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APRIL 1964 Vol. 6 No. 3 PRICE 2/-


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- TAPE RECORDER SERVICE - No. 28 - TELEFUNKEN STEREO 77

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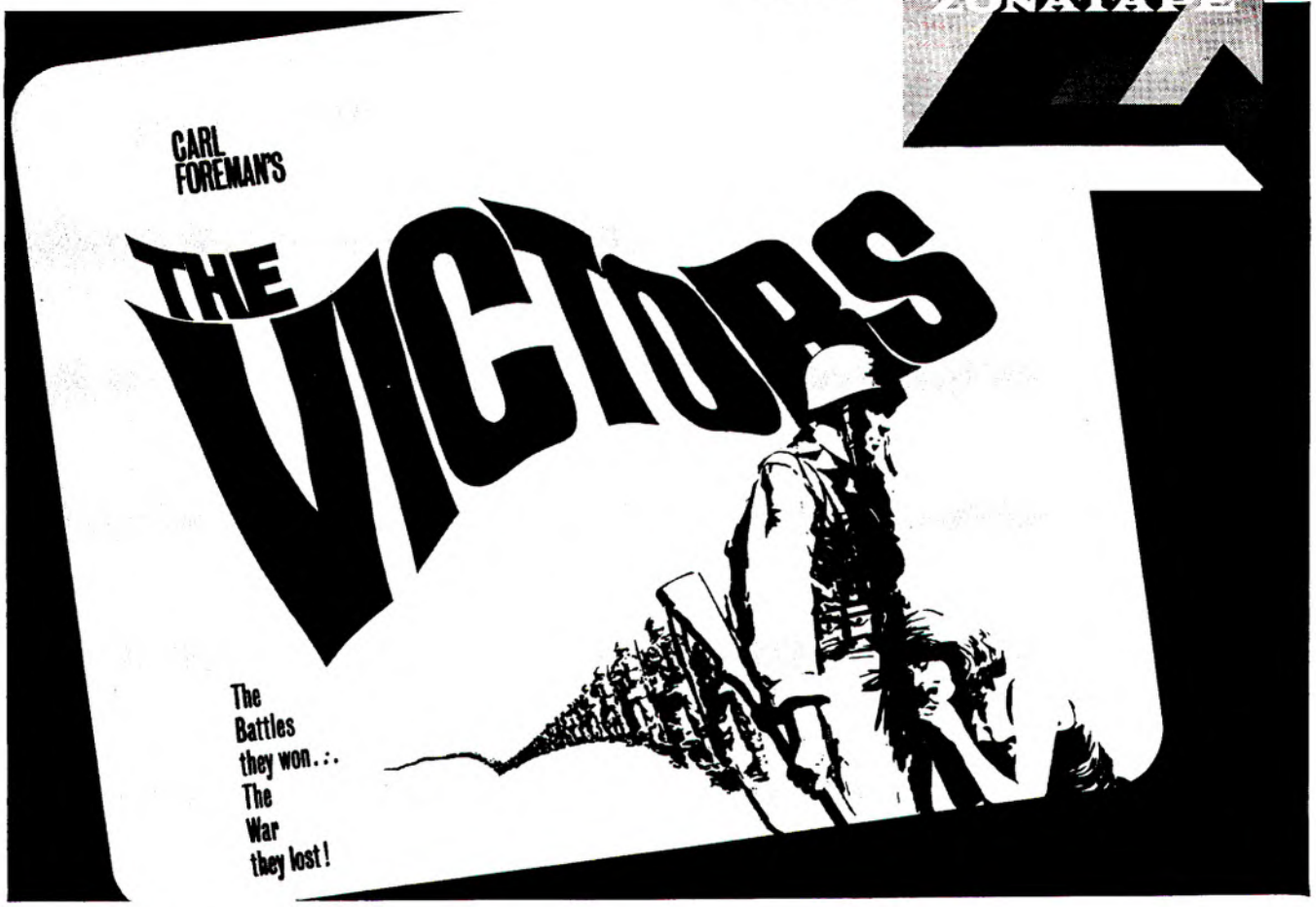


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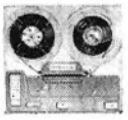
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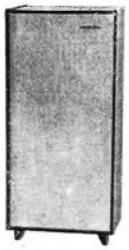
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| Impedance: | 200 ohms nominal |
| Price: | £3.13.6. |

These microphones are available from your retailer or Standard Telephones and Cables Limited, Electro-Mechanical Division, West Road, Harlow, Essex. Telephone Harlow 21341. Telex 81184.

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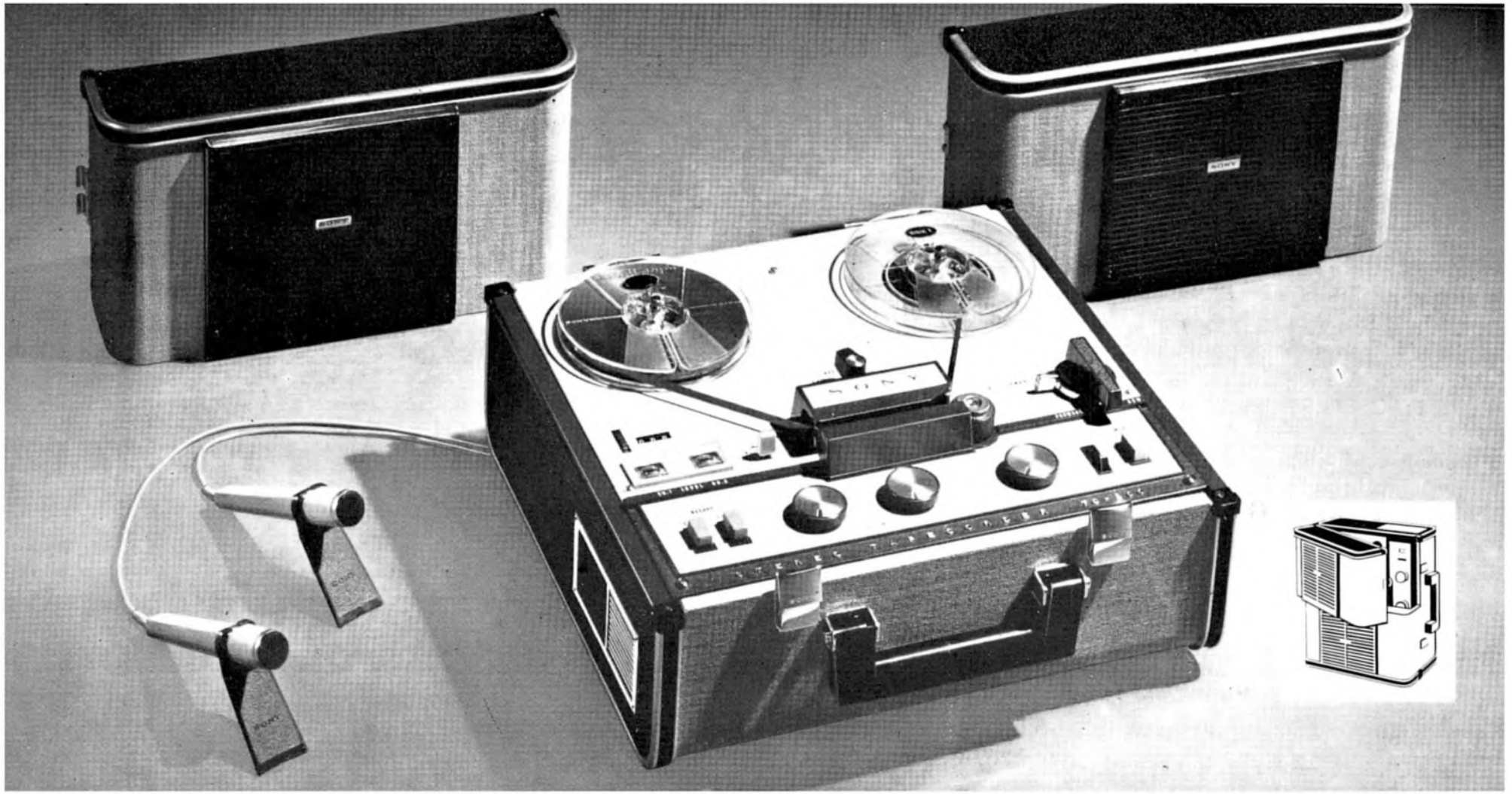

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Ask your dealer to demonstrate the UHER 4000 REPORT-S. If you do not see this amazing Portable tape recorder displayed in your area, write for illustrated leaflet and further information to:

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**205 Gt. Portland Street, London W.1 Tel: LANgham 1809**

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# TAPE RECORDER

APRIL - - - - - - - - - - 1964
VOL. 6 - - - - - - - - - - - - - - NO. 3

*Editor* - - - - - - - - - - - - - - - MILES HENSLOW
*Editorial Offices* - - - - 99 Mortimer Street, London, W.1
*Telephone* - - - - - - - - - - - - - MUSeum 3967 to 3969

## Contents



## EDITORIAL

A SENTENCE tacked on to the end of a news item in our "World of Tape" demands more attention from us than its authors so modestly claim. It notes that a television camera for amateurs is on its way, so that pictures may be recorded on tape in addition to sound. Such a casual announcement is really rather breath-taking, even though we have been hoping and waiting for it for quite a while! Think of it this way: anyone over twenty-eight years of age is older than high definition television; the first domestic tape recorder appeared on the British markets just about seventeen years ago; less than seven years back technical pundits were shaking their heads at the thought of using professionally designed tape equipment for recording television pictures. And now, without any great ballyhoo or fuss, and for approximately fifty pounds sterling, we will soon be able to buy a TV camera as an add-on attachment to the home tape recorder. There are some provisos, needless to say, and the main one is that the recorder must be capable of running at a speed of about 120 to 180 inches per second. In fact it must be a machine designed to work with the camera, and also tailor-made to work hand-in-hand with a television set. Nevertheless it is great progress, and we congratulate the *Telcan* experimenters for for what they have achieved, and even more for their adventurous thinking and action. It cannot be long now, before others begin to hop on to the band waggon as it begins to roll along the new trail that *Telcan* have opened up.

This, mark you, is only the very beginning. It is easy to talk and to speculate, and even to be a theoretical armchair inventor, but in this field we are dealing with facts and probabilities—not unknown quantities and wishful thinking. Any electric message can be recorded electromagnetically on tape or on some similar medium. Once recorded it can be stored almost indefinitely and called upon at any time to repeat itself or to trigger off other machinery. At the moment we are unable to store as much as we would like on tape because we still have to learn a lot about the material itself and the electronic devices for handling it. And it is more than likely that the new *Mullard* tape heads (see page 123 of this number) may be a significant breakthrough in this direction. We may learn that the material we now use is inadequate, and we may have to find a substitute. So many people are working on so many problems in so many corners of the world that no one can really say at any moment just how much potential progress has been made. There must be more behind the design of the recently described *Revere* tape player than is immediately apparent. Good quality music from tape playing at a speed of less than two inches per second means progress. *Ampex* wanted a tape speed of about 2,000 inches per second for their Videotape machine. They achieved it by using a double motion, and by means of this device the tape has only to move at 15 i s. Other tricks, dodges, devices and bright ideas are being thought out and adapted every week. We only hear of some of them and others may only become news when, fitted into place with some other discovery, they make yet a further idea practicable. And so we come back to the point at which *Telcan* entered the picture.

Instead of seven-inch spools and a tape speed of 180 inches per second, imagine two-inch spools and a basic tape speed of one or two inches per second. Then think of finely miniaturized electronics and very small batteries, and a streamlined metal case measuring about 6″ x 3″ x 1½″. There will be a lens at one end—a zoom of course—and two or three small controls in the form of buttons, rings or levers. That will be the home cine camera of the future—and the not-too-far-distant future at that. It will record colour pictures and sound, and both will be ready for immediate replay through the home television set—which incidentally, will also be a less ugly brute than it is today! There is no fantasy in this at all. It will all come about as surely as the sun continues to rise and set over a world populated by sensible people. All the bits and pieces of the picture exist. Some of them are still very crude and need much refining, and others will probably need a bright stroke of luck or genius, or both, before they are adaptable— but all the pieces will eventually fit (plus a few more that we have overlooked!) and it is only a question of time before such domestic apparatus becomes available.

**SUBSCRIPTION RATES**

The Subscription rate to *The Tape Recorder* is 30s. per annum (within the British Isles) and 32s. 6d. per annum overseas (U.S.A. $4.50). This includes a free copy of the annual index. The same rates apply to *Hi-Fi News*.

*The Tape Recorder*, 99 Mortimer Street, London, W.1

## COVER PICTURE

SOME tape decks are more convenient than others for editing tape, although there are plenty of tricks for getting amazing accuracy from even the most awkward of them. The *Tandberg* shown on our cover is "a piece of cake" for editing, for once the front cover plate is removed there is direct access to the tape heads and it is easy to make a mark, smack over the gap, with a *Chinagraph* pencil—as this enthusiast is doing. After that, cutting and jointing is a matter of seconds.

# *let the experts guide your selection*

Top sound-studios everywhere use TELEFUNKEN recording equipment exclusively. Reason why? TELEFUNKEN made the world's first tape recorder, and with that head start they've been way ahead in research and development for years. TELEFUNKEN's wide range gives you a superb choice of equipment that integrates perfectly with your set-up, yet sounds great on its own. Whatever model you buy you'll know you bought the best . . . TELEFUNKEN, the machine the professionals use at home! TELEFUNKEN has sound quality taped.

**Magnetophon Stereo 97 and 98** Stereo from TELEFUNKEN! These recorders were news when first released and live up to their great promises. The 97 and 98 are the same price, but the 97 is a quarter-track recorder. Both have a high signal to noise ratio, wide frequency range and three speeds. **95 gns**

**Magnetophon 85 De-luxe.** Two-speed half-track with excellent frequency response: New-styled case and plenty of exciting new features and refinements including built-in splicing groove, remote control connection, new-style magic-eye recording level indicator. **83 gns**

**Magnetophon 96** Quarter-track perfected! Wide frequency range, three speeds. Full inter-track transcription offering ideal effects for cine-enthusiasts. No limit to trick effects that can be achieved with this machine. Can be used for stereo playback utilising stereo amplifier or radio. **62 gns**


## AND NOW... A BATTERY PORTABLE TELEFUNKEN, THE BRAND NEW MAGNETOPHON 300...

The new 300 on show for the first time in this country. It operates in any position powered by five 1.5 volt batteries (or a rechargeable battery can be supplied if preferred), and uses 5" spools at 3¾ ips. There is a pause button and combined recording level/playback volume control built into the handle. The machine is *completely* push-button operated and introduces high-quality Telefunken electronics into the fully-portable field. Including TD7 microphone, **59 gns**

**MAGNETOPHON 55** A recent addition to the famous family bringing high quality tape-recording into a lower-priced field. Elegantly styled, the smart wooden case ensures good sound reproduction. Two-speed half-track performance gives amazing frequency range for a machine in this class. **43 gns** including TD7 microphone. ⟶

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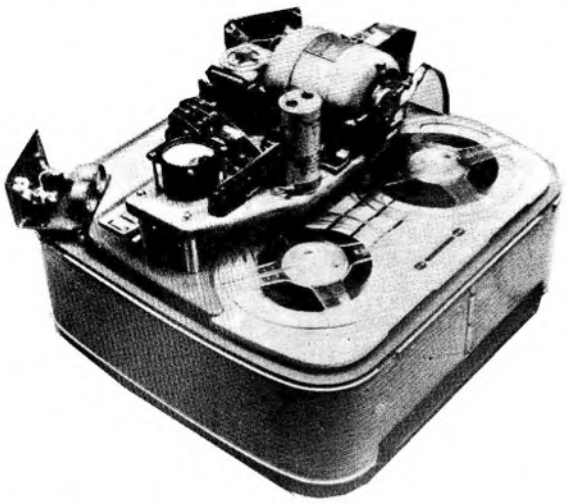
# WORLD OF TAPE

### 'Emichimes' in Piccadilly

THE well-known chimes of the Guinness Clock in London's Piccadilly Circus come, not from an arrangement of bells and



clockwork, but from a combination of Long Play Emitape and a player unit manufactured by Associated Fire Alarms Ltd.

The clock chimes every fifteen minutes and consequently the tape is subjected to over 35,000 operations in the course of a year.

* * *

### Gevaert and Agfa Merge

GEVAERT Photo-Producten N.V. and Agfa A.G. have just announced that, after several months of negotiation, they are to combine into a single unit. The formation of this unit will include the entire technical, industrial, and commercial activities of both groups, but since formal mergers are not yet legally possible, the economic unit will be realised through the take-over of all activities by a new Belgian and a new German company. Gevaert and Agfa will each hold 50% of the shares of both operating companies, and the managing boards will consist of the same directors in both companies, in equal proportions. These companies will start their activity on July 1st.

The branded products of Gevaert and Agfa, however, will remain on the market for the time being.

* * *

### Play that Landing Again!

A CONTRACT was recently awarded to the Ampex Corporation, by the United States Navy, for a closed-circuit television system to assist pilots landing on aircraft carriers.

Known as *Pilot Landing Aid Television* (*PLAT*), the system was adopted by the Navy in 1962 and is now operating aboard 14 carriers. The new contract is for the equipping of 11 additional ships and four training stations.

The *PLAT* system comprises a Videotape recorder, several cameras, and associated equipment, and provides the carrier personnel with greatly improved facilities for guiding in-coming aircraft. It can also be used to give pilots an immediate video replay of each landing.

