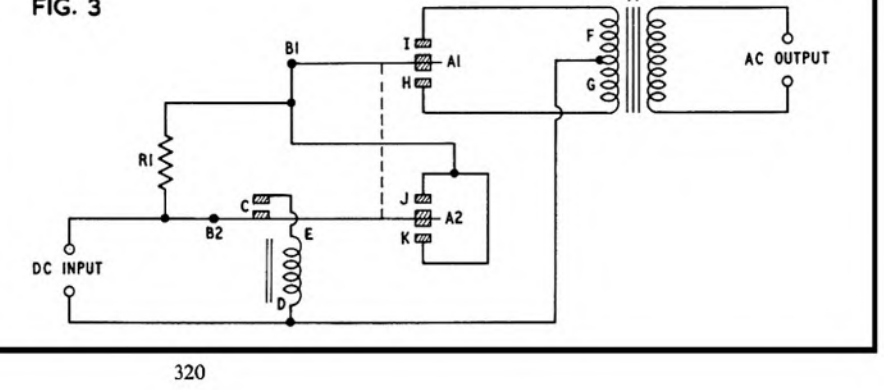


FIG. 3



THE HAZARDS OF RECORDING BIRDSONG

Philip Radford recounts some experiences

BBC Photograph

SOME years ago I achieved an ambition by buying a new, battery-driven, portable tape-recorder. My aim was to record the songs and call-notes of birds ; having obtained my recorder I thought the rest would be easy. As an ornithologist I was used to watching and listening to birds. I knew where to find them and the sounds to expect at different seasons. All I need do, I believed, was to locate my singing or alarming bird, direct the microphone, and record. But I soon discovered that in this noisy world the human ear, if concentrating on a particular subject, is to some extent selective. Magnetic tape, however, stores all sounds within the frequency range of the recording apparatus.

I remember well my first attempt at bird-song recording. I had decided that the nightingale would be a good choice for my virgin tape, so one May evening I went to a Gloucestershire wood where I knew the birds to be present. I found them singing vigorously, chanting one against its neighbour and contrasting with the last calls of cuckoo in the fading light. I sat amidst brambles and a tangle of grasses and held my microphone in the direction of a singing bird. It was shouting its song from the thick undergrowth of that woodland glade. I switched to the recording position, turned up the volume control fully, and recorded.

Minutes passed. The nightingale sang on as though he knew I was expecting him to give of his best ; the rest was up to the recorder and to me. Then came an interruption ; a farm dog raced to investigate, crashing through the grasses and nettles. He was friendly, but too intelligent, and took interest in the revolving tape-spools. He sniffed and pawed at the machine. I stopped my recording and attempted to send him elsewhere. That was not easy, but eventually he ambled away. I had carried out about five minutes of recording, and I decided to rewind and play back at that stage and sample the result. But for the dog's interference, I thought, it should be first-class, and anyway I could easily erase the portion with his scratching and rustling sounds.

I played back the tape from the beginning. I was appalled at the result. The nightingale screamed from my amplifier, interposed by creaks and coarse jarring notes. And so it went on until the dog arrived ; one would have thought him a lion from the amplitude of the approach noises. Clearly, this was no tape to keep, no sound sequence to reproduce in winter to remind me of the spring.

Of course, I had over-modulated the loud nightingale notes, giving a distorted reproduction. Also, foolishly, I had held the microphone in my hand. Wrist and arm movements had been transmitted, the cable had swayed and grasses had brushed against it. And I had allowed long grasses, which I had trodden flat, to spring up, thus further vibrating the cable.

So I had my first lesson in bird-song recording. I learnt that I must never over-modulate by recording at too great a volume. Also, I must support the microphone on some rigid structure and must not let the cable sway against adjoining vegetation. I found a stout stick with a horizontal branch at the top ; this served admirably to hold the microphone. I wound the cable twice round the branch, plunged the stick into the ground and directed the microphone towards the sound I wished to record. I have used that method in the field ever since.

I was annoyed with myself when I played back that distorted and noisy nightingale song that evening. But I soon found that someone else was annoyed, too. The cock nightingale came to investigate, evidently incensed that any other nightingale should dare to sing in his territory. He sang at the recorder, emerging from thick cover to show himself on a popular tree. His own altered and rather crazed voice was, surprisingly, enough to make him suspect an intruder. The sight of that bird, vibrating its song against a star-covered night sky, was enough to compensate for my own failures.

It may be thought that once the technique of outside recording has been mastered, when modulation is correct and the microphone and cable are kept steady, then the hazards of bird-recording would be few. But that is not so. There is none of the security that the indoor recordist takes for granted.

For example, once I placed my recorder on a grassy patch while taping a lesser whitethroat's monotonous rattle one warm June afternoon. At first, good recordings were made. But the later reproductions were irregular and poor in quality. One look at the recorder showed the reason. Large, energetic ants crawled over and into the machine which I had obviously put on an ants' nest. I blew and shook and dusted with my handkerchief. But some material of animal origin got stuck on the recording-head, having to be removed later by an expert hand. I recall also the large spider descending by its thread from a tree branch, only to land on the recorder and meet its death by becoming entangled in a revolving spool. That roundabout proved the end of that spider.

It is obvious that rain must stop an outside bird recording ; one cannot risk a wet tape or water getting inside the machine. In light rain I have retired to the shelter of a tree and attempted to continue. But it is no good, even if one is completely dry the sound of the rain dropping on the leaves above spoils the recording.

(continued overleaf)

Rain falling on the roof of a motor-car makes an even greater noise. This is unfortunate as a car can make an excellent hide. I have recorded the corn bunting's metallic jingle on several occasions by this means. It is easier to approach the bird's song-post in this way rather than on foot, always assuming that it obligingly sings by a roadside. But should rain start, even a few drops, the loud pinging notes resounding from the saloon roof drown all bird-song.

A strong wind is picked up by any sensitive microphone and proper recording is impossible. Even if one can find a sheltered area, branch and leaf movement in wind increases background noise. Also, blown sand or leaves or seeds may infiltrate to the moving parts of the machine. If it is proposed to record where dust, sand or sea-spray may be blown, then it is as well to carry the recorder in a plastic bag or case.

Clearly, external sounds are of the greatest annoyance to the bird-song recordist. One of the worst offenders is the motor-cycle ; in this country one is rarely far from some sort of road along which motor-cycles pound and speed, especially at weekends. Hooting motor-cars, swooping aeroplanes and railway trains are other noises which can interrupt a sound-recording, possibly one which will never be repeated in one's recording lifetime.

Two or three pairs of greenfinches nest each year in my own garden, but I can never record the cock's delightfully melodic song. I live near a main road and traffic noises, even at dawn, are too great. Naturally, I think my greenfinches sing better than others, but as yet I have failed to get a sound-recording to prove this to my friends.

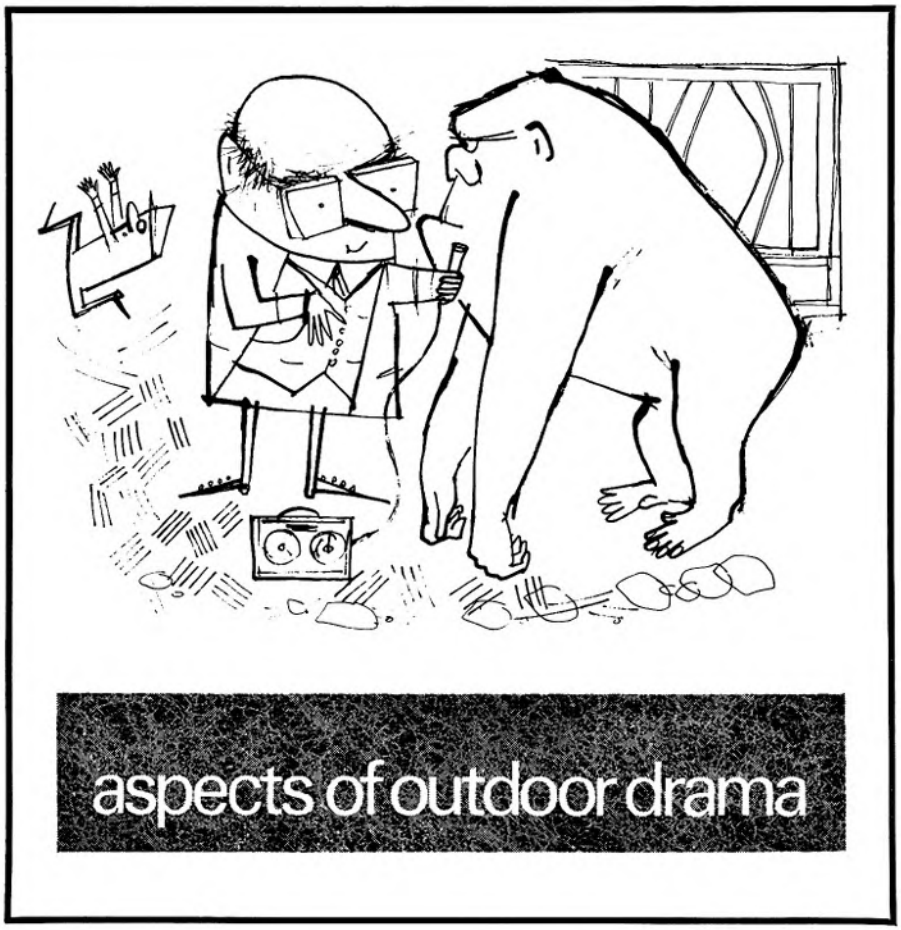
Yes, a recordist of bird sounds must be prepared for disappointments. Last November I set up my microphone in a reed-bed at a Somerset lake. A party of bearded tits from East Anglia, or possibly Holland, had been located. They were calling frequently as they fed amongst the reeds. I found a relatively dry patch in the marshy ground. I reassured myself that neither I nor my apparatus was likely to sink into the surrounding bog. No wind blew, motor-cycles were infrequent, and I sat patiently to record the pinging call-notes as the birds drew near. But at that moment a circular saw from a nearby farm started up, relentless and undulant. I was rewarded, perhaps, by excellent views of the bearded tits through my binoculars, but no recording was possible that day.

Interference by man is another danger. Fishermen are friendly people, but they find it impossible to realise that anyone comes near water to do anything but fish. I have had excellent sequences of reed warbler and reed bunting song ruined by the heavy steps of approaching anglers, coming to discuss the weather and prospects for fishing. But once they have settled and assembled their rods they become too engrossed in their hobby, no longer a menace to disturb birds and recorders by their chatter and innocent conversation.

Some recordists incite curiosity by carrying elaborate equipment, especially a parabolic reflector. Small boys just cannot imagine the use of such an object, looking like a polished dust-bin lid. Droves of boys may follow an intending recordist up a country track ; answers to their questions are not believed. They are convinced that a new ray-gun is about to be tested and are determined to watch the process. Such boys really take some evading.

Birds themselves may hazard a recording. On several occasions I have had the raucous notes of song thrush or even nightingale drown a softer song I was hoping to tape. The strange reeling of grasshopper warbler, for instance, must be heard without close competition from louder singers. Or, a screeching jay or chattering magpie may drown a recording of a smaller bird, perhaps stopping their song and dispersing them to cover. But there may be compensations ; the presence of an owl or hawk may give an opportunity to record the alarm calls of other birds. A bird-recordist must be an opportunist.

Essentially, bird recording must be a solitary project. Usually a second person leads to increased timidity of the birds. There is possibly another hazard if bird recording is attempted in company. Just as the light begins to fade and preparations have been made for the taping of a nightjar's churr or owl chorus, one's companion becomes restless after an evening in the field. The lure of a neighbouring *Bird-Watcher's Arms* conflicts with the uncertain prospect of bird sounds of the night. Sometimes a falling evening temperature and strong persuasion by the friend make it difficult to resist the temptation.



A NEW DEPARTURE IN SOUND SKETCHES

BY H. WOODMAN

THE production of plays on tape is chiefly the hobby of individuals and small domestic groups. During the summer, it is these people alone (with the exception of educational concerns) who continue to make 'dramatapes'. Most drama societies virtually cease to function between May and September.

But this period of abeyance is the one I like the best! To me, nothing is so interesting as recording out-of-doors.

Summer was formerly a time for gathering effects and choosing plays for winter. But complete dramatapes can now be recorded both indoors *and* out—thanks to the advent of superb battery-portables such as the *Telefunken 300* and the *Grundig TK6*.

Indeed, for the casual dramatape enthusiast, I now see little point in a preference for a mains model. A good battery portable will do everything he wants—provided he has facilities for play-back presentation. And this means nothing more than a reasonably-priced amplifier and extension-speaker.

There are two functions in exterior production. *The first :* where the cast 'go on location' to secure a natural background. *Second :* where the entire play is enacted against a background of extraneous sound—an aural 'backcloth'.

The material most suitable for presentation against an aural backcloth is that which could normally be enacted *al fresco*. Folk drama, comic interludes, masques, Greek drama, dramatised readings, narrative poems, Renaissance drama—these are the acceptable categories. From the Elizabethans onwards (Shakespeare excepted) dramatape adaptations call more for naturalistic treatment. For example, a nautical melodrama of the 1850's would be out of place against a garden backcloth of birdsong.

The main object in choosing a backcloth is to make the subsequent play-back reminiscent of a particular locality. A railway station, a market-place with the town clock, the treble cries from a children's play-park, the cawing of rooks in the farmyard elms, the sound of the incoming tide—all these are fairly typical backcloths.

But one can experiment with the bizarre—such as race-track circuits, cement-mixers on a building-site, jet-airports. Any one of these, heard behind, say, a ballad (each verse being spoken by a different member of the company), creates a stimulating juxtaposition.

Modern one-act plays and sketches can frequently be enacted, in their entirety, in their outdoor location. To take the cast to the seaside is an entertaining diversion ; and acting a sketch in a reserved carriage (during the journey) is not unknown.

Much the same procedure is adopted as in the drama studio. For example, deck-chairs can be arranged in a small circle on a lawn—with the microphone (on a tripod) in the centre. But gain must be much higher out-of-doors—and this inevitably makes the level of the 'backcloth' too high. Actors should therefore be grouped fairly close to the microphone-face. And the whole unit must draw back from the source of the backcloth—testing various distances until the backcloth is at a suitably low level.

But, in addition, the actors must be grouped in a partial enclosure to 'contain' their voices. So, instead of being in the centre of the public park, they move over to the deserted brick wall. The angle of intersection between two high walls makes a useful aural enclosure. The microphone is placed in the corner and the actors turn their backs on any unwanted background noise which may be present. Archways, stone steps, adjacent cliffs and rocks, stable-yards—these are the recording sites to look for.

Even where the action supposedly takes place *within* the location, the principle of drawing back still applies. For example, dialogue at a railway-station might not be recordable on the actual platform. The locational-sound is possibly overweight—thus taking a lion's share of the modulation. It might be preferable to record the scene on the bridge further down the line. The balance is then more in favour of the dialogue.

There are, of course, occasions when one wishes to record out-of-doors purely for the sake of sunshine. The locational sound is then minimised by recording in a suitably desolate spot. I haven't yet tried producing a play up in the mountains, but I have tried a certain ruined castle in Sussex. It has a silent floor of well-kept grass, and the open shell gives excellent insulation from distant black-currant pickers. The surviving towers and staircases provide, in addition, some highly dramatic acoustics. Unfortunately, as the summer advances, so does the tide of other trippers, and my group is bashfully obliged to seek fresh pastures.

