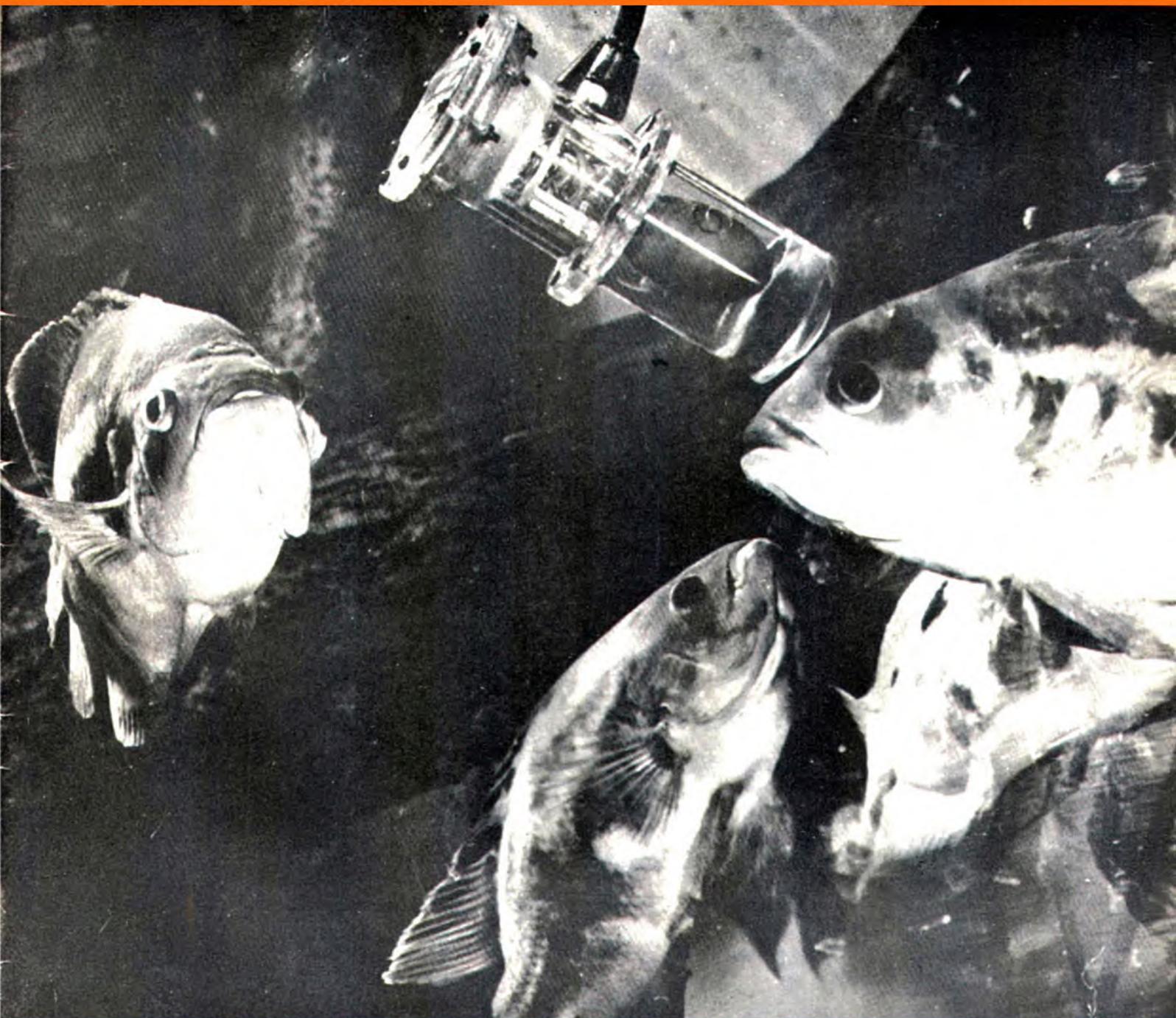


the TAPE RECORDER

PRICE 1/6

April 1962
Vol. 4 No. 3

INCORPORATING "SOUND AND CINE"



IN THIS NUMBER

Frequency and Wavelength in Tape Recording

Our Readers' Write

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Audio Festival Details

News from the World of Tape

Why pay eighty-one guineas?

Yes, indeed, you may well ask "Why do people continue to pay 81 guineas for a Ferrograph when they can buy a Tape Recorder for less than half this price?" We venture to suggest that those who choose the Ferrograph do so for several sound reasons. Firstly, there are those who have learned from past—and perhaps bitter—experience that low price invariably means a low standard of performance.

How can it be otherwise when price is the manufacturer's main objective?

Then there are those who take pride in the ownership of a product that has achieved a world wide reputation for its excellence—that stands alone for its outstanding performance.

And finally there are those—and this may apply to the majority—who take the trouble to assess the claims and counter-claims of competitive makes in their quest for the truth. To these we say that at no time have we ever indulged in extravagant claims for the Ferrograph.

Instead we have always preferred to state the simple facts and let the instrument speak for itself. And here let us pay a grateful tribute to Ferrograph users who are always so ready to praise our Tape Recorder and demonstrate it to their friends.

Let it be sufficient for us to say that among regular users of the Ferrograph are Broadcasting and Television organisations, H.M. Services, leading personalities in the world of music and drama, educational authorities, explorers and news commentators, and record manufacturing companies. Surely no higher tribute can be paid to Ferrograph quality than the recognition that with so many the final choice depends, not upon price, but upon the more lasting qualities of performance and reputation.



**INTERNATIONAL AUDIO FESTIVAL
ROOM 247, BOOTH 61**

Series 4A

For conventional Monaural Recording and Playback.

Model 4A/N (3½/7½ i.p.s.) **81 GNS**

Model 4A/H (7½/15 i.p.s.) **86 GNS**

Series 4S

As above but in addition fitted with stereo head to permit playback of pre-recorded stereo tapes through external hi-fi amplifiers and loudspeakers.

Model 4S/N (3½/7½ i.p.s.) **88 GNS**

Model 4S/H (7½/15 i.p.s.) **93 GNS**

Series 420

For Monaural and Stereo recording and playback, with monitoring, re-recording from one track to the other, introduction of echo effects and many other advanced features. Requires power amplifiers and external loudspeakers.

110 GNS

*Three Independent Motors · Synchronous Capstan Motor · Recording Level Meter · Brief Stop · Interchangeable Plug-in-Heads
Switched Speed Change with Compensated Correction Network · Separate Tone Controls · High Fidelity 2½ Watts Output Stage · Uses
8½" Tape Spools · Gear Driven Turns Counter · Automatic Switch cuts Motors at end of Spool · Endless Loop Cassette (Optional Extra)*

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84, BLACKFRIARS ROAD, LONDON, S.E.1

Telephone: WATerloo 1981

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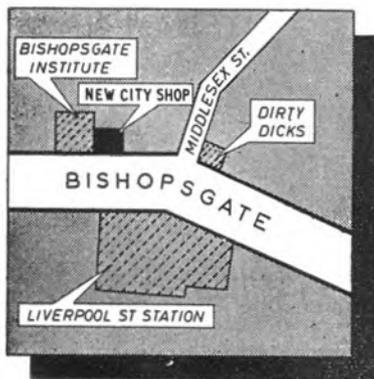
DON'T BUY A TAPE RECORDER!!!

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CITY & ESSEX TAPE RECORDER CENTRES

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lowest possible prices



TAPE AMPLIFIER UNITS

Models TA-IM and TA-IS

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

TA-IM £18.2.6 TA-IS £23.6.0 TA-IC £6.10.0



TRUVOX TD-1 Mk. 6 TAPE DECK. Some of the facilities of this Mono/Stereo Tape Deck are: record; playback; fast-forward; fast reverse; dual braking; two tracks, side by side. £29.15.0

With TA-IS £52.1.0 With TA-IM £46.17.6



COLLARO "STUDIO" TAPE DECK. Operating speeds: 1½ in., 3½ in. and 7½ in. p.s. Wow and flutter not greater than 0.15% at 7½ in. p.s. £17.10.0

With TA-IS £35.14.0 With TA-IM £30.10.0

"MOHICAN" GENERAL COVERAGE RECEIVER Model GC-1U. Fully transistorised. 4 piezo-electric transmitters. To overcome the problems of alignment, etc. the R.F. "front end" is supplied as a pre-assembled and pre-aligned unit. £38.15.0

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AUDIO SIGNAL GENERATOR Model AG-9U. Delivers up to 10 volts pure sine-wave (less than 0.1% distortion, 20 c/s to 20 kc/s). Decade switch-selected frequencies from 10 to 100,000 c/s. Internal 600 Ohm N/I load, or external. £19.19.6



AG-9U

SUGDEN MOTOR UNIT "CONNOISSEUR". Heavy duty motor operating at 33½ and 45 r.p.m. Very heavy 12 in. turntable. £17.1.5

TO ALL MUSIC LOVERS AND HI-FI ENTHUSIASTS

Our wide range does not permit adequate coverage of all models. A FREE CATALOGUE and full specifications of any particular model will be gladly sent on request, without obligation on your part.

'COTSWOLD' SPEAKER SYSTEM

This is an acoustically designed enclosure 26" x 23" x 14" housing a 12" bass speaker with 2" speech coil, elliptical middle speaker, and a pressure unit to cover the full frequency range of 30-20,000 c/s. Capable of doing justice to the finest programme source, its polar distribution makes it ideal for really Hi-Fi Stereo. Delivered complete with speakers, cross-over unit, level control, Tygan grille cloth, etc. All parts pre-cut and drilled for easy assembly and left "in the white" veneered for finish to personal taste. Assembled weight 61 lb. ... £21.19.0



'COTSWOLD'



'THE MALVERN'

'MALVERN' EQUIPMENT CABINET A NEW AND ATTRACTIVE CABINET in modern style designed to house all your Hi-Fi equipment (including tape deck and full-sized transcription record player). The cabinet parts are veneered and pre-drilled, with edging in Panoplex plastic strip, for ease of finishing. Complete with everything you need for assembly, including screws, hinges and even a padsaw! Left "in the white" for finishing to choice. Size 39½ x 32 x 21½ in. ... £17.18.6

HI-FI FM TUNER Model FM-4U

For your convenience, this model is available as two separately sold units: the Tuning Unit, Model FMT-4U (£3.5.0 inc. P.T.), with IF output of 10.7 Mc/s and the Amplifier Unit, Model FMA-4U (£11.11.0). Built-in power supply; 7 valves. Total ... £14.16.0



FM-4U



S33

HI-FI STEREO 6-WATT AMPLIFIER Model S-33. Attractively styled, completely self-contained. Printed circuit makes it easy to build. Only 0.3% distortion at 2½ W/chal. 20 dB N.F.B.; sensitivity 200 mV. U/I output, ganged controls. £12.8.6

HI-FI STEREO 16 WATT AMPLIFIER Model S-88.