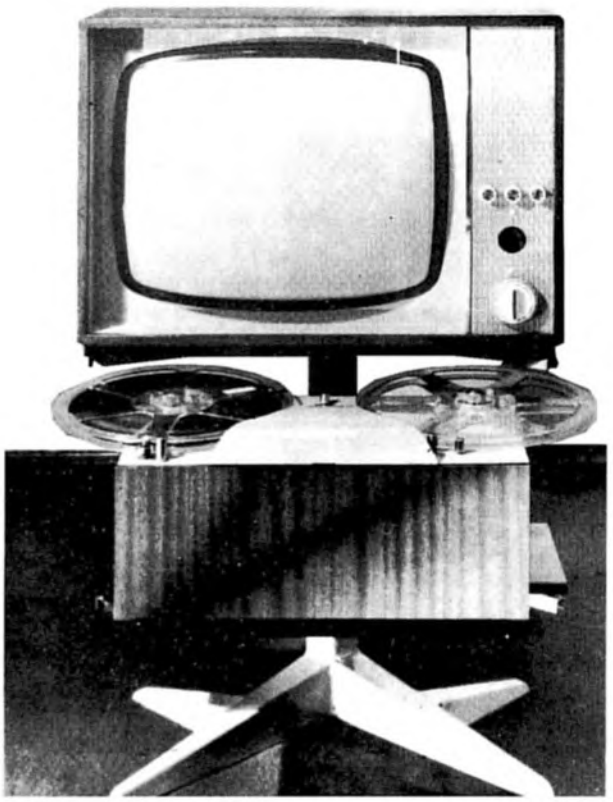
* * *

### Telcan to be Marketed this Month

MORE information has recently become available concerning the *Telcan* sound and vision recorder. The manufacturers hope to market their first model late this month, to retail at about £60.

Using normal ¼ in. wide tape, the unit operates at three speeds. The lowest of these is 7½ i/s for sound recording. The two other speeds are 120 and 180 i/s, enabling both sound and vision to be recorded with complete synchronisation. An 11 in. reel of tape gives a total playing time of 30 minutes on two tracks.

The Telcan will enable the user to tape programmes from a standard television while watching the programme as it is being taped, or watching one channel while the *other* is being taped. Plans have been made to market a miniature TV camera to enable users to record their own pictures. This will probably retail for approximately £48.



### BBC Organise Tape Competition

THE BBC has just issued details of a Wildlife Recording Competition for amateurs. The recordings must be at least one, and not more than three, minutes in duration, and are confined to wild, non-captive, animals.

There are five classes of entry: *Class One*—Individual Bird Species. Certain species are disallowed including the Nightingale, Blackbird, and Robin song. *Class Two*—Individual Mammal Species. *Class Three*—Individual Insect Species. (Insects may be 'temporarily captured' for recording purposes.) *Class Four*—Individual Amphibian Species. *Class Five*—Atmosphere—i.e. environmental recordings (not necessarily with one species dominant, typifying a season, region, time of day, or habitat.

Recordings in classes one to four must have individual lengths of not less than ten, and not more than 90 seconds. The entries will be judged on popular interest value, technical quality, and freedom from extraneous and irrelevant sounds.

A prize of £26 5s. is offered for the best entry in each class, with £10 10s. for the runner-up. These prizes may be altered if the standards prove unacceptably low.

More information is available from: **BBC Natural History Unit, Whiteladies Road, Bristol, 8.**

* * *

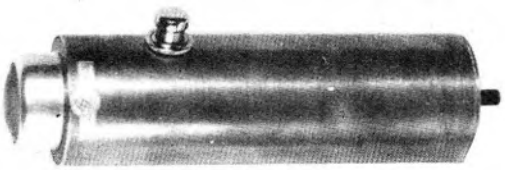
### Metro-Sound Move to Larger Premises

METRO-SOUND SALES LTD., and Metro-Sound Manufacturing Co. Ltd., recently moved to a new and larger premises in order to accommodate the expanding business that has increased rapidly since its formation in 1957. The new address is: **Bridge Works, Wallace Road, Canonbury, London, N.1.**

# AUDIO FAIR PREVIEW

**Lustraphone FMR/900**

**Clarke & Smith TR634**



**Lustraphone D59/RT**

BETWEEN Thursday 2nd and Sunday 5th April, some 40,000 tape and hi-fi enthusiasts are expected to converge on the Hotel Russell, Russell Square, London. The following is a summary of what the *tape* addict can expect to find.

### This Year's Theme

'Initiation', we are informed by the organisers, is the theme for this year's festival, although the information received from exhibitors does not, at the time of writing, reflect this.

At the *Lustraphone* demonstration room a number of interesting products will be on show for visitors to see and hear. These include the popular Stereolus dual-head microphone, transistor amplifiers, mixers, microphone stands and booms, as well as a wide variety of products for specialised use in education, public address, and broadcasting. A particular feature, though not new to this year's fair, is the *Radiomic* a system permitting complete freedom from trailing microphone wires. Basically, it comprises a moving-coil microphone—almost any from the Lustraphone range can be used, although a special microphone, the *D59/RT*, is available specifically for this purpose—which is connected to a tiny FM radio transmitter. This unit measures approximately 3½ x 2¼ x 1 ins. and is crystal controlled, working at frequencies within the 174·6 to 175 Mc/s band.

The signal from this unit is converted into audio frequencies by an FM receiver; the FMR/900 is capable of handling five separate channels simultaneously.

### Tape in Education

Moving on to Room 321, the temporary home of Messrs. *Clarke & Smith*, we find, amongst other things, two high quality recorders designed for use in education and theatres. These are the *TR634* and *TR635*, fitted, respectively, with *Wearite* and *Truvox D82* decks. Both machines offer facilities not often found on semi-professional and 'domestic' recorders. These include 10W output, permitting playback in a large room or hall without additional amplification. The three-channel mixing and amplification system can be used 'straight-through', the tape transport being out-of-action or recording, whichever mode is required.

The three inputs permit a high impedance (300 K, 1 mV), low impedance (15 to 30 ohms, 10μV), and 'gram' (60 mV 500 K) to be used simultaneously. Two speeds, 7½ and 3¾ i/s, are available on both models, as well as two separate tone controls, providing bass and treble cut and lift. These operate on replay only. The *TR634* retails at £108 3s. and, despite its specialised nature, has facilities which other manufacturers might do well to adopt.

Whereas the *TR634* is a general-purpose machine with many obvious uses in education, the new Ferrograph *Ferro-tutor* is of a more specialised nature. Costing £125, complete with microphone, stand and headphones, it is designed to form the basis of a Language Laboratory. A special head-arrangement permits simultaneous recording on the lower track whilst playing back on the top track. Also on show are the new *Series Y* range, comprising the mono *YD5* and stereo *Y500*. Of the former, four versions are available, with varying speed configurations. These are the *YD5A* and *YD5B*, offering 7½, 3¾ and 1⅞ i/s; and the *YD5AH* and *YD5BH*, offering 15 and 7½ i/s. The suffix *B* denotes separate record and replay heads. Available as a portable or rack-mounted unit, the prices are in the order of £137.

The *Y500* models, there are six versions, are equipped with stereophonic recording and playback, with continuous monitoring on both channels. They are available only as portable boxed units. The prices vary between £167 and £175.

Also on show at the Ferrograph booth, and in Room 337, will be a range of *Rendar* plugs, sockets, and accessories.

Moving now to Room 311 we come across a wide variety of new recorders from Japan. These form part of the *Sony* range, although we somehow doubt whether the rumoured Sony television recorder, said to be introduced sometime this year to retail at £150, will be on show. Turning, however, to the positive side of the demonstration, we find four particularly interesting recorders, two in the 'domestic' and two in the 'semi-professional' class and price range. The two cheaper models are labelled *TC272*, price £58 16s., and the *TC200*, price £82 19s. They are both equipped with two speeds, 3¾ and 7½ i/s and have frequency responses, at the higher speed, of 50 c/s to 15 Kc/s, and 50 c/s to 14 Kc/s ±2 dB, respectively.

Going into the more expensive price bracket, we come across an interesting new machine, the *TC777A*, price £166 19s. This is a ¼-track monophonic recorder, fully transistorised, and fitted with separate record and playback heads, permitting off-the-tape monitoring. It has two speeds, 3¾ and 7½ i/s, with a frequency response of 30 c/s to 17 Kc/s, ±1 dB at 7½ i/s. Wow and flutter figures at this speed are claimed as 0·15%. Replay characteristics are to NARTB standards, and the maximum spool size is 7 in. Microphone Input impedance is quoted as 'low'.

At £111 6s. the stereophonic *TC500* is worth some attention. Its specification is similar to that of the *TC777A* although a ¼-track mode of recording is incorporated. The price includes two extension speakers and microphones.

**Sony TC500**


**Telefunken Magnetophon 300**

# EXHIBITORS OF TAPE RECORDERS AND ACCESSORIES

Of the three other Japanese exhibitors at this year's Fair, *Akai Electrical* would appear to be of greatest interest to the tape enthusiast. Their new *Model 345*, retailing at £208 19s., might well be financially out of reach of most, but nevertheless it has many unusual, even unique, features. To quote from the informative leaflet, these include an "*I.R.A.P. (Instantaneously Resetable Automatic Protecting) Circuit to avoid damage of costly Transistorised Main Amplifiers from excessive ambient heat of unexpected over-current, etc.*" The machine has facilities for remote control and can take spools of up to 10½ ins. diameter, with the addition of special extension arms. Other features include '*Reverse-O-Matic*', '*Repeat-O-Matic*', and '*Shut-off-O-Matic*'. Another newcomer is the *M-7*, a ¼-track, three-speed recorder costing £139 13s.

From manufacturers of recorders we move to manufacturers of tape. Messrs. *Agfa*, *BASF*, *EMI*, *Gevaert*, *Kodak*, *Scotch*, *MSS* and *Zonal* represent this corner of the trade—and it is often with tape manufacturers that we find the most interesting demonstrations.

Kodak Limited, a newcomer to the Festival, will be showing the results of their recent entry into the tape market, and an informative booklet, *Kodak Sound Recording Tape*, will be available from the stand.

EMI Tape Limited are combining with their Electronics Section in demonstrating four types of Emitape and Emidiscs (lacquer recording discs). Three professional recorders, the *Type 311*, *RE301*, and *TR52* will be on show for visitors to examine and hear.

At Booth 5 and Demonstration Room 402 we find Messrs. *Telefunken* of Germany. Their new portable recorder, the *Magnetophon 300*, is claimed to be one of the *thinnest* recorders manufactured in that country, though it does not pretend to be the smallest, having a 5 in. spool capacity and dimensions of 3 x 10¾ x 11 ins. The *M300* has two tracks and wow and flutter figures, at its single speed of 3¾ i/s, of ±0·2%. The amplifier has a maximum output power of 1W, and a frequency range from 40 c/s to 13 Kc/s. The retail price is £61 19s.

### How to Get There

Presuming the above information has whetted your appetite, you may want to know, particularly if this is your first visit to the Audio Fair, how to get there. The easiest way is probably to travel by underground on the Piccadilly Line to Russell Square. The hotel is on the left as you leave the station in Bernard Street.

There is no charge to enter the exhibition but all visitors must possess tickets. These can be obtained from most hi-fi and tape dealers, or, in cases of difficulty, from this office. It is essential, however, that the quantity required is stated—one ticket permits two persons—and a stamped addressed envelope is enclosed.

**Reslo MPD Microphone**

**Sony TC200**

**Clarke & Smith** *TR635.*

* * *

**Akai:** Pullin Optical Ltd., 11 Aintree Road, Perivale, Middlesex. A variety of tape recorders including the new *M-7*, and *Model 345*.

**Ampex:** 72 Berkeley Avenue, Reading, Berks. Several new machines being exhibited for the first time; the *F-44 Series*, the *PR-10* and the *E.65*.

**A.K.G.:** Politechna Ltd., 3 Percy Street, London, W.1. A number of microphones and headphones including the popular *K.50* lightweight phones.

**Agfa:** 27 Regent Street, London, S.W.1. *PE31*, *PE41* and *PE65* high-definition tapes.

**BASF:** Badische Anilin and Soda Fabrik, A.G.—U.K. Office, 5a Gillespie Road, London, N.5. Magnetic recording tape.

**Brenell:** 1a Doughty Street, London, W.C.1. A range of stereo and mono machines.

**Butoba:** Denham & Morley, Denmore House, 175 Cleveland Street, London, W.1. Three battery portable recorders, the *MT5*, *MT7* and *MT7R*.

**Clarke & Smith:** Melbourne Works, Wallington, Surrey. Several new products of interest to hi-fi fans, and two educational recorders, the *TR.634* and *TR635*.

**E.M.I.:** Hayes, Middlesex. Several professional recorders including the *RE.321* portable and the new *Type 311*. Also EMI tapes and *Emiguides*.

**Fi-Cord:** 40a Dover Street, London, W.1. A battery recorder, the *202*. Messrs. Fi-Cord are also the agents for *Beyer*, who are exhibiting at a separate stand.

**Ferrograph:** 84 Blackfriars Road, London, S.E.6. A variety of recorders and accessories including the *Rendar* range of plugs. Of particular interest is the new *Series Y* range.

**Garrard:** Newcastle Street, Wilts. A battery and magazine tape deck.

**Grampian:** Hanworth Trading Estate, Feltham, Middlesex. Several microphones and accessories, also the Grampian Parabolic Reflector.

**Gevaert:** Great West Road, Brentford, Middlesex. A range of magnetic recording tape.

**Grundig:** Newlands Park, Sydenham, S.E.26. A wide range of recorders, the latest addition to which is the *TK6* battery portable.

**Loewa-Opta:** U.K. Distributors, Highgate Acoustics, 71-73 Great Portland Street, London, W.1. The *414* portable recorder.

**Luxor:** Distributor, Britimpex Limited, 16-22 Great Russell Street, London, W.C.1. Two recorders, the *MP-423* and *424*.

**M.S.S.:** Colnbrook, Bucks. Magnetic recording tape.

**Philips:** Century House, Shaftesbury Avenue, London, W.C.1. Three new machines, the *EL3541/H*, and the *EL3586*—superseding the popular *EL3585* battery portable, and the *EL3548*.

**Revox-Studer:** U.K. Concessionaires Ltd., 90 High Street, Eton, Windsor, Berks. A range of very high quality recorders for the amateur and professional.

**Sony:** U.K. Distributors, Tellux Limited, Avenue Works, Gallows Corner, Essex. Several new recorders, including the *TC.272*, *TC.200*, *TC.500* and *TC.777A*.

**Standard Telephones & Cables:** A wide variety of microphones and headphones.

**Stuzzi:** U.K. Agents, Recording Devices Limited, 44 Southern Row, Kensington, London, W.10. Four new recorders: the *502*, *802FM*, *202* and *604*.

**Tandberg:** U.K. Distributors, Elstone Electronics Limited, Edward Street, Leeds 2. A range of domestic recorders.

**Telefunken:** U.K. Distributors, Welmec Corporation Limited, Lonsdale Chambers, 27 Chancery Lane, London, W.C.2. Two new recorders, the *Magnetophon 55*, and the *M.300* battery portable.

**Truvox:** Neasden Lane, London, N.W.10. The new *Series 90* range, including the *R.92* and *R.94*.

**Vortexion:** 257-263 The Broadway, Wimbledon, London, S.W.9. Several high-quality semi-professional recorders.

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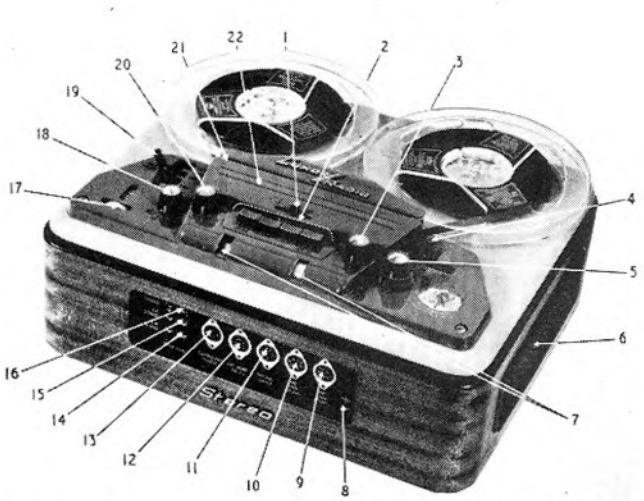


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*12* Radio input, and external amplifier output
*13* Earphones
*14* Socket for external loudspeaker (mono)
*15* Socket for external stereo loudspeaker
*16* Socket for external stereo loudspeaker
*17* Tape-consumption indicator (cuemeter)
*18* Loudspeaker switch
*19* Power on/off and speed selector switch
*20* Tone switch
*21* Tape guide
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# our readers write . . . . .

**. . . about 'too much technicality'**

**From: A. S. H. Hodges, 43 Merton Road, Harrow, Middlesex.**

*Dear Sir,* I am a regular reader of *Tape Recorder* and in response to your repeated requests for readers' views and ideas about the contents of the magazine, I am now writing to express my own personal views in the matter.

The title of the magazine doubtless explains why the subject-matter consists mainly of articles and advertisements dealing with new and existing commercial tape recorders, their characteristics, performance, maintenance and so on. These articles are usually very technical and, I think, of very limited interest to non-technical readers such as myself, whose sole reason for possessing a tape recorder is for the purpose of recording and listening, and with little thought about the construction and function of the various mechanical and electronic devices which comprise the modern instrument.

At the risk of being severely contradicted, I would say that the majority of your non-technical readers (and there are probably more non-technical readers than technical) have have purchased their recorders before considering the need to subscribe to a magazine. In other words, the purchase of the magazine would be secondary to the purchase of the machine and having decided upon their choice of tape recorders which, I need hardly point out, are already extensively displayed in retail shops and advertised in the Press, it is reasonable to assume that many of these people would begin to take more interest in the various methods of recording in order to improve their recording ability. This is the moment when thought would be given to the question of purchasing a magazine such as *Tape Recorder* and I am quite sure I am voicing the disappointment of many readers of the magazine when they find there is so little to read on the subject of recording itself. It is on this aspect of the tape recorder, i.e. the different recording techniques, and the types and makes of apparatus normally used for recording that I am at variance with your editorial policy.