As a last resort, one can find access to a private garden. Judicious pausing can obviate the more blatant noises, but here again one must beware of recording too loud a backcloth of birdsong. On playback, it can give the impression that the characters are trapped in an aviary. Which is hardly illustrative of the freedom of summer-in-sound.

television on tape

Part two: modern techniques and a look at the future

V.E.R.A. was a marvellous girl. Born at the BBC in 1958, she worked for the corporation until rejected in favour of the more reliable and more attractive *Ampex Videotape*. V.E.R.A. (*Vision Electronic Recording Apparatus*) was the first tape recorder ever employed in this country for broadcast television recording. To achieve the very high frequency response required to record four million 'bits' (of information) per second, the machine operated at a tape speed of 200 i/s. Even this did not, in itself, provide a 4 Mc/s frequency response, and the video signal needed to be coded into three channels, recorded side-by-side on the ½in. tape.

The first high definition video tape recorder appeared four years before VERA and was developed by a team under Dr. H. F. Olson at *RCA* in the United States. This device operated at a rather higher tape speed (240 i/s) and itself used ½in. tape.

High linear tape speed brought many problems, not least of which was that of keeping wow to an extremely low fraction of the nominal speed. Early video equipment was much more demanding in this respect than audio and modern television recording machines. Another difficulty was that of retaining efficient head-to-tape contact, though recent experiments by *Par* in the USA, with moving belts rather than conventional pressure pins, are claimed to have overcome this.

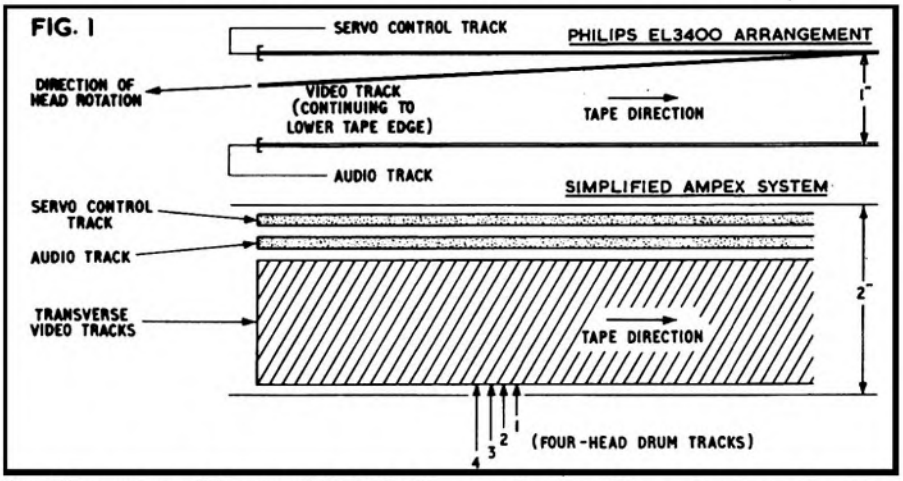
The result of poor head-hugging and worn tape has long been known to audio enthusiasts as 'dropout'. Whereas dropout can mar a sound recording by momentarily obliterating the audio reproduction, a video dropout is seen as a single white 'dot'. Poor splicing of a modern video tape (for accurate editing is now possible) would result in a series of such dots, not necessarily on the same line or frame.

In last month's article reference was made to the problems of feeding a bi-dimensional object—the picture—through a uni-dimensional wire. Making allowances for the electronic trickery employed in the RCA and BBC fixed-head machines, the same terms may be applied to 'uni-dimensional' tape. The track width is generally much greater in fixed head recorders than is necessary for a usable signal.

Factors governing track width are signal-to-noise ratio, dropout level and crosstalk, all of which deteriorate as the track width is reduced. Frequency response is barely affected, being related almost entirely to tape speed.

The width of tape scanned by one segment of a ¼-track audio recording head is three-hundredths of an inch (0.03in.). The signal-to-noise ratio required of a video system is less than that demanded for audio equipment, particularly since the sound accompanying a video recording is split from the video signal and taped on a completely separate track.

A track width of about 0.01in. is to be found on modern television recorders. The reader should not imagine, however, vast reels of ultra-narrow tape shooting past a stationary video head at 20ft. per second. The Ampex Videotape startled the world by employing 2in. tape at only 7½ i/s. A. M. Poniatof and friends had conceived the brilliant scheme of employing the bi-dimensional properties of a wide magnetic tape to store the bi-dimensional picture. In other words, they scanned the tape *width* (rather than the tape length) with the aid of a high-speed rotating head. **Fig. 1** shows



the oblique pattern of the scan while, in **fig. 2**, we see the machinery which accomplished it. The video heads (there are four) are located 90° apart on a metal wheel of some 2in. diameter. As the rim of this wheel rotates from top to bottom of the cupped tape, the four heads trace a near-vertical path across the oxide. Careful synchronisation of the wheel-speed and linear tape speed causes the four heads to rotate over equally spaced areas, the precise spacing being predetermined to give minimum cross-talk from adjacent obliques.

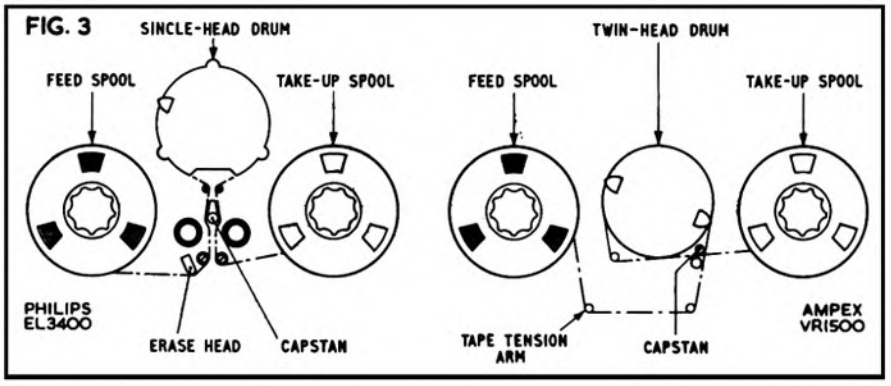
It will be seen from **fig. 1** that not all of the tape carries the video signal, the outer edges being taken up by the audio track (carrying sound) and one or more auxiliary tracks. The purpose of the control track is to stabilise the tape speed by 'informing' a circuit whenever the tape speed increases or decreases. The circuit then passes a suitable signal to a servo-mechanism, accelerating or slowing the tape transport to the correct speed.

A straight-forward switching system ensures that the heads are disconnected from the recording amplifier as they leave the video area, being re-connected on commencing the next scanning cycle.

The very act of cupping the tape round the video head presented problems, and these were solved by pulling it across a vacuum-guide. An air-pump attached to the guide extracted air from the chamber formed by the metal guide and the un-coated surface of the tape, providing a very efficient (and very expensive) head wrapping system. Audio and control tracks are recorded in the conventional manner with stationary heads located in a separate block between the video head and capstan. **Fig. 2** shows both head groups.

Transverse scanning of the type employed by Ampex is probably as near to perfection as any video recording system will ever come, using present television techniques. The one disadvantage of the system, however, is that it does not lend itself to 'cheapening' for the domestic market. Broadcasting authorities themselves find the equipment hard on their pockets and, with 2in. professional tape at its

Fig.2 Fig.5



present price, are by no means fond of splicing.

It is only a few years now since *Precision Instruments* chopped more than £6,000 from the price of rotating-head television equipment by introducing the *PI-3V*. This model sold in Britain for £4,340 and utilised a completely new scanning technique to achieve good-quality video at 6¼ i/s on 1in. tape. The low price and reduced tape area had been made possible by helical-scanning, of greater simplicity than the *Ampex* system and greater economy than offered by VERA.

But even the PI-3V was way beyond the enthusiast in terms of price. Its mark was made in those fields of industry and commerce that required a 'remote eye'. But a considerable amount of 'remote looking' was needed to justify the cost of the machine, even for the wealthiest companies, when 16mm. was capable of colour, superior picture quality, lower initial cost, and greater portability.

We have hitherto dubbed the vertical rotating head process of tape scanning 'the Ampex system'. This we can no longer do, however, since Ampex themselves now manufacture helical-head recorders. The model *VR-650* illustrated on our front cover uses 2in. tape at a nominal 8 i/s and costs some £4,000.

The *Philips EL3400* finally broke the £1,000 price barrier—by sheer weight of the manufacturer's experience in design, costing and mass-production. Philips have been in the television field for years, and produce cameras and domestic receivers in great number. One can, in fact, purchase this unit 'over the counter' at *Harrods* of Knightsbridge, by arrangement between that retailer and the U.K. agents for Philips professional equipment—*Peto-Scott*.

The purpose of the moving-head tape scanner is to provide a high head-to-tape speed without a similarly fast linear tape speed, narrow tapes being difficult to handle and generally uneconomical. *Effective* tape speed of the rotating head systems is in the order of 1,000 i/s.

There are several systems of helical scanning, varying in respect of tape wrapping path and number of heads. **Fig. 3** shows the Philips single-segment and Ampex double-segment

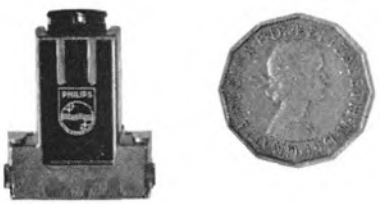


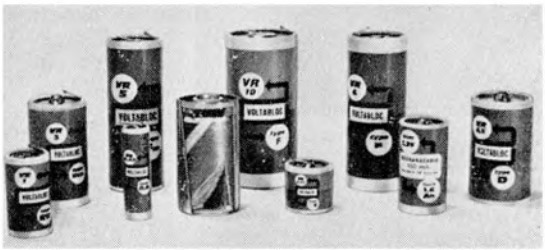
Fig. 4 (above):
Philips video head shown life-size.
Fig. 6 (below):
Telcan tape deck mounted on television receiver.

(*continued on page 327*)

VOLTABLOC

CADMIUM-NICKEL
rechargeable
portable

SEALED CELLS & ACCUMULATORS



ADVANTAGES

- Exceptional life: more than a thousand cycles.
- Easy recharged, insensitive to heavy overcharges
- Withstand impact and vibration.
- Unlimited shelf life.
- Total absence of maintenance.

APPLICATIONS

- Electronics and telecontrol.
- Satellites, space applications.
- Laboratory Equipment and measuring instruments
- Transistorised radio and television receivers, electric razors, etc.
- All types of portable equipment.

CADMIUM NICKEL BATTERIES LTD.
SPEDANT WORKS · PARK ROYAL ROAD
LONDON N.W.10 Tel: ELGAR 7424
A.I.D. & A.R.B Approved
Licensees of :
SOCIETE DES ACCUMULATEURS FIXES ET DE TRACTION
Romainville (Seine), France.

SAVE POUNDS . . .
with this TOP QUALITY EQUIPMENT

Save . . . £15.4.6

EXCLUSIVE BULK PURCHASE OFFER

HITACHI
BELSONA

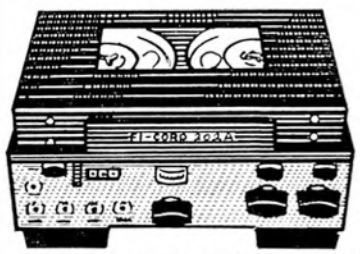
by one of Japan's foremost Electronics Manufacturers

LIST PRICE 42gns.
OUR PRICE ONLY **27½gns.**

or on INTEREST FREE TERMS £7.11.6 dep. and 12 monthly payments of £1.15.6. Carr., packing and Ins. 19/6.

Designed and engineered to semi-professional standards, R.E.W. specially recommend this machine as giving years of trouble-free service. Featuring : one hand control for easier operation ; large elliptical front mounted speaker ; recording level meter ; monitoring facilities ; 2 tape speeds ; 3¾ and 7½ i.p.s. ; freq. response at 7½ i.p.s. 50-12000 c.p.s. mains operation. Complete with high quality dynamic microphone.

Save . . . 27gns.



FI-CORD
202A

LIST PRICE 66gns.
OUR PRICE ONLY **39gns.**

or on INTEREST FREE TERMS £10.19.0 dep. and 12 monthly payments of £2.10.0 (mike optional). Carr., pck'g and Ins. 12/6.

Another scoop by R.E.W. ! Top quality portable tape recorder at ridiculously low price. Extremely compact, 9" x 6½" x 4½", 2 tape speeds 3¾ and 7½ i.p.s. Freq. response at 7½ i.p.s. 50-12000 c.p.s. Weighs only 6¾lb. (inc. Batteries). 4in. spools give up to 90 mins. recording time. Mains or battery operation. Can even be used from 12v. Car battery. 3in. loudspeaker. Used extensively in many professional fields.

Save . . . £1.15.6

LUSTRAPHONE LUSTRETTE
Microphone Type LD/61

Current price £3.15.0
OUR PRICE ONLY 39/6

Brand new, high quality moving coil microphone. Freq. response 50-12000 c.p.s. high impedance. Supplied complete with 9ft. lead.

★ **We specialise in a fast, efficient service by mail. Order by post with confidence, or call and see these magnificent money-saving offers for yourself !**

R·E·W (Earlsfield) LTD.

Dept. T.R., 266-8 Upper Tooting Road, London, S.W.17
Telephone: BALham 9174/5
Please note this is our only address

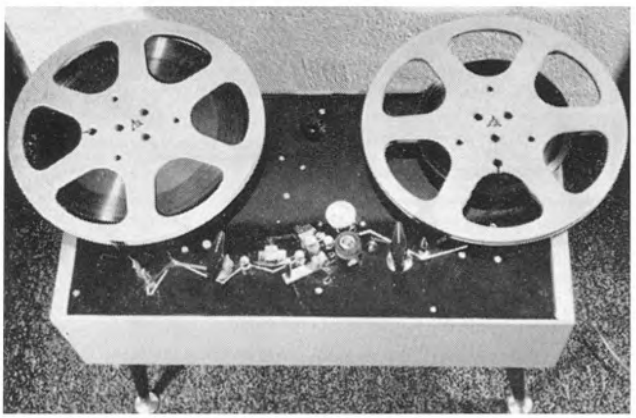


Fig. 7 (far left): Wesgrove VKR2000 was advertised at £150.

Fig. 8 (immediate left): Ampex fixed-head video recorder employing ½in. tape.

transports. It should be clear from the drawing and photographs of these machines just how much they differ. Certainly the two are not compatible. In neither case does the tape describe a full 360° path round the drums. On the Ampex machine only some two-thirds of the drum are in contact with the tape at any one moment. The picture is prevented from vanishing, during one-third of each head rotation, by the provision of a second head. Thus, the two heads operate in sequence, each scanning the tape for a little over half the drum cycle.

With the Philips machine, only a tiny portion of the drum is 'wasted' in tape entrance and exit. The short break in recording results in a few lines of vision being lost on each frame. A single rotation of the drum records one odd- or even-line half-frame. The frequency of drum rotation is 50 c/s—identical to that of the pre-interlace half-frame.

To overcome the distressing effect of five or six horizontal lines being lost from part of the resultant picture, the monitor receiver can be adjusted so that the lost lines are distributed equally at the top and bottom of the frame. The resultant "405-line" picture may have only 400 lines, but the difference will not be noticeable.

Single-head scanning is something of a compromise, but a very reasonable one, between the loss of a few lines of video and the addition of £2,000 in price.

No two heads (audio or video) have exactly the same electromagnetic characteristics and, on the VR1500, the signal must be passed through an elaborate limiting circuit to iron out variations. Another problem overcome by employing a single rotating head is that of head-wear. No two heads on any helical drum would wear at the same rate, and the increasing variation in head characteristics would result, after a period of time, in a more and more distressing 'flicker'. Tough ferrite materials are now being introduced into video and professional audio heads and these greatly prolong head life.