Within its power rating, this is the finest stereo amplifier available, regardless of price. 200 mV. basic sensitivity (4 mV. available, 7/6 extra); ganged controls. U/L push-pull output. 0.1% distn. at 6 W/chal. £26.12.6



S88

TRANSISTOR INTERCOM, Models XI-1U & XI-1IU

Designed for use in the business office or the home, the Master unit (XI-1U) can operate up to five Remote units (XI-1IU) which give instant service without warming-up delay. "Private" switch. 9 volts battery operated. Sapele-mahogany cabinets supplied assembled. XI-1U £4.3.0 XI-1IU £10.15.6



REMOTE XI-1IU



MASTER XI-1U



USC-1

STEREO CONTROL UNIT Model USC-1

Push-button selection, accurately matched ganged controls to ±1 dB. Negative feedback rumble and variable low-pass filters. Printed circuit boards. Accepts inputs from most tape heads and any stereo or mono pick-up. £18.18.6

TRANSISTOR PORTABLE RADIO Model UXR-1

Presented in elegant real hide case with gold relief. Can be assembled in 4 to 6 hours. Pre-aligned I.F. transformers, printed circuit and a 7 in. x 4 in. high-flux speaker. £14.18.6



UXR-1

4-wave TRANSISTORISED PORTABLE RADIO Model RSW-1

Using 7 latest type transistors and three diodes this highly sensitive set is specially designed for Short and Medium wavebands (200-550, 90-200, 18-50 and 11-18 m.). In leather case fitted with retractable whip aerial. £22.10.0



RSW-1

HEATHKIT ELECTRONIC WORKSHOPS KIT, Model EW-1. This new kit will help your boy to understand electronics, by making at least 20 exciting experiments, including Transistor Radios, Intercom Sets, Burglar Alarm, Electric Eye, etc. £7.18.0

POWER AMPLIFIER 12-WATT Model MA-12. Single channel, ideal for stereo conversion. £10.19.6

HI-FI SPEAKER SYSTEM Model SSU-1.

This kit is easily assembled. It contains twin speakers and balance control in its ducted port reflex cabinet. It is equally suitable for stereo or mono in average room. (Legs £1.1.0). Less legs £10.17.6



SSU-1

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

ALL MODELS ARE ALSO AVAILABLE, WIRED AND TESTED. PRICES ON REQUEST.

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HT2

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VARIABLE FREQUENCY OSCILLATOR	...	Model VF-1U	£11.2.0
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RESISTANCE/CAPACITANCE BRIDGE	...	Model C-3U	£8.6.6
AUDIO VALVE MILLIVOLTMETER	...	Model AV-3U	£13.18.6
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THE LARGEST-SELLING ELECTRONIC KITS IN THE WORLD

You are invited to
STEREO FORTNIGHT
at TeleTape of Marble Arch

24th APRIL — 5th MAY

**LONDON'S MOST EXCITING
AUDIO CENTRE**

To coincide with the 1962 Audio Fair, TeleTape are staging a special Stereo Fortnight at their Marble Arch showrooms. This advertisement is your free invitation to see—and hear—this unusual show.

Here's what Stereo Fortnight offers you:

- * A unique stereo tape demonstration (continuous performance) including fantastic 'headphone stereo'.
- * A chance to win £100 of tape records of your own choice (mono or stereo) in the TeleTape Stereo Competition.
- * A free copy of the comprehensive TeleTape catalogue of pre-recorded tapes (all brands).
- * A tape recorder and high fidelity exhibition, with all leading makes on display.

Be sure you visit TeleTape—Britain's largest tape record and recorder specialists—during Stereo Fortnight. The TeleTape showroom is at 33 Edgware Road, W.2 (two minutes from Marble Arch) and open six days a week and up to 8 p.m. on Fridays.

Admission is absolutely free.

FOR PRE-RECORDED TAPES AND TAPE RECORDERS
visit TeleTape

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AT TELETAPE NOW!

The Sensational **SONY 521**

THE MOST VERSATILE HIGH-QUALITY TAPE
RECORDER EVER OFFERED!



Look at these unique features:

- * Mono or stereo recording and playback at the press of a button.
- * 2-track or 4-track at the flick of a switch.
- * 7½ and 3¾ ips.
- * Built-in stereo pre-amplifiers, stereo recording amplifiers and stereo playback monitor amplifiers.
- * Built-in professional mixing facilities.
- * Automatic cut-off switch at end of playing time.
- * Advanced 'rim-drive' mechanism . . . no pulleys or belts to wear out.
- * Separate channel recording indicator meters.
- * Two built-in speakers.
- * Push-button adjustment for characteristic (CCIR and NARTB).
- * Supplied with two dynamic microphones.
- * Price 124 gns. complete.

SONY Research makes the difference

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Here, for the real enthusiast, is a new tape recorder to make your dreams come true. Not only does its performance meet the most exacting standards; but it has also brilliant operational refinements which make it a delight to use. Please study some of the highlights of the specification below and then try a TK.40 for yourself. We are proud of it, and are sure you will be too.



STAR FEATURES

Three tape speeds

1 $\frac{1}{2}$, 3 $\frac{1}{2}$, 7 $\frac{1}{2}$ i.p.s.

Frequency response

60 to 10 Kc/s at 1 $\frac{1}{2}$ i.p.s.
60 to 15 Kc/s at 3 $\frac{1}{2}$ i.p.s.
60 to 18 Kc/s at 7 $\frac{1}{2}$ i.p.s.

Wow/Flutter

$\pm 0.1\%$ at 7 $\frac{1}{2}$ i.p.s.
 $\pm 0.12\%$ at 3 $\frac{1}{2}$ i.p.s.
 $\pm 0.2\%$ at 1 $\frac{1}{2}$ i.p.s.

Four-tracks

Selected by positive piano-type keys.

Signal to noise ratio

Better than 50 db at 7 $\frac{1}{2}$ i.p.s.
Better than 45 db at 3 $\frac{1}{2}$ and 1 $\frac{1}{2}$ i.p.s.

Pressure sling

This, unlike the conventional pad, is flexible and maintains even pressure over the whole surface of the head. It gives better H.F. response and minimises "drop-out" effects.

Multi-disc clutches

In addition to the normal slipping clutches the TK.40 embodies additional multi-disc clutches to remove excessive tape strain. Using *double-play* tape you can switch immediately from fast-forward to fast rewind or vice versa without tape breakage or stretch.

Inching

Fast-forward and rewind are controlled by a slider actuating a progressive clutch. Inching is thus unusually easy and accurate. A lock position is also provided.

Cine-socket

To connect magnetic heads from a cine projector to the TK.40 to record sound films or play back from them.

Built-in tape cleaner

Retractable, and press-button operated.

Indicator re-set

The digital indicator is provided with a button for immediate zero re-set.

Automatic stop

At the end of the tape.

Remote control

An adaptor is available.

Mixing facilities

For microphone/pickup and microphone/diode.

Monitoring

Through loudspeaker when required.

Synchronous recordings

Output for monitor amplifier provided.

Superimposition

Push-button provided for adding effects or commentary to existing recordings at will.

GRUNDIG

Ask your Grundig Approved Dealer for a demonstration or write to us for an illustrated leaflet.

TK40

75 GUINEAS
(INCLUDING MICROPHONE)

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(Electronics Division, Gas Purification & Chemical Company Ltd.)

CS.301



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See all makes. Dozens of different models, by all well-known makers. They are *all* at the Tape Recorder Centre—the country's leading specialists in tape recording. At the Tape Recorder Centre you can see all makes, hear all makes, compare all makes, on the spot. Experts are on hand with informed advice, based on the wealth of Tape Recorder Centre experience, to make sure you choose the model that is best suited for you (and for your pocket). You will find everything you need for tape recording, office dictation and hi-fi at the Tape Recorder Centre, plus excellent HP terms. Hear all makes, see all makes, at

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T C R **TAPE**
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CENTRE

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Philips
Elizabethan
Grundig
Ferrograph
Stella
Vortexion
Brenell
Ampex
Tandberg
etc

YES! YES! YES!



INTERNATIONAL triumphant new WyndSOR recorder

There is so much one could say about the new vertical-operating 'INTERNATIONAL' that you should write to us for the colour leaflet to do it justice. Briefly:

Four tracks—two speeds ($7\frac{1}{2}$, $3\frac{3}{4}$), fantastic performance, independent bass and treble controls, 8 in. round speaker (11,000 lines gauss) facing rear, recording level meter with horizontal scale, three inputs, three outputs, output for stereo, monitoring through speaker, switched straight through amplifier, red/green warning lights, tape position indicator, storage space for microphone and six spools, ribbon microphone with flexible column and stand, centrifugal locking nuts for spools, pause control (temporary or lock down).

75 gns. complete with ribbon microphone and flexible column

69 gns. without microphone



AT THE AUDIO FAIR STAND NO. 32
DEMONSTRATION ROOM 261

WyndSOR RECORDING COMPANY LTD.
WyndSOR Works, 2 Bellevue Rd., Friern Barnet, London, N.11 Tel: Enterprise 2226/7



A PROGRAMME

Make the most of your tape recorder and your tape recordings. Whatever the type of programme you most enjoy you'll immediately recognise the consistent, uniform quality that you get from AUDIOTAPE . . .