Admittedly, your magazine may be of considerable practical interest to the technical 'bods' and especially those who are primarily concerned with the manufacture, sale and servicing of electronic apparatus. If, however, you are anxious to increase the circulation of your magazine, then surely it should not be your policy to cater mainly for the needs of the technical section of your readers and to neglect the reader who is interested only in using his prized possession for the purpose for which it was intended, and who represents the bulk of the purchasing public.

The subject of recording is invariably disposed of by an occasional article in the magazine describing the basic methods of recording which are usually adequately covered in the 'Book of Instructions' and, perhaps, an article or two about tape indexing and editing, which can be seen in most published books on tape recording. Although you may devote pages of printed matter to new or existing commercial tape recorders, praising their virtues and criticising their shortcomings, you seldom write about or review apparatus which can be used for the actual job of recording, e.g. the many proprietary makes of AM and FM tuners, tape-jacks, radio sets with diode output, etc. How often do you discuss or review proprietary makes of amplifiers or extension loudspeakers for connecting to tape recorders, which latter, you must agree, are essential for tape recordists who aspire to the ultimate in Hi-Fi.

*Yours faithfully*

Thank you, Mr. Hodges, for these criticisms. I think you have come down a little too heavily against 'the technicalities', but I agree entirely with you when it comes to the last part of your last paragraph. The series of articles by Gordon King which begins this month, has been planned to cover this shortcoming. I hope they—and others—will provide what you are looking for. **Ed.**

* * *

**. . . about organ recording**

**From: A. L. Galliford, 46 Trevor Drive, Crosby, Liverpool, 23.**

*Dear Sir,* May I express appreciation of M. F. Woodward's excellent article on organ mechanics, and the problems involved in recording them, in the January 1964 issue of *Tape Recorder.*

However there is one small, but important, statement which is basically incorrect; I refer to his comparison of the organ reed stop with a mouth-organ reed. He would have been more correct to have compared it with the reeds used by clarinetists and saxophonists. The mouth-organ reed (like the reeds of the harmonium, American organ and accordion) is a *free reed* vibrating in a slot slightly larger than itself and each such reed is capable of producing only one fundamental note, the pitch of which is determined by the dimensions and weight of the reed itself. Organ and clarinet-type reeds are *beating reeds* which are slightly larger than the aperture over which they vibrate, and which as a result alternatively open and close the latter as they vibrate, allowing the wind or breathe to pass through in a series of puffs. The pitch and quality of the note produced is governed largely by the dimensions of the pipe or tube attached to it. In the clarinet or saxophone this is varied in effect by opening or closing side holes by fingers or keys, but in the organ each note is produced by a separate pipe of fixed length. The fact that the organ reed is made of brass and not of cane is a minor matter and does not alter the basic principle.

*Yours faithfully*

**M. F. Woodward comments:**

Mr. Galliford is, of course, quite right in the vast majority of cases organ reeds are beating, and not free. I chose the rather homely similie of the mouth-organ reed deliberately to appeal to as many readers as possible, a more obscure (but in detail more technically accurate) example would have appealed to fewer readers, who probably know about such matters anyway!

Having raised this to the 'slide rule' level, I must disagree with the statement that organ reed pitch and quality "is governed largely by the dimensions of the pipe or tube" . . . (surely—'resonator'?) . . . "attached to it".

Reed pitch and quality depend upon many *interrelated* factors, chief amongst which are: (a) Materials of construction. (b) Resonator size and shape. (c) Wind pressure. (d) Relative size and shape of the shallot orifice (the 'aperture'). (e) Size, weight and curvature of the reed tongue. (f) Presence, or absence, of weights on the reed tongue. To single out any of these as necessarily dominant is equivalent to assessing the quality of a tape recorder by it's capstan motor!

Looking at the influence of the resonator on pitch alone, some resonators are 'harmonic' (i.e. double 'normal' length) some can even be 'double harmonic' (double, double, 'normal' length). Some pedal reed pipes have 'half length' some even 'quarter length' resonators. One or two exotic stops have equal length resonators throughout their compass.

I suggest Mr. Galliford tries tapping up or down the 'tuning wire' fitted to an organ reed and observing the effect caused by the consequent alteration to the effective length of the reed tongue. That will dispose of the theory of the sole effect of the resonator on pitch.

However, readers are probably more interested in 'drop outs' and 'decks' than 'diapasons' and 'dulcianas'—I suggest that we transfer this advanced organ duet to the columns of that excellent Quarterly *The Organ*—there to exercise our slide rules surrounded by the faithful!

* * *

**. . . about amateur clubs and modern recorders**

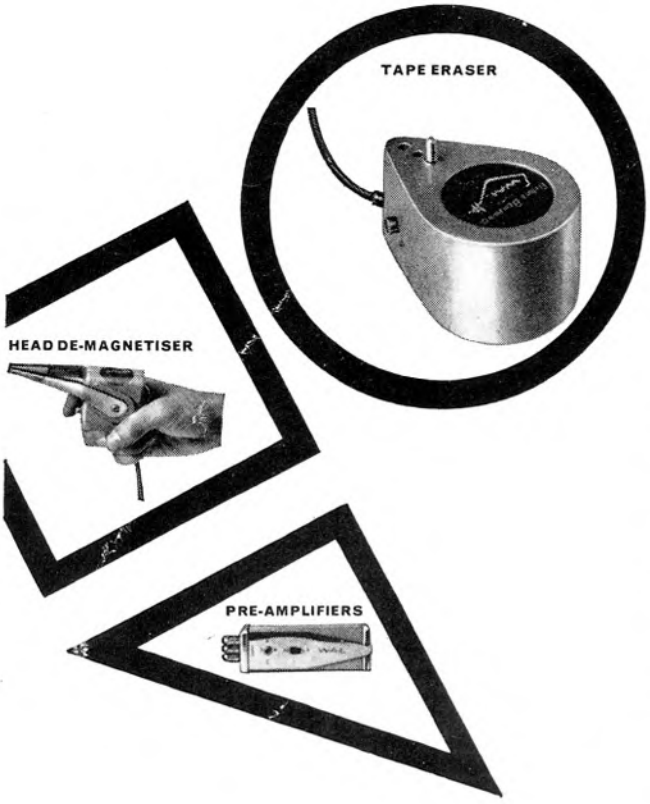
**From: W. J. Tomlinson, 62 Beacontree Avenue, London, E.17.**

*Dear Sir,* Michael Moore speaks truly when he says history tends to repeat itself (referring to Edison's original phonograph) as it can be related to the modern tape recorder, but I feel that this is not altogether the fault of people who buy (and presumably *use*) contemporary equipment. I contend that the tendency to regard the tape-machine as a play-back unit is the direct result of commercial interests in the equipment, because these people no doubt see greater opportunities for business in this form than any other. We are slowly being brainwashed!

As regards Mr. Moore's remarks about clubs, I think these are more than a little unfair. My own, the Walthamstow Tape Society, could by no stretch of the imagination be placed in the category he describes and I am sure there are a good many clubs in the country equal to our society.

This leads me nicely on to another point: if Mr. Moore buys only this magazine, he will of course fail to read any news of clubs. I notice such news no longer appears, in any shape or form in *Tape Recorder* as it did in time gone by, and I have been reading this magazine a very long time now. Can we have some explanation please?

*Yours faithfully*

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# Readers' Problems

### Squeaking Tape Guides

*Dear Sir*, I have encountered a problem to which I cannot find the solution locally, and should be glad of advice. In moist conditions here, I often experience an unpleasant screeching sound as the tape passes the highly polished guides on my recorder. Could you please tell me of some way in which this difficulty can be overcome? Silicone perhaps?

*Yours faithfully*, **M. H. G., Lusaka, Northern Rhodesia.**

*The problem of a squeaking tape and oxide deposit that you describe is not to be cured, unfortunately, with any sort of lubricant. Absolute cleanliness is the only answer.*

*But your climatic conditions undoubtedly have a lot to do with this, and I don't see what solution there can be, except to reduce the speed of fast-wind and rewind and to check that there is not too much back-torque during play, nor too great a take-up pull. As you do not state what machine you are using, this again is difficult to be specific about.*

*The screeching is often caused by friction with tape surface and guides and a kind of magneto-striction action. The more highly polished the guides, the worse it is! But your other remark about oxide deposits worries us. It may be something quite different. In other words—tape storage. If the tapes are stored so that the humid atmosphere of a moist day can attack the oxide before unspooling, then the oxide bonding may be loosened, leaving a deposit. Again, this is merely theory. I would say, check that your tapes are stored in as cool and dry a place as possible. It is not enough to seal them in an airtight bag, as some people do when in sub-tropical or tropical climates, because the heat can cause an emission of sorts within the bag, and a kind of condensation.*

*It is a point of interest that guide material can be a cause—brass tends to drag, chrome to set up a squeal with polymer tape, nickel to set up flutter when double-play polyester is used. I have been tentatively experimenting with glass rod, but have not made secure clamps yet. One day, someone will think of spooling another way, perhaps floating the heads up to the uncontacted oxide tape side.*

* * *

### Mains Power for a Fi-Cord

*Dear Sir*, I have a Fi-Cord *1A* battery-operated tape recorder and I wonder if you could advise me on any process whereby the recorder could be run off the mains (240V AC). Would it be possible to run the recorder directly coupled to the Fi-Cord battery-charger, the supply going straight from the mains, via the charger, to the recorder?

If this process is not possible could you recommend any other economical way of converting the recorder to mains operation?

*Yours faithfully*, **J. P. T., Barnsley.**

*It would not be advisable to operate your Fi-Cord 1A directly from its charger. During charging, the voltages are slightly higher, and not adequately filtered for use as a DC supply. There seems no reason why additional filtering should not be fitted, with the filter resistor sufficient to reduce the voltage from 12V to the necessary 8V. This would need trial and error, as I do not know the effect of the loading on the existing RC filter for the metal rectifier.*

*A better, if more expensive, alternative would be to adapt the excellent AC input unit of the 202.*

* * *

### Oiling 'Self-lubricating' Bearings

*Dear Sir*, I own a Philips *EL3541/15B* recorder which has been in regular use for over two years. In the instruction booklet, the bearings are described as 'self-lubricating' and I have therefore not applied any additional lubricant, but recently the recorder has started running slowly for about ten minutes when switched on from cold. I feel that this may be due to lack of lubrication and would appreciate any advice you could give me about which points may need attention and what sort of lubricant would be the most suitable.

*Yours faithfully*, **H. G., Stockport.**

*'Self-lubricating' is one of those relative terms that can be better interpreted as 'not needing re-lubrication for long periods of use under perfect conditions'. The procedure is to form the bearing from sintered metal, powdered basic material formed under great heat and pressure, with oil trapped in the crevices during the manufacturing process. Machining of parts is very precise, and the effect is that the metal itself exudes the necessary thin film of oil.*

*But—and it's a big but—if dust gets to the bearing, or excess heat is produced by prolonged periods of use, the oil tends to vanish. If dust gets into the bearing, it grits up, causes abrasion, wear, and the effect is rapidly aggravated.*

*The best cure is a couple of drops of sewing-machine oil in the bearing, run in at the upper spindle entry with a fine dropper, a few minutes running, then a couple more drops. Do not over lubricate. This is for rotating bearings —slide levers, etc., need a slightly heavier oil.*

* * *

### Harmonics on the R10

*Dear Sir*, Your opinion in the following matter would be much appreciated. I own a Reps R10, which, up to now, has been quite satisfactory. I have recently been attempting to record pure tones, and find, on playback, the following disturbing features: (1) Audible harmonics are present; (2) When replaying a note of above 9 Kc/s a lower note is also reproduced. This points to the fact that all is not well with either the bias waveform or the record amplifier. A voltage check referring to the typical voltages shown on the circuit diagram, shows nothing amiss; but checking the oscillator circuitry with a valve-voltmeter shows that there is an unbalance of some 4V AC across each half of the primary oscillator coil. Reversing the outer anode connections reduced this to 2V (anode-to-anode 230V), with a consequent slight improvement in the effects previously described. Is this line of approach worth following up, to clear the trouble, or would there be some simpler reason, such as lack of bias reject filter in the circuitry? Changing the ECC82 does not alter the unbalanced voltages.

*Yours faithfully*, **D. L., Colchester.**

*The symptoms you describe with your Reps 10 tape recorder certainly seem to indicate that your oscillator is not in order. The probable trouble is a non-sinusoidal waveform. Your VVM readings appear to confirm this. Your line of approach is, I think, the right one.*

*If the 4V AC out-of-balance reading reduces to 2V with the outer connections reversed, resulting in a slight improvement, it seems that the primary itself is at fault. Very often, the self-capacitance of the winding is sufficient to throw things out of balance. You might try putting a couple of 5-50 pF variable capacitors across from outers to tap point, adjusting these until balance is obtained. Frequency variation should be within tolerable limits and the additional capacitance across the whole primary would be very small.*

* * *

### Chugging in the Studio

*Dear Sir*, I own an *Elizabethan TT3* recorder, which is fitted with a Magnavox *Studio* deck. Recently the mechanical noise, a regular "chugging", as well as the amount of wow and flutter, have increased considerably. The machine is also running somewhat slow at 3¾ i/s. Greasing and oiling the capstan and motor bearings as well as cutting out the left-hand motor, has had no effect. I have heard that capstan-roller eccentricity can give a high wow-level on this deck, but cannot get at the roller properly, as it does not appear possible to remove the plastic cover.

I would be grateful if you would give me some indication as to the trouble.

*Yours faithfully*, **M. P. C., Southampton.**

*The regular "chugging" noise that you are getting with your Collaro "Studio" deck is undoubtedly due to a malformed idler wheel. This is, unfortunately, a prevalent fault, usually aggravated by the deck having been left in an engaged position when switched off, and a flat forming on the idler wheel.*

*First, to remove the plastic plate, it is necessary to remove speed-change and record/play knobs, then prise this cover up very gently from each side. It is held in place by stud and plastic collar pieces just inward and forward of the knob apertures. You may find two fairly wide-bladed kitchen knives useful if you meet with a reluctant cover. Slide the blades diagonally in from the corners toward the spools and lever gently upwards.*

*The slow running of the motor is probably caused by capstan slip. The pulley is held to its spindle by a single grub-screw. If this slackens, or if the motor pulley and fan drops slightly on its spindle, the milled edge tends to wear away the idler rubber and causes both apparent slowness and uneven wear, resulting in wow. The only effective cure for the idler-wheel trouble is replacement. These should be available from Messrs. Magnavox, Ripple Works, Barking, Essex, and cost 7s. 6d.*

**Manufacturer's Comments on the Truvox PD99 Review (February 1964)**

**(1)** The Wow and Flutter figures quoted by us are RMS values as measured on the Gaumont-Kalee wow and flutter meter and not the peak to peak reading obtained by your reviewer.

**(2)** The Truvox PD99 is equalised to the new CCIR time constant proposals of 70 microseconds for 7½ i/s and 140 microseconds for 3¾ i/s. As there is not, and never has been, a recommended time constant for 1⅞ i/s, the equalisation at this speed is inevitably a compromise choice dictated by considerations of musical balance, signal-to-noise ratio, etc. The curves obtained by your reviewer as given on graph **No. 2** will therefore be inaccurate with the test tapes used. Unfortunately it is not possible to see what the actual departure from the flat response might be, due to the fact that the dB scales seem to have been omitted from graphs **2** and **3**.

**(3)** The figures of −28 and −30 dB respectively of hum and noise relative to the output from the test tape used in your review have no significance unless one is aware of the level below peak modulation that the test tape used was recorded. One assumes from your reviewer's comment that as bias was near optimum and an extra 14 dB could be recorded on the tape without excessive distortion that in fact hum and noise could be construed as being approximately −44 dB.

**(4)** The manufacturer's recommended bias for the recording heads used on the PD99 is 55V at 62 Kc/s and not 40V as measured by your reviewer. In fact the value used on the PD99 is 75V, this being the optimum figure for lowest distortion. As your reviewer comments that the bias for this particular head is near optimum, one can only assume his method of bias measurement to be incorrect. It is interesting to note that the review machine, when returned, did in fact measure 75V.

★

**Truvox PD99**

★

**To Which Our Reviewer Replies:**

**(1)** The percentage figure on each wow and flutter pen recording is, as always, an RMS measurement of the total wow and flutter, measured through a low-pass filter which is 3 dB down at 200 c/s. It *should* therefore match the Gaumont-Kalee total reading very closely.

**(2)** The effect of using 70 and 140 microsecond test tapes instead of my 100 and 200 microsecond ones at 7½ and 3¾ i/s would be to raise the bass response and lower the top response by about 1½ dB respectively. My criticism of over-correction at high and low frequencies would still be valid. Each large division is 5 dB on all my review graphs.

**(3)** My test tapes are recorded at a level 12 dB below peak recording level, where peak recording level is defined as the point where 3rd harmonic distortion due to the tape is 3%. On domestic recorders 5% total tape and amplifier distortion is accepted at peak recording level. With good amplifier design and optimum bias a level 13 to 14 dB above test tape level can usually be recorded with no obvious waveform distortion. This proved to be so on the recorder under review, proving that under-biassing was not the cause of the distortion noted on subjective listening tests. Peak signal-to-noise and hum level is therefore 44 and 42 dB for top and bottom tracks respectively.

**(4)** There is no dispute over the fact that the bias is at, or slightly above, optimum. We must agree to disagree about our actual readings.

I must admit I would prefer to have had Truvox's detailed comments on the record-level meter design fault, which was the prime cause of most of my criticism, rather than the other details chosen for their reply.

The points that the dB scale on my graphs, and the RMS percentage markings, were omitted from this review are well taken and I will do my best to see that it does not happen again. **A. Tutchings.**

By K. R. Wicks

# BIAS IN TAPE RECORDING

## Part One

THE purpose of this article is to show why bias is needed in the tape recording process, and any reader who can understand graph-type drawings should be able to follow the explanations. In a tape recording system, when a current is passed through the record head, a magnetising field is set up. This field will exert a magnetic force on the tape coating, and thereby magnetise it.