Fig. 4 shows the head (beside a coin, to illustrate its very small size), while **fig. 5** displays the relation of head to rotating drum. To insert the head, the operator merely removes the drum-cover and slips the tiny component into a recess. The head is locked in position by a forward sliding movement from the thumb, being held in place by sprung arms. Replacing the video head is thus easier than fitting a new cartridge to a gramophone.

Philips are proud of the video head. An EL3400 operating manual described it as "Perhaps the most ingenious part of the video recorder". A replacement head costs some £25, which sounds expensive until one realises that this component cost more to develop than the rest of the EL3400 put together. Two million pounds were invested in its production.

Fig. 5 shows the elements of the Philips helical transport mechanism. It will be noted that, as on the Ampex transverse-scan machines, a single erase head obliterates unwanted signals over the entire tape width.

When these two articles were first envisaged, it was generally accepted that the first generation of domestic video recorders would employ the helical-scan technique. Roger Gregory's recent survey of American developments bore witness to the fact. At the time of writing, however, details have been announced of two developments that turn attention back to the fixed-head system.

Before studying these developments, let us examine the spate of fixed-head recorders that *almost* reached the domestic market between 1962 and 1965. The very first model made its debut in, of all things, a BBC Television News programme. *Telcan* was born.

Its life was a short one, marred by lack of capital, or technical difficulties—no one seems to know quite which. Quarter-inch tape provided the recording medium, transported at a speed of 120 i/s. Telcan (illustrated in **fig. 6**) took 10½in. spools and had four tracks —two for video and two for audio. This enabled two sound-plus-vision programmes to be recorded on a single length of tape.

Shortly after Telcan's demise, a machine of similar design appeared, under the distributive wing of *Wesgrove*. The *VKR2000* (**fig. 7**) was advertised as being available in two forms—ready-built, at some £150, and as a kit—at about £100. The commercial-television magazine *TV Times* even went so far as to offer ten machines as competition prizes. Supplies have been, to say the least, irregular, and it is still not known whether the VKR2000 is actually on the market.

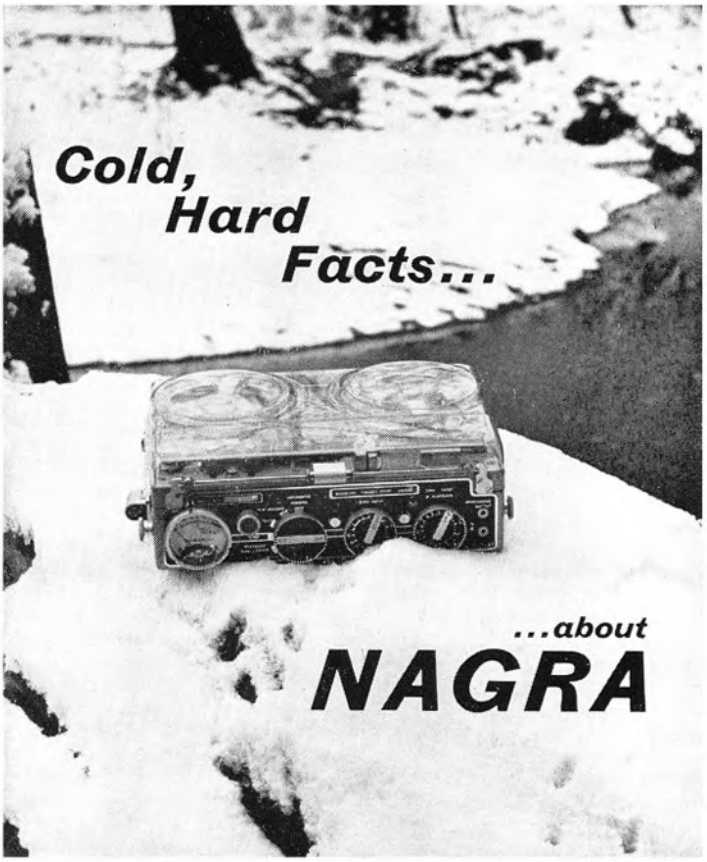
Not to be outdone, Ampex produced a high-speed fixed-head television recorder (**fig. 8**), though this was never actually sold in Britain, and has lately been superseded by the *HVR* series, helical-scan machines in the two-to-three thousand pounds price category.

Telcan, Wesgrove and Ampex fixed-head machines all used more-or-less conventional recording techniques, what technical trickery there was being in the adjacent circuitry. The Akai *VX-1100*, however, employs a development of the cross-field bias system to achieve a 1 Mc/s response at 30 i/s. This is equivalent to some 62 Kc/s at 1⅞ i/s! (Hitherto, the maximum response to be expected at that speed was a mere 2 Kc/s.)

We have often questioned, as a magazine, the value of cross-field bias in the manner that it is applied to Akai audio recorders. Assuming that it follows the pattern of a very recent American development, however, the new system is considerably more sophisticated than the old. It is also simpler, bias being supplied by an auxiliary winding on the record/play head itself. In this respect, the term 'condensed-field' is probably more descriptive than 'cross-field'. A comprehensive specification of the VX-1100 is given on page 315 of this issue, together with an illustration.

Permission to publish details of the American development has not yet been granted, but suffice to say that it offers slightly longer playing time per tape reel than the VX-1100, greater bandwidth, and lower manufacturing cost.

And what of the far future? The day may well come when *tape* recording and *magnetic* recording are divorced. The video recorder of ten years hence may conceivably use ¼in. transparent plastic tape, in other words the very material we are using now, minus the oxide. *Thermo-plastic* tape recording combines the advantages of magnetic recording with those of chemical cine photography—instant playback, low-cost recording medium, capable of being erased and re-used, high information packing density and ease of editing. Each frame is literally burned in plastic and may be viewed optically. Reproduction is, in fact, achieved by optical-projection. The video recording head is little more than a miniature cathode ray tube, working in similar fashion to the television display tube described last month. (*continued on page 334*)



- Neopilot version for lip-synchronisation filming.
- Frequency response 30 c/s to 18,000 c/s ±1dB at 15 i.p.s.
- C.C.I.R. equalisation.
- Wow and flutter ±0.06% RMS at 15 i.p.s.
- Battery operated, fully transistorised and completely portable. Weighs approx. 20lb. with batteries.
- Signal to noise ratio better than 70dB at 15 and 7.5 i.p.s.
- Speed variation between beginning and end of 7" reel ±0.2%.
- Operates within the temperature range —20°C and +50°C.

These typical performance figures are impressive but they are just part of the story. If you would like to know more, write for literature from the sole U.K. agents for Kudelski Nagra Tape Recorders:—

THE Livingston GROUP

LIVINGSTON LABORATORIES LTD.

COMMUNICATIONS DIVISION
LIVINGSTON HOUSE, GREYCAINES RD., N. WATFORD, HERTS.
WATFORD 44344

FRANCIS OF STREATHAM

LEADING STOCKISTS OF EQUIPMENT FOR

TAPE and HI-FI

. . . and NO EXTRA FOR CREDIT TERMS

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

MAINS TAPE RECORDERS

*Akai X-300	190 gns.
*Akai 910	62 gns.
Akai 4aS	75 gns.
Akai M.8 Stereo	136 gns.
Akai ST.1 Stereo	105 gns.
*Akai 355 Stereo	239 gns.
*Beocord 2000	119 gns.
*Beocord 1500	89 gns.
*Brenell STB2	£150
*Brenell Mk. 5/M Series III	93 gns.
*Brenell Mk. 5 Series III	74 gns.
Cossor 1607 Stereo 4 Tr.	57 gns.
Elizabethan LZ34	34 gns.
Elizabethan LZ32	32 gns.
*Ultra	49 gns.
Ferguson 3218	33 gns.
Ferguson 3222	33 gns.
Ferguson 3224	44 gns.
*Ferrograph 631	95 gns.
*Ferrograph 632 Stereo	126 gns.
Ferrograph 633	120 gns.
Fidelity Playmatic	28 gns.
Grundig TK400 2sp 4 Tr.	47 gns.
Grundig TK17L	43 gns.
Grundig TK14L	37 gns.
Grundig TK18L	41 gns.
Grundig 23L Auto	49 gns.
Grundig TK40 4 Tr.	87 gns.
Grundig TK41 2 Tr.	83 gns.
*Grundig TK46 4 Tr. St.	107 gns.
Grundig TK120	29½ gns.
Philips 3556	62 gns.
Philips 3558	42 gns.
Philips 3553	36 gns.
Philips 2 Tr. Auto 3552	24 gns.
*Revox 736	124 gns.
Sony 250A Deck & Pre-amp	59 gns.
Sony TC 260	95 gns.
Sony 200	72 gns.
Sony 500	105 gns.
Stella 463	39 gns.
*Tandberg Series 6	110 gns.
*Tandberg Series 12	105 gns.
*Tandberg Series 8 2 Tr.	54 gns.
*Tandberg Series 8 4 Tr.	59 gns.
*Tandberg Series 9	69 gns.
*Telefunken 85	91 gns.
Telefunken 200	39 gns.
*Telefunken 98 ½ Tr. Stereo	95 gns.
Telefunken 203	69 gns.
Telefunken 201	44 gns.
Truvox R.40	41 gns.
Truvox R.102	76 gns.
Truvox R.104	79 gns.
*Uher 724	75 gns.
*Uher 784	129 gns.
*Truvox PD.102 Stereo	93 gns.
*Truvox PD.104 Stereo	89 gns.
*Vortexion WVA 3-speed	£96.7.0
*Vortexion WVB 3-speed	£115.10
*Vortexion CBL Stereo	£172.0.0
Wyndsor Vanguard	59 gns.

BATTERY PORTABLES

Akai X-IV 4 Tr. Stereo	131 gns.
Grundig TK6	69 gns.
Cossor 1621	26 gns.
Loewe Opta 416	51 gns.
Loewe Opta 408	79 gns.
Grundig EN3 Notebook	23 gns.
Philips EL3301	26 gns.
Philips 3586	26 gns.
Stella 472	26 gns.
Uher 4000L	103 gns.
Sanyo Auto	22 gns.
Sanyo Batt/Mains	36 gns.
Telefunken 300	49 gns.
Telefunken 301	54 gns.

**Microphone extra*

MAINS POWER PACKS

Philips, Stella or Cossor	£5.12.0
Uher 4000, with cell	18 gns.
Telefunken 300 with cell	£16.17.0

Tape to disc and copy service.

●MICROPHONES, MIXERS

Hammond condenser M.100	29 gns.
Grampian Reflector	£6.15.0
Grampian Ribbon	£11.10.0
Grampian DP/4 Dynamic	£8.5.0
Reslo Ribbon	£11.2.6
AKG D.119	£20.10.0
AKG D.14S	£14.0.0
AKG D.19C	£17.10.0
Eagle Mixer	3 gns.
Grundig Mixer Stereo	18 gns.
AKG K.50 Headphones	£7.10.0
Philips Pre-amp	£6.10.0

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

●TAPES & ACCESSORIES

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

● DEFLUXERS BY WEARITE, WALGAIN

● *Pre-recorded Tapes by Columbia, H.M.V. and all E.M.I. Labels, Crown, Phonoband Eagle etc.*

Bib, Bond and E.M.I. splicers. Matching transformers. Plugs, sockets, etc. *Prices subject to alteration as announced by manufacturers.*

STANDS OF ALL TAPES

HI-FI DEPT.

● STEREO AND MONO AMPLIFIERS
Quad Pye Rogers Cadet Mk.III
Leak Armstrong Tripletone
Scott B & O Truvox

● TUNERS
Quad Rogers Pye Leak
Armstrong B & O Tripletone

● LOUDSPEAKERS
Quad Pye Rogers W.B. Kef
WharfedaleGoodmansTannoy
Lowther Leak Elac Truvox
Ditton B & O SHB Tandberg

● MOTORS, PICKUPS

GARRARD incl.	Thorens
SP.25, 401, etc.	Tannoy
Goldring	Shure
Connoisseur	Ronette
DECCA incl.	Sonotone
ffss Mk. III	B & O
Deram, etc.	SME Mk. II
Philips	ADC BSR
Ortofon	Pickering
Acos	Transcriptor

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

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

Between St. Leonard's Church and Streatham Station

STReatham 0466/0192

Please note this is our only address
OPEN ALL DAY SATURDAY—EARLY CLOSING WEDNESDAY

THE RIGHT TO COPY

PETER TURNER SURVEYS A BARRIER OF RED TAPE AND SMALL PRINT

ACCORDING to Dr. Johnson, anyone who writes other than for money is a blockhead. The good doctor was, of course, given to exaggeration : artists have starved in garrets rather than abandon their chosen means of expression. But they have not done so because they wanted to ; and the world of art would shrink almost to non-existence if only the strictly non-professional works were included in it.

In our time, standards are so high that it is difficult for the amateur to attain to any kind of equality with the professional ; and though in the first Elizabethan age one had to be a musician to be accounted a gentleman, one wonders how good many of those gentlemen really were. Haydn and Beethoven, to name only two, wrote music to be played by a patron who was a gifted amateur musician ; but recordists are well aware that amateurs rarely produce performances which can be listened to again and again like professional ones.

The first classical concert I attended was conducted by a great professional—Sir (then Doctor) Malcolm Sargent—and the soloist was Madame Guilhelmina Suggia. From that moment on, my life has been enriched perhaps more by professional musicians than by any other single source, and I can never begin to assess what I owe to these dedicated, absorbed virtuosi, who have slaved in a way I cannot think of to perfect their technique and understanding of music. I hope they are well paid for their work. If they are not, something is very wrong with our sense of values. I suspect that The Beatles get more than Sutherland ; but I prefer not to think about it : that way madness lies. The point is that people expect to pay for first-rate music ; and if The Beatles provide first-rate music of their kind—a thing I would not know—they *ought* to be well paid.

The advent of the means of recording and replaying musical performances introduced a new complication. Where formerly a composer had the right to expect to be paid when copies of his works were purchased, and played in public, the performer had been concerned only to collect a fee for each appearance. Now both composer and performer could expect a fee for each record sold ; and few people would dispute that right. Further, the possibility developed of playing a recorded performance in public ; and it seems reasonable that a fee should be required by composer and performer for that, too. Broadcasting, sound film and television have all added to the complications of liability for fees ; but nobody disputes the right of artists to be paid for their work.

For some reason, however, minds change when we reach the final complication : the sale to the public of means whereby records can be copied, broadcasts permanently recorded, and even television performances made repeatable at will. Not long ago I was discussing this question with a tape correspondent who said bluntly : "When I've bought a record, I expect to be able to do anything I like with it". I find this attitude quite extraordinary. I am not concerned with the question of legality, and with what does or does not break the law of copyright : those interested are referred to an article in *Tape Recorder* for February 1965. I am concerned with the ethics of the thing. My friend would not, I hope, think of trying to steal into the Festival Hall without paying ; but having bought a record which enables him to hear as often as he wishes music of his own choice, he assumes rights over the recorded performance which he would not think of assuming over the live original. This is presumably because the record is materially only plastic, and it is not easy, imaginatively, to regard a few ounces of plastic in the same light as a live performance.

My friend might reply that due payment was made for the live original, and that thereafter it ought not to matter to the performer what is done with the record. Something like this view obtains in communist countries, which do not subscribe to international copyright conventions, on the grounds that musicians should be adequately paid, and have no other material concern with the records they make. In our society this view is not taken ; and I have no doubt that when the fee to be paid even to the most distinguished artists is being calculated, part of that calculation concerns royalties which will accrue from sales of the record. It follows that anything which deprives the artist of a sale deprives him of a fee which he has the right to expect. If I buy a record and my friend buys another, and we then exchange records and each copy the other's on to tape (and I have heard of such things being done), royalties are lost on two records, to say nothing of sales lost to the companies which have put their money into the production of the records.