WORTH RECORDING

the extra crispness at the top and the extra depth of bass – without the loss of the essential middle tones that often prove so elusive. AUDIOTAPE has only one standard of quality – the finest obtainable –



IS WORTH THE

backed by more than ten years' experience in magnetic tape manufacture and more than two decades of practical experience in the art of sound recording. You cannot buy a better tape than AUDIOTAPE – it speaks for itself.



BEST OF TAPES

Available in 5 different types with a base material and reel footage to suit every requirement. All 5" and 7" reels of AUDIOTAPE are supplied on the exclusive C-Slot Reel – the fastest threading tape reel ever developed.

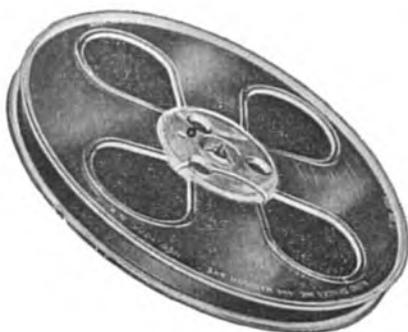


AND THE BEST OF TAPES IS

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TRADE MARK

... on the sensational C-SLOT REEL!



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the truest sound

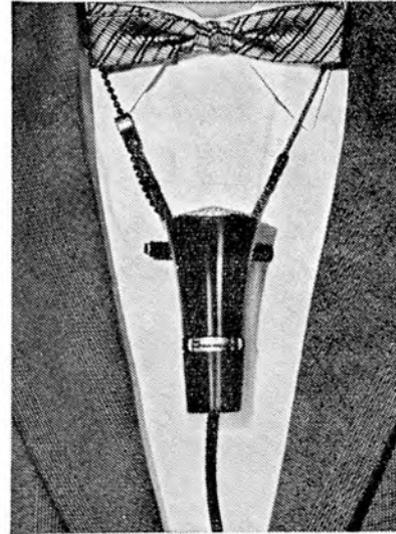
For sound reproduction as it should be—as close as possible to the original—make Shure microphones your unvarying choice. They are the finest for every purpose, years ahead of others in the technical excellence of their design and performance, the most comprehensive range obtainable anywhere.

Model 545 'Unidyne III' for public address, tape recording, communications and similar applications requiring compactness with maximum operating efficiency.

Model 420 'Commando' can be used indoors or outdoors, for all general-purpose applications. Quality performance at moderate cost.

Model 540S 'Sonodyne II' This versatile new microphone features *variable frequency response*, allowing the user to tailor the microphone to the application.

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Model 420 'Commando'

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Setting the world's standard in sound



Model 55SW
'Unidyne'

Model 540S
'Sonodyne II'



**YOU'LL KNOW GOOD SOUND
WHEN YOU SEE IT!**



If you've seen "Ben Hur" or "The Guns of Navarone" you'll know what we mean. Both these outstanding films were recorded on Zonatripe—a fact worth remembering when you are buying tape and want to buy the best. Zonatapes are supplied in handsome case bound library containers and are obtainable from most high class radio, music and photographic shops.

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THIS IS THE COMPLETE TAPE RECORDER



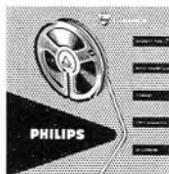
92 GNS.
complete with
microphone, 7" reel LP
tape, empty 7" spool,
connecting leads.



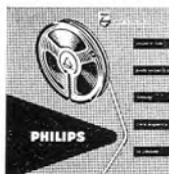
PHILIPS MODEL EL 3536

Philips De Luxe Tape Recorder, Model EL 3536, is an instrument for the true enthusiast. It makes available—in one superbly designed machine—every worthwhile development in the art of tape recording, including stereo recording and playback. Look at these features: four-track mono recording/playback at three speeds for up to 16 hours' recording on one 7" reel of DP tape; four-track stereo; magic-eye modulation indicator; automatic tape stop; coupled stereo gain controls; wide frequency response and high fidelity reproduction, plus many more.

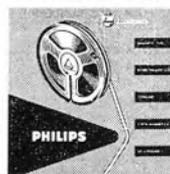
Philips tape makes every recorder sound better than ever.



GREEN
FOR STANDARD



RED
FOR LONG-PLAY



BLUE
FOR DOUBLE-PLAY

Model EL 3536—the top recorder in the top tape recorder range—can be seen and heard at THE AUDIO FESTIVAL, Hotel Russell, April 26-29—STAND 46 and Demonstration Room 342.

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(PR.4006)

EMITAPE captures all the right effects

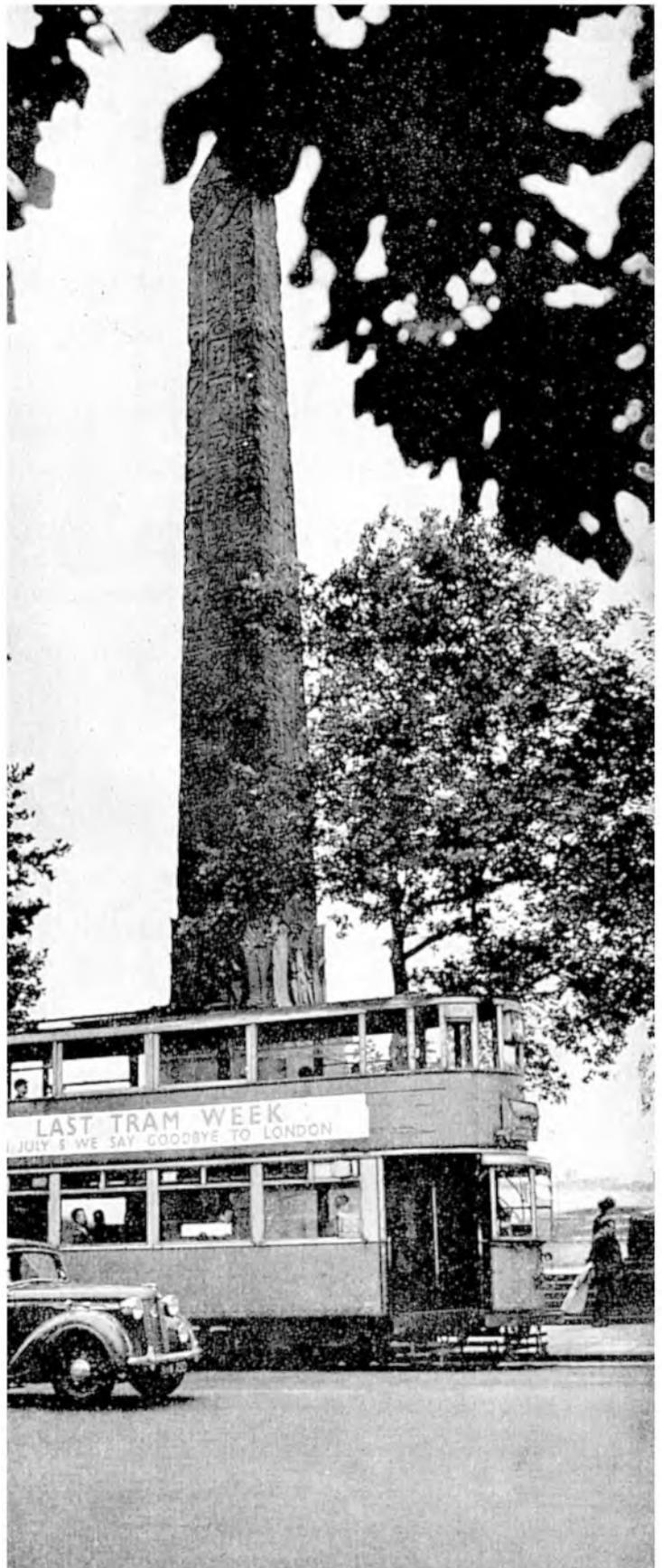
You can still hear the rumble-hiss-whine of a London tram in Covent Garden—it's just one of the 60,000 effects on Emitape at Stagesound, Britain's largest independent effects library. But, if Stagesound keep their tabs on the past, they've also got more than half an ear on the present with a satellite's bleep to match the croak of a klaxon.

All these miles of Emitape at Stagesound keep ITV, commercial radio and film studios well supplied with any effects they may want. Incidentally, Stagesound also supply most of London's West End theatres with alarums, excursions and noises off.

There simply *must not* be any mistakes in this business. That's why Stagesound always use Emitape—the world's finest magnetic recording tape.

EMI **Emitape**

E.M.I. TAPE LIMITED, Hayes, Middlesex.



ET30

the TAPE RECORDER

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 Advertising Editor - - - - - Julian Berrisford
 News Editor - - - - - Alan Lovell
 Editorial Offices - - - 99 Mortimer Street, London, W.1
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★
EDITORIAL

MEMBER OF THE
AUDIT BUREAU
OF CIRCULATIONS

WITH the 1962 Audio Show close at hand, many readers who have been debating the purchase of a tape recorder are, we know, waiting a few weeks longer in order to make sure that they miss nothing. On this score they may be wise, because it is at large gatherings such as this annual event that one meets many people, picks up many odd bits of information, and often finds the right person to provide just the right answers to questions at the right moment. This, indeed, is one of the least appreciated of the many advantages of the show, and one which can often be the most useful.

There will probably not be a spectacular number of new recorders at the show: if there are more than half a dozen from the English manufacturers we shall be surprised. What is to come from overseas will in all probability not be publicised before the doors open—so we may find more new types than we expect from the Continent and from Japan. However, this apparent “decline” in the quantity of new types and models indicates a healthy trend, and not (as might easily be thought) a falling off of interest. The tape recorder industry went through a very unhealthy period fairly recently, which resulted from too much enthusiasm—and not a little greed—on the part of too many people who did not care nearly enough about the quality of what they manufactured. *Anything*, it seemed, would pass for a tape recorder if it had 2 spools, 3 speeds and a reasonably attractive case and price. Many people fell for these products; and, fortunately, their makers soon fell out of the running.