The graph which shows how the magnetic flux-density in the tape varies with the magnetising force applied by the record head is called the *tape transfer characteristic*. If this graph were a straight line, as in **fig. 1**, then the signal recorded on the tape would be an exact replica of the signal applied to the record head.

Unfortunately the tape transfer characteristic is *not* a straight line graph. The shape of the graph is shown in **fig. 2**, and it can be seen that if a pure sine-wave signal is applied to the record head, the signal imposed on the tape will be greatly distorted due to the changes in the slope of the transfer curve at points P and Q. If, however, the input signal could be applied to a *straight* portion of the curve, then the signal would be recorded without distortion. This is the idea behind any form of bias.

When a DC bias system is used, a constant direct current is passed through the record head together with the signal current, so that the total magnetising force is always of such a magnitude that the straight part of the transfer curve is used (see **fig. 3**).

With this system the polarity of the DC bias determines whether the upper or lower of the two straight portions of the curve is used, though with an alternative and less frequently used arrangement the tape is saturated by the erase head and then partially desaturated at the record head.

The main disadvantage of DC bias is that the background noise is very high. The tape is magnetised throughout its length by the field produced by the bias current. When the tape is replayed, small irregularities occur in the magnetic oxide and in the contact between the tape and the playback head; as the oxide particles and/or the distance between the magnetised tape and the playback head change, the latter is subjected to a changing magnetic field—this causes an EMF to be induced in the head, and the effect is heard as background noise.

The majority of tape recorders use a system of AC bias, the frequency of the bias current usually being about 60 Kc/s; the bias and signal currents are both fed to the record head. The combined effect of the two currents is shown in **fig. 4**. The audio signal is recorded without distortion on the tape, since only the straight portions of the transfer curve are used in the recording of this signal.

The bias waveform will be distorted and will be partially recorded on the tape, but when the tape is reproduced there will be little output at the bias frequency. This is largely due to the "gap effect" in the playback head. Another factor which reduces the effect of the recorded bias is self-demagnetisation. Any signal is recorded on the tape as a series of magnets; at the relatively high bias frequency these magnets are very small, and consequently their poles are very close to each other —because of this they tend to cancel each other out.

Thus, the original audio signal is reproduced by the tape machine with negligible distortion, and without the high background noise which is experienced when DC bias is used.

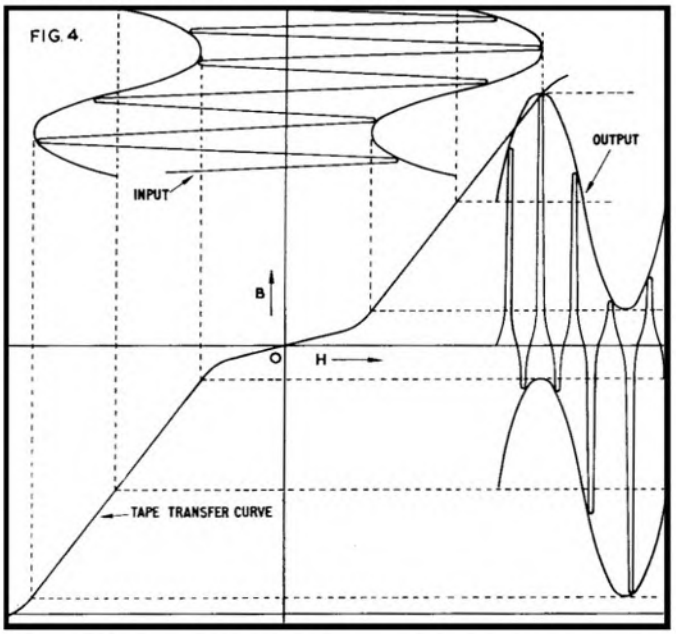
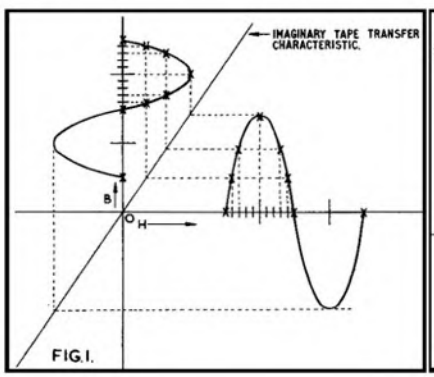


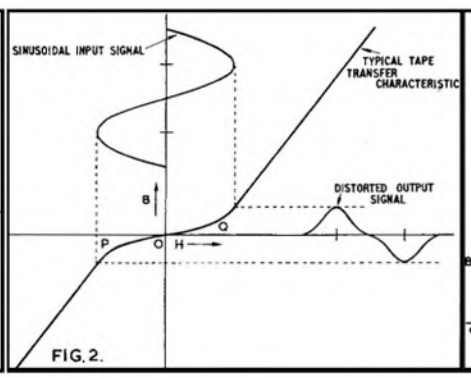

**Fig. 1:** *This shows the tape transfer characteristic of an imaginary perfect tape without hysteresis. A sinusoidal waveform is applied to the record head (left), and the resulting variation of flux on the tape provides an undistorted output signal (right). The dotted lines show how the output waveform is plotted. The co-ordinates are: B—flux in tape coating; H—magnetising field at record head.*

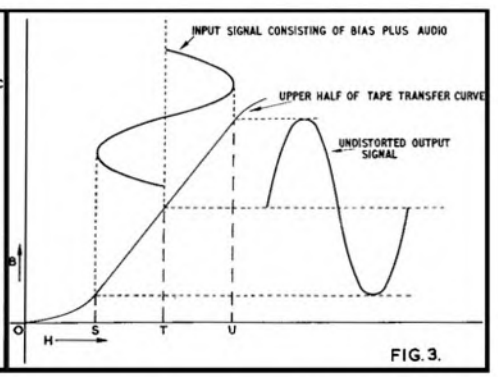
**Fig. 2:** *In practice the tape transfer characteristic is not linear, and a sinusoidal magnetising waveform produces a distorted output.*

**Fig. 3:** *With DC bias, one half only of the transfer characteristic is used. O-T represents the magnitude of the magnetising field due to the bias current alone, while O-U and O-S represent the maximum values, respectively, of this field when an AC waveform is superimposed on the DC bias.*

**Fig. 4:** *With AC bias, the input waveform consists of a mixture of bias and audio signals; the result is an envelope of bias signal corresponding to the audio signal. The output signal consists of undistorted audio plus the distorted bias signal, though the latter is not actually reproduced.*




(Continued overleaf)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# BIAS IN TAPE RECORDING Part Two — Bias Amplitude

The magnitude of the AC bias which is applied to the record head together with the audio signal is very important. In **fig. 1** the amplitude (a) of the bias signal has been carefully chosen so that the audio component of the input signal falls vertically above the straight portions of the tape transfer characteristic. The diagram thus shows how a virtually distortion-free output signal is obtained.

If, however, the amplitude of the bias signal is reduced to a new value (b) **fig. 2 (a)**, then part of the audio component of the input signal will fall on the lower bends P and Q of the tape transfer characteristic curve. As a result, the recorded audio signal will be distorted

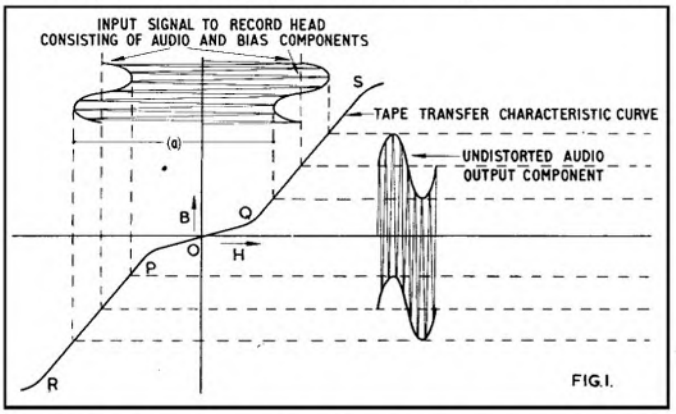



**Fig. 1.** *This shows the normal optimum bias arrangement, where* **B** *is the magnetic flux density in the tape coating,* **H** *is the magnetising field applied by the record head, and* **(a)** *is the peak-to-peak amplitude of the bias voltage.*

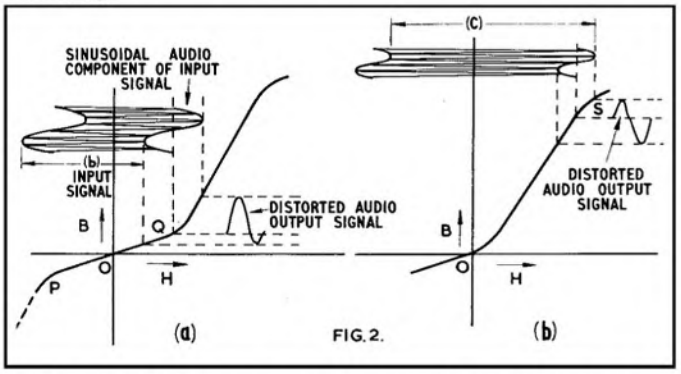



**Fig. 2.** *At* **(a)** *the bias is reduced in value to* **(b)**, *causing 'bottom bend' distortion, while at* **(b)** *a high level of bias* **(c)** *causes 'top bend' distortion as the tape approaches saturation.*

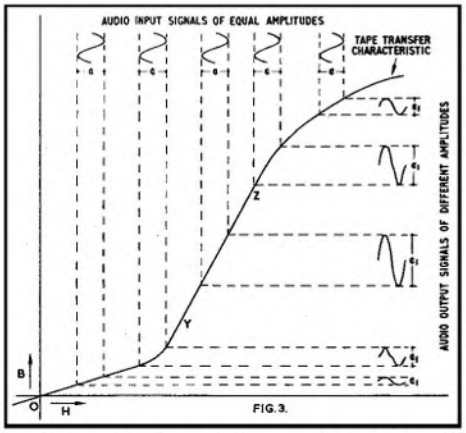



**Fig. 3.** *This shows how the output level varies according to the operating position on the curve.*

as shown. Similarly, if the amplitude of the bias signal is *increased* beyond a certain value (c), then the result will again be a distorted output signal, this time the distortion being caused by the bends R and S at the extremities of the tape transfer characteristic curve **(fig. 2 (b)**. From this it follows that to obtain a minimum percentage of non-linear distortion there is a definite critical value for the bias current.

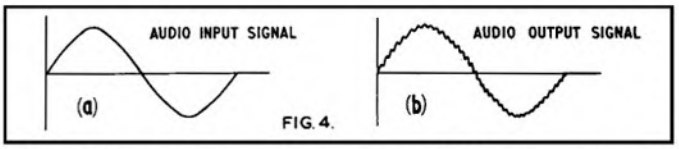



**Fig. 4.** *The pure audio input signal is shown at* **(a)**, *but the output varies as at* **(b)** *due to imperfect tape/head contact. This results in a sort of modulation hiss.*

Now when an audio signal is recorded, the amplitude of the output signal obtained will vary according to the portion of the transfer characteristic curve to which the audio input signal is applied. It can be seen from **fig. 3** that the output signal will have maximum amplitude when the input signal is applied to the portion of the transfer curve which has maximum slope, namely the straight portion, YZ.

Thus, the bias setting which gives least non-linear distortion by applying the audio waveform to the straight part of the transfer curve, will also give the maximum output waveform amplitude. Therefore, to adjust a tape recording amplifier so that it gives minimum distortion, the bias amplitude has merely to be adjusted so that the recorded level of a constant amplitude input signal is a maximum.

### The Problems of Hiss

Another important factor when a recording is made, is the level of background noise, i.e. hiss, behind the recorded signal.

When an AC bias system is used the background hiss is quite small compared with the high hiss level associated with DC-biased recordings. However, it is still present, and is produced in the following manner. When the tape passes any head of a tape recorder, there are always slight imperfections in the contact made between the tape and the head. In the first article, this effect at the *playback* head was shown to be the main cause for the high hiss level when DC bias is used. With an AC bias system the main cause of hiss is the slightly imperfect contact between the tape and the *record* head. As the distance between the tape and the record head varies, then the level at which the audio signal is recorded will also vary, the level being a maximum when the tape makes perfect contact with the head.

The variations in tape-to-head distance with which we are concerned here are very rapid and are of an irregular nature. The effect on the recorded audio signal is shown in **fig. 4.** When the tape is played the relatively high frequency variations in the amplitude of the recorded signal are reproduced as hiss.

Self-demagnetisation in the tape tends to reduce the level of the recorded hiss, and it should be noted that the manner in which hiss is thus attentuated is exactly the same as the way in which recorded bias is attenuated. The recorded hiss contains elements of much lower frequency than the bias signal, so the hiss is not attenuated to the same extent.

It is obvious, after analysing the cause of background hiss, that when there is no input signal there will be no hiss recorded *by this particular process*, since the method by which hiss is recorded relies on the presence of an input signal. (Other factors which contribute to hiss may, of course, still be present, but these will not be dealt with now, since the prime concern here is the effect of the bias amplitude on the hiss level.)

### Hiss Rises With Audio

If the level of the audio signal is gradually increased the recorded hiss level will also rise. This is because a given variation in contact between the tape and the record head will result in a certain percentage variation in the level of the recorded audio signal. Therefore, if the level of the input signal is increased the variations in its recorded amplitude will increase correspondingly, and it is these variations which give rise to hiss when the tape is played.

The result is that if the bias amplitude is adjusted so that the audio output signal is a maximum, the hiss level will also be a maximum. This does not mean that under these conditions the signal-to-noise ratio is poor; in fact it is comparatively good. On the graph **(fig. 5)** the signal-to-noise ratio is represented by the vertical distance between curves A and B. As the bias amplitude is increased from zero, the signal-to-noise ratio improves all the time. At the point when the audio output signal is maximum, the separation between signal and noise is of the order of 45 dB, and the distortion level is at a minimum.

*(Continued overleaf)*

On many tape recorders, the bias level is set for these conditions, and the performance is very satisfactory. Some manufacturers prefer to have a slightly higher level of bias so that the audio output level drops by about 2 dB. It can be seen that the signal-to-noise ratio is now much better, and the improvement may be as much as 4 or 5 dB. This has been gained at the expense of increasing the percentage of non-linear distortion, but the increase in distortion is negligible if the output level is not allowed to drop by more than about 3 dB below maximum.

There is another effect caused by increasing the bias level. It should be remembered that the bias current at the record head always acts (although not to such a great extent) like the erase current at the erase head. This means that when a signal is recorded there is a tendency for it to be erased by the bias current. At middle and lower audio frequencies the effect is negligible, but at frequencies above about 5 Kc/s a much more noticeable loss occurs. The reason why the loss is more pronounced at high audio frequencies is that these signals are recorded in the outermost layers of the tape coating; because of this they are much more readily erased than low frequency signals, which are recorded in the main body of the tape coating. Therefore, over-biasing will cause some loss in HF response during recording, and conversely, underbiasing will result in a boosted HF response.

Some manufacturers quote a fantastic frequency response for their machines, but omit to quote the distortion figures obtained. The extended frequency response is often acquired by underbiasing the machine to such an extent that the distortion produced is intolerable to anyone who knows what 'high fidelity' really means.

To sum up, the bias level should be set either to such a value that the audio output from the tape when played is a maximum, or to a slightly higher value so that the audio output level drops by up to 3 dB.

With *some* tapes that have thin bases (long-play or double-play tapes), the contact made with the record head is very good and so the hiss level is quite low. In these circumstances no appreciable improvement in the signal-to-noise ratio will occur if the bias is increased past the value which gives maximum audio output, so it is better to leave it at this setting. The non-linear distortion is decreased, although the reduction is too small to be noticed. The main advantage is an extension of the frequency response at the HF end of the spectrum.

With other tapes the slight increase in bias amplitude may cause a considerable change in the quality of the output as far as hiss level is concerned. Some compensation for the resultant falling off of the HF response can be made in the record amplifier by increasing its gain at high frequencies.

Finally, on many tape recorders there is no provision for adjusting the bias level. In this case, when trouble is experienced which may be due to the bias level being incorrect, there are two possible solutions. One is to fit an adjustable control to vary the bias amplitude; this will be dealt with in a later article. The second solution is much simpler. Different makes of tape have different types of coatings, and the shape of the tape transfer characteristic curve depends on the type of coating. Therefore, the correct bias level for one tape may be entirely unsuitable for another brand of tape. Most manufacturers of tape recorders decide on a tape to be used with their machine, and set the bias level accordingly. For this reason the recommended brand of tape should give optimum results, and one should not be too surprised if, when a different brand of tape is tried, distorted recordings are obtained.

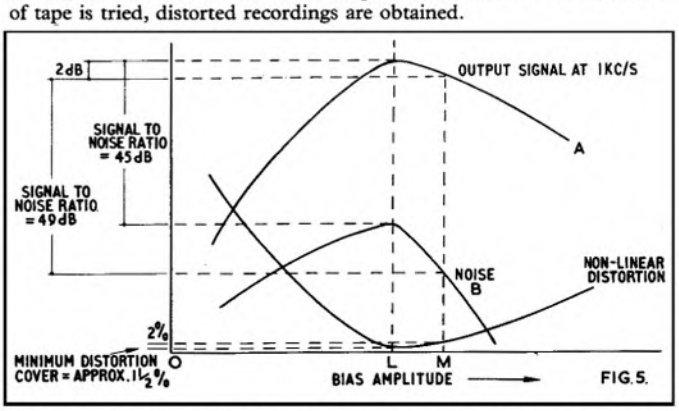



**Fig. 5.** *With a bias current level* **L** *signal-to-noise ratio is 45 dB, and distortion is about 1½%. If the bias current is now increased to* **M**, *the signal-to-noise ratio improves to 48 dB, while the distortion becomes very slightly worse (around 2%).*

By R. S. Finlayson

# THE BAR IS MOVED

A LITTLE hammer hits the strings. That is what happens when a note is played on the piano. The impact of the hammer causes the strings to vibrate and make a note. This note is loud to start with, but gradually gets quieter and quieter as the vibrations decrease; until eventually, it becomes inaudible. This effect is reversed on organs or other wind instruments, because their notes are made by the release of air, and the air takes some time to build up to full volume. So the sound starts quietly, and gets louder as the air is released.