But let us take another case. Again, I am not concerned with the legality of the matter. I buy a record, which I am naturally anxious to preserve. I therefore clean it with care, and then re-record it on to tape and put it away. For as long as I wish, I keep that tape, and play it instead of the record. Am I, from the ethical point of view, doing any wrong? I think not. It becomes different if I subsequently sell the record (or the tape), or even if I give one away and keep the other ; but if I merely use the tape in order to preserve the record—perhaps only during the period when it is new and likely to be played frequently—then I do not think I am. It is arguable that I ought to be prepared to wear out the record and then buy another ; but that is hardly realistic.

Or again, I may have a tape-recorder I wish to test. One of the best ways of doing so is to re-record a disc (or another tape) and compare the recording with the original, particularly if the tape-recorder provides for an A-B comparison. Is there anything morally wrong with doing that? I cannot see that there is.

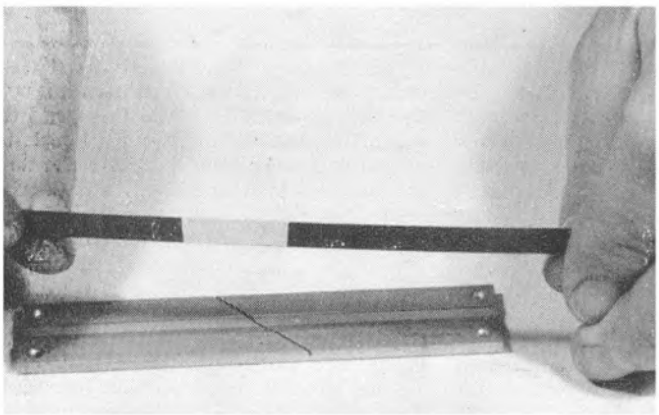
I find the question of recording broadcasts much more difficult. That is done by people who would hesitate to copy a disc or recorded tape, and done without a second thought. But *should* it be done?—again, I mean morally, not legally. I have great doubts about it. After all, an artist is engaged to broadcast a performance, just as he might be to give a public concert. Were I to try to enter a concert-hall with recording gear, I should be escorted away; but as broadcasting comes into my home I can do what I like and get away with it. But what is the difference, detectability apart? I submit that there is none. My annual licence no more entitles me to record broadcast material than does my entry-fee to a concert that is played there. Yet there can be no doubt that the recording of broadcast material is the largest single function of domestic tape-recorders ; and that means, as I see it, that the main use to which these machines of ours are put is one which is certainly illegal and morally dubious.

I submit that we ought not to be happy about such a situation. If it be true—and our society, at any rate, assumes that it is—that a performer has the right to be remunerated for his services, and that his performances shall not be pirated, then we ought not to avoid the awkward fact that the tape-recorder has produced a great many infringements of an obligation which, it seems to me, we owe in proportion to the enjoyment which great artists, conductors and composers have brought us.

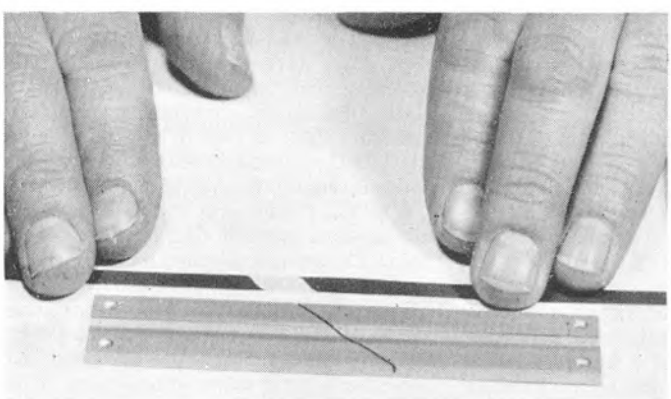
I have no doubt that the principal reason why this situation has arisen, and why it is contemplated with utter complacency by most owners of tape-recorders, is because there is no means of avoiding it! The law on copyright is complicated enough to give a Q.C. pause ; and the ordinary chap may be pardoned for having almost no idea of what is involved : what he wants is a simple means of being able to satisfy his conscience and the law—presumably by making some financial restitution for his acts. But let him look round for such a means, and he is met by a barrier of red tape and small print which he cannot be blamed for

(*continued on page 331*)

HOW TO SPLICE TAPE . . . . . .



Everyone who uses tape should know how to splice it. There are no exceptions to this hard fact because the tape user who has no mishaps has yet to be born ! It is as easy to splice tape the professional and perfect way as it is to do it badly. That is why this booklet was written—by a professional—nearly seven years ago. Thousands of copies



have been sold, and thousands of reels of tape are the better for it. Your copy will be sent by return, post paid, for 2/6. It describes precisely, and with the help of fifteen actual photographs, how to cut, splice and edit, and to make simple joints.

Price, post paid ..... Two shillings and sixpence.

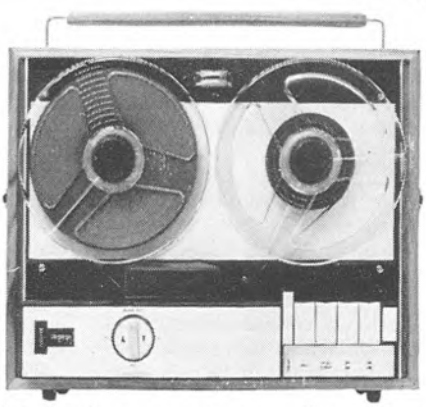
MILES HENSLOW YEAR BOOKS LTD
99 MORTIMER STREET · LONDON W.1

There's more to this tape recorder than meets the eye

A masterpiece of disguise, a portable tape recorder housed in a beautiful teak veneer cabinet. But don't be deceived, the works entrance is just around the back.

4 tracks—3 speeds—5 watts output—8″ round speaker —7″ spools—fully transistorised.

The **Van Der Molen** is a symbol of superior **British** manufacture—the co-ordination of aesthetic design vertical operation and excellent reproduction *available at only*..... **59 GNS.**



Consider these outstanding features

Listen while recording—Mixing—Recording level Meter—Can be synchronised with cine and slide projectors—Straight through Amplifier—Response 40 Cycles to 15,000 Cycles

All enquiries to

Van Der Molen LIMITED FACTORY & SERVICE

42 MAWNEY ROAD · ROMFORD · ESSEX ENGLAND

Telephone Romford 41904

OUR READERS WRITE . . .

. . . about the business of copyright

From: E. G. Waters, 28 Chatsworth Road, Croydon, Surrey.

DEAR SIR, In your Editorial of July 1966, you mention the reluctance of record companies to give people permission to tape their records. We are all (as you say) aware that this goes on, but I cannot agree that the record companies lose money all the time. I have, I suppose, about 20 tape correspondents to whom I have played, at one time, a tract from a disc, only to be asked for the number of the disc, since they wished to purchase it. This happens time and again and, far from harming the record manufacturers, you might say we sell the records for them.

Yours faithfully,

. . . about a £2,000 fee

From: Philip P. Towell, Secretary, Boston Soundhunters, 107 Spilsby Road, Boston, Lincolnshire.

DEAR SIR, Your July Editorial, and Mr. Aitken's letter regarding licences, draw attention to the ridiculous state of affairs which is now hindering the progress of amateur recording in this country.

I was asked some time ago by the conductor of our local choral society to undertake the recording of their major annual choral concert. I have done this for a number of years, the necessary licences having been obtained, and written permission being given in advance by the artists taking part (including prominent soloists). This latter point is particularly important if they are members of the *Incorporated Society of Musicians*. It has always been stressed that the tape would be wiped off after it had been heard by the choir, the whole purpose of the recording being for their study, and to improve their performance.

This year the local choir joined with another, and engaged a small group of singers and three soloists, none of whom objected to being recorded under these conditions. The trouble came when it was decided to engage the *Midland Sinfonia*, a professional orchestra, whose management said recording could not be allowed under any circumstances as the players were *Musicians' Union* members. Since I knew the orchestra's manager and their permanent conductor, I phoned them to get the decision reversed. Apparently they had no personal objection, but the M.U. would not permit it.

I was advised to contact the secretary of the I.S.M., who is conversant with the legal side of these matters, and who assured me that it would be all right, providing neither the local M.U. or any of those taking part objected. I then contacted the local M.U. Branch Secretary who was most helpful, and obtained confirmation from the District Organiser at Lancaster. This was duly conveyed to the orchestra's manager, requesting a letter to cover me. However, they decided to contact the M.U's head office in London, where a Mr. Harry Francis said that the officials in Lancaster and Boston had no authority to permit recording unless each player was paid an additional fee of £9 for each completed 20 minutes of recording. Thus, for *The Dream of Gerontius*, we should have to pay over £2,000 in recording fees, in addition to the £600 already being paid for the concert!

Mr. Francis's reason was that the law does not permit anyone to be recorded without their permission, and all their members had instructions not to give this unless they were paid the extra fees. He told me that he quite appreciated that this decision might prejudice future engagements of their members. I have since heard that this orchestra has been refused permission to allow tapes to be made of some important 'first performances', particularly requested by the composers concerned.

Fortunately this madness apparently only persists in this country. I have just returned from the Prague Spring Festival, where I found no objection to recordings being made Indeed, the *Czechoslovakian Song and Dance Ensemble* asked me if I would prefer to move to a better position to get maximum stereo effect. And that behind the Iron Curtain, where the restrictions are supposed to be. Perhaps we are erecting our own Iron Curtain.

Yours faithfully,

. . . about the MCPS Licence

From: B. W. Pratt, General Manager, Mechanical-Copyright Protection Society Ltd., Elgard House, 380 Streatham High Road, London, S.W.16.

DEAR SIR, I refer to Mr. C. W. Aitken's letter published in your July issue, in which he alleges that MCPS is making a "nice little cash rake-off" for grant of its licence to record music, without there being any value.

It has been made perfectly clear in press announcements, and in correspondence, that the Society's licence covers only the recording of music and we are in no position to deal with the right of other parties concerned, much as we would like to enjoin them in our scheme.

It must be taken into consideration that commercial gramophone records are not the only source of musical performance, and the licence is not restrictive in any way as to the source from which recording is made by the licensee.

Mr. Aitken is quite right about the *little* cash rake-off, but I wonder what knowledge he has of present-day values and labour costs when even the 10s. fee barely covers the work involved in granting such licence, and if he is still of the same opinion when we advise him that of this amount, 8s. 6d. is allocated to our members, the music copyright owners?

Do please let us be realistic about this. The MCPS can only act for music copyright owners and has no responsibility for the action of other interested parties. It has gone out of its way to introduce a licensing scheme at what is a very nominal and uneconomic fee, payment of which does no more than acknowledge the legal right of copyright owners. If Mr. Aitken requires a 'whipping boy' he should look elsewhere.

Yours faithfully,

THE RIGHT TO COPY CONTINUED

making no effort to circumvent.

My own efforts suggest to me that the present situation is as follows : there is no means whereby a record can be re-recorded on to tape, legally, and one might as well not try. A licence can be obtained, for a very reasonable annual fee, which allows the recording of certain musical works (a large number) of which commercially available recordings are already issued. Recordings so made may be used only for private purposes, and for certain activities in connexion with clubs, charities and competitions ; and they have to be erased when finished with. But let us be clear that the licence covers only *recording* of certain *musical works :* that is to say, you have to assemble your own performers, have them play the work, and record them yourself: you may not copy existing commercial records of any kind.

With regard to broadcasts, you are required to obtain prior sanction from the BBC and from everybody else involved who has any rights in the performance. Presumably that extends to composers, conductors, players, publishers and god knows who else ; and since one rarely knows that a broadcast is taking place before the weekly publication of *Radio Times*, there simply is no opportunity to write all those letters, having done all the research necessary to know to whom to write them. The legal recording of broadcasts, therefore, is out. (There are certain concessions for schools' broadcasts which need not concern us.)

It follows that, if I am right, the uses to which a recorder can be put without infringing some moral or legal principle are very few. There is no copyright in bird-song, so far as I know, or in the sound of trains, or in the sound of one's own voice or that of a consenting friend. One may tinker with electronic 'music' to one's heart's content and a clear conscience —neighbours apart. If one has musical friends, they may play, and you may record, any music the copyright in which has expired—*provided that* the original score only is used, and not an arrangement by any person who has not been dead for more than fifty years.

Now, we all know what goes on ; and it will continue to go on until such time, which heaven forfend, as snoopers from the Ministry of Love are allowed to enter our homes, seize our tapes and monitor them. By that time it will probably not be thought necessary to identify exactly what right we have infringed and prove it ; and tape-recorders may be banned anyway (think of the uses Winston Smith might have put one to). Meanwhile, and in happier days, infringements are extremely difficult to prove, and the tapes glide silently past the heads. As they do so, artists and their employers are wronged, simply because nobody seems able or willing to recognise the way things are, and *do something about it.*

Surely there is nobody who has the slightest respect for music and those who make it who would not be prepared to pay either a reasonable annual sum, or a once-for-all sum, in order to do what he knows to be right? The fact that one can get away with murder, I

(continued on page 334)

K. J. ENTERPRISES

BRITAIN'S PREMIER MAIL-ORDER RECORDING TAPE SPECIALISTS

IMMEDIATE 24 HOUR SERVICE ON ADVERTISED LINES

SEND TODAY AND SAVE!

● NEW AMAZING OFFER! ●

GRUNDIG TAPE 40% Off

Brand new, fully guaranteed, Premium Grade Magnetic Tape. Complete with the specially designed Grundig Plastic Tape Storage Cassette. Full leader and stop foil at both ends, and suitable for use with all makes of tape-recorder.

DON'T MISS THIS RARE OPPORTUNITY. SEND NOW!

TYPE	DESCRIPTION	LIST PRICE	ONE	THREE	SIX
GL18	1800' L/P 7" reel	50/-	29/6	86/-	165/-
GL15	1200' L/P 5¾" reel	35/-	21/-	60/-	114/-
GS9	900' S/P 5¾" reel	28/-	17/-	49/-	93/-

Post and Packing 1/6d. for single reels. OTHERWISE POST FREE!

ILFORD TAPE NEAR HALF-PRICE

A bulk purchase of premium grade, top quality P.V.C. 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/-	15/6	45/-	84/-
1800' on 7" reel.	List price 50/-	26/6	78/-	150/-

Please add 1/6 p. & p. for single reels. Otherwise POST FREE!

TRIPLE PLAY TAPE—HALF PRICE!

A large purchase from a famous world renowned manufacturer enables us to make this unique 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	22/-	12/-	35/-	66/-
600' on 3¾" reel	27/6	14/6	42/6	82/6
900' on 4" reel	39/-	20/6	60/-	117/-
1,800' on 5" reel	66/-	34/-	101/-	198/-
2,400' on 5¾" reel	90/-	46/-	137/-	270/-

Post and Packing 1/6. ORDERS OVER £3 POST FREE

SCOTCH MAGNETIC TAPE AT NEARLY HALF-PRICE!

Over 3,000 REELS of top quality MAGNETIC TAPE, double coated, **SCOTCH** made to the best possible specification and intended for the electronic industry. This type of tape is rarely, if ever, offered for domestic consumption and is unobtainable elsewhere

THIS UNREPEATABLE OFFER REMAINS OPEN ONLY WHILE STOCKS LAST! DON'T DELAY—SEND NOW!

SCOTCH (150 D/C) Polyester L/P, 900' on 7" reel. **ONLY 15/6** p. & p. 1/6 Three reels for **45/-** post free ; six reels for **84/-**, post free. Boxed, add **1/-** per reel. Can be supplied on 5¾" reels at special request.