Fewer tape recorders there may well be this year, but better tape recorders there most certainly will be. As the market has narrowed itself down, so are the products improving. Therefore, the visitors to this year's London Audio Festival who come with “tape” as their primary interest, are certain to benefit from their period of deliberation. While they have been waiting, the goods they have been thinking about have been improving!

A word of advice to these potential buyers may not be out of place. We suggest that they make a point of hearing “sound from tape” at its very best. We recommend a visit to the demonstration rooms where the most expensive professional equipment can be seen and heard—E.M.I. for example. Even though the apparatus is astronomically high in price—and completely out of reach, even if the space were available to house it!—the results that can be heard from it are a most valuable yard-stick when making *any* future comparison. They make it possible for the novice to keep his feet on the ground when making up his mind about his own modest purchase at a later date. After hearing the best, he will not fool himself or be fooled (or even unintentionally deceived) by the often ambitious claims made for very ordinary, good, domestic equipment. Such

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an experience may, at first impact, be rather shattering—because tape reproduction at its very best will equal (if not surpass) the very best that can be heard, via good equipment, from good B.B.C. broadcasts. But this experience should also be a good leveller. The average tape recorder enthusiast does not expect to pay more than about £60 to £70 for his instrument: what he will hear, if he follows the above advice, would cost him at least ten times that amount of money. But the attractive claims so often made for “average” tape recorders really do suggest that their performance should equal or surpass the best.

No one—or at least very few enthusiasts—would consider this professional equipment a worthwhile outlay for normal domestic requirements, and most of us will be content with a good, average machine that works well and reliably. Accepting that fact, and having the yardstick of the best in mind, it is commonsense to make the next step a genuine trial and hearing of the machine that is selected. First, hear it without any extras—listen to it replaying an “on-the-spot” recording through its own speaker. Next, listen to it replaying a good, commercially recorded tape of music, such as might well be bought in the future for home entertainment. *Only then listen to it playing good tapes through expensive external speakers.* In other words, hear it first as it will probably sound in the home, as unpacked and used. *Then* hear it with the frills that it may one day be possible to add to it.

There have been far too many tape recorders sold by a reversal of this procedure. Such sales methods invite disappointment. Beware of them. And so, to close on a note that we have already sounded, make use of the forthcoming Audio show in two ways: first, see all that there is to attract; second, use the very valuable opportunity that it offers for comparisons of many different kinds.

COVER PICTURE

WE are indebted to the Telefunken Company for our cover picture this month. The idea which lay behind it was triggered off by a Berlin skin diver when diving in the Mediterranean. He was so fascinated by all the sounds that he heard under water—from surf to thudding motor boat engines—that he decided to try to record sounds in the Berlin Aquarium on his return. His collection of tape recordings now include many fish noises—even their munching of food! And here, for all we know, the fishy group may be criticising the design of the special microphone used for recording their bubbles, etc.

AUDIO FESTIVAL DETAILS

ONCE again, the London Audio Festival and Fair is being held at the Russell Hotel, Russell Square, London, W.C.1, from April 26th to 29th. It will be open to the general public from 4 p.m. to 9 p.m. on Thursday 26th and 11 a.m. to 9 p.m. on Friday and Saturday. On Sunday, the 29th, the Festival opens at 11 a.m. and closes at 8 p.m.

Recording enthusiasts will find plenty to interest them including new machines from Sony, Ferrograph, Fi-Cord, Tandberg, Kolster Brand, Truvox, Telefunken, Bang and Olufsen, Grundig, Philips, Stella, Wyndors, Simon and Cossor. Also of interest will be an entirely new deck—the Planet U.1 which uses a Papst Hysteresis Motor and Miniflux heads. Some of the above-mentioned machines have been available for a few months, others will be completely new.

Tickets are available on request, for any day from the organiser, C. Rex Hassan, 42 Manchester Street, London, W.1. Stamped addressed envelopes are required.

Due to the early dates we go to press, only a few manufacturers have sent in details of the equipment to be demonstrated. However, three interesting machines to look for are pictured below.



**PLANET U1
TAPE DECK**



**BANG AND
OLUFSEN
BELCANTO
RECORDER**



**SONY
MODEL 521
RECORDER**

LIST OF EXHIBITORS

Name	Booth No.	Dem No.
Acoustical Manufacturing Co. Ltd.	31	147
A.K.G.	69	321
Ampex (Gt. Britain) Ltd.	1	254
Armstrong Wireless & Television Co. Ltd.	9	359
Aveley Electric Ltd.	19	355
BASF	36	312
Braun Electric International S.A.	OX	319
Brenell Engineering Co. Ltd.	70	259
Chapman (Ultrasonics) Ltd.	17	347
Collel Ltd.	48	320
Clairtone Sound Corp. of Canada, Inc.	12	161
Clarke & Smith Manufacturing Co. Ltd.	7	211
Cosmocord Ltd.	64	302
The Decca Record Co. Ltd.	68	212
Denham & Morley Ltd.	40	118
E.M.I. Electronics Ltd.	54	354
Elstone Electronics Ltd.	24	255
A. C. Farnell Ltd.	23	—
Fi-Cord Ltd.	71	311
The Ferrograph Co. Ltd.	61	247
Garrard Eng. & Manufacturing Co. Ltd.	37	248
Gen. Gramophone Publications Ltd.	—	—
Gevaert Photo-Production N.V.	60	122
Goldring Manufacturing Co. Ltd.	53	215
Goodmans Industries Ltd.	14	317
Grampian Reproducers Ltd.	59	252
Grundig (Gt. Britain) Ltd.	8	115
Hanover Press Ltd.	—	—
Hansom Books Ltd.	—	—
Highgate Acoustics	55	314
Illiffe Electrical Publications Ltd.	—	—
K.E.F. Electronics Ltd.	20	214
H. J. Leak & Co. Ltd.	4	113
Leevers-Rich Equipment Ltd.	22	313
Long Playing Record Library Ltd.	—	—
Lustraphone Ltd.	6	149
Lowther Manufacturing Co. Ltd.	34	237
Minnesota Mining & Manufacturing Co. Ltd.	49	120
M.S.S. Recording Co. Ltd.	35	—
Mullard Ltd.	10	111
Miles Henslow Publications Ltd.	67	—
Metro-Sound Manufacturing Co. Ltd.	72	112
Odhams Press Ltd.	21	—
Pamphonic Reproducers Ltd.	15	—
Parman Electronics Ltd.	11	352
Philips Electrical Ltd.	46	342
Picture Story Publications Ltd.	41	—
Planet Projects Ltd.	OY	233
Pye Ltd.	30	234
Reslosound	18	—
Rola Celestion Ltd.	58	348
Radford Electronics Ltd.	5	121
Record Housing	63	213
Recording Devices Ltd.	56	114
Reflectograph Tape Recorders	16	152
Rogers Developments (Electronics) Ltd.	2	202
Robuk Electrical Industries Ltd.	52	315
Simon Equipment Ltd.	65	220
Saga Records Ltd.	57	159
Shure Electronics Ltd.	43	361
S.M.E. Ltd.	66	—
Soundcraft Magnetics Ltd.	26	218
Standard Telephones & Cables Ltd.	50	—
A. R. Sugden & Co. (Engineers) Ltd.	47	304
Tannoy Products Ltd.	39	204
Tellux Ltd.	74	117
Teppaz S.A.	45	222
Truvox Ltd.	44	336
Vitavox Ltd.	25	337
Vortexion Ltd.	73	144
Waverley Records (Geo. Jeffrey) Ltd.	51	221
Welmecc Corp. Ltd.	62	242
Wharfedale Wireless Works Ltd.	38	334
Wyndors Recording Co. Ltd.	32	261
Whiteley Electrical Radio Co. Ltd.	33	322
Zonal Film (Magnetic Coatings) Ltd.	42	236

Exhibitors listed with no Booth no. or Demonstration Room have Offices only.

NEWS FROM THE WORLD OF TAPE

Recorded Books on Tape



THE Berlin Audio Book Library for blind civilians and ex-servicemen has opened a new studio. The studio is furnished with the most modern equipment installed in an Audio Book Library for the blind in the Federal German Republic and West Berlin.

Nowadays tape recorder technique is proving more and more a blessing for the blind and revolutionising their daily life. At one time radio was often the only recreation for many blind—particularly those who lost their sight late in life. Today tape recorders are increasing the possibilities for recreation and the blind are able to suit their leisure hours more and more to their wishes.

Over 700 books—novels, histories, scientific essays and books etc.—are listed in the collection of the Berlin Audio Book Library. These books have been read by radio announcers and actors and recorded on tape, copied several times, sent for exchange to other libraries, and loaned to blind. At home, the blind hear the literature from the tape: “The Buddenbrooks” by Thomas Mann, for example, which lasts about 19 hours, Margaret Mitchell’s best seller “Gone with the Wind”, which takes 44 hours to hear or Hemingway’s book “The Old Man and the Sea”, which is heard in two hours.

On entering the recording room, it seems as though one is standing in a modern broadcasting studio. Walls, ceiling and floors have been fitted with noise-absorbant plates. The speaker has about the same technical aids at his disposal as his counterpart in the studio of a broadcasting station. In the sound engineer’s room there were installed a modern broadcasting studio control desk, two Telefunken studio tape recorders “Magnetophon M5”, which are used by the majority of German broadcasting corporations, nine small studio equipments “Magnetophon 24”, which are used to copy the recordings, and a record player.

In this way the blind are also able to enjoy the world of literature and philosophy, and do not feel so left out of everything.

Tape in Space

THE historic flight on February 20, 1962 of Col. Glenn in the Mercury Space capsule featured a unique form of tape detected by sensitive pickups taped to his body, the on-board the capsule during the flight, obtaining detailed information for post-flight analysis.

No radio frequency is involved in the on-board recording. One channel of voice communication from the astronaut and up to 6 channels of multiplexed analogue data from appropriate record amplifiers are recorded. In addition to the astronaut’s voice commentary and physiological phenomena which are detected by sensitive pickups taped to his body, the on-board tape records environmental conditions such as temperatures, pressures, acceleration and shock. On two separate tracks pulse

duration modulation records the sequence of events and performance of the space craft.