If a piano note, recorded on tape, is played backwards—that is, from right to left, instead of from left to right in the normal manner—the original decreasing note is reproduced as an increasing one. The reproduction starts quietly, and builds up in volume until the loudest point is reached when the hammer originally hit the strings. As a consequence, the "tone" of the note is changed to one like a wind instrument. The pitch of the note, of course, remains the same.

A tape cannot be played from right to left on an ordinary domestic recorder. Although it is possible to arrange this with two machines, or an extra head, the same effect can be obtained on one machine by playing through the back of the tape. After a recording has been made, the spools are reversed, and the tape twisted before threading it over the replay head. Experts may be inclined to frown on this practice, because of the likelihood of damaging the head, but this risk is reduced if recordings only are done in this way, instead of more frequently playing back in "reverse". With standard tape, the results are "woolly" but using triple-play tape, reproduction is passable.

Piano music, recorded backwards, sounds rather like a broken barrel organ when replayed from left to right. Even a well-known is not recognisable. Not only is the "tone" changed, but the sequence of notes is reversed: the reproduction starts with the last note of the original tune and ends up with the first.

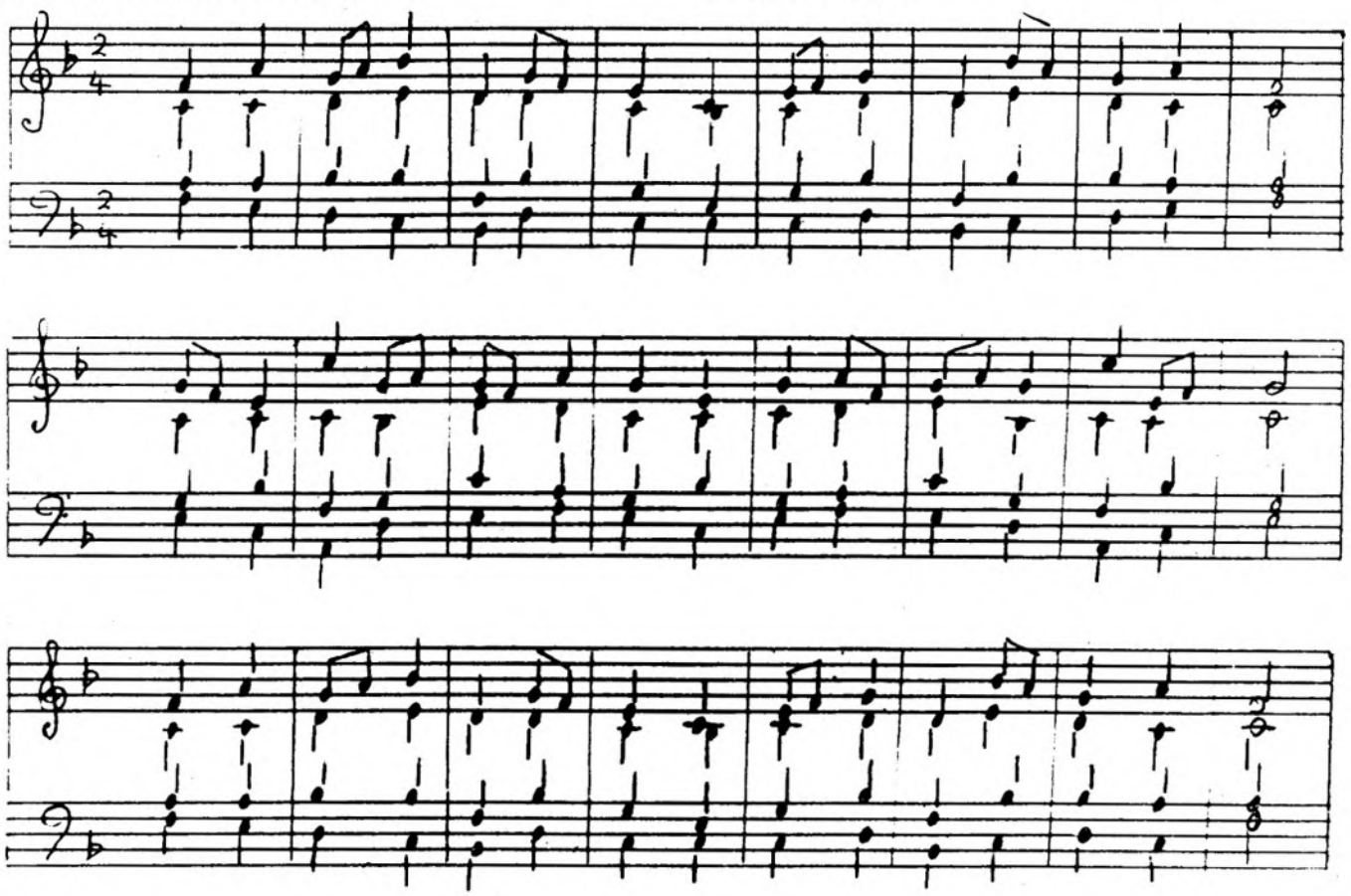
We were taught at school that two negatives make a positive. In tape terms, a recording made "backwards" and also reproduced "backwards" will sound exactly the same as one played and reproduced "forwards". Now, instead of recording a melody "backwards", it can be *Played* on the piano backwards—starting with the last note and playing back to the first. If that tune is recorded backwards, we again have two negatives, and when the tape is played back in the normal way (from right to left) the melody will be the right way round, but instead of sounding like a piano it will be more like a wind instrument.

To play a melody backwards on the piano is difficult, unless the music is re-written first in manuscript. When doing this it must be remembered that, in reverse, each note takes the "time value" of the preceding note in the original, and the bar is moved one beat to the right. Start with a short and simple tune.

A melody taped in this way, when replayed can be accompanied at the same time on the piano: thus playing a duet with oneself backwards!

But that is not the end of the story. Ronald Binge (the composer of *Elizabethan Seranade*) has written an interesting piano exercise called *Vice Versa*, which can be played with the music upside down, or the right way round, and it sounds exactly the same either way! The same principle can be applied to music on tape, by composing a palindromic tune that sounds the same whether it is taped backwards or forwards. An elementary and rather amateurish example is appended.

This melody, recorded through the back of a tape, and played back in the ordinary way, sounds exactly the same tune, but the tone is changed to a wind-like instrument. This reproduction, of course, can again be accompanied on the piano, thus playing a duet with oneself backwards and forwards at the same time! When you have recovered your equilibrium, try it!



# TOWARDS BETTER TAPING

THE so-called 'popular' type of tape recorder can be credited for the birth of many a keen tape enthusiast. In spite of the low basic purchase price, this kind of machine can be logically exploited to provide results considerably in excess of those tabulated in the original specifications.

However, let us not get too excited over this, for it must always be remembered that there are limits beyond which the performance cannot be raised economically and without complicated technical modifications and redesigning. Like all other things in life, one gets only what one pays for.

It is proposed in this series of articles to reveal the various ways that the beginner can improve upon his basic equipment without being expected to reason like a fully fledged electronics engineer! We shall, of course, talk about many technical things; but where these tend to get a bit out of hand we shall endeavour to bring them down to earth before going on to other things. In that way it is hoped that the series will not only show the beginner ways towards better taping but also help him to get a better understanding of the way that the tape recording and reproducing system works right from the microphone to the loudspeaker.

To start, then, let us suppose that the tape novice is in possession of a brand new tape machine within the popular price range. We will leave him together with the machine and its instruction book (the latter being very important to the beginner) for a few weeks so that he may acquaint himself with the practical aspects of recording and replay.

During that time the user's tape exercise will consist mainly of making and replaying recordings of himself and his family. He will learn about recording levels and experience first-hand the disconcerting effects caused by over-recording, when on peaks the recording level indicator swings beyond the datum corresponding to maximum modulation.

He will get to know the microphone and discover from practice (which is always the best way) the correct positions for obtaining optimum results from the various types of recordings. It will not be long before he establishes the fact that speaking directly into a microphone held close to the mouth simply emphasises breathing effects and does not improve the clarity of the recording, and that the best results are often achieved by speaking across the microphone at a distance of several inches (here the type of microphone plays a big part, but we are considering for the time being a machine in the popular price range which incorporates a relatively inexpensive crystal, ceramic or moving-coil microphone).

### Understanding Dynamic Range

It will also be noted that the background hiss assumes a highish level when a recording is made at low modulation; that is, at levels which barely cause a deflection of the recording level indicator. The newcomer will soon realise that the main reason for this rise in hiss is that on replay a greater setting has to be used on the volume control to secure a reasonable output from the speaker.

The correct term in this context is *signal-to-noise ratio*. If the signal on the tape is high, then the inherent noise which is for ever present on all tape is at a very low level in comparison, thereby resulting in a desirably high signal/noise ratio.

If, on the other hand, the tape programme signal is weak, then the ratio between the level of that and the tape noise will be smaller, causing superimposition of the hiss upon the required sound.

The effect is aggravated because more gain will be needed in the replay amplifier to magnify the extra weak programme signal to a suitable level for working the loudspeaker.

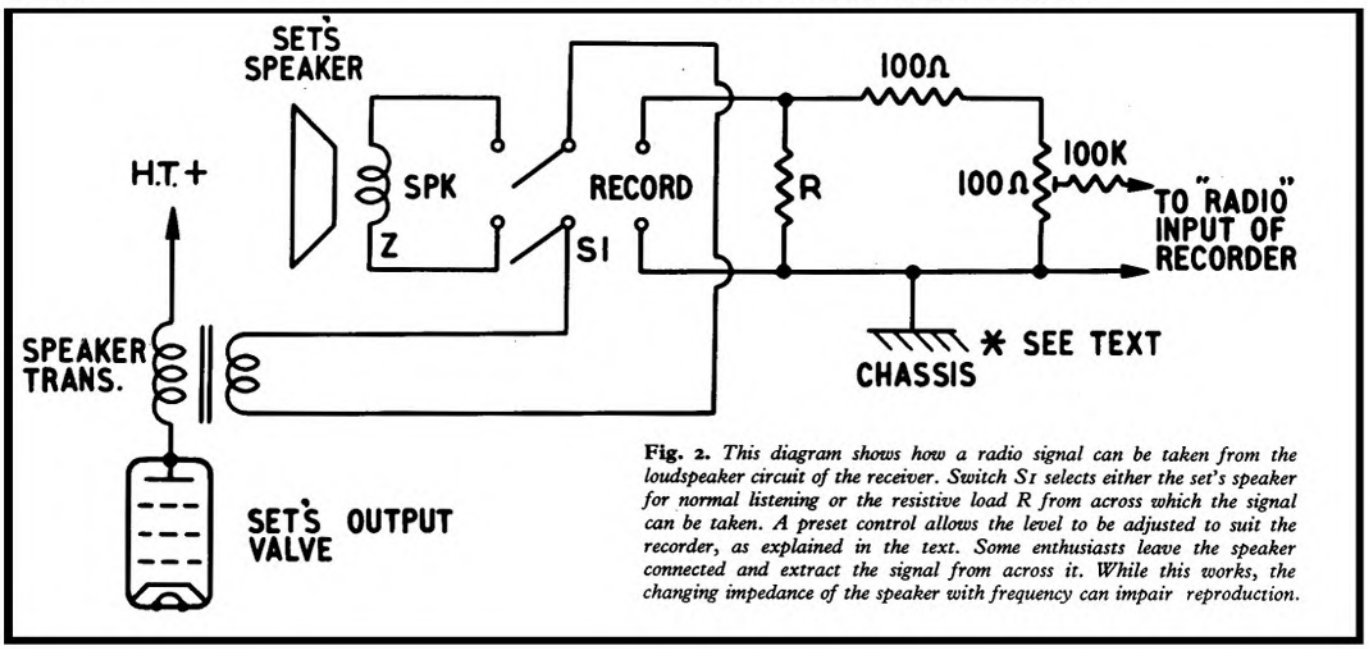



**Fig. 2.** *This diagram shows how a radio signal can be taken from the loudspeaker circuit of the receiver. Switch S1 selects either the set's speaker for normal listening or the resistive load R from across which the signal can be taken. A preset control allows the level to be adjusted to suit the recorder, as explained in the text. Some enthusiasts leave the speaker connected and extract the signal from across it. While this works, the changing impedance of the speaker with frequency can impair reproduction.*

# TOWARDS BETTER TAPING

**Part One**

By Gordon J. King

At this juncture, therefore, it should be noted that tape recorders have two main noise sources to contend with. The noise signal which is actually present on the tape itself and the noise which is created during the process of normal amplification of the programme signal. The greater the amplification, the greater the level of the noise signal produced.

Tape recorders thus work in a 'sandwich' between two margins: the margin of overload on the one side and the margin of noise on the other, as illustrated in **fig. 1.**

This sandwich effect is not clearly defined in practice, and it will take some time for the enthusiast new to the art of tape recording to establish the ideal working range of his own equipment. The working range between overload distortion and background noise is called the *dynamic range* of the equipment, not to be confused with the dynamic range of the programme material, which is the ratio of sound intensity between the smallest and the largest sounds of the programme.

The dynamic range of expensive equipment is, as would be expected, greater than that of equipment in the popular price range, because with the former extra special attention is paid to keeping the noise on the one hand and the distortion (overload) on the other as small as possible.

### Recording from the Radio

The newcomer to the art will almost certainly try his hand at recording from the radio or television set. This he will do simply by placing the microphone in front of the set's loudspeaker and adjusting the recorder's recording level control for normal modulation conditions.

It is now, probably, when one starts to realise that there is a little more in the tape recording business than merely holding the microphone near to the sound source. The radio or television sound programme will, of course, be recorded direct from the microphone, but the results are likely to be singularly disappointing. The distortion content will be found to be well above that produced when a direct voice or musical instrument is recorded and there will be weird acoustical background effects.

The reason for these shortcomings is twofold. Firstly, the radio or television set itself produces distortion and the recorder's microphone is very sensitive to these distortions as reproduced on a loudspeaker system. Remember that an average radio or television set can produce as much as 10% towards full output, and when this is added to the distortion produced by the tape recording process itself the subjective effect of the distortion rises considerably above that of either the set or the recorder.

It seems as though the two distortions multiply by some law, meaning that if, say, 5% is produced by the set and 5% by the recorder, the total is in excess of the expected 10%. This is a rather sticky technical consideration which we just cannot delve into in this series. After trying this mode of recording a few times, the beginner will appreciate the observations of the foregoing paragraph.

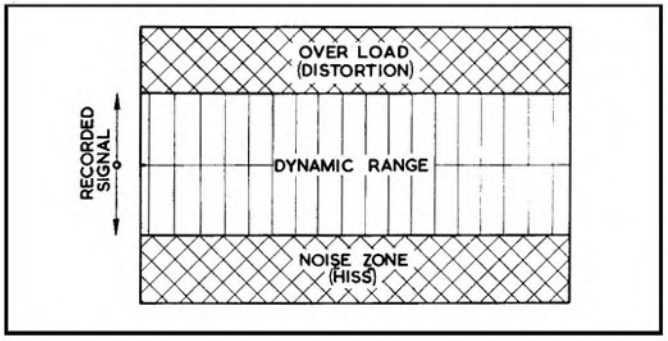



**Fig. 1.** *The beginner soon finds that if the recording level is too low background 'hiss' is troublesome, while if it is too high overload distortion is present on peak signals. The ideal is to arrange the controls so that the signal operates within the 'sandwich' shown here.*

### Not Like the Real Thing

Secondly, no loudspeaker can sound like the real thing even if there is no electrical distortion present, and the acoustic environment between the set's speaker and the microphone placed in front of it can never represent that of the live programme. The microphone picks up not only those sounds from the loudspeaker direct, but also sounds reflected from the walls and ceiling of the room in which the recording is made. Clearly, then, life is certainly made difficult for the new enthusiast whose aim is to 'capture' a broadcast transmission or, indeed, to tape the programme of a disc record.

How, then, can such a recording be made without these two extra distortions being produced? The acoustic shortcoming can be deleted simply by cutting out the set's loudspeaker and using the *electrical* signal to feed direct into the tape recorder.

This is not too difficult to establish. The loudspeaker should be disconnected completely and its place should be taken by a 5W wire-wound resistor of a value equal to that of the nominal impedance of the speaker.

It helps to have a switch available to change quickly from the set's speaker to the resistive load across which the programme signal appears. Such an arrangement is shown in **fig. 2.** This takes in the set's output valve and speaker transformer. Switch S1 is a double-pole, double-throw changeover variety and connects across the secondary of the speaker transformer either the speaker of impedance Z or the load resistor of resistance R (note that both Z and R are measured in ohms). Thus, a 3-ohm speaker would require a 3-ohm load R, and this low value may have to be wound with resistance wire. This can be done by selecting the correct length of wire to give the resistance and then winding this over the body of an insulated high value 1W resistor, connection being made to the two lead-out wires.