Don't forget our other ACCESSORY BARGAINS!

Tape Head Demagnetizer, essential for any enthusiast! Ready for immediate use. Fully guaranteed. Worth 50/-..... .....**Only 27/6** P. & P. 1/6
Tape Splicer, fully auto., no razor blades. Worth 32/6.....**Only 16/6** P. & P. 1/6
Semi-Professional Bulk Eraser—operated by revolving spool around a spindle Takes up to 7" reels. Worth 7 gns.....**Only 79/6** P. & P. 4/6
Full Pro. Model taking 10" reels..... **Only 119/6** P. & P. 5/6
Eagle Pioneer S.E.1 Stereo Headphones.....**Only 105/-** P. & P. 2/6
Deram Stereo Transcription Cartridge.....**Only 75/-** Post free
Gevaert Tape 600' 5¾" reel (boxed).....10/6 (p.p. 1/6)
or 3 for **30/-** Post free
International Polyester Tape, 2,400' 7" reel (boxed).....**Only 25/-** P. & P. 1/6
Boxed 8¼" Zonal Reels.....3 for **15/-** Post free

SEND FOR LISTS OF OTHER TAPE AND HI-FI BARGAINS

K. J. ENTERPRISES. (Dept. TR), 7 MASONS AVENUE, WEALDSTONE, MIDDLESEX (OPPOSITE HARROW & WEALDSTONE STATION)

HARROW 0395 (CLOSED P.M. WED. & SAT.) **REFUND GUARANTEE**

SLEEP LEARNING AND THERAPY

TIME SWITCHES with large clear 24 hour dial, 3 ons and offs **£4 12 6**
PILLOWSPEAKERS, high intelligibility, only 4in. square, matched to speaker socket of all recorders **£3 3 0. ENDLESS TAPE CASSETTES :** 15 mins. cycle at 3¾ **£5 5 0;** 10 mins. cycle **£3 12 6;** 8mins. cycle **£2 17 6** (Double at 1⅞)
INFORMATION AND GUIDANCE TAPE (3gns.) covers whole field of Learning and Therapy with demonstrations how to make your own tapes.
INDUCTION TAPE No. 1 (3gns.). Vital necessity for use in learning any subject. **INDUCTION TAPE No. 2 (3gns.).** Equally vital where these revolutionary techniques are to be used for removing illnesses, disabilities, personality weakness, etc.

Send now for FREE LITERATURE and FULL LIST with details of the optimum Tape Recorder for the job to :

THE INSTITUTE OF SLEEP-LEARNING

16 KING'S COLLEGE ROAD, LONDON N.W.3. Primrose 3314

"Q"-CORD.

BATTERY PORTABLES. 3¾ ips.

'SPECIAL OFFER, UNREPEATABLE'

10 ONLY DEMONSTRATION MODELS

4 type 203 6 type R 119K

Only defects, Slight Cabinet Faults.
Slightly Soiled or Other Minor
Cabinet Defects
otherwise perfect
Complete with all Accessories

DELIVERED FREE ANYWHERE IN U.K.

£25.0.0.

New models type R119K **32gns.** 203 **34gns.**

Write for full details

C. BRADDOCK LTD.

266 Waterloo Road, Blackpool

Tel. 45049

LEDA recording tape

THE ULTIMATE IN TAPE VALUE! British made to full specification. Leaders, Trailers and Stop Foils on all types 5" and above. Strong, attractive hinge-lid boxes.

GUARANTEE. If you do not agree that the quality of this tape is as high as any you have ever bought (irrespective of price!) we will immediately refund your money and return postage costs.

Standard Play (P.V.C.)			Long Play (P.V.C.)			Double Play (Polyester)			Triple Play (Polyester)		
3"	150'	2/3	3"	225'	3/-	3"	300	4/3	3"	600'	8/9
4"	300'	3/9	4"	450'	5/-	4"	600'	8/3	4"	900'	12/6
5"	600'	8/3	5"	900'	9/9	5"	1200'	15/3	5"	1800'	22/6
5¾"	900'	10/-	5¾"	1200'	12/3	5¾"	1800'	19/3	5¾"	2400'	28/6
7"	1200'	12/3	7"	1800'	17/3	7"	2400'	21/9	7"	3600'	38/6

P. and P. 2/- per order. We also stock a wide range of accessories, all at lowest-ever prices. S.A.E. list.

LEDA TAPES (D), 30 Baker St., London, W.1

MAGNETIC SOUND RECORDING

5 THE RECORDING PROCESS

BY C. N. G. MATTHEWS

WE saw last month that the tape recording process is simple enough in theory. But when we begin to put it into practice we run into complications even before the signal reaches the tape.

All magnetic systems offer a certain amount of opposition to the magnetising force. Very roughly it corresponds to the resistance of an electrical circuit. But whereas resistance is by definition constant for any value of applied voltage, *reluctance* changes with the magnetising force.

This means that the magnetic field set up by an electro-magnet will not vary directly with the current through the coils. For our own particular application, this current is the audio frequency signal from the recording amplifier. If we allow the reluctance of the head to vary, equal relative changes in signal will not produce equal relative changes in magnetic field strength. So our signal will be distorted before it is transferred to the tape.

We minimise this effect by placing a high reluctance in series with the *magnetic* circuit, which tends to keep the reluctance constant in the same way as a high resistance in series with an *electrical* circuit tends to keep the resistance constant.

Think, for example, of a 100-ohm fixed resistor in series with a 1-ohm variable resistor. Suppose we apply 100V across the series combination. The resultant current will be within 1% of 1A, no matter how we twiddle the variable. But if the 1-ohm resistor were fixed and the 100-ohm variable we would be able to vary the current between 100A and less than 1A.

A high series reluctance in a magnetic system has much the same effect. In the recording head we introduce this high reluctance by leaving gaps in the magnetic material, giving the design shown in **fig. 1.**

Here the soft-iron laminated core is in two halves. The halves are separated by gaps into which shims of some non-magnetic material such as copper are placed. If a substance cannot be magnetised its reluctance must be very high, so we achieve our high series reluctance without difficulty.

Two gaps are used because we need a concentrated magnetic field to magnetise the tape effectively. We achieve this by drawing the tape past a very narrow gap. The other gap is made as wide as necessary to give the high series reluctance we need. Of course it must not be too wide. Otherwise the overall reluctance of the head would be so high that we would not be able to produce a useful magnetic field.

Another feature of the recording head is its *astatic* winding. The two coils are wound in such directions that the effect of a magnetising current passed through them in series is additive, but the currents induced by stray fields are in opposition and tend to cancel out. This helps to avoid hum pick-up and other undesirable effects.

Having overcome the effects of variable reluctance in the recording head, we are faced with the limitations of the tape itself. In **fig. 2** we see a graph showing, with some exaggeration, how the magnetism of a typical tape varies with the magnetising field. This curve is called the *low frequency tape transfer characteristic.* It applies only when about half a cycle or less of the audio signal occurs while a length of tape as long as the gap width is passing the gap.

The shape of the curve is logical when we remember that if a material is difficult to demagnetise it must be equally difficult to magnetise. Since there would be no point in using tapes that did not retain their magnetism, we have to accept this type of characteristic. Going back to the figure, we see that the magnetising effect of a weak field is negligible, but that it increases out of proportion as we increase the strength of the field.

So if we used a sine-wave to supply the magnetising current those portions of the waveform close to zero would produce no magnetism at all. The mid-portions would produce only a small amount, but the peaks would be recorded out of all proportion, giving us the effect shown in the figure.

Since all of our signals are mixtures of sine-waves of different amplitudes, all of the low-frequency content will be severely distorted. Some idea of the effect may be gained from **fig. 2.**

In early magnetic recording systems, a DC biasing current was passed through the coils. This kept the zero of the signal away from the 'unmagnetisable' section of the curve, as shown in **fig. 3.** As a result, the magnetism was unidirectional but varied in time with the applied signal. By choosing the bias current so that the working point was on a more or less linear part of the curve it was possible to obtain something like linear recording. Unfortunately, though, DC biasing of this nature introduced a considerable amount of background noise, which increases with frequency to such an extent that it was necessary to filter out everything above about 6 Kc/s. Thus the useful frequency response of these systems was only from about 50 c/s to 6 Kc/s, nowhere near good enough by modern standards.

When the tape is subjected to the magnetising influence of more than half a cycle of signal as it passes the recording head gap, its response becomes very complicated. As it recedes from the point of maximum field intensity within the gap, it is in effect subjected to a decreasing alternating field, which introduces a certain amount of demagnetisation. The extent of this self-demagnetisation depends upon the number of signal cycles which occur while the tape is in the gap. So it will increase with frequency and decrease with increasing tape speed.

Now the distortion of any sine-wave consists of harmonics at multiples of the signal fre-

(*continued overleaf*)

FIG. 1 A TAPE HEAD

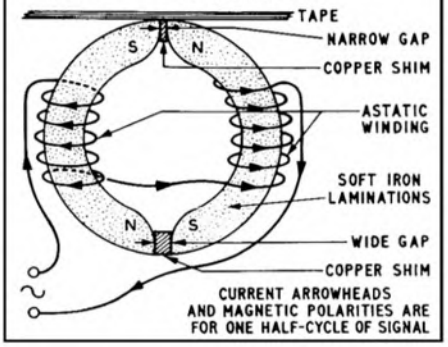


FIG. 2 LOW FREQUENCY TAPE TRANSFER CHARACTERISTICS

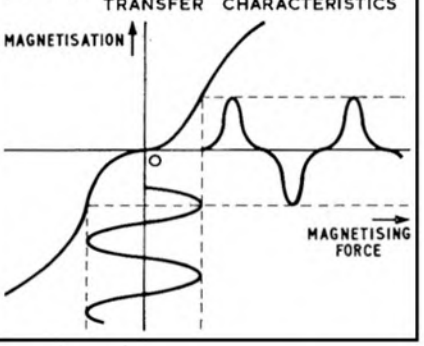
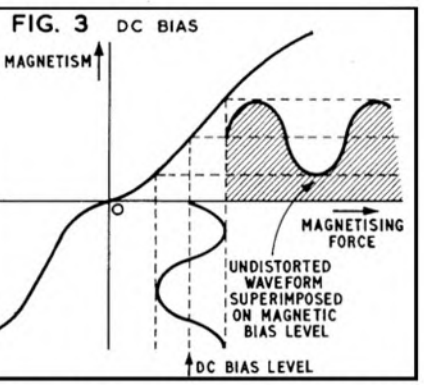
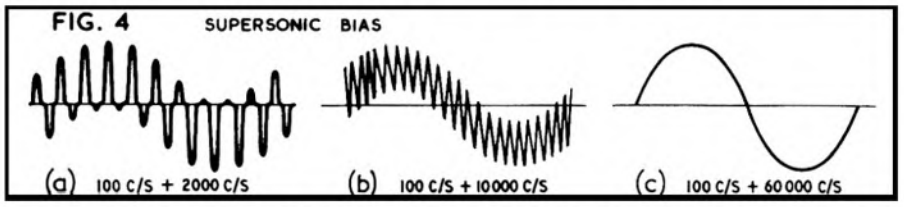


FIG. 3 DC BIAS



quency. As the demagnetisation increases with frequency it attenuates these far more than it attenuates the signal. At the same time, the effective permeability of the tape decreases with increasing frequency. Again, then, the distortion is attenuated more than the signal. The interaction of these and other factors is complex, but its result is that the response of tape to high signal frequencies is substantially linear.

Modern machines take advantage of the high frequency tape characteristic by using *supersonic* bias. **Fig. 4(a)** shows the recorded waveform produced when frequencies of 100 c/s and 2 Kc/s are superimposed in a record head. We can see that the result is a high-frequency recording whose average amplitude varies at the lower frequency. There is no low-frequency distortion because the magnetic field is alternating too rapidly for the low frequency transfer-characteristic to apply.



In **fig. 4(b)** the higher frequency has been increased to 10 Kc/s without changing its amplitude. Now we see the result of the attenuation of higher frequencies. The low-frequency signal amplitude is still the same, but the high-frequency component is much smaller.

Finally, in **fig. 4(c)**, the high frequency has been increased to 60 Kc/s—well outside audio range. Now it has been attenuated to such an extent that it is not recorded at all, but the low frequency is still present *and undistorted.* This is precisely the result we were seeking. Since the upper frequency is too high to record as individual cycles we are left with a recording of its *average* amplitude variations. So by using supersonic bias we can achieve satisfactory recording over the whole audio frequency range.

An important factor is the amplitude, or *level*, of the bias. If this is too low the recorded signal will be distorted, output will be low, and there will be a high proportion of background noise. If it is increased above an optimum level, signal output will fall off, distortion will increase and high-frequency response will deteriorate. By a very fortunate coincidence, the bias which gives maximum output is the bias which gives minimum distortion. At this level of bias, though, there is still too much background noise, but above it the noise falls off very rapidly while the decrease in output and increase in distortion are only slight. So normally we use a bias slightly higher than that which would give minimum distortion and maximum output. The improvement in signal-to-noise ratio is so marked that we can afford a slight falling off in output and a negligible increase in distortion.

All modern tape recorders incorporate an oscillator which performs the dual purpose of providing the supersonic bias and supplying the erase head. The tape passes over the latter which is fed with a high-amplitude supersonic signal, just before it reaches the recording head. So again we get the demagnetising effect of a decreasing alternating field. But now the field is so powerful that it wipes the tape clean of any previous recording or incidental magnetism. Part of the erase oscillator output is tapped off and used to bias the record head.

When the recorder is being used to reproduce a previous recording the oscillator is switched off. Otherwise the recording would be erased before it reached the reproduce head, which itself is generally the recording head switch to a different part of the circuit.

Most tape recorders have a 'trick switch', which removes the oscillation from the erase head while the machine is recording. This enables the operator to superimpose recordings. If he attempted to do this while the erase head was operating the original recording would be destroyed.

Now we have got our signal on to the tape. Next month we shall be taking it off.

submit, is no reason for committing it. As things are, recordists with a conscience have no means of escape ; and if the law were taken seriously there would be very few recorders purchased : we may fill the columns of *Tape Recorder* with articles on creative recording, but the truth is that the majority of machines are used for passive entertainment which is strictly illegal. The more time that elapses, the harder it becomes to do anything about it ; and either the present silly pretence should be given up or the means should be provided quickly for ending it. Broadcasting and licensing came, sensibly, together ; and it would not be difficult, I should have thought, to issue a special licence, with a higher fee, to those who wish for the right to record broadcasts, and thereby appreciate them more highly and hear many they otherwise could not hear.

I am in doubt whether it could ever be right to copy a commercial record and part with the copy, unless it were of some otherwise unobtainable material ; but there are occasions—I have in mind musical links between items used in tape programmes for charitable purposes—when a disc or tape could be copied without harm to anybody. What is needed is a realistic facing of the facts, and the willingness to accept some compensation in place of piracy. It would make most serious-minded people happier.

A beam of electrons scans the width of the plastic tape, which occupies the position of the phosphor coating on a display screen. The area of plastic bombarded is reduced to a momentarily molten state and distorted to a level dependent on the beam current. This current is, of course, modulated by the video signal from camera or television receiver. Each horizontal line is 'burned' across the tape width, the electron beam scanning at the 10 Kc/s line frequency. At the end of each scan, the beam skips to the start of the next line. In this way, a complete television frame may be stored on less than half an inch of tape, giving an overall speed of about 14 i/s.