The reel-to-reel tape recorder used measures $11 \times 13 \times 3\frac{1}{2}$ in. and weighs only 12 lbs. fully loaded with tape. It operates at $1\frac{7}{8}$ i/s, recording a maximum of 3 Kc/s. The capsule recorder’s two stacked $10\frac{1}{2}$ in. reels hold, 3,600 ft. of a special “heavy duty” instrumentation tape developed by the 3M Company. This tape, “Scotch” No. 499 Instrumentation Tape, has a long-wearing coating designed to minimize oxide rub-off, reduce build-up of electro-static charges and resist high temperatures. The tape was specified by Consolidated Electroynamics Corporation (CEC), makers of the special recorder, to ensure optimum performance. On its thin (.92 mil) polyester backing, the $\frac{1}{2}$ in. wide tape provides nearly $6\frac{1}{2}$ hours of continuous recording.

Information of great research and development value was gained through similar recordings of previous flights. On January 31st, 1961, when Project Mercury’s Chimpanzee-carrying capsule was launched, unexpected thrust from the Redstone booster and the escape rocket of the abort system raised the launching missile’s velocity to 5,000 m.p.h.—1,000 m.p.h. faster than anticipated. During this flight, chimpanzee “Ham’s” reactions were continuously recorded.

When this capsule was fished from the ocean 2 hours after launching, water had seeped into the tape recorder resulting in



a dramatic test of the tape’s heavy duty binder. Despite the excessive acceleration pressures and a prolonged soaking in corrosive salt sea water, the tape retained its construction and played back with full fidelity to provide the only continuous record of the flight from 2 minutes before take-off to touch-down.

Recorders in the five previously recovered Mercury capsules were all found to be in excellent condition with taped records intact. The on-board recording obtained during Commander Alan Shepard’s historic sub-orbital trip on May 5th, 1961, contained every phase of the flight from start to finish, providing invaluable background data for Col. Glenn’s recent successful space flight. Shepard’s voice came through much clearer on the on-board tape than on the recordings made by the ground stations and an on-board recording is the only guarantee of a continuous recording, since part of the signal on a ground recording can be lost as the craft goes through the ionization blackout stage.

NEWS AND PICTURES FROM THE CLUBS



Visitors to tape recording clubs always receive a warm welcome. This was the case when Mr. R. Judd, Chairman of the Tanganyika Tape Recording Club recently visited the South Devon Tape Club and met the Chairman Mr. Gordon Furneaux.

THE meeting of **Rugby Amateur Tape Recording Society** (presided over by Mr. J. O. Bannister) was this time given to synchronisation of sound with film. Mr. T. P. C. Davis brought along his equipment to do the demonstration with and in conjunction with the Society's Tape Recorder coupled with a Stroboscope. Mr. Davis showed the film he had taken at the last meeting so that the members present had the pleasure of seeing themselves on film. Mr. A. Lovett was the first "Volunteer" to undertake putting a running commentary to the film. After this the Quiz was played—this being provided by Mr. G. Dawson—and the winner once again was Mr. B. Pick. An interval followed after which more film was shown and this time Mr. Dawson provided a commentary.

Much regret was expressed by all present at the news of the secretary—Mr. M. Brown's return to hospital—but all gave best wishes for his speedy return to health.

Details of future meetings are available from *M. Brown*, 219 *Clifton Road, Rugby*.

AT their latest meeting, members of the **Cotswold Tape Recording Society (Cheltenham)** heard a lecture by T. Bolt on "Tape Copying and its Implications". To illustrate his lecture, Mr. Bolt brought along his own tape-copying equipment, consisting of a Ferrograph 4A/N recorder, a Collaro Studio deck connected to a pre-amplifier to provide initial amplification and equalisation, and thence into a power amplifier and loud-speaker for monitoring, and into the recorder for copying.

Mr. Bolt pointed out that an advantage of a copying system is that unwanted items can be omitted from the copy—being retained on the master if desired—and editing is possible, whereby the order of recorded items can be changed. Without a second replay system, this can only be done by the physical cutting of the original tape, which is expensive and also destroys the original master tape.

The great disadvantage arises from the fact that losses, especially of the higher frequencies, are bound to arise in copying. To some extent this can be minimised by use of a preamplifier which carries tone-controls. Mr. Bolt had prepared two demonstration tapes: one the original recording, and the other a first copy. These were played in rough synchronisation, switching from one to the other without revealing which was the original.

Members were then asked to indicate the original. Most of them did so correctly; but the fact that some were wrong and others were in doubt did show that a first copy of an original can be extremely close in quality to the former.

Other demonstration tapes showed the effects of repeated copying, which is less disastrous on speech than music, and of various faults in copying, such as under- and over-recording, hum loops and the like.

The meeting terminated with a demonstration by Eric Jones of a transistorised audio oscillator of his own design and make. This gives a single frequency of approximately 3.5 Kc/s, and is intended for use when choosing a recorder. The "works" are carried in the pocket; a jack plug is connected to the recorder being examined, which is switched to record and the tone put on the tape. An immediate playback indicates the wow and flutter standard of the machine far more accurately than any musical recording, and particularly more than any demonstration tape which may be used to demonstrate, and which may have been specially made on a professional machine. This fascinating gadget seems likely to worry many a local dealer; and will certainly be in great demand!

Further details can be obtained from *D. Turner, Cave Cottage, Oakridge Lynch, Stroud, Glos.*

ELEVEN members of the **Whitstable and District Tape Recording Club** accepted an invitation from the Maidstone Society to attend a lecture at Maidstone given by a technical member of the staff of E.M.I. Ltd. The hospitality of the Maidstone club was appreciated, and it is hoped that future combined meetings will be arranged.

Plans for entering the local blind association are well advanced and a monthly tape will be made containing news items, sounds of the district and local entertainers. Members have already visited several blind people in their homes and have recorded messages from them to relatives overseas.

Among the items planned for the future are tape slide shows, a lecture on battery portables and visits from tape recorder manufacturers. The secretary *T. Robinson, 17a St. Anne's Road, Whitstable, Kent*, will supply further information.

THE **Clacton Tape Recording Society**, meeting at the Ebor Lodge Hotel, recently re-elected the Committee back into office for another year. Activities planned for the future include many outside recordings such as interviews, recording sound effects and other items of topical interest.

More demand is being made on the members who visit the local hospitals and Old Folk's Home and helpers are needed to produce recorded programmes.

At the last meeting the club received a visit from the Ipswich Tape Recording Club. A local astronomer provided a lecture and slide demonstration on the stars and planets. More information regarding future activities can be obtained from *J. Heavens, 27 Chapman Road, Clacton-on-Sea*.

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NEWS AND PICTURES FROM THE CLUBS

DURING February, the members of the **Thornton Heath Tape Recording Club**, welcomed three committee members of the Croydon Voluntary Association for the Blind. Tape recorded programmes are planned for the blind in the Croydon area by the Association, and the recording club members were asked if they would be willing to assist. In a very short time, the necessary helpers were found and plans are now well advanced.

So many entries were submitted for a "Five-minute Tape" contest, that the playback of tapes had to be extended over two weeks. Another contest will be held next month.

Any reader interested in joining this club should contact the Chairman, *E. J. Bashford, 4 Dunheved Road North, Thornton Heath, Surrey.*

CERTAIN members of the **Ellesmere Port Tape Recording Club** have expressed a desire to couple tape recording activities with cine and slide synchronising. This problem was discussed and it was decided that as the majority of members were in agreement that the club would become a combined sound and cine club.

As this will appeal to other people in the area interested only in cine, but anxious to produce sound tracks to accompany the film, an invitation to visit the club has been issued by the secretary *S. J. Powell, 11 Cressington Gardens, Ellesmere Port, Cheshire*

THE **Cambridge Amateur Tape Recording Society** recently held its first Annual General Meeting the president, in his opening address, remarked that it had been a most successful year for the society. Activities had been varied and had given some insight into other aspects of tape recording which should be developed during the coming year. The treasurer presented a statement of accounts and balance sheet which were adopted by the meeting.

In his report, the secretary said that 1961 had been a trial for the society, from which they had emerged with flying colours. He mentioned the social services carried on by the society and emphasised that these functions should be pursued to an even greater extent in the future. The technical representative spoke of the demonstrations his sub-committee had arranged and looked forward to seeing increased activity in this field.

The committee was then dissolved and each officer re-elected for a further year.

After the main business of the evening, Mr. Hiam, manager of Messrs. G. P. Reece, presented prizes, donated by his company, to Peter Shiston and John Holliman, winners of the society's competitions. Mr. Hiam, remarking on the competition entries, said that it was very easy to copy the style of the B.B.C., but this year members had been different, and he hoped that they would continue to do so. The evening was concluded with a questions and answers session, when members were able to put forward suggestions for the next year's programme.

Further details from *M. E. Renshaw, 6 St. Vincent's Road, Girton, Cambridge.*

MR. R. V. **HUDDLESTONE**, Secretary of **Stereo International Magnetic Tape Club** of 9 College Avenue, Melton Mowbray, Leicestershire, sent the following letter to this office.

"I have in my possession 9,000 ft. of Multiplex Stereo FM broadcasting which was recorded by the Director of Stereo International (O. B. Sloat) in New York for the benefit of club members in all parts of the world. However I now make the same offer to readers of *The Tape Recorder* to make copies of some of the contents including the commercials, providing they send the tape and postage and state which speed (7½ or 3½ i/s) their machine uses.—*Yours faithfully.*



Members of Friern Barnet Tape Recording Club photographed before touring the Temple Mills Marshalling Yards.

EARLY in January 1961, a group of blind tape recording enthusiasts got together to pool their knowledge and experience and as a result, the **Stoke-on-Trent Workshops for the Blind, Tape Recording Club** was formed.

From the outset, it was realised that there was little literature on the subject of tape recording generally in Braille, and so it was decided to enlist the help of students at the University College of North Staffordshire to read the various monthly publications. As might be expected, these readings have provoked much discussion and comment throughout the past year, and a great deal of useful information has been gleaned from these publications.