A preset potentiometer is used for adjusting the level of the signal fed to the 'radio' input of the recorder, adjustment being made for the correct recording level with the recorder's recording level control set to about two-thirds on. The 100-ohm resistor in series with the preset acts as a signal limiter while the 100 K resistor serves to raise the

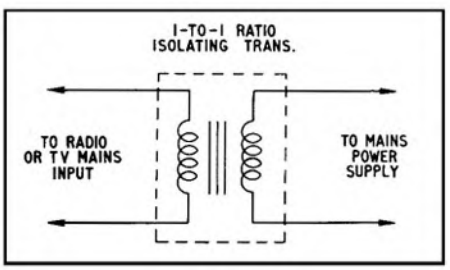



**Fig. 3.** *This diagram reveals the only successful method of achieving safe isolations from the mains supply with AC/DC type equipment.*

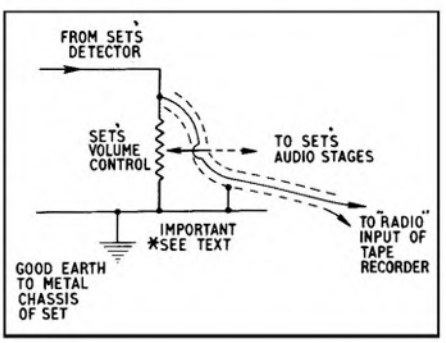



**Fig. 4.** *For the best quality the signal should be taken from across the volume control as this circuit shows. A screened cable is desirable to avoid hum problems and mains isolation* **must** *be used with AC/DC receivers. A thoroughly screened switch can be used to connect the inner conductor of the signal cable to the top of the volume control when it is required to record.*

# TOWARDS BETTER TAPING

impedance as 'seen' by the tape recorder input to a suitably high value (though this will not be necessary in many cases).

### Isolating from the Mains

We now come to an extremely important part of the exercise. Most television and radio sets from which it will be required to record will be of the so-called AC/DC type. Apart from working on both AC and DC mains supplies, this type of set has the characteristic of having its metal chassis and/or negative HT line connected direct to one side of the mains supply. Correctly installed, this connection should be made to the neutral side of the mains supply.

However, there is always the possibility of the 'live' side of the mains supply being inadvertently connected to the metal chassis or 'earth', and for that reason some method of isolating the set from the power supply *must be adopted.* **Fig. 2** shows the necessity of connecting the 'earthy' end of the signal output circuit to chassis. Now, if that connection is made without isolation at the set, the whole metal-work of the tape recorder could rise to mains potential relative to true earth. This could prove fatal to a body and destructive to the equipment. Isolation must therefore be employed.

One must never *rely* on connecting the set's power supply so that the metal chassis is on mains neutral, for in any case a true earth must never be connected to neutral. To avoid hum problems the metal chassis (or HT negative) of the set from which the recording is to be made must be connected to a good earth.

Some people say that adequate isolation is possible by the use of capacitors of suitable voltage rating interposed in the two signal output leads. This is true, but to conform to various regulations the capacitance must not exceed 0·005 μF and such a low value puts a limit on the passage of the bass signals from the set to the recorder, and under certain conditions the bass is sadly attenuated.

More important, the impedance at 50 c/s (mains frequency) across the isolating capacitors (of 0·005 μF) is fairly high. This means that a substantial hum voltage can develop across them, and it is virtually impossible to get rid of hum when the capacitor mode of isolation is used. It is not, therefore, to be recommended.

### Make Use of a Transformer

By far the best idea is to employ a 1-to-1 ratio isolating transformer between the mains power supply and the mains input lead to the radio or TV set, as shown in **fig. 3.** The transformer should be chosen to handle the power requirements of the set used (about 60W for a radio and 150W for a television). Models of this nature can be supplied by radio dealers, these being available from *Radiospares Ltd.* and other factors.

When mains isolating of this kind is installed the radio or TV chassis becomes perfectly safe to handle. It can be efficiently earthed so as to minimise considerably hum pick-up problems.

The newcomer to tape recording, then, will now find that a tape recording of better quality than that produced by way of a microphone held in front of the loudspeaker is possible by cutting out the acoustic shortcoming. But there will still be a high level of distortion, since the output stage (and AF amplifier) of the radio or television set is still in use. The ideal is to take the radio signal from the set *before* it is applied to the audio stages therein. **Fig. 4** shows how this can be accomplished.

This little circuit illustrates the set's volume control which picks up its audio signal from the detector and sends it on via the slider to the audio stages. The audio across the control is totally free of amplifier distortion and is absolutely ideal for sending to the recorder.

It does not take long for the beginner to discover for himself that the signal is best extracted through a length of screened cable, whose metal braid is connected to the metal chassis of the set. Here again the question of isolation crops up, and the connections shown in the circuit must only be made after fully isolating the set transformer-wise, as shown in **fig. 3.**

### A Potential Killer

The great importance of isolation cannot be over stressed, for inattention here could turn a harmless tape recorder and receiver combination into a potential killer, and it is often the exploring fingers of a child which seem to make that fatal contact.

More will be said about isolation in next month's article, when the question of whether a better quality extension speaker is likely to improve performance will be discussed.

by H. W. Hellyer

# TAPE RECORDER SERVICE

**No. 28— TELEFUNKEN STEREO 77**

ALTHOUGH similar in many respects to the mechanical construction of the Models *75-76*, with the exception of the press-button unit, the *Stereo 77* presents quite a different problem electrically.

The circuit, which has been roughly 'blocked out' in **fig. 2**, consists of two quite separate channels, even to the individual oscillators. There are two versions: the *77T*, which has no internal loudspeaker, but has two output stages, as shown in the diagram, with connections for low impedance loudspeakers; and the *77K*, with a built-in loudspeaker (in the lid) for playback of either channel separately or simultaneously. For stereo, this can be one channel output, although it is often better to have two separate speakers, using the internal one only as monitor. There seems little point in going to the trouble of setting up a stereo circuit unless one is also going to strive for as much fidelity as possible—and even Messrs. Telefunken would not insist that the reproduction from a built-in loudspeaker does full justice to their stated frequency range of 40 to 16,000 c/s with a 2½W output.

This two-channel arrangement has its advantages for the experimenter, for even in the Monophonic mode, each channel can be recorded separately, then both played back simultaneously, and, of course, normal ¼-track facilities are available.

There are two or three queries that have arisen from the method of input connection on this model, and also the track selection. Taking the latter point first: when the left push-button is depressed, the upper track is selected and *both* output stages are fed with the playback signal from Channel 1. Thus, mono recordings can be played back through both outputs in parallel. Switch contacts short-circuit the output of the second channel. With the other button depressed, the Channel 1 output is short-circuited at the driver stage (prior to the output), and the Channel 2 amplifier is connected to both output stages, in the same way. This combined output is also connected to the 'Radio' socket, enabling the taking off of another signal for monitoring if required.

Depressing both buttons together gives completely separate amplification of both channels, for stereo playback. If both buttons are left up, and the machine switched to Play, both channels are applied simultaneously to each output and the mixed signal is available at both loudspeaker outputs and at the radio socket, as before.

During Recording, the channel separation is much the same, except that the appropriate output stage is employed as HF oscillator (63 Kc/s approx.) for bias and erase voltage and current, both being employed for stereo recording. More about this last point later.

Returning to the input conditions, it may be noticed that both microphone sockets are coupled. Actually, if we look a little closer, we see that they are cross-coupled, so that pin 4 of channel 1 is connected to pin 1 of channel 2 and vice versa. The result of this arrangement can be seen if we connect a coincident stereo mic. via a normal DIN plug to each mic. socket. Using the mic. in channel 1 socket (left-hand) gives correct stereo placing, but inserting it in socket 2 gives apparent side reversal. When mono recording is employed, the pin 1 connection of channel 1 is applied to the base of the first transistor.

Input matching is considerably simplified on this machine, despite the transistorised input, which generally imposes fairly rigid limits. The nominal input impedance is 90 K, and a 2 mV input fully modulates the tape. But if a high impedance source is employed, the treble loss that would sometimes occur is compensated by a frequency conscious circuit of which R1 and 2 (or *W513/563*, to use the maker's numbers), 100 K are variable. Correct setting of this variable requires a signal generator and a valve-voltmeter. For those who have the instruments available, the method is to feed a 1 Kc/s signal to pins 1 and 2 of the left mic. socket with a 1M resistor in series (connected directly to the input—no long leads). The input voltage is adjusted with the signal generator attenuator to give a valve-voltmeter reading of 1·5V between tags 2 and 5 of the right side of the pre-amp unit (see **fig. 1**). Next step is to increase the frequency of the input to 10 Kc/s without increasing the input voltage. The VVM reading should remain at 1·5. Adjust *W513* for these conditions, and repeat the test. For channel 2 a similar arrangement is carried out, using the right-hand mic. socket, tags 2 and 5 of the left side of the pre-amp unit, and adjusting *W563*.

A further input arrangement permits the use of a transistorised matching unit, similar to a matching transformer but actually using two transistors and having a gain of 18. To energise this, a 27½V negative supply is laid on, and the connection from the power pack is to pin 5 of each microphone socket.

### An unusual Component

From the pre-amplifier, which is quite conventional in design, the signal is applied, via switching, to the Record Level and Playback Gain control. A point worth noting here is that the component used in the original machine is a ganged 330 K linear potentiometer with on/off switch. Ganged, because this is necessary for stereo coupling, but linear because the makers say that logarithmic components of close enough manufacturing tolerance were not available. So they have had to use tapped linear tracks with three resistors across the tapping points, in series-parallel, to give a roughly logarithmic characteristic (this being necessary as our ears do not respond linearly to loudness levels).

This argument may have applied when the *77* was first designed, but I feel sure that Messrs. *Egen*, *Morganite*, *Plessey*, etc., would hardly subscribe to the view that ganged log. pots of close matching are not available, and there should be no hesitation in replacing the gain control with a 250 K log. dual-ganged potentiometer of good make. It may be necessary to experiment with the values of the coupling capacitor from the OC603 collector, at present 3 mfd, to maintain the time-constant and preserve treble response.

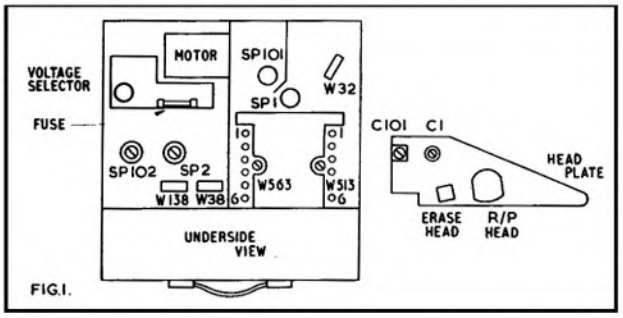


FIG.1.

From the gain control, the signal passes through two stages of amplification, two triodes of an ECC83 in each channel. The equalisation circuit, modified by the speed-change switching, is applied from the anode of the second triode to the cathode of the first as normal. At the output of the second triode, again via switching, the signal is passed either to the output stage (playback) or the recording head. Here it will be noticed that there is one small difference between the two channels. This is W32, whose purpose is to adjust the playback level so that both channels give the same output from a test tape, as measured between pins 2 and 5, Channel 1, and pins 2 and 3, Channel 2, of the Radio socket. This measurement should be rechecked after any adjustment to Azimuth alignment of the head, for all depends on the balance of the two channels—any subsequent test is valueless unless the two channels are balanced this way.

To measure the overall frequency response, it is necessary to feed two spot frequencies, 1 Kc/s and 15 Kc/s at the higher tape speed, to the Radio socket, via a potential divider circuit. The suggested arrangement is to connect the common of generator to pin 2 of the Radio socket, a 20 K resistor in series with the 'live' lead of the generator and a 20 ohm resistor across the radio socket connection. For Channel 1, this is pins 1 and 2, for Channel 2, pins 4 and 2. The input voltage (at generator) should be 60 mV. Tracks should be recorded at both frequencies, then replayed, and the output voltage of each, measured with valve-voltmeter at the earphone socket, with suitable 1 K terminating resistor, should be within ±3 dB. To adjust the overall frequency response to achieve this, the two trimmers C1, C101, on the head plate (see **fig. 1**) are used. Turning the trimmer clockwise increases treble response.

It will be noted that there is a single magic eye, and the arrangement here is that a bridge circuit is connected as a voltage doubler and each channel has a separate preset potentiometer to enable independent setting-up. Quickest method is to play back a test tape 1 Kc/s band, measure the output, and note gain setting, then record a 1 Kc/s signal, at same gain setting, adjusting input so that the signal, replayed, gives the same voltage output. Then adjust the preset, *W38* or *W138* as appropriate, to give shadow touch of the EM84.

Other adjustments on this model include the equalising coils SP1, SP101, and the oscillator coils, SP2, SP102. Normally, the equalising coils should not require any adjustment—but human nature being what it is, there are occasions when it is necessary to rectify a maladjustment! If the same hook-up is employed as for the overall characteristic, and a 1 Kc/s signal fed to the Radio socket, the oscillator 'killed' with a 0·1 mfd capacitor from grid (pin 1) to chassis, and the signal adjusted to give about 50 mV across the load at the earphone socket, then the core of each coil (as appropriate) can be adjusted for peak. This peak reading may be fairly difficult to determine.

### Setting the Oscillator Frequency

The principal adjustment that needs our attention with the oscillator circuits is the exact setting of frequency. During stereo recording, each oscillator is working independently (although there is actually a 0·002 mfd capacitor between the two grid circuits). If the discrepancy between the two oscillators is more than about 1 Kc/s, it is necessary to tune one or other, or both, to get back in step. This must not be done carelessly, as the recording bias (which is adjustable by C1, C101) and the erase current are also dependent on frequency. Erase current should be 210 to 250 mA, measured at the erase head with a thermocouple meter. This should give a 2·5V reading across a 10 ohm resistor in series with the erase head, measured with a valve-voltmeter. An ordinary meter is unsuitable for this test.

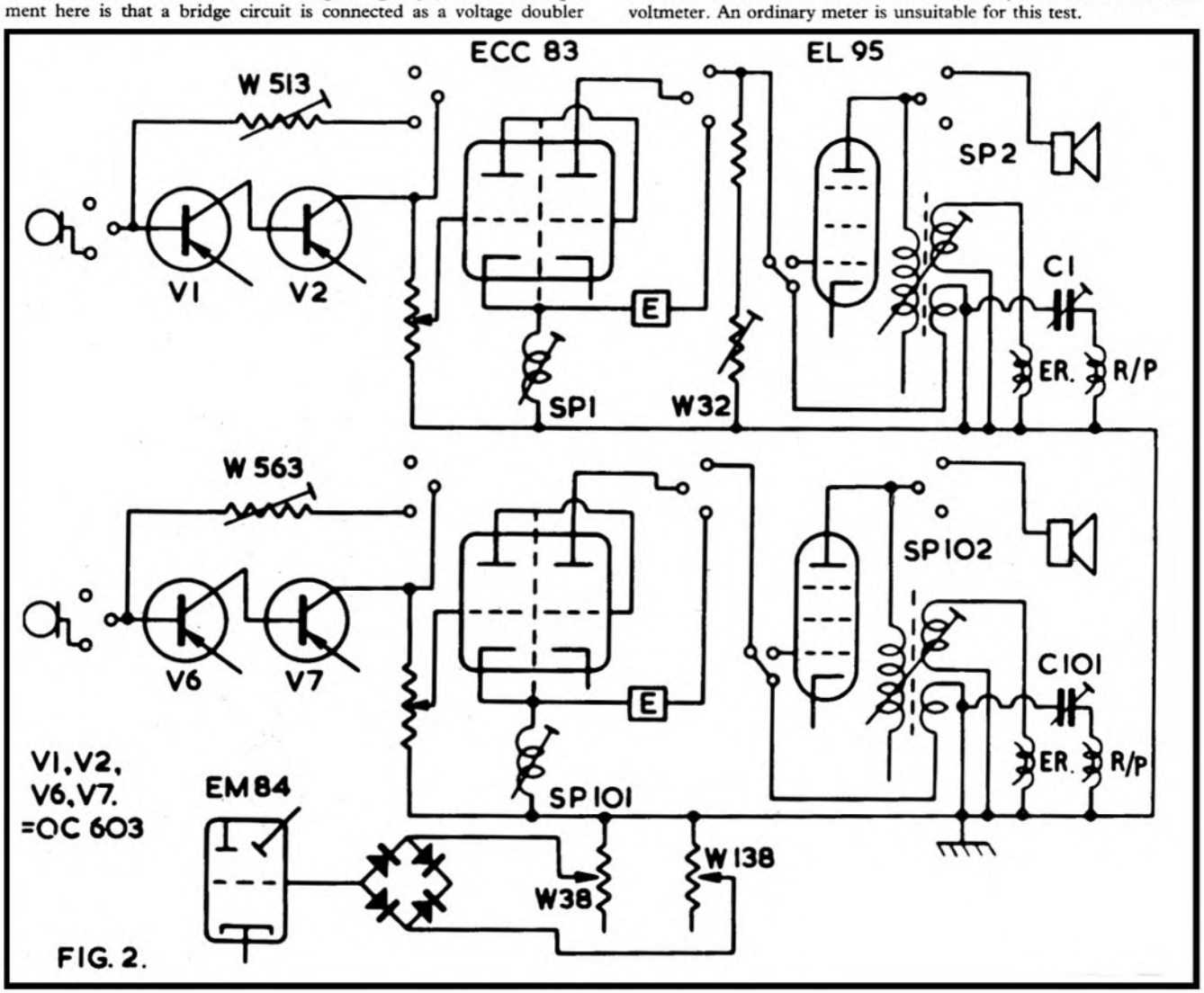
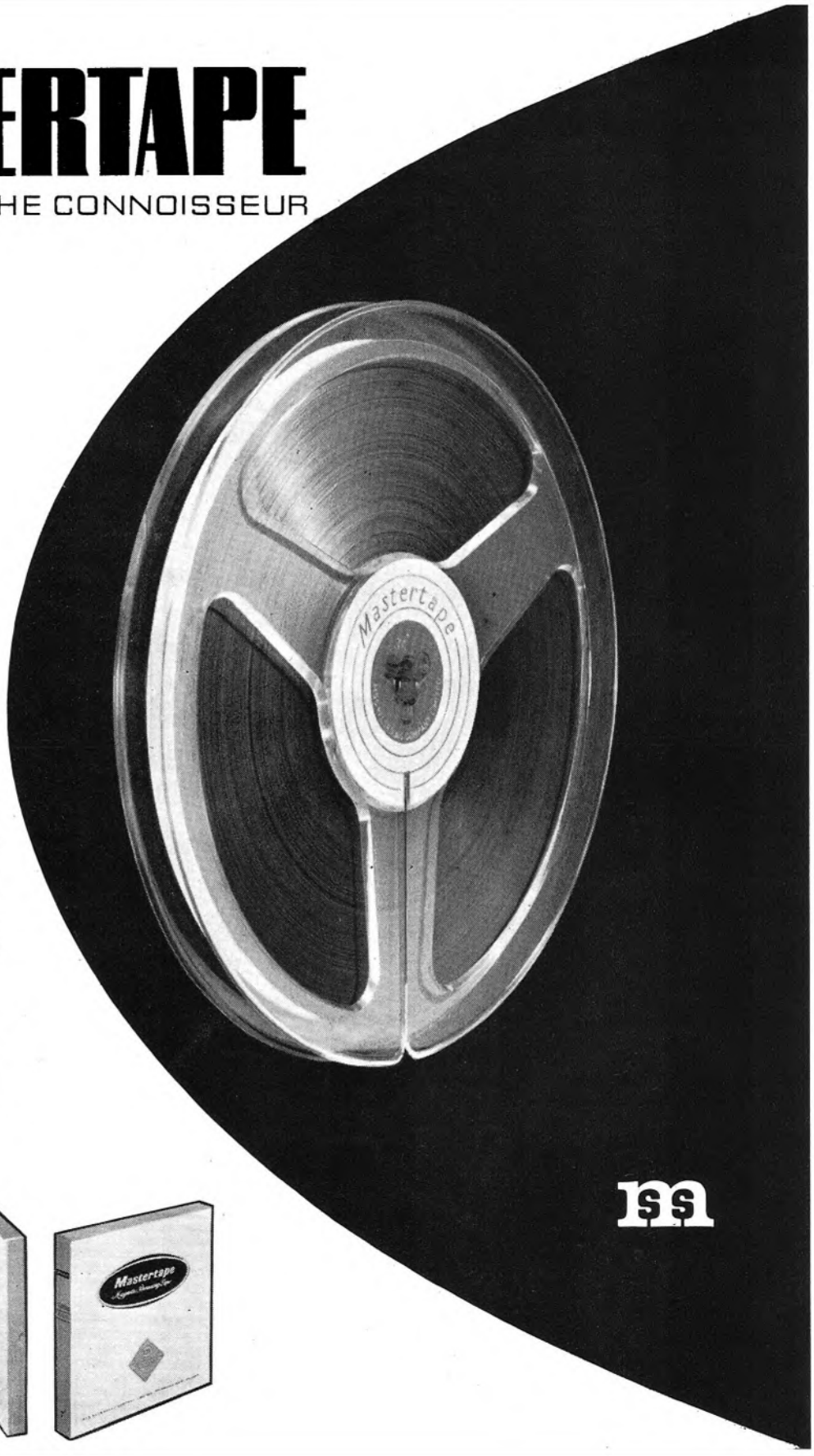