If one allows for the fact that the Akai VX-1100 is twin-track, the two systems appear to have much in common. It is worth noting, however, that some 160,000 'bits' may be stored in a single 'thermo-plastically-recorded' frame, compared with the compromise 40,000 'bits' possible within the 1 Mc/s response of the VX-1100. We would add that the latter should prove perfectly adequate for domestic purposes. Thermo-plastic recording, when it comes, will cater for the purists, though not necessarily unduly-wealthy purists.

One drawback remains to be overcome before 'domestic' electron-beam recorders become feasible. A cathode ray tube, like most other valves, needs a high degree of internal vacuum. The electrons, as it were, need plenty of room to move.

Electrons do not actually pass through the glass surface of a television screen (though some little radio-activity is generated by the glowing phosphor). What material, then, can be used to retain the vacuum and, at the same time, conduct the electron beam on to the adjacent tape ? An ordinary steel or copper conducting plate would be unsuitable, since the charge created by the beam on any one spot would tend to disperse across the entire plate area. Present-day machines of this type incorporate a simple 'open-face' recording tube, relying on an elaborate vacuum-pump to retain the necessary evacuation. Few details are available of the experimental thermo-plastic machines currently in existence, though it is possible to envisage a head with a face gap corresponding, not to an entire frame area, but to a single line width. The resultant gap would be of similar dimensions to that of a full-track electromagnetic audio head, the necessary longitudinal scanning being supplied by the movement of the tape itself. This would certainly render vacuum-pumping less of a problem and may even simplify the search for an air-seal with the necessary conducting properties. Research is currently taking place in this field and, if successful, may have spectacular results.

Still further ahead in time is the prospect of solid-state television display screens—'transistorised' cathode-ray tubes. The problems here are immense, but the outcome might well be wall-mounting receivers offering the size, colour and definition of a 35mm. transparency projection. Some of us may even live to see solid-state recording heads!

Meanwhile, if the thought of spending £400 on a video recorder is frightening, remember its potential museum-piece value. In 2066, the Akai VX-1100, Telcan and the *Sony TCV-2010* may share a cabinet in the Science Museum, along with Poulsen's *Telegraphone*, as the first of their kind.

GRUNDIG STEREO RECORDER

SEPARATE ¼-track record and reproducing heads are featured on the *TK340* stereo tape recorder, lately announced by *Grundig*. Retailing at £152 5s., it operates at 7½, 3¾ and 1⅞ i/s, with respective wow and flutter figures of ±0.1%, 0.12% and 0.2%. Claimed signal-to-noise ratio at the two faster speeds is 52dB, 47dB being quoted for 1⅞ i/s. Input sensitivities are 2mV at 1.5M (microphone), 100mV at 1M (gram) and 22mV at 22K (diode). Output power is 8W per channel. Side-facing loudspeakers are incorporated in the cabinet and may be employed with the transistor output stages as a public address system. The TK340 is finished in charcoal and ivory, weighs 37lb., and has dimensions of 21 x 8¾ x 16in. An alternative model, the *TS340*, is available for an extra 4 gns. with walnut case and Perspex lid.

Manufacturer: Grundig (G.B.) Ltd., Newlands Park, Sydenham, London, S.E.26.

ADDITIONS TO RESLO RANGE

RESLOSOUND have introduced a transistor FM radio-microphone, to sell at £122 10s. The equipment comprises a battery-powered transmitter and receiver, operating between 30 and 175 Mc/s. Approved by the GPO, it is intended for high quality music and speech recording or relay in circumstances where trailing leads are inconvenient.

Also announced is the *CPD Pencil* dynamic microphone, available in various versions. Frequency response (to —2dB points) is from 70 c/s to 16 Kc/s, and sensitivity (30-50 ohms impedance) is 88dB below 1V/dyne/cm². Polar response is omni-directional, partially suppressed at the rear. The low-impedance *CPDL* retails at £15, while the medium and high impedance *CPDM* and *CPDH* are £16. A non-switched CPDL, is available at £14.

Manufacturer: Reslosound Ltd., 24 Upper Brook Street, London, W.1.

LEM DYNAMIC MICROPHONE

NOW being imported from France, the *LEM DH-80* dynamic microphone is suitable for table or stand mounting, and may also be hand-held or attached to a breast pocket. Available in high impedance (80K) and 200-ohm versions, price £8 7s. 6d., or 50 ohms at £6 10s., the unit has an omni-directional pick-up pattern and is supplied with 6ft. 6in. of light shielded cable. A 'speech/music' switch gives optional drop in level below 200 c/s, response at music setting being 70 c/s—14 Kc/s (low Z), 70 c/s—10 Kc/s (high Z), ±4dB. The microphone is 2¾in. long, of 1⅜in. diameter, and weighs 3½oz.

Distributor: Douglas A. Lyons and Associates Ltd., 32 Grenville Court, Dulwich, London, S.E.19.

PHILIPS QUADRUPLE-PLAY CASSETTE

OWNERS of *EL3300* and *3301* battery recorders are now offered greater freedom from the restricted playing time of the *C60* cassette. The new *C90* is being marketed at £1 7s. 6d. and permits 45 minutes recording per track at 1⅞ i/s, compared with the 30 minutes per track of the C60. The latter will continue to be available at 19s. 6d., but now features a re-styled Perspex tape housing.

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

DANSETTE BATTERY PORTABLES

INTERESTING development in the field of tape cassettes is the introduction, by *Dansette*, of a Japanese battery portable designed to take the *Philips C60*. The *JTR909* weighs 3lb. and sells for £27 6s. Operation is from four torch cells or optional mains adapter, a battery supply cut-out being incorporated on the microphone. Recording time is 60 minutes per cassette, on two tracks, monitoring facilities being provided by a 2½in. internal speaker. Maximum amplifier power is 400mW.

Automatic gain control and speeds of 3¾ and 1⅞ i/s are offered by the *JTR93*, employing conventional 3½in. spools. An original feature is the carrying handle, which forms part of the main cabinet and provides storage space for the pencil-microphone. Output power is 800mW maximum. The recorder costs £23 2s.

Distributor: Dansette Products Ltd., Dansette House, Honeypot Lane, Stanmore, Middlesex.

SONATEST DEMAGNETISER

RETAILING at £35, the *Emag 8* demagnetiser is capable of operating continuously for periods of up to one hour at 250V, 5A AC. The unit will demagnetise objects passed through the 8¾in. central aperture, versions of alternative aperture diameter being available to order. Overall dimensions are 16 x 12½ x 9in. and the weight is 26lb.

Manufacturer: Sonatest, Beacon House, 113 Kingsway, London, W.C.2.

the procedure is simple. Four 6 BA screws, two long, two short, the longer ones seating through distance pieces, hold the board to the metal chassis. A spring at the right side should not be overlooked, and great care taken with the harness of cables coming up from bottom left. Perhaps the principal fault is a noisy amplifier, which has a peculiar symptom of excessive crackling noises as the set is switched on, followed by a surge of noise which continues for a second or two after switching off. The trouble is usually a dry joint at the mounting of one of the group of capacitors, mounted upright beside the switch sliders. As any hard-pressed field engineer will attest, vertically-mounted capacitors are immediate sources of suspicion when intermittent 'movement' faults are observed. Touch these components lightly with an orange-stick or pencil, noting whether disturbance causes a crackle, and re-solder the mounting, not forgetting to run the solder lightly along the print and avoid spreading. The printed circuit boards used by Philips are pretty good, and there is seldom trouble with raised print, flexing fractures and so on, but with any mass produced article, the odd dry joint may get past inspection, and should be chased carefully.

More usual is the mechanical fault. The motor drives a flywheel from which fast winding and clutch action are derived via additional pulleys. A common trouble is wow and flutter caused by incorrect clutch pulley pressure. This pulley, which has a rather floppy rubber tyre, mounted on a stepped bush with a brass bearing piece below, is supported on a sprung lever. A series of holes in the lever allows some adjustment of the inward pressure, but a limit is placed by a tongue on a fixed bracket, with a plastic sleeve over the end, against which the aforesaid brass bushing rests in the Play position. Too much inward movement will impose excessive load on the flywheel, with resultant wow; too little prevents correct take-up. The method of adjustment should be to move the 'floppy' idler away by pressing the tongue which comes through the top of the chassis until take-up just fails, then allow a fractional inward movement and bend the fixed tongue to the correct limit position.

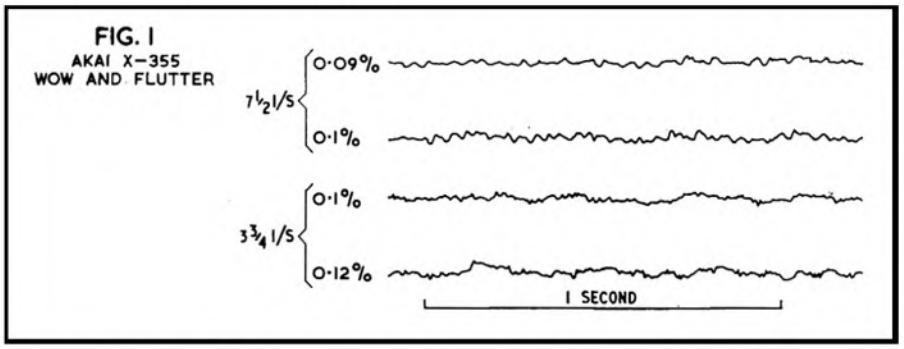
This takes less time to do than to describe—but should be mentioned, for the temptation will usually be to slacken off and reposition the spring end mounting of the take-up and fast wind levers. Getting this back into exact position can be a tricky job, and a check on the above setting should always come first.

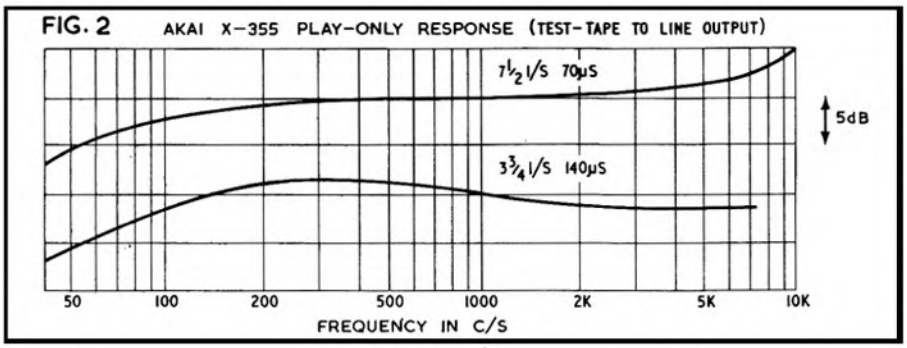
A further cause of excessive friction may be the light brake beneath the right-hand turntable, and indeed, can be caused by a dry bearing of the latter. Only a single drop of light oil is needed—more will aggravate matters, and the stand-off tongue which holds the brass spring on which the felt brake pad is mounted should be bent slightly if adjustment is needed.

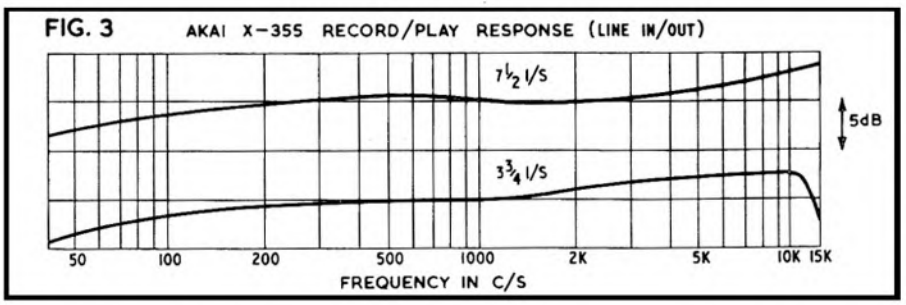
Removal of the turntable means taking off the limiting plate, which screws through the switch shown as SK6 on the diagram. Note that this switch must be in a position to be operated by the slide lever operated in turn by the push-button mechanism. There are small

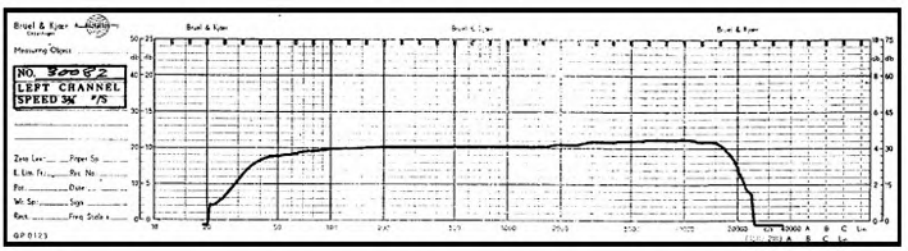
(continued on page 341)

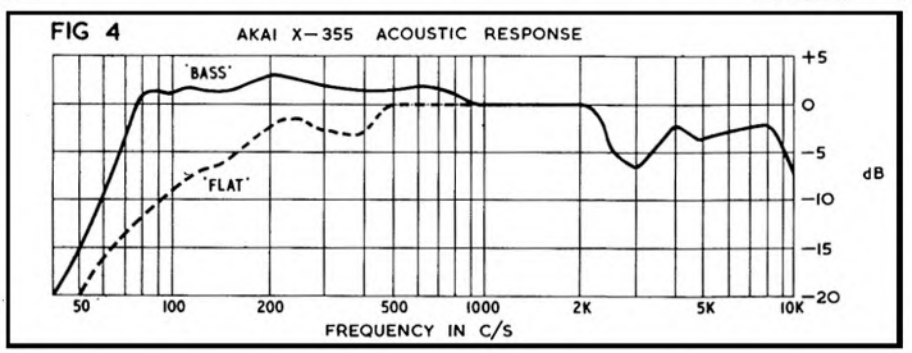
AKAI X-355 AUTOMATIC











MANUFACTURER'S SPECIFICATION. Quarter-track transistor stereo tape recorder with cross-field bias. **Tape Speeds:** 7½ and 3¾ i/s (switched-pole hysteresis synchronous motor). **Wow and flutter** (respective): 0.08% and 0.14% RMS. **Frequency Response** (respective): 30 c/s-24 Kc/s, 30 c/s—18 Kc/s, ±3dB **Equalisation:** NARTB. **Signal-to-Noise Ratio:** 47dB. **Distortion:** 4% (total harmonics), zero VU at 10W. **Sensitivity:** 0.5mV (microphone), 50mV (line). **Output Power:** 20W per channel. **Rewind Time:** 45 seconds per 1,200ft. **Weight:** 62lb. **Dimensions:** 18 x 16 x 12in. **Price:** £250 19s. **Distributor: Pullin Photographic Ltd., 11 Aintree Road, Perivale, Middlesex.**

IT is nearly two years since I reviewed the *Akai 345*, the forerunner of the present *X-355*. At over £250 the X-355 is the most expensive non-professional recorder ever reviewed in these columns.

If sheer weight is any guide, one gets slightly less for more money—the 355 is 3lb. lighter and £20 dearer—and technically my tests bear out this forecast. In a number of small ways the 355 is inferior to the older 345. I should perhaps remind my readers that in this price class we are entitled to look for *Rolls Royce* standards of tape recorder performance.

The basic deck design is similar to that of the 345, with a front panel 'face lift' and the substitution of an *M-8* type of cross-field head structure for the more orthodox head layout.

At this point we note that the facility of being able to move the ¼-track heads so that they scan the centre portions of ½-track recordings has been lost. A pity, because many of us have valuable ¼-track recordings which do not take kindly to ¼-track edge scanning.

The new panel layout is an improvement on the old one, with clear separation of the record and play controls and push buttons for connecting VU-meters and power amplifiers to either record amplifier or play amplifier outputs. They can also be used for track-to-track transfer or multiplay. Smaller rocker type push buttons give a choice of stereo or mono replay, 7½ or 3¾ i/s equalisation, bass lift for internal speakers or flat response for external speakers, internal speakers on or off. A stereo headphone jack is also provided on the front panel.