Another item which figured greatly back in the early days of the club was tapes brought along by individual members, and these gave rise to the idea of a competition. The rules and conditions of entry were drawn up and the date fixed for April 26th, and a most enjoyable and enlightening event it proved to be. Entries ranged over a very wide field from a Comedy Sketch on the then topical census, to an entry made up of recordings of a musical evening.

With the competition over, members turned their attention to their first tape production. This was a documentary feature dealing with a visit to Hawkesmore Park, a bird sanctuary; and to Ilham Hall, at the head of the Manifold Valley. Here was a chance not to be missed for those members owning battery operated machines. The portable brigade, three in all, were asked to do various jobs; two to get as much bird song and country sound generally as they could, and the third to find out all he could from the wardens of the places visited, about their work. Despite the weather which was anything but pleasant, the outing was a great success, and most important, some very useful material was obtained.

Arrangements are well in hand for a trip to the Audio Fair. Any reader wishing to join the club should contact *N. J. Toslevin, 20 Victoria Road, Newcastle-under-Lyme, Staffs.*

New Club

A TAPE RECORDING CLUB is being formed in Boston, Lincs., in conjunction with Pilgrim College, University of Nottingham's local centre for Adult Education. Any readers interested in such a project should contact *P. P. Towell, Tressillian, 107 Spilsby Road, Boston, Lincolnshire.*

SUBSCRIPTION RATES

The subscription rate to *The Tape Recorder* is 21/- per annum (U.S.A. \$3.00) from The Tape Recorder, 99 Mortimer Street, London, W.1. Subscription + Index, 24/- (U.S.A. \$3.25).

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Tel: COLindale 0161

FREQUENCY AND WAVELENGTH IN RECORDING

PART I — TIME AND MOTION — by GRAHAM BALMAIN

ONE of the more subtle paradoxes in tape recording—indeed in all practicable sound-recording systems—is the extent to which a so-called “frequency-response” is actually controlled by the wavelengths involved rather than by the frequencies. Before any readers start muttering about hair-splitting, let me say that although it need not lose the amateur any sleep, the distinction has certainly more than an academic interest for engineers. And even the most uncaring amateur has probably met it, if unwittingly, at some time or other; whenever he talks about gap length, or tries to re-adjust azimuth, or cleans the dirt off a head, he is concerning himself with wavelength effects and not directly with frequencies.

The significance of wavelength is a direct consequence of the nature of practicable sound-recording systems, which, in turn, is due to the limitations of our technology. Being unable to construct time-machines of the science-fiction type which would enable us to re-experience interesting events in glorious Universal Four-Dimensional Naturama, we are forced to some relatively clumsy methods of storing limited impressions of those events at the time they occur for subsequent reproduction. We cannot recall time, but we must nevertheless reproduce the original time-sequences involved, for time-relationships are of the essence of events.

Since in direct recording we can preserve a time-sequence only in terms of some relative physical movement between the signal or the recording device and the recording medium, and simulate it only in terms of a similar movement of the stored signal relative to the reproducer, there are two alternatives: the signal must either be kept in motion in the storage medium, or stored as a stationary pattern on the medium which is itself then moved during reproduction.

Method One

Both methods are possible in practice. The first is often used in electronic computers for short-term storage of data, and can take the form of a tube containing mercury along which the data travels as acoustical pulses, suitable transducers being fitted at each end to transmit and receive them. More modern “circulating stores” consist of polygonal slices of quartz in which the pulses circulate via successive internal reflections from near-opposite faces. Quartz stores are usually about the size of a 5½ inch tape spool.

The snag with this kind of store is its limited capacity, for the total available delay time from input to output (at which point the signal has to be re-shaped and re-circulated if it is to be kept) is only a few milliseconds—not enough for even one note on the piano. Something about 50 miles in diameter would be needed to store a half-hour programme, assuming that the signal ever survived the journey in a recognisable form. One cannot do much about this; having chosen a favourable material, one has also chosen a fixed signal propagation speed (which is a physical constant of the material) and, therefore, a fixed delay for the given path length.

Method Two

However, the familiar second method (the use of a moving medium on which signals are impressed) bypasses this snag simply by using other physical properties of the materials; mechanical rigidity, magnetic retentivity, photochemical sensitivity or whatever. Since we are not now storing the actual sounds, but only patterns representing them, the dimensional scale of the recording can be much smaller than that of an acoustic store provided the correct time relationships are preserved in the overall record-playback process. One could perhaps run a tape at the speed of sound to make a sound-recording, but it is no

more necessary to do so than it is to run a cine film at the speed of light to make a motion picture. At the other extreme, certain system losses which are wavelength-dependent will impose an absolute practical limit at some low tape speed because of the shortness of the signal wavelengths involved. The lowest usable speed, giving the smallest usable scale, will be somewhat larger and will depend on the practical limit together with the quality of the tape and one's subjective tolerance of the various distortions which are aggravated by approaching that limit.

The significance of wavelengths is thus practically forced on us by the fact of there being nothing else on the tape—except the local variations in magnetisation which define the wavelengths, of course. One cannot record a frequency as such on

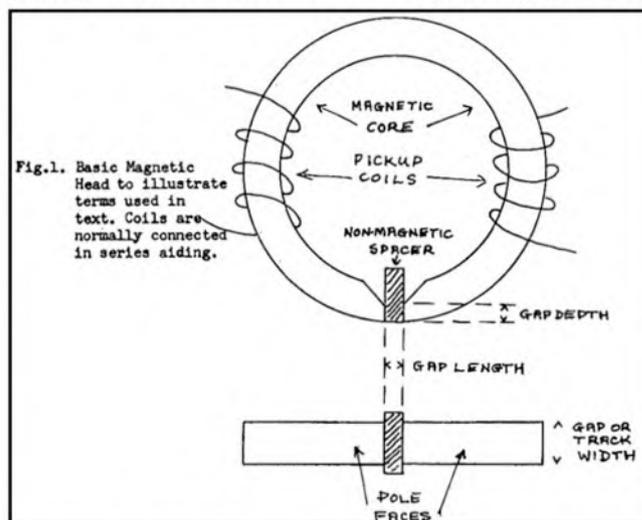


Fig. 1. Basic Magnetic Head to illustrate terms used in text. Coils are normally connected in series aiding.

a tape. As the tape passes the recording gap, the magnetic field there (whose value is proportional to the recording input at any instant) impresses a corresponding magnetisation pattern on it which is purely dimensional. It should be remembered that the whole object of the exercise is to convert time intervals into distances. Wavelengths will, therefore, become shorter as the signal frequency increases, and longer as the tape speed increases, and vice versa; but the whole thing, once it is recorded, will remain a superficially meaningless pattern—an odd kind of graph, if you like—until it is used to energise a playback head and reproduce the original explicit frequency-intensity-time pattern. The whole system is influenced by wavelengths simply because its critical parts have to be tailored to handle them.

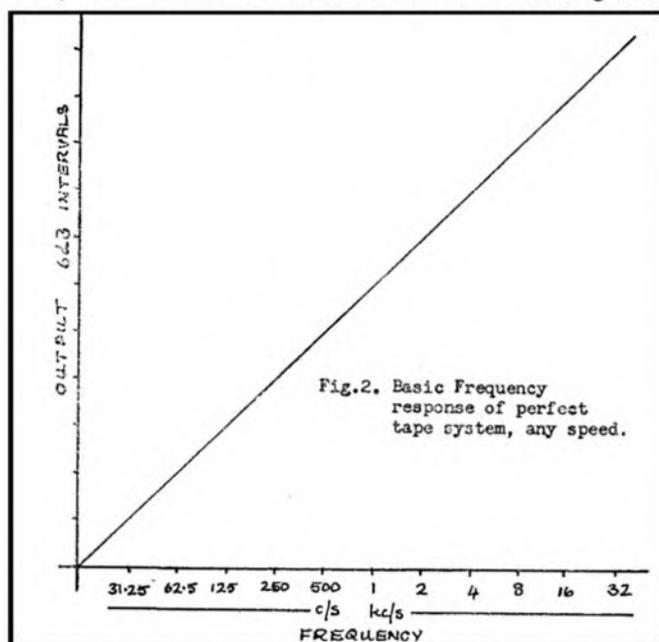
Perfection Costs Money

It is interesting to compare this with the performance of the acoustical circulating store. Being designed to handle frequencies, its performance might be expected to depend largely on frequency, and in fact does so. However, in spite of the dominant influence of wavelengths in practicable sound-recording systems, wavelength effects must still be considered as subsidiary ones because they are actually losses of various kinds which subtract from the basic performance inherent in a perfect system; they are present because the practicable system cannot be perfect for economic reasons. This argues that one can approach perfection in this respect by spending enough money, and it is in fact possible to eliminate wavelength losses almost entirely from a wide audio working range by running the tape at, say, 60 i/s and using record and playback heads with special pole structures.

FREQUENCY AND WAVELENGTH IN RECORDING (cont.)

To arrive at the basic performance itself we have to dig gently into a little elementary electro-magnetism, although the recording process is simple enough from this point of view. Assuming the perfect system (i.e. one having no losses or distortions of any kind) the recording field is instantaneously proportional to the input, and the tape moving through it retains a proportional degree of magnetisation whatever the input frequency or recorded wavelength—even if the frequency is zero and the wavelength apparently infinite, corresponding to a steady direct current through the head windings. Let us for the moment assume a constant input at all frequencies, giving a constant tape magnetisation at all wavelengths.

The playback process is a shade less obvious. We shall have to assume that the playback head (Fig. 1) has a gap whose length is finite but much smaller than the shortest wavelength of interest, instead of the infinitesimal one necessary in a truly perfect system (see footnote). We shall also assume the record and playback speeds are the same. When the recorded tape passes across the playback gap, the magnetisation impressed on it produces a proportional magnetic "flux" through the core whose time-pattern is similar to that of the flux in the recording head



core which originally produced the recording. But the existence of a flux in the playback head will not in itself mean that we shall get an output from the head. This will happen only when the flux changes. And the explanation of that reveals a much more fundamental paradox than the one we observed earlier on: the flux must change to cause an output because Nature abhors change.