FIG. 2.

# MASTERTAPE

THE CHOICE OF THE CONNOISSEUR

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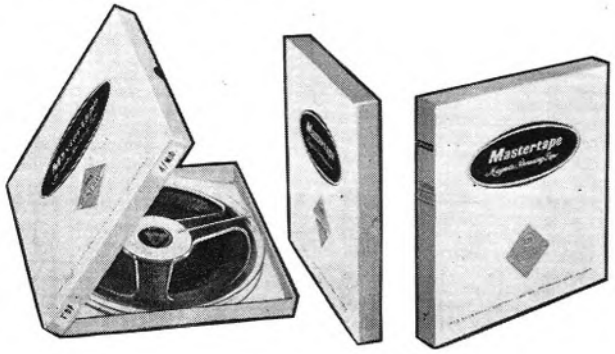
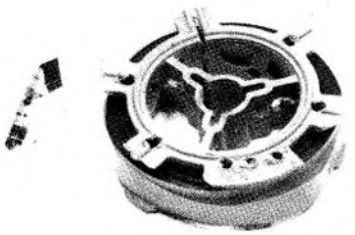


## HALF OUNCE TAPES

WHAT on earth is the use of a tiny tape, weighing only half an ounce? The answer is: "On earth, very little, but put it in the air and its weight becomes very important." Tape letters overseas lose much of their topicality when posted by surface mail, and to send the usual small 3 in. tape by air-mail costs about 7s. 6d. A half ounce tape costs 1s. 3d., just the same as an ordinary air-mail letter.



Half ounce tapes cannot be bought, but they can be made quite easily and at small cost. The heaviest part of a short tape is its spool. The grey plastic spools used for 8 mm. cine films are much lighter in weight than the kind usually supplied with tape, and they can be made lighter still by drilling and cutting. The size of the spool must first be reduced to a diameter of about 2 ins., by cutting off the rims and reducing the "spokes" to about ¼ in. in length. All flat spaces on the spool and its hub can be drilled out to reduce weight, and to avoid damage to the winding tape the edges of the spokes should be smoothed and bevelled with a file.

A spool of this size will easily accommodate about 110 ft. of triple play tape, giving about 6 minutes on each track at 3¾ i/s. It is helpful to standardise the length of tape to avoid timing difficulties when recording, and it will generally be found that six minutes on two tracks is quite long enough for regular exchanges, without overtaxing either the sender or recipient.

Packing, of course, also has to be reduced to a minimum, and an ordinary air-mail envelope can be suitably modified. Cut the envelope laterally to about three quarters of its original size, and seal the cut edge with narrow transparent adhesive tape. After addressing the envelope, place the spool on the left to avoid damage when the postage stamp is cancelled in the post office. The envelope is then reinforced with two bands of adhesive tape crossed over the "bulge", and the spool secured in position by a staple through the envelope. The weight of the spool, tape (with leaders) and packing can easily be kept under half an ounce, and these tapes travel well and seldom show any signs of damage.

**By R. S. Finlayson**

* * *

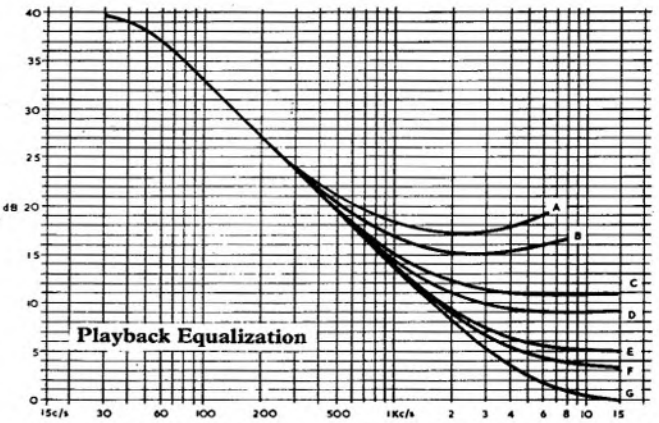
### Notes on Standard Tape Equalization Characteristics

IT does not seem to be generally known that there has been a revision of certain standards for tape equalization. Measurements conducted on certain Continental recorders show that the new standards have already been adopted, e.g. Mr. Tutchings, in a recent review of the Tandberg recorder, pointed out that the playback equalization at 7½ i/s appeared to be "midway between CCIR 100μ S. and NAB 50μ S.".

The revised standard for 7½ i/s was originally put forward by CCIR in June 1962 and the IEC in September 1962. This standard now calls for a shorter time constant of 70μ S. as opposed to the earlier 100μ S. curve. Furthermore, the non-standard but generally accepted playback characteristic of 200μ S. for a tape speed of 3¾ i/s has also been revised and given a DIN Standard No. 45513 dated June 1962. This standard calls for a playback curve having a time constant of 140μ S. and a 3180μ S. low frequency roll-off.

In order to illustrate the different playback equalizations now required, a graph is shown together with a Table giving the various characteristics for tape speed from 1⅞ i/s to 15 i/s. The curves have been normalized about the low frequency end in contradistinction to what appears to be an erroneous display which shows a series of separate curves at varying relative levels. In the curves shown the 30 c/s roll-off, which is only applicable to the new DIN Standard for 3¾ i/s, has been included for all equalizations, since experience shows that frequencies below this point are seldom recorded and that its permanent inclusion has advantages.

The higher frequencies beyond the turn-over points for curves C, D, E, F and G are shown to progress as horizontal lines and therefore represent a playback condition which supposes a perfect loss-free replay head. Since the Standard Test Tapes have recorded signals up to 18 Kc/s it would necessitate a head having a gap length of less than 1μ (0·04 thou.) to ensure freedom from gap losses. The standard high

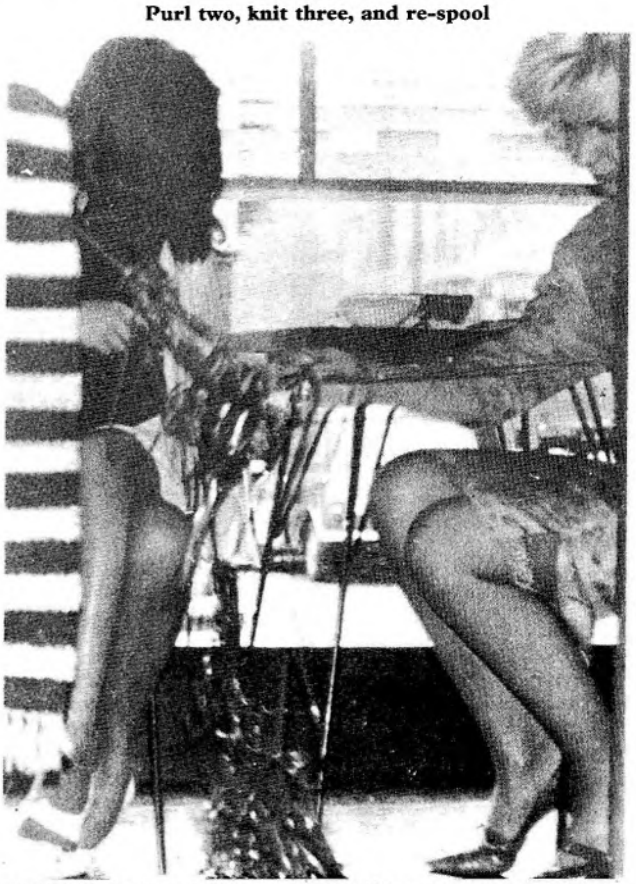



quality replay head, having a gap of 3μ (0·12 thou.) will therefore require an additional high frequency lift to maintain the desired replay characteristic. The amount of high frequency lift is not great (approximately 3 dB at 10 Kc/s) and would take the shape shown in the curves A and B of the graph.

*Some notes, with table and curves, kindly supplied for publication by the technical department of Miniflux Electronics Limited—because, as the covering letter stated, "We believe that your contributor (page 477, December 1963) is over-simplifying the matter of tape equalization characteristics". The writer also noted that the matter of tape equalization has now become rather complex; and we certainly agree with him. A similar state of affairs existed some time ago with gramophone records.* **Ed.**

* * *

### Purl two, knit three, and re-spool



HAS this happened to you yet? Not if you are a male, of course though an engineer in a well-known broadcasting organisation *did* once confess to us that he had spilled the entire content of a 10½ in. spool of a symphony concert, and was still untangling it (using the length of a long corridor) half an hour before the programme was scheduled to go on the air. This example of what *can* happen was taken recently by reader Ian Fenton in a London café.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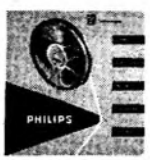


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# TAPE RECORDS REVIEWED






THIS month sees us very nearly through the backlog of tape records with which we started these reviews last September, and though some older tapes are still waiting in our pile (and some are reviewed here) we hope from now on to keep up with current issues as they arrive. We have been taken to task by one reader for giving undue favour to tapes from one particular source; this has not been due to bias but to an unbalanced supply of review tapes from the recording companies, and we hope from next month onwards to receive recordings from more sources. The only reason for not mentioning (eventually) any tape received is that the recording and/or musical content are definitely very poor, and with tape copying techniques at present in use—especially at 3¾ i/s—this inevitably means that a considerable number fail to get through the net.

We start this month's half-dozen with Russ Morgan and his Orchestra playing *Music in the Modern Manner* on *WRC TT145*. Twelve pieces are included, most of them sung by male soloist or chorus with band accompaniment. The numbers include popular sentimental songs such as *The Object of my Affection*, *So Tired* and *There Goes that Song Again*. All are well sung with very effective support from the band—in fact it is really the orchestra which stars on this tape and there is frequently some extremely intriguing playing from muted solo wind instruments. The recording is bright, clear and very enjoyable, especially for those with the sort of memory which has retained the popular songs of the last 20 years or so.

Those with a similar affection for 'tunes from the shows' will like Ferrante and Teichner's renderings in *Themes from Broadway Hits* (*WRC TT318*). These two skilful pianists form a sort of American Rawicz-and-Landauer partnership and offer here arrangements of eleven well-known tunes from successful shows such as *Gypsy*, *Sound of Music*, *Music Man* and *Bye Bye Birdie*. The piano duette is supported by various types of rhythm/percussion combination and the beautifully clear and rhythmic playing is recorded with great clarity. This is a very polished production and should provide good background entertainment for parties, dancing, etc.

Also transatlantic in origin and light in character is *Band Call*, with Duke Ellington and his Orchestra playing arrangements of twelve popular pieces (*WRC TTP86*). The selection covers a long period and includes (for the not-so-young) *Blue Moon*, *Isle of Capri* and *12th Street Rag*. These are 'big band' presentations in the Ellington style and some of the re-shaping of well-known tunes is very clever—if a little noisy at times. This is stylish and tightly rhythmic popular music, well recorded and—if you happen to like the Duke's particular pseudo-jazz style—good listening.

A long established *Saga* tape which has only just come to the top of our pile is *Collaboration* (*STG 8059*). This carries music which attempts to bridge the gap between jazz and orchestral music, with the Johnny Dankworth Band and the London Philharmonic Orchestra under Hugo Rignold. Three pieces are included: *Improvisations for Jazz Band and Symphony Orchestra* by Mátyás Seiber and Johnny Dankworth, *Rendezvous*—a Rondo for jazz soloists and Symphony Orchestra by Leonard Salzedo and David Lindup, and the *Ebony Concerto* by Stravinsky.

The first piece will no doubt interest jazz fans keen on experiment, though the orchestra and band are not, on the whole, integrated convincingly enough either musically or acoustically. The orchestra is set in a reverberant hall and the band is apparently well forward; the resulting sound is at times slightly muddled for one and rather noisy for the other, but some interesting effects do result. *Rendezvous* has a similar sound quality but is slightly more 'of-a-piece' musically—a catchy Latin-American touch is evident at times. The Stravinsky contribution is of a different world: jazz ideas are refined and filtered almost beyond recognition, resulting in an economical interplay of jazz wind tone-colours—astringent but satisfying. The recording is clear and well forward.

Stravinsky is also the composer of *The Rite of Spring*, a savage modern masterpiece of orchestral music. Performance is by the London Symphony Orchestra under Sir Eugene Goosens (*WRC TT159*), and for a 3¾ i/s mono tape the recorded quality is remarkable: large resources are presented in a clear, clean, full-bodied manner, all set nicely in a 'hall'. The performance is excellent—dramatic and bitingly powerful where needed, but with a lyrical and quietly beautiful quality elsewhere. At one time so controversial, *The Rite* is now accepted as a normal part of the concert repertoire despite its forceful dissonance in places. This performance gives an admirable fusion between the brutal and the beautiful.

A large public was introduced to Stravinsky via this work through the film *Fantasia*, where *The Rite* was made to represent the evolution of life up to the Dinosaurs. The picture on the box reminded us of Disney's conception of the volcanic wastes of a primitive Earth, but it actually turns out to be a reproduction of an impression of central Australia by artist Sidney Nolan. But whatever the interpretation of this musical depiction of a pagan ritual and sacrifice, it is mightily impressive and compelling.

Another 20th Century master of the orchestra was Ralph Vaughan Williams, and for the second month running we end our review with some music by this great Englishman. Like a number of other composers, RVW produced nine symphonies, and *No. 9 in E Minor* is performed by the London Philharmonic Orchestra under Sir Adrian Boult on *WRC TT144*.

This is a grand and spacious work containing many of the essential elements from the earlier symphonies. A large orchestra is used to encompass moments of cosmic grandeur *á la Sinfonia Antartica* (No. 7), some of the biting drama of *Job* and, at times, the ecstatic visionary beauty of the *Tallis Fantasia*. Boult handles everything magnificently, as might be expected from RVW's greatest exponent, though the recording has not the bright freshness accorded to the Stravinsky tape. However, unless you are playing via expensive wide-range equipment and have ultra-hi-fi standards, this is obviously the Vaughan Williams No. 9 to have.

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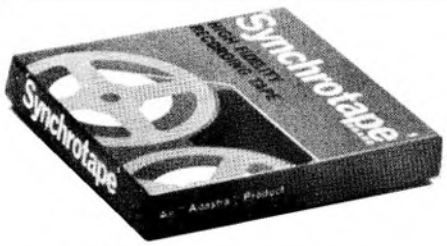


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According to the manufacturers it can be used under water, in snow or ice, or in a corrosive atmosphere, and is said to be capable of continuous operation for up to a year without attention. The basic components of the unit are an analogue to digital converter, a precision clock mechanism, and battery-powered transistorised recording amplifiers. A Garrard battery-type deck is incorporated.

The manufacturers provide a service of translating information and recorded data into a form suitable for computors.

**Manufacturer: Dobbie McInnes (Electronics) Limited, 4 The Mount, Guildford, Surrey.**

* * *

### Bell-O-Matic Cartridge Recorder

AN interesting form of cartridge is used on the *Bell-O-Matic* recorder, now being marketed in America and Switzerland. Two versions are available, the *Model 601* mono, and *Model 603* stereo. Both are equipped with 'professional' ¼-track record and erase heads and speeds of 3¾ and 1⅞ i/s.