Long-term tape speeds were measured by strobe tape at the beginning and end of 7in. reels at both tape speeds and on normal and reverse tape transport, and proved to be within ±0.5% limits under all conditions.

Short-term speed fluctuations are shown by the high-speed pen recordings of **fig. 1.** 25 c/s flutter is clearly evident on the trace and could just be heard on a sustained pure tone at 7½ i/s. Integrated wow and flutter readings did not fall below 0.09% and rose occasionally to 0.1% when record and play flutters came into step.

At 3¾ i/s, a 12½ c/s motor flutter was quite audible on a pure tone, and this can be seen on the lower speed fluttergrams of **fig. 1** where the best and worst readings were 0.1% and 0.12% rms. Although they were within the specification limits, the speed fluctuations were

(continued overleaf)

at a frequency where a critical listener could pick them out on a sustained musical note or chord.

Wow and flutter readings of the 345 were 0.04%—0.05% at 7½ i/s and 0.06%—0.08% at 3¾ i/s.

Play-only responses were measured by playing test-tapes of 70μS and 140μS at 7½ i/s and 3¾ i/s and measuring the line output levels to give the responses of **fig. 2.** The playback equalisation would appear to be nearer the test-tape CCIR characteristics than the specified NARTB response.

Record/play responses from line input to line output were measured to give the curves of **fig. 3.** Individual *Bruel & Kjoer* automatic-pen charts were supplied for both channels at 3¾ i/s and one of them is reproduced with **fig. 3.** The dB scale to be used on these charts is not marked, but reference to **fig. 3** indicates that the outer 50dB scale should be used where each division represents 2dB. The right and left channel responses are matched within ±0.5dB.

System noise, with no tape passing the heads, was extremely low at 45dB below test-tape level. Bulk-erased tape gave a very slight hiss at 40dB below test-tape level, and tape erased and biased on the recorder with all gain controls at zero gave a reading of 37dB below test-tape level.

Test-tape level was recorded at a VU-meter reading of −6dB and waveform distortion was negligible at 12dB above test-tape level and only just visible (estimated 5%) at 14dB above test-tape level at line output. The specification seems rather pessimistic in asking for "total harmonic distortion within 4% at 0 VU (6dB above test-tape level) at 10W". Perhaps it is the 10W output that accounts for most of the 4% distortion! If so, the distortion at the specified 20W must be pretty considerable—or could it be that the watts are American music watts? With peak recording level 14dB above test-tape level and erased tape noise 37dB below test-tape level, the signal-to-noise ratio, unweighted, is 51dB. With so little hum, weighting the meter reading to correspond with the ear's response at low listening levels only improved the reading by a further 2dB.

One channel showed an intermittent increase of tape hiss by an estimated 4—5dB. Degaussing the heads always cleared the trouble, but on other occasions it disappeared without degaussing. As the playback head is not switched and is never fed with bias, it is difficult to see how it ever got magnetised (if this was in fact the cause of the hiss). I have come across a similar fault before on transistor amplifiers where a strong pulse or switching transient on the output of the amplifier gets all the way back through the amplifier to the head. Remember that a transistor, unlike a valve, can act as a conductor in the opposite direction. If the

ME101 WOW AND FLUTTER METER

MANUFACTURER'S SPECIFICATION Mains-powered wow and flutter meter. **Oscillator Frequency:** 3.15 Kc/s (1 x 10^{-3} constancy). **Output:** 0.4V and 20mV approx. **Input:** 30mV-30V, 3.15 Kc/s ±0.5% at 10K. **Measuring Ranges:** ±0.02—±0.5% and ±0.1—±2.5% (peak value indication according to CCIR and DIN). **Drift Indication:** ±4.5% maximum. **Output to oscilloscope or high-speed pen recorder:** 20V p-p at 22K. Test discs also available. **Dimensions:** 7 x 8 x 11¾in. **Weight:** 10lb. **Price:** £110. **Distributor: Lennard Developments Ltd., 7 Slades Hill, Enfield, Middlesex.**

ABOUT fifteen years ago Daniels and Axon published a BBC monograph on the subjective assessment of the effects of wow and flutter on various types of programme material. In a very elegant experiment, signals were recorded on a high-speed magnetic drum with an out-of-contact playback head vibrated by a moving-coil drive unit so that current in one direction moved it clockwise round the drum, and a reverse current moved it in the other direction, so that the incoming programme was frequency modulated to an extent dictated by the current, waveform and frequency of the 'wow and flutter' signal fed to the head drive system. A panel of listeners then provided data on the audibility and annoyance value of short-term speed disturbances on different types of signal.

Similar experiments were carried out in Germany, and the official DIN/CCIR weighting curve of **fig. 1** shows that the ear is most sensitive to speed fluctuations in the range 2-10 c/s. A very low frequency wow at 0.3 c/s (one cycle in 3 secs) due to an eccentric 33⅓ gramophone record, or a high frequency 50 c/s flutter from a 3,000 r.p.m. motor, would have to be four times (12dB) larger in amplitude to produce the same distress. It will be seen that the average capstan rotation frequency lies squarely in the ear's most sensitive range of 2-10 c/s, and this explains why tape recorders are so prone to wow and flutter troubles.

The second decision which has to be made in designing a wow and flutter meter is whether to measure *peak* frequency (or speed) variation or to measure the RMS or root-mean-square magnitude of the wow and flutter waveform. If all speed variations were sinusoidal in waveform, either method would be suitable, as a simple conversion factor changes one to the other. A glance at **fig. 2,** however, shows that the waveforms can be far from sinusoidal, so that a peak, or peak-to-peak, method of measurement is to be preferred.

The *ME101* wow and flutter meter contains its own 3,150 c/s oscillator. This is a two-transistor multivibrator chosen for its stability and because the frequency can be varied over a small range by altering the DC bias voltage on the two transistors. A switched DC change alters the frequency by precisely 2% for calibration of the drift meter, and a 50 c/s square-wave derived from the mains supply wobbles the frequency by plus and minus 0.3% for calibration of the wow and flutter meter. The fact that the oscillator waveform is square rather than sinusoidal does not matter, as the higher frequency harmonics are lost in the recording process and the reproduced waveform is nearly sinusoidal anyway.

The reproduced signal is fed to a three-stage limiter which takes care of signal amplitude variations of nearly 1,000 to 1, so that even the

transient pulse happened to occur with reverse polarity, the head could get another 'tick' which could cancel the first. On the other hand the hiss increase could have been due to intermittant changes in the extreme high-note response of one playback channel.

The overall electro-acoustic response was measured by playing a 7½ i/s white-noise test-tape and measuring the sound output of one of the internal speakers on 25 one-third octave noise bands with a calibrated microphone. The resultant responses with bass-lift in and out is shown by **fig. 4.** It will be seen that the response of the internal speakers is well maintained down to 80 c/s by the bass-lift circuit.

COMMENT

This is a good recorder by normal standards, but it is doubtful whether it is worth more than twice the price of any other contemporary self-contained stereo recorder, particularly when it is realised that microphones and other extras such as remote control unit, large reel adaptors and external speakers still have to be paid for.

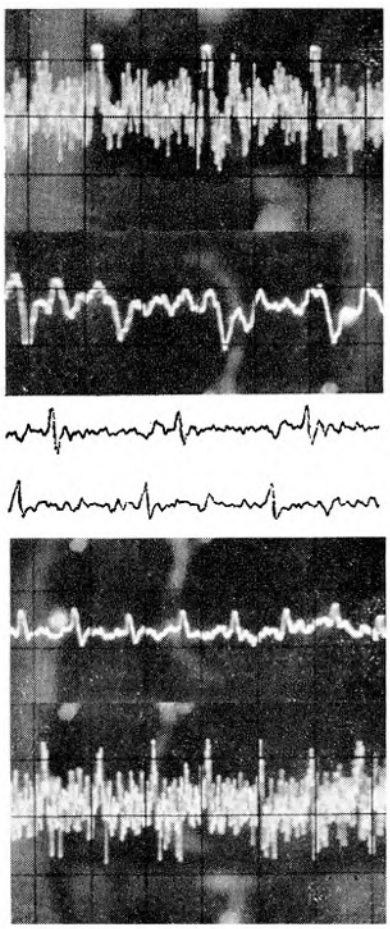
A lot of the cost must go towards the beautifully produced slide-in printed circuits and mountings, and more into the multiplicity of switches and relays which allow remote control, auto-reversing, auto-rewind, etc.

The circuit diagram shows that a transformer is used to couple the driver stage to the push-pull output transistors. With so much trouble taken to eliminate the output transformer, this

would seem to be a retrograde step, as a complementary pair of low powered transistors could replace this component and allow more negative feedback around the power amplifier to cut distortion down to a very low level. If the power amplifiers were to be used only to feed the internal speakers there could be no objection to the present circuit, but a recorder in this price range deserves better power amplifiers if it is to be used with equally expensive wide-range external speakers.

A. Tutchings.

FIG. 2



most vicious drop-out due to tape imperfections cannot cause faulty readings.

At this point the signal is again a square-wave of constant amplitude, with frequency modulation proportional to the speed variations of the equipment under test. It is now passed through a low-pass filter with a cut-off frequency just below 3 Kc/s so that all harmonics are eliminated, converting it once again to a pure sine-wave. As the 3150 c/s carrier frequency is well down the 30dB-per-octave slope of the low-pass filter, the output voltage is critically dependent on frequency, and full-wave rectification provides 2V DC which rises to 2.5V when the 2% drift calibration switch is operated. The oscillator frequency modulation gives approximately 0.1V p-p signal at the output of the rectifier, which is amplified and fed through an emitter-follower to provide a low impedance output of 3V p-p for ±0.3% frequency modulation. This signal is fed directly to the peak voltmeter circuit on the 'linear' setting of the weighting switch, and via a filter with the characteristic shown in **fig. 1** for 'weighted' readings. The meter is switched to give full-scale readings of ±0.5% and ±2.5% frequency (speed) deviation. A further amplifier provides a 20V p-p signal for feeding a CRO or high-speed pen recorder.

The 'linear' response to the CRO output sockets is shown by the dotted curve of **fig. 1** and is only 3dB down at 0.5 c/s and 500 c/s. The effect of letting this full bandwidth through to the CRO is shown by **fig. 2(a).** It will be seen that it is difficult to 'see the wood for the trees', or the bumps for the 'grass', due to high frequency flutter above 50 c/s. **Fig. 2(b)** shows the effect of switching in the weighting network to give the response of **fig. 1** to the meter and

(continued on page 341)

1st Class *PERFORMANCE SOUND QUALITY and STYLING . . .*

R.T.5 34 gns

A.M. RADIO TUNER 9 gns EXTRA

This is a tape recorder designed and made to fulfil all the essentials of a first class machine plus the advantages of a Consolette cabinet in Teak veneers with space to add a radio tuner. Record direct to tape, or use it as a radio with excellent sound quality reproduced through the tape amplifier and its high fidelity speaker.

From retailers everywhere or write to manufacturers for leaflet.

STEREOSOUND PRODUCTIONS LTD
CAPITAL WORKS BRIGHOUSE YORKS.
London & Southern Counties Distributors
HIGHGATE ACOUSTICS, Gt. PORTLAND ST., W.1. (Museum 2901)

TAPE RECORDER COVERS

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

Grundig TK.1	... ...	49/6
,, TK.5	... ...	55/-
,, TK.6	... ...	57/6
,, TK.8	... ...	63/-
,, TK.14 & 23 & 18		59/6
,, TK,14L, 17L, 23L, 18L	... ...	67/6
,, TK.20	... ...	52/6
,, TK.24	... ...	55/-
,, TK.25	... ...	55/-
,, TK.30	... ...	60/-
,, TK.35	... ...	63/-
,, TK.40 & 41	...	66/-
,, TK.46	... ...	82/-
,, TK.55	... ...	63/-*
,, TK.60	... ...	75/-*
,, TK.400	... ...	67/6
,, TK.830/3D	...	63/-
,, Cub	... ...	35/-*
Telefunken 85	... ...	65/-
,, 75/15 & 76K	...	55/-
,, 95	... ...	69/6
Philips 8108	... ...	57/6
,, 3548	... ...	79/6

Philips 3534	... ...	87/-
,, 3549	... ...	79/6
,, 3556	... ...	67/6
,, 3558	... ...	65/-
,, EL3542	... ...	63/-
,, EL3536	... ...	70/-
,, EL3515	... ...	57/6
,, EL3541/15	...	57/6
,, 3541/H	... ...	72/-
Cossor 1601	... ...	63/-
,, 1602	... ...	57/6
,, 1604	... ...	79/-
,, 1605	... ...	84/-
Stella ST454	... ...	57/6
,, ST455	... ...	63/-
,, ST458	... ...	79/-
,, ST459	... ...	84/-
Saba 2305	... ...	79/6
Tandberg 72, 72b, 74, 74b, 823, 843; Hard case	...	141/8
Soft case	...	112/6
Tandberg 62, 62b, 64, 64b, - 92 Hard case	...	141/8
Soft case	...	112/6
Brenell Mk. 5 + 5M	...	77/-
Truvox R92, 94 and 102	...	99/-
Robuk RK.3 + RK.4	...	67/6
Ferrograph	... ...	88/-
Sony 521	... ...	90/-
Revox F	... ...	84/-
Optacord 414 + 412 + 416		63/-

*Without pocket

A. BROWN & SONS LTD.
24-28 GEORGE STREET, HULL. TEL. : 25413, 25412

We are happy to announce that we can now supply

BRAND NEW BRITISH & GERMAN RECORDING TAPES

P.V.C. POLYESTER & MYLAR
(ALSO PRE-RECORDED FOREIGN LANGUAGES)

Both manufactured by world reputable British and German firms. Fitted with leaders and stop foils. Not rejects or sub-standard in any way—tapes are splice free and are boxed. Remember : full refund plus postage should goods not meet with your full approval. To date no refund has been requested.

Standard Play	*Length*	*English price*	*German price*
3″	150′	2/6	2/-
4″	300′	4/-	3/6
5″	600′	9/-	6/6
5¾″	900′	11/6	8/-
7″	1200′	16/-	10/-
Long Play			
3″	220′	3/-	2/6
4″	450′	6/-	5/-
5″	900′	11/6	9/-
5¾″	1200′	16/-	10/6
7″	1800′	23/-	14/-
Double Play			
3″	400′	6/-	4/-
4″	600′	8/6	7/-
5″	1200′	21/-	13/-
5¾″	1800′	24/-	17/-
7″	2400′	39/-	22/-

LEARN FOREIGN LANGUAGES the easy way from BRAND NEW PRE-RECORDED TAPES in GERMAN, FRENCH, SPANISH and ITALIAN. 26 step-by-step easy lessons on each tape recorded at 3¾ i.p.s. supplied complete with Handbook. Retail 59/6 each. OUR PRICE **19/6** each.

Postage and packing 1/- per spool, 4 or more post free.
EMPTY SPOOLS : 3″ 9d. 5″ 2/-. 5¾″ 2/3. 7″ 2/6.

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

NAGRA'S FOR HIRE

Livingston Laboratories are now able to offer the famous NAGRA portable tape recorder, type NTPH for hire. Recognised by broadcasting authorities, film and recording studios throughout the world, the NAGRA is noted for its quality reproduction and rugged dependability. For full information call or write:

Instrument Hire Division,
Livingston Laboratories Ltd.,
Livingston House,
Greycaines Road,
N. Watford,
Herts.

Tel: WATFORD 44344

CRO. The 'grass' has been cut down, and the bumps are clearly visible.