Now this experience is common enough in human nature. We have all met obstinate toddlers, recalcitrant young men and reactionary old ones, who will reject and actively oppose any suggestion for change in the *status quo* on principle. It is familiar also in the more tangible everyday aspects of science and engineering. For instance, pushing a loaded trolley on a hard flat surface is easy enough when you have got it moving (provided the wheels are well-oiled); but getting it moving, making it move faster or slower or stopping it needs much more effort than merely keeping it moving. Not only that, but the quicker you make it change its speed, the more effort still is needed. These efforts are spent in overcoming the trolley's mechanical inertia, its reaction to the changes in state. This inertia is not too unlike that of a well-fed human body on a Sunday afternoon: a general unwillingness to be pushed around.

Inertia crops up in one form or another, under different names, in almost any physical system one cares to think about.

In electricity, inductance possess "inertia" of a kind, and inductance is an important property of all electrical windings—chokes, coils, transformers and tape heads, for example. Thus, when the flux in our playback head changes, there is a reaction due to the inductance which tries as best it can to oppose the change. It does not succeed, of course, or we should get no output from the head at all, but the effort produces a driving voltage (more properly called an "electromotive force", or *emf*) in the coil which would cause a current flow opposing the flux-changes if it were allowed to do so. Instead, we connect the two output leads to a high impedance, such as a valve input circuit, and set the driving voltage to some useful work.

The point of all this is not particularly to explain how a flux-change induces an *emf* into the head winding, but to emphasise that because it happens in this way the *emf* must depend on the rate at which the flux changes in the head. Remember, the increased effort needed to change the trolley's speed more quickly, because of the greater reaction to the quicker change? Exactly the same idea applies here: the faster the flux changes, the more strenuous the reaction and the greater the output *emf*.

Of the two possible ways of altering the rate-of-change of flux, we shall ignore the obvious one of increasing or decreasing the signal level (and thus the total flux swings per cycle) for the moment, since we have assumed our recorded magnetisation constant. The alternative is a decrease or increase of recorded wavelength, corresponding to an increase or decrease of the input and output frequency. Thus we arrive finally at the basic performance of a perfect system: *Output voltage is directly proportional to input frequency*. And since the actual wave-lengths themselves do not matter here, only their relative variations, the output at any given frequency is independent of tape speed; but again, it must be emphasised, in a perfect system.

The more usual way of expressing the basic performance is to say that "the output rises at 6dB per octave", since these relationships are more easily handled and illustrated using logarithmic scales. (A series of articles explaining decibels, logs and graphs is currently appearing in *Hi-Fi News*, by the way). The line in Fig. 2 illustrates our basic frequency response in this way. Next month, in part 2 of this article, we shall discover the various losses in practical systems which cause the high-frequency end of the response to fall from grace.

Footnote: The purpose of the gap in a playback head is to force most of the flux emerging from the tape to travel via the ferromagnetic core of the head and link with the winding on it. Being filled with a non-magnetic material, the gap has a marked reluctance to allow the flux to traverse it; although this route is apparently shorter, the longer, less reluctant core offers the much easier path. However, decreasing the length of the gap reduces its reluctance and does allow a greater proportion of the flux to take the short cut and thus not to contribute to head output. This is why shortening the gap reduces head output—the price which has to be paid for the advantages of reducing gap-length losses. In the limit, the infinitely short gap required by a perfect system has zero reluctance, so that *all* the flux is diverted from the core and the head gives no output.



Hi-Fi News

**APRIL
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Contents include:

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THESE DEALERS OFFER GOOD SERVICE

From: Electrical and Radio Supplies, 29 New Street, St. Neots, Hunts.

Dear Sir:—We fully agree with the views expressed in your recent editorial articles, and would say that we make an especial point of providing good service on any equipment which we sell.

As far as possible we specialise in electronic equipment (although we have to handle some domestic electrical goods) and we sell nothing which we cannot undertake to service properly.

We have been in electronics for more than a quarter century, and we sell most of the reliable makes of tape recorder, and can undertake repairs to practically any make of recorder or high fidelity equipment.

Yours faithfully,
D. G. Frost, proprietor.

From: L. Bishop (Radio and Television), Ltd., 1708 Bristol Road South, Rednal, Birmingham.

Dear Sir:—In response to your editorial in the December issue of *The Tape Recorder*, we would like to offer our services to your readers.

We are primarily Grundig specialists and carry very good stocks of spares and accessories for this make.

We also service Ferrograph, Brenell, Philips, Wyndor and other leading recorders.

This work is at present carried out almost entirely by the undersigned, with our service engineer giving a hand under close supervision.

We give 12 months' free service with all recorders sold by us, valves excepted, which are covered by the maker's guarantee. We are members of the R.T.R.A.

Yours faithfully,
L. Bishop.

From: R. E. W. (Earlsfield) Ltd., 545 Garratt Lane, Earlsfield, London, S.W.17.

Dear Sir:—In response to your editorial in *The Tape Recorder* magazine regarding "service after sales", we fully endorse your action in this matter and wish to inform you that we as a company have been established for over 18 years. We have a fully-equipped and staffed service department with our own transport consisting of three vans covering the London area. Efficient servicing to all types of tape recorders and Hi Fi equipment is undertaken regardless of the fact that these were sold by our own shops or not.

Yours truly,
M. Murray, director.

From: Reeves Sound Service, 416 Moseley Road, Birmingham, 12.

Dear Sir:—The recent Editorials have been of extreme interest to us, during the past seven years the activities of this Company have been solely in service. Prior to this we were also engaged in retail trading and probably the first dealers in this area to provide a specialist service in tape recording.

Our service department now enjoys a reputation that would be hard to obtain without the long-standing recommendations of our customers. Service is being currently executed for government departments, the local hospital board, therapy clinics, British Railways publicity, N.S.P.C.C., etc. We are service representatives for several leading manufacturers.

Our domestic interests until now have been by operating a trade service for twenty or so dealers who do not have the facilities available as required by the manufacturers of quality equipment. In this field we have regrets, service requested on equipment which has been maltreated making a major job of a small one. This may be due to either the customer or the dealer concerned. Charges levied from our office on a strictly timed and very reasonable basis attain an abortive figure when it reaches the customer. A flood of cheap and inferior machines with requests to cure defects which have been inherent since manufacture, due to unfounded claims by manufacturers. All this has determined that we should provide a direct contact to

the public and in this connection we are now accepting service direct from customers. Our advice is given freely in respect of audio equipment, the goodwill received being of immeasurable value.

During the first week in January we opened our retail showroom which is exclusively "tape" both domestic and industrial, restricted to equipment of known quality and reliability. This particular time was chosen to avoid the acceptance trade of a seasonal nature which would have contained some of the problems of the previous paragraph.

Our position as a subsidiary of A. J. Reeves and Co. (Birmingham) Ltd., internationally recognised as leading model and experimental engineers, we think to be unique in respect of the facilities we are offered mechanically. The substance of the company being mainly that of taking over all interests of A. J. Reeves and Co. as far as electronic sales and service are concerned.

Yours faithfully,
H. Reeves.

From: Holdings of Blackburn Ltd., 39-41 Mincing Lane, Blackburn, Lancs.

Dear Sir:—With reference to your letters regarding service in the March issue of *The Tape Recorder* Magazine.

We agree that there is a deficiency of after-sales service for tape recorders, but in all fairness, we must pass the responsibility for this on to the customer, as we feel that he buys a tape recorder at a shop which does not have any after-sales service facilities and then when the tape recorder needs attention he has to go somewhere else to find satisfaction.

We ourselves have found this in our own business, when people bring to our premises for repair tape recorders which have been purchased from other sources. We treat these in all fairness, and whilst we do not refuse to repair their tape recorders, we give attention to our own customers' requirements first.

In conclusion we would like to point out that we can offer one of the best after-sales services, as we specialise in Ferrograph, Grundig and Philips tape recorders, and also hi-fi equipment, including Leak, Armstrong, and Garrard. We also carry good stocks of speaker equipment.

Our service engineer is of the best, having passed the Certificate of the R.T.E.B. City and Guilds Radio and T.V. examination. Our workshop is equipped for tape recorder service, with equipment installed for that particular purpose.

Yours faithfully,
W. Jackson, Manager.



"Now then, Charlie, what's all this nonsense about resigning?"



From his control panel the recording engineer can look into the commentary room. The picture is being projected from the panel nearest the window. On the adjoining panel the commentary is being recorded on 16 mm fully coated film. Both these panels are so coupled that it is impossible to lose sync. even when run rapidly in reverse. This makes it simple to re-record a single phrase if the commentator makes a mistake.

Now is the time when the experienced amateur turns his filmic thoughts towards the attractive possibility of spending his holiday, with all expenses paid, on some short descriptive travelogue for a tourist agency or on a worthy instructional film for a local authority or charity. The opportunities are many and so are the pitfalls among which, not the least, is the costing of the production. It is all very well, as an amateur, to try to make the film on a shoestring, but a job suffering from patchy continuity or a shoddy soundtrack through underpricing is not fair to the sponsor who does not understand the difference that a few extra pounds could have made to his film.

The cost of a professional sound transfer, at least, should be included in the initial budget, because a top quality track is essential on the film that may be presented in all sorts of conditions by all sorts of projectionists. With this in mind, and because I have had several letters from readers asking for such information, I decided to review the facilities offered by the latest 16 mm recording studio in London, namely, **Colour Film Services Ltd.**, where, in their basement extension, they have installed a recording suite that is the last word in sound for the 16 mm colour film producer.

The normal procedure

In the suite which contains two sound editing rooms, a dubbing room, mixing and transfer rooms and a commentary room, I met the head of the sound department, Mr. Hanks who, after introducing me to two of his colleagues, Mr. Billing and Miss Bowden, proceeded to show me exactly what happens from start to finish on a normal production.