On the stereo version the second channel is played through a speaker built in to the detachable lid. Although designed to take cartridges containing 600 ft. of tape, the machine will take ordinary 3 in. spools without an adapter.

**Manufacturer: Thompson Ramo Wooldridge Inc., 6325 Huntley Road, Columbus 24, Ohio.**

* * *

### Reslo MPD Microphone

A RECENT addition to the Reslo range is the *Mini Pencil Type MPD* dynamic microphone. Available with 30 and 50 ohm impedances, it has a frequency range from 50 c/s to 15 Kc/s. The price, £9 9s., includes a lavalier attachment, though the microphone can be used with a stand.

The pick-up response is omni-directional, although in a horizontal position it has a rear response 18 dB down at 11 Kc/s.

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

### Eagle Tape Head De-gausser

THE TD.79 tape head de-magnetiser was announced recently by Eagle Products. Operating from 250V AC, it is designed to remove all trace of residual magnetism that, if allowed to accumulate in the core of a head, can cause troublesome background hiss. Retailing at £1 9s. 6d., it is distributed by **B. Adler & Sons, 32a Coptic Street, London, W.C.1.**

* * *

### Stereosound Radiotape Mk 4

INCORPORATING the new BSR TD10 three-speed tape deck, the *Carousel Radiotape Mk 4* combines a recorder and AM radio tuner in a single cabinet. Recordings can be made directly from the tuner which can also be used as a normal radio. The *Mk 4*, complete in a walnut-veneered cabinet with detachable legs, retails at £42.

A similar version, with a VHF tuner and *BSR UA15* record changer, is available at £75 12s.

**Manufacturer: Stereosound Productions Limited, Capital Works, 12-14 Wakefield Road, Brighouse, Yorks.**

* * *

### Synchrotape Triple-Play

SYNCHROTAPE, we were informed recently, are now adding an inexpensive triple-play tape to their range. It is available in two sizes, 450 ft. on a 3 in. spool, price 13s. 9d., and 900 ft. on a 4 in. spool, price £1 7s. Both sizes are fitted with leaders, and the 4 in. size also has metallic stop-foils. Free samples are obtainable, on request, from dealers stocking the brand.

Substantial price reductions are also announced for double-play Synchrotape. This will now retail at the following prices: 5 in. 1,200 ft. £1 9s.; 5¾ in. 1,800 ft. £1 16s.; 7 in. 2,400 ft. £2 8s.

**Distributor: Adastra Electronics Ltd., 167 Finchley Road, Swiss Cottage, London, N.W.3.**

* * *

### Mullard Professional Tape Heads

MAGNETIC recording heads for professional applications are now available from Mullard, through their new design and manufacturing service.

The heads are made from a high-density ferrite, rather than the conventional laminated metal. As a result, it is claimed, their working life is increased ten-fold, and they can be used for recording frequencies of up to 10 Mc/s. A process in which glass is moulded between the pole-pieces is said to eliminate erosion of the head, and to give a sharply defined gap with a minimum width of one micron.

Typical uses for the heads include video, computor-data, and professional sound recording.

**Manufacturer: Mullard Limited, Torrington Place, London, W.C.1.**

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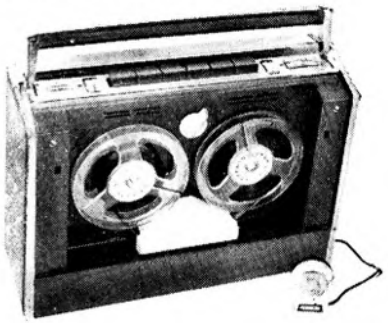

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# EQUIPMENT REVIEWED

## TELEFUNKEN MAGNETOPHON 96 TAPE RECORDER


**Manufacturer's Specification: Tape Speeds:** 1⅞, 3¾, 7½ i/s. **Frequency range:** 30 c/s to 18 Kc/s at 7½ i/s. 30 c/s to 16 Kc/s at 3¾ i/s. 30 c/s to 9 Kc/s at 1⅞ i/s. **Input sockets:** 2mV at 47 K ohms (radio input). 2mV at 2 Megohms (microphone input). **Outlet sockets:** 1V at 18 K ohms (radio outlet). 10V at 100 K ohms (earphone outlet). 2·5W at 4·5 ohms (loudspeaker). **Voltages:** adjustable to 110V, 200V, 220V or 240V. **Power consumption:** about 55W. **Fuses:** two 0·2 amp for all voltages, two 0·8 amp (motor fuses) for all voltages. **Dimensions:** height 7⅞ in., breadth 19 11/16 in., depth 11½ in. **Price:** £72 9s. **Distributor: Welmec Corporation Ltd., Lonsdale Chambers, 27 Chancery Lane, London, W.C.2.**

THIS is the first *Telefunken* recorder I have tested in my capacity as reviewer for this magazine, although I know their professional machines well and have been very impressed by their quality and reliability.

This is a ¼-track, three-speed recorder with a built-in pre-amplifier for the lower head so that only a power amplifier and speaker, or radio set with pick-up terminals, are required for stereo playback of pre-recorded tapes. The internal pre-amplifier can also be used for monitoring one track while recording the other, and transfer from track to track, with the addition of extra material from microphone or disc, is a simple process which can be carried out with no extra equipment.

### Central Control Bar

The well-known Telefunken central control bar controls all tape motion other than record or play. Tape can be spooled backwards or forwards and stopped under perfect control with no risk of tape spill or dangerous tape tensions. This is made possible by the unique servo tape control system which uses levers operated by the tape tension to pick up the required power from the single motor as needed and to brake the spool drums whenever the tape tension falls below a certain value.

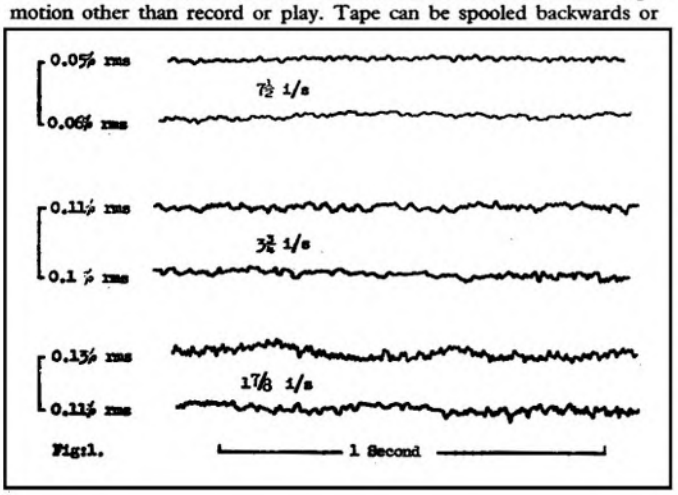

Fig:1.

### Separate Gain Controls

Separate record and playback gain controls are provided, and this is a great convenience when recording and checking short sections of tape. The tone control is well out of the way off the main control panel, but it will be used infrequently as it is a simple top cut control operating on the output stage only, and will be used mainly by devotees of 'mellow' reproduction, or to make it easier to talk over quiet background music.

The track selection buttons operate independently and can be depressed together if parallel reproduction of top and bottom tracks is desired.

The 'Pause' control is unusual in being a rotary knob instead of a push key. Personally I like it very much.

### Speed Tests

The makers are careful to point out that the recorder should be warmed up for five or ten minutes before using for a serious recording. Despite this I have to report that I found the speed unstable at the highest speed of 7½ i/s even after an hour's continuous use. A strobe test showed that the variations were all negative, i.e. below the nominal speed. If the tape was stopped and switched on again, it would sometimes come up to within about ½% of 7½ i/s, but generally it was 1% to 2% slow. So far as I could see there was no wander of speed; on any start the speed remained constant even though slightly slow. On the other two speeds there was no such trouble, they came up to speed every time. It may be a small fault on the positioning of the idler wheel, or it could be that the motor loading is rather critical.

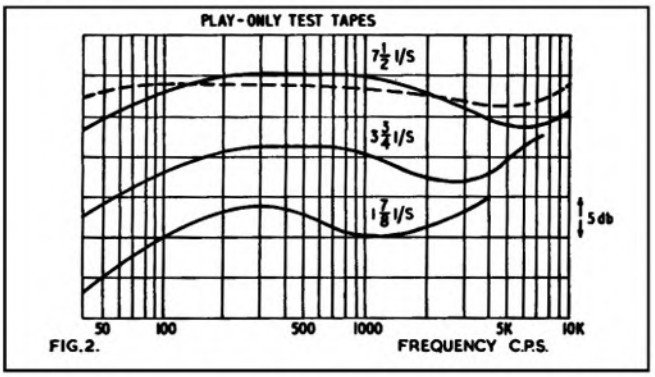

FIG.2.

The pen recordings of **fig. 1** show the short-term speed variations together with the integrated RMS total wow and flutter readings measured through a low-pass filter with a cut off at 300 c/s. These are excellent and need no further comment. Only at the lowest speed of 1⅞ i/s is there the slightest indication of cyclical speed changes, and then only when the record and play wows happen to coincide.

### Play Only Tests

The play-only section of my testing procedure has given rise to more controversy and questions than any other part of my reviews, so I now hope to make clear my reasons for including these tests:

(a) It is necessary to play a tape recorded to a known recording level to be able to make any estimate of true signal-noise ratio when playing pre-recorded tapes. The test tapes are recorded 12 dB below peak recording level where 3% third harmonic distortion is generated by the tape itself. Tests have proved that all modern tapes are capable of recording a virtually undistorted signal at 12 dB above test tape level if properly biased and fed with a clean recording signal.

(b) It is useful to play tapes recorded to known surface induction recording characteristics. We do *not* expect all recorders to reproduce these tapes with a level response. On the other hand any deviations from a level response give us important information about the playback

(*Continued on page 127*)

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characteristic of the recorder under test, and together with the record play responses, an indirect indication of the *recording* characteristic selected by the manufacturer.

With these points in mind let us examine the results of these tests on the recorder under review.

The 7½ i/s solid curve of **fig. 2** shows the response obtained by playing a test tape with a surface induction time constant of 100μs on the Telefunken *96*. The 6 dB step in the playback response indicates that the manufacturers have chosen to use the NAB recording characteristic with a time constant of 50μs. This is done by using more high frequency pre-emphasis in the recording process so that the overall record/play response is level (see **fig. 3**), but with an improvement in signal/tape-hiss ratio.

The dotted curve shows the response of the same test tape played on the bottom track via the extra internal pre-amplifier. It will be seen that it is very close to the CCIR 100μs. characteristic. When a signal recorded to the NAB response is replayed on this channel there will be a 6 dB rise in top response. This has probably been done deliberately so that the tone control on the external amplifier or radio can be used to reduce the high note response to match that of the recorder's own amplifier. It is much easier to reduce high note response than to boost it, with consequent risk of exaggerating noise and harmonic distortion. Noise and hum was 37 dB below test-tape level on these tests.

**Record-Play Response**

The lower speed playback responses of **fig. 2**, taken with 200 and 400μs. test tapes, show a 6 dB step on a slightly top-tilted response, indicating that the level responses of **fig. 3** are obtained by using NAB recording pre-emphasis together with a little bass boost.

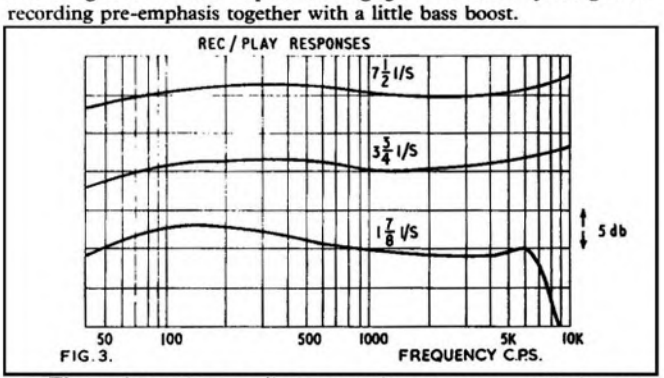


FIG. 3.

**Fig. 3** shows the overall record-replay responses—radio input to line output via the diode socket. These responses were taken at 6 dB below test-tape level to allow for the severe high note pre-emphasis used when recording 50, 100 and 200μs. time constants at tape speeds of 7½, 3¾ and 1⅞ i/s, respectively.

Peak recording level, as indicated by the clashing of the magic eye beams, was 8 dB above test-tape level, but an undistorted signal 12 dB above test-tape level could be recorded with the beams overlapping by about 1/16 in. So that letting the beams clash occasionally will give recordings with a dynamic range of between 45 and 49 dB, which is excellent for a four-track recorder.

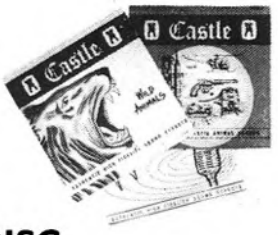
**Clean Quality**

Bands of filtered white noise were recorded and the sound output on the axis of the loudspeaker was measured with a calibrated microphone to give the overall electro-acoustic response shown in **fig. 4**. The dotted curve shows the response with the tone control at maximum top cut. The low note cut-off below 200 c/s is caused by the inadequate baffle area and volume inseparable from a table model recorder such as this. Nevertheless, the response from 200 c/s to 8 Kc/s is smooth and well balanced, and both speech and music are reproduced with a 'forward' uncoloured clean quality.

(*Continued on page 129*)

# Castle

# SOUND EFFECTS

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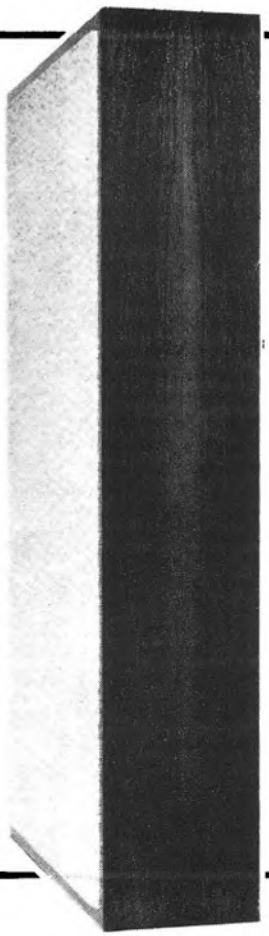

## EQUIPMENT REVIEWED — *continued*

### Circuit Notes

The circuit is straightforward, using a high-gain low-noise pentode in the first stage, followed by a double-triode with feedback equalisation from the second plate to the first cathode. The output pentode doubles as a single-ended bias and erase oscillator during record. The lower channel pre-amplifier consists of a high-gain double-triode with negative feedback equalisation from plate to grid of the second stage, and with the head tuned to give a slight high note lift followed by a sharp cut in response to prevent bias cross-talk amplifier overload when the upper track is recording.

### Comment

A glance at the underside of this recorder reveals that no tiny detail has been neglected which might improve the performance of the recorder to the smallest extent; let me give a few examples:

The first stage amplifier valve is encased in sponge rubber and is further surrounded by a mu-metal shield so that not the slightest trace of microphony or hum pick-up on the electrode system of the valve can mar the excellent signal-noise ratio of this recorder.

The head is completely encased in a mu-metal box with a lid which completely seals off the sensitive head from unwanted hum pick-up when the tape is in motion.

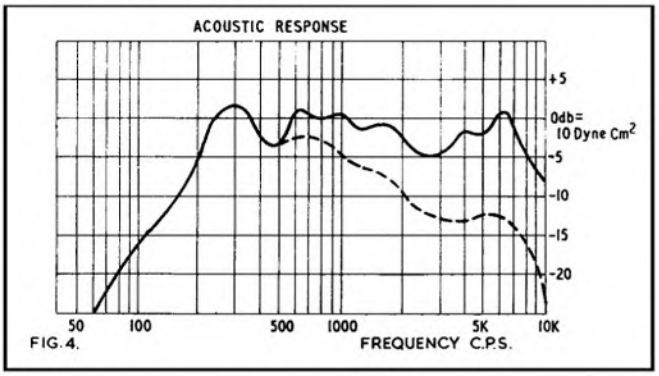

FIG. 4.

The motor is surrounded by a steel enclosure which still further reduces hum radiation into the surrounding circuits and, in addition, acts as a duct to ensure that the fan on the motor shaft efficiently cools the rest of the 'works'.

Although the basic circuit of this recorder is completely orthodox, it is the tiny details of layout and placement of parts which make it obvious that the development and engineering is fully professional and based on wide experience of tape recorder design.

I would guess that the speed instability at the highest speed is a fault of some kind, probably in the idler wheel system. I have no means of knowing whether it is a design weakness or not, but, just to be on the safe side ask your dealer to check this point carefully before delivery.

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*Continued*



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**Lee Electronics, The Tape Recorder and Hi-Fi Specialists,** can now undertake Wow and Flutter Tests with their latest 'Gaumont Kalee' Wow and Flutter Meter. Test Report supplied. 24-Hour Service. Price —25s. 400 Edgware Road, Paddington, W.2. Paddington 5521.

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*(Continued*

# CLASSIFIED ADVERTISEMENTS

**Tape Recorder Cleaning Kit,** a new accessory by Nusound. Includes hypodermic oiler, special oil, cleaning fluid, brush, cloth, etc. Attractively packaged, price £1 post free. Nusound Recording Co., 93 Mortimer Street, Oxford Circus, W.1. Telephone MUS 1219.

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## WANTED

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

**Highest cash prices offered** for good quality Tape Recorders and Hi-Fi. See our ad. page 00 this issue. R.E.W., 266 Upper Tooting Road, London, S.W.17.

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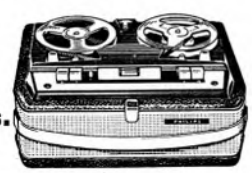

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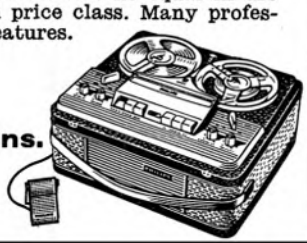

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