Fig. 2(c) is provided by a 'linear' feed to my high-speed pen recorder, which has a response 3dB down at 100 c/s. (d) and (e) are the 'weighted' and 'linear' CRO traces at a higher tape speed.

The 'chopped' peaks on (a) are due to the energy absorbed by the charging of the peak voltmeter reservoir capacitor, which has to hold the meter reading steady until the next peak comes along. This was proved by disconnecting the peak meter feed, when the amplitude of the peaks increased by another full graticule division. The rather 'peaky' waveform was chosen deliberately to underline this effect, which is negligible on a smoother waveform where the capacitor is 'topped up' more frequently.

COMMENT

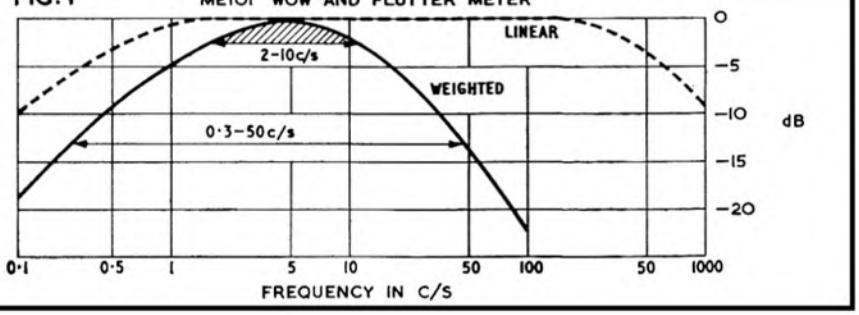
This is a well designed and nicely styled piece of test equipment which should prove invaluable to anyone engaged in the design or production testing of tape recording equipment. I found it particularly convenient to have the oscillator, filters, meters and switches in one small compact package—my own wow and flutter measuring equipment is made up of a number of separate laboratory units. For recorders with a standard DIN input/output socket, a set of readings can be completed in a very few minutes.

Analysis of the various components of the wow and flutter waveform requires at least a long-persistence screen, and preferably a means of photographing the CRO to obtain a permanent record, as the eye can expect little useful information from the jiggling spot on an ordinary CRO.

Close correlation between one type of wow and flutter meter and another is hardly to be expected, as so much depends on the bandwidth and method of measuring the waveform. The *Gaumont-Kalee* flutter meter measures short-term speed fluctuations in two bands: 0-20 c/s and 20-200 c/s, nominally called 'wow' and 'flutter' bands for its original purpose of measuring sound film transport imperfections. The lower range corresponds most nearly to the weighted response of the ME 101 and, if the speed variations are of a sinusoidal character, it should be possible to convert the peak ME 101 reading to the Kalee RMS readings by multiplying by 0.7.

The unfiltered CRO outlets on the two test equipments have bandwidths of 200 c/s for the Kalee and 500 c/s for the ME 101, so that the CRO displays will look markedly different and the converted 'linear' and 'total' meter readings on the two test units will not agree if any appreciable high frequency flutter is present in the machine under test. **A. Tutchings.**

FIG. 1 ME101 WOW AND FLUTTER METER



plastic lugs which locate in holes or depressi ons of the main deck and re-assembly needs so me care. If SK6 does not close properly, intermittent drive will result.

A further cause of flutter—harsh reproduction—is an excessive pressure pad inward springing. The pads are both pivoted with a hold-on spring and adjustment is again by bending a lug—this time the one to which the fixed end of the spring is attached. Holding the pads off slightly with the tip of a pencil will prove the fault. Always look out for hardened pressure pads, which can be relaxed by a dab of ethyl alcohol or methylated spirit. In addition, always observe the golden rule—keep head channels spotlessly clean. Avoid dust, fluff, loose hairs and what the polite gentry call 'foreign matter'.

If small black specks are observed at the right of the head channel assembly, look to the rubber tyre of the right-hand turntable. This, regrettably, is subject to wear from the hard plastic (or in earlier models, metal) pulley used for fast winding. Unfortunately, it is not possible to renew the tyre, and replacement of the complete turntable is called for. However, the cost is not excessive.

Pinch wheel pressure and the belt-driven idler system used for fast rewind have both been dealt with in earlier articles on the deck mechanism, and there is not space to go into great detail. It may be worth mentioning that these machines are rather fussy as to tape thickness, and using anything thinner than DP tape may cause drive troubles. On any battery-driven machine, drive pressures are fairly exacting, and liberties should not be taken by readjusting for thinner tape where the drive system appears reluctant.

When re-assembling these machines, care must be taken with the slotting of the edge controls in the apertures of the cabinet, and especially with the location of the meter. It is very easy to damage the latter by wrong seating followed by the clamping action as the bolts are tightened. Where particular difficulty is encountered, a small piece of *Sellotape* temporarily over the face of the meter as it is juggled into the correct seating in its slot can help.

CLASSIFIED ADVERTISEMENTS

Advertisements for this section must be pre-paid. The rate is 6d. per word (private), minimum 7s. 6d., Box Nos. 1s. 6d. extra. Trade rates 9d. per word, minimum 12s., Box Nos. 2s. extra. Copy and remittance for advertisements in **OCTOBER 1966** issue must reach these offices by **19th AUGUST** addressed to: The Advertisement Manager, Tape Recorder, Link House, Dingwall Avenue, Croydon, Surrey.
Replies to Box Nos. should be addressed to the Advertisement Manager, Tape Recorder, Link House, Dingwall Avenue, Croydon, Surrey, and the Box No. quoted on the outside of the envelope. The district after Box No. indicates its locality.

SITUATIONS VACANT

Tape Recorder salesman required by busy City Specialists. Trainee considered; enthusiasm main asset. Equiv. 5-day week approx., alternate Sats. Opportunity to join an organisation of repute. Please write in the first instance to Mr. Atkins, Wallace Heaton (City Sale) Limited, 93 Fleet Street, London, E.C.4.

A vacancy occurs at the Tape Recorder Centre of High Holborn for a first class experienced salesman. Wonderful opportunity and excellent prospects for right man to work for Britain's largest Tape Recorder Specialists. Good salary and pleasant working conditions. Apply Mr. Allerhand, Magnatape House, 191 Plashet Road, London, E.13, or ring GRAngewood 2185/2110 for appointment.

FOR SALE—PRIVATE

Telefunken Microport F.M. Radio Mike. Excluding microphone. In original carton. £20. 4 Faversham Court, Faversham Road, Catford, London, S.E.6.

Tandberg Tape Recorder Model 3B. Bought for 76 gns. (including case) in Nov. 1962. In mint condition because not used and carefully stored for 3½ years while owner overseas. £48, or would consider exchange for good battery/mains recorder. Brownleaves, Great Somerford, Wilts. Tel. Seagry 418.

Brenell Mk. V deck and amplifier, in case. As new. No reasonable offer refused. Box No. 395 (Leicester).

Uher light portable recorder, as used by BBC. Leather case, choice ribbon or standard mic. Acknowledged to be finest professional portable available. Serious illness compels sale; this unused equipment purchased Dec. Reasonable offers to Dr. Morey, 1 The Grove, Lincoln.

"Tape Recorder" vol. 7, 14/6. Lustraphone Lavalier Microphone, perfect, £6. New AC/DC Multimeter, cost £5.7.6, 75/-. Mono/Stereo Mixer, 4-channel, powered from Ferrograph, £5. Ferrograph Add on Deck 35/-. Box No. 398 (Liverpool).

FOR SALE—TRADE

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

A unique tape buy! Top brand 7in. 2,400ft. 25/-, 5¾in. 1,200ft. 15/-; p/p 1 at 2/-, 2 at 2/9, 3-6 at 3/6. Bargains in all sizes. S.a.e. for list. E. C. Kingsley & Co. Ltd., 93 Tottenham Court Road, London, W.1. EUSton 6500.

Your sole U.K. agent for "Saja" spares and service. We carry many spares for the M40/M5 Export and M50. C. Braddock Ltd., 266 Waterloo Road, Blackpool. Tel. 45049, 24 hours answering service.

For sale—well established l/u shop on South Coast—Hi-Fi, Tape Recorders, Record Players and Records, Instruments, etc. Price £4,000 s.a.v. Apply Box 397 (Sussex).

Announcement: Lee Electronics, 400 Edgware Road, W.2, will be closed for annual holidays from 15th August to 5th September, inclusive.

Grundig TK6 portable battery/mains recorder. Display model complete with maker's guarantee, etc. List price £75; one only reduced to £54. Lancs Hi-Fi Ltd., 8 Deansgate, Manchester 3.

Vortexion CBL/6 complete with Grampian DP4/L microphone and stand. Practically unused, 3 speeds. List over £180; for £125. Camera Hayes, Brooklands Road, Bletchley. Phone Bletchley 2284.

You will be glad to have contacted Audio Supply Association before your next purchase of quality equipment. 65-page illustrated catalogue 4/6. Unbiased advisory service, preferential terms. High quality records manufactured from suitable tapes. Bulk prices on pressings (choirs). 10 Clifford Street, W.1. REG 2745.

WANTED

4-track stereo tapes. Enthusiast will buy few or large number. Varied tastes. Box 396 (London).

WANTED *continued*

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

Highest cash prices offered for good quality Tape Recorders and Hi-Fi. See our ad. page 326 this issue. R.E.W., 266 Upper Tooting Road, London, S.W.17.

Wanted: Non-exclusive copyright of recordings of the following birds: Long-Tailed Tit, Tree Creeper, and Redstart. Box No. 399 (Worcs).

MISCELLANEOUS

Tape Recorder Repairs. We specialise in the servicing of Recorders, including professional machines. Telesonic Ltd., 92 Tottenham Court Road, London, W.1. MUS 8177.

Collector of old gramophone records in excellent condition wishes to contact a Tape Recording Society or Record Group who would be interesting in storing several hundred records for an indefinite period at a moderate charge. Suitable offers from individuals would be accepted. Box No. 500 (Kent).

STUDIO FACILITIES

John Hassell Recordings. Tape to Disc. Latest high level micro-groove cutting system. Competitive prices. Studio and Mobile Services, 21 Nassau Road, London, S.W.13. RIVerside 7150.

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

7in. 45 from 18/-, 10in. LP 42/-, 12in. LP 48/-. 3-day postal return service. High level disc cutters, Limiters, Equalisors, variable pitch, etc. Professional work at provincial rates. 40ft. Studio. Trade terms available. S.a.e. leaflet to: Deroy, 52 Hest Bank Lane, Lancaster. H.B. 2444.

J & B Recordings. Microgroove tape to disc, mastering service, pressings, mobile studio. 14 Willows Avenue, Morden, Surrey. MITcham 9952.

PERSONAL

Get 1966 AUDIO ANNUAL. Top features include: What matters in amplifiers; Comparing and measuring tape recorder performance; Judging audio quality; Creative taping as a hobby; An approach to tape recorder servicing; Whither stereo?; Tape prospects and problems; the hi-fi revolution. Plus a selection of the more important equipment reviews that appeared in HI-FI NEWS and TAPE RECORDER during 1965. 5/- from newsagents or 6/- (pp) from Link House, Dingwall Avenue, Croydon, Surrey.

ADVERTISERS' INDEX

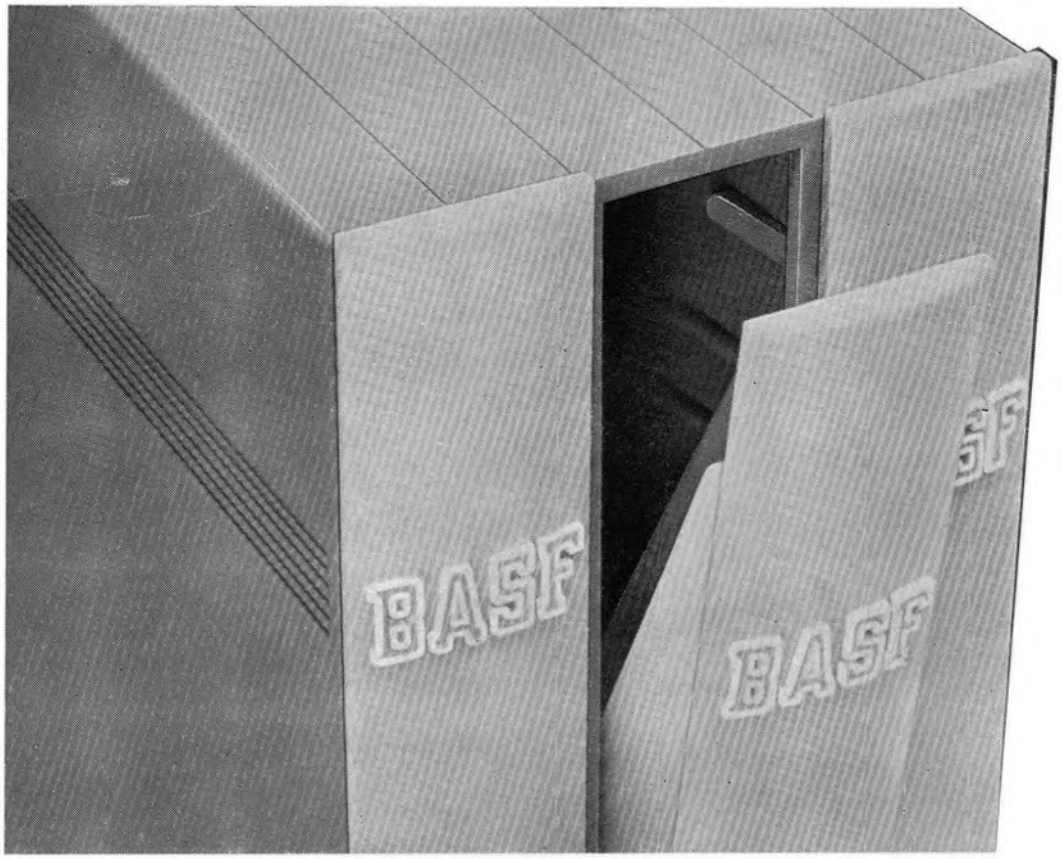
buzz along to the Do it yourself Exhibition Olympia 9-24 Sept

New do-it-yourself ideas are flowering throughout Olympia. Come and hover with the family. See how do-it-yourself can save you money. Talk to the experts from Do it yourself magazine, watch fascinating DIY demonstrations, learn about the latest equipment and materials. Examine native craftwork from many countries. Enjoy yourself.

Olympia

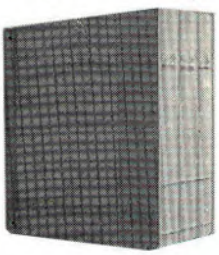
Empire Hall, 10 am to 9.30 pm
Admission: Adults 3/6. Children 1/9

14th International Handicrafts and Do it yourself Exhibition
Sponsored by Do it yourself magazine



The only catch about this new better-looking, longer-lasting library box from BASF is deliberate.

(It goes click)



Inside the hard wearing Polystyrol case of the new BASF library box is a hard wearing Polystyrol catch.
Its sole function is to ensure that when the easy-swivel cassettes click tight, they stay tight. So your tapes stay in. And the dust stays out.
The new BASF library box is better-looking, harder wearing — and costs no more. It's solidly built to give your valuable tapes greater protection, longer playing life than ever before. The new library box is available with either Long Play or Double Play tape in 5", 5¾" and 7" spools. See it at your dealer's now. And for a ready reference to your collection ask him for the BASF Library Index, FREE.

BASF —THE SYMBOL OF AUTHENTIC SOUND

BASF CHEMICALS LIMITED · 5a Gillespie Road, London, N.5 · Tel : CANonbury 2011

BASF 1865 1965