First of all we examined the procedure of timing a written commentary to the cutting copy of the film. This was aided by the new *Acmade* editing table, which enables two magnetic tracks to be run through with the cutting copy. The position of either track may be varied relative to the picture and it is possible to run either at a fixed speed of 24 f.p.s., or at a very fast speed without losing sync. The footage counter plus the second timer allows the start position of each paragraph to be pin-pointed.

Mechanically Interlocked Equipment

With the commentary cue sheet completed, with all footages marked down, the commentary recording session can begin. The small sound-proofed commentary room contains a double desk where the narrator sits slightly in front of the cueist, who is usually the producer and who knows the film through and through. At the bottom of the screen in front of them is a

SOUND AND CINE

AMATEURS CAN NOW EMPLOY FIRST-CLASS EDITING EQUIPMENT

By RICHARD GOLDING

footage counter and when this registers the appropriate number the producer cues the narrator who then reads one paragraph and awaits the next cue. The recording engineer, sitting behind them in another room but watching through a window, controls the projector and recording machine. These are mechanically interlocked, the recorder using 16 mm fully coated sprocketed magnetic stock. This enables the recordist to stop, start and reverse picture and track in order to pick up any precise point in sync. wherever required. This makes it quite easy to re-record a single line if the narrator makes a mistake, clever circuitry in the recording amplifiers allowing these retakes to be dropped in with no clicks to mar the track.

The continuous prism projector is mechanically locked to the 16 mm magnetic recorder. The footage counter under the screen in the commentator's booth is driven by a Selsyn motor and the master Selsyn is mechanically coupled to the main projector and recorder drive motor. The speed of film at 24 f.p.s. is 7.2 i/s. Flat frequency response ± 1 dB 40-12 Kc/s to C.C.I.R. characteristics. The end of this session gives a commentary track which is in complete sync. with the visuals and free of all mistakes.

Music and Effects

The customer is now free to choose his own music and effects, and it is possible to select material from Colour Film Services' own small library, but the use of the main music houses is encouraged for reasons of wider choice.

Tracks can be taken from disc or tape (tape is preferred at 15 i/s but lower speeds can be accepted) on to fully coated 16 mm sprocketed film which takes a 200 mil head centre track running on a four-panelled transfer machine with extra facilities



The article this month deals with the latest professional 16 mm recording studio in London. Amateurs have in the past had to edit their own films and the photograph above shows members of the Bury Amateur Cine Club at the editing table.

SOUND AND CINE

AMATEURS CAN NOW EMPLOY FIRST-CLASS EDITING EQUIPMENT

By RICHARD GOLDING

for 35 mm and 17½ mm magnetic stock. The centre track is less liable to damage and its extra width gives a better signal to noise ratio than the earlier 100 mil edge track standard.

Effects from portable recorders, such as the *Fi-Cord*, can be transferred and it is usual to have about four separate tracks, commentary, music on A and B rolls (fading out on one track and fading in on the other) and effects. Where the effects are complicated several tracks can be pre-mixed to make one composite effects track.

Dubbing

The customer now has a session with the editor for laying these sprocketed tracks against the picture, and when everyone is satisfied the dubbing session can follow.

The dubbing theatre contains about twenty seats, a large screen and a smart looking console controlling the six-panelled mixing machine in another room. The tracks are run on this machine against the picture which is projected by a Bell and Howell, modified to run in sync., while the dubbing engineer listens to the composite recording and watches the screen. From this session results the master magnetic track which is eventually played off via filters and frequency correction into a sound-on-film camera to make the optical track needed for release prints.

When the married print returns from the processing laboratory, the preview may be held in the luxury 124-seat theatre on the ground floor—where, at the small bar, the delighted sponsor may buy a round of drinks for all concerned in the production.

The budget

Quite obviously there are stages in this procedure that may be eliminated by use of one's own equipment and advice on this can be had from Mr. Hanks and his staff who would be pleased to discuss ways, means and costs with any 16 mm producer interested in dubbing his film. For those of you who would like to know how much the full treatment or any single stage would cost, here are some prices:

(1 reel equals 400 ft. 16 mm)

Cueing commentary on editing table—£2 per hour (allow two hours per reel). *Recording commentary*—£10 per hour (allow one hour per reel). *Commentator's fee* (if required) between £10 10s. and £15 15s. per reel. *Selecting music*, assuming that there is to be carefully fitted music through the film (allow at least a morning for a reel)—£2 per hour. (The music publishing houses sometimes provide this service free of charge.)

Music and Effects Transfer

Transfer of selected music and effects to magnetic sprocketed stock—£10 per hour plus cost of stock at 1½d. per foot. *Track-laying* on editing table with editor—£2 per hour (for a full music track with some effects allow about 8 hours for laying). *Mixing*—£10 per hour (allow one hour per reel for mix and playback).

The transfer of magnetic track to optical negative—normal rate is 6½d. per foot but a reduced rate applies when the commentary has been recorded at Colour Film Services. Music copyright fees by arrangement.



Mr. Hanks, the head of the recording department, at the transfer machine where 16 mm magnetic tracks are prepared, for subsequent mixing. The nearest panel carries a sound-on-film camera which makes the optical track needed for release prints.

Two-day Courses Arranged

Rank Precision Industries Ltd., are arranging five two-day courses throughout the coming year at Mitcheldean, Glos., the main purpose of which is to give basic training in the use and routine maintenance of 16 mm sound equipment. Accommodation is arranged at a local hotel at a charge of approximately 27s. 6d. per day but there is no fee for the course. Further details from the Education Dept., Rank Precision Industries Ltd., 37/41 Mortimer Street, London, W.1.

Sound Alphabet

Location: is any place chosen for shooting the film or recording sound apart or away from the actual studio.

Loop: is an endless band of film or tape used in post-synchronisation or in making up an effects track via two or more recorders.

Master recording: refers to the complete composite recording of the film sound track, usually on tape, from which the final transfer to optical sound on film is effected.

Mixing: is the process of feeding signals from two or more inputs into the master recorder at the proper level and balance.

Monitoring: is listening to the recording a fraction of a second after it has been made. This is only possible with machines fitted with a separate playback head and amplifier. Comparisons can then be made with the original signal.

Mood music: is used to establish atmosphere or to heighten the dramatic impact of the scene.

Off-mike: is the delivery of lines away from the sensitive side of the microphone to give the impression that the actor is some way in the distance.

Print through: occurs when one magnetic pattern is transferred by accident from one tape layer to another.

Room sound: sometimes known as room tone, this describes the special track recorded in a particular studio and which is to be used in certain silent passages of the film. It is sometimes essential for the editor to have such a track in order to space out dialogue sequences when no other sound is required. Every room or studio has its own distinctive and different quality of silence depending on its own acoustics.



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42 Manchester Street, London, W.1.

by H. W. Hellyer

TAPE RECORDER SERVICE

No. 4 THE MOTEK K10 DECK

MORE than three-quarters of the tape recorders brought to the author's workshop for service require nothing more than adjustment, cleaning and lubricating. This may be explained, to some extent, by the compact circuitry of tape amplifiers; printed panels, transformer-fed A.C. operation, and a limited range of valves developed to a high degree of reliability. But the reverse of the coin, the mechanics of the matter, causes most of the serviceman's headaches, and accounts for a higher proportion per sale total of tape recorders returned for service than other electronic equipment. Nevertheless, it is a fact that many of the machines being cursed by their owners need no more than a minor adjustment to remedy. Even more disturbing—many suffer from maladjustment by repairmen who work by the age-old method of trial and error.

The *Motek* K10 deck, manufactured by Modern Techniques, Wedmore Street, London, N.19 (telephone: ARCHway 3114), is particularly prone to this trouble of maladjustment—possibly because the manufacturers have made it too easy for fiddling fingers to get at. Removal of the four cross-headed screws at the corners of the upper deck allows complete withdrawal of the mechanism and access to the vital parts.

The ornamental top-plate needs careful handling, to avoid damage to the thin edges—and to one's fingers. Perhaps the best way of removing this deck from the cabinet (as in the popular *Regentone* models that employ it), is to remove the fixing screws and to tip the tape recorder on one side, allowing the deck to swing downwards, supported by the palm of one hand.

Positive Brake Action

The adjustments on this deck are principally brakes, pressure pad assembly and spool height, each of which is especially important when we consider the extremely fast *Rewind* action (1,200 ft. in approximately 1 minute).

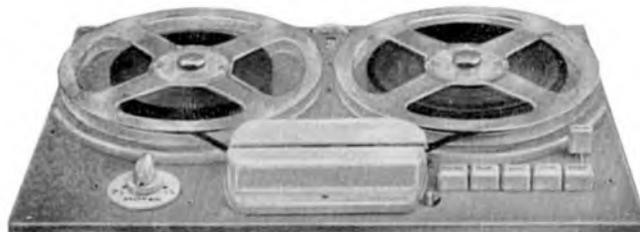
The brakes are applied when either the *Stop* or *Pause* buttons are pressed, and released when any of the other buttons is pressed. The action is quite positive, and because of the shape of the brake bands, (See fig. 1), a servo action takes place, according to the direction of rotation of the spool.

Referring again to the diagram, it will be seen that the brake bands are secured at their outer ends to the deck underside, and at their inner ends to swivel levers (pivoted on the bars Q) which rest against two screw heads, locknotted in a common bracket. The springs attached to lever S tend to apply the brakes in the absence of pressure from the two swivel levers. Depression of the "stop" and "pause" buttons brings lever N downwards (in plan), on its pivot O, carrying the lever and bracket P, releasing the pressure of the screw-heads and applying the brakes simultaneously.

It is obvious that application that is *not* simultaneous will result in tape spillage—even in snapping, at the extreme. Therefore it is necessary to adjust both brakes individually, in the "on" position, before adjusting the screw settings that determine the release setting. Beware setting the screws to the "on" position—there must be some clearance as will be noted.

First, then, to set each brake, press the *Stop* button and ensure that the two levers pivoted on bars Q have no pressure applied to their inner ends by the screw heads. Then, grip each spool hub and turn. In the "normal" direction of rotation there should be a positive grip by the brake band, but in the opposite direction the spool should turn with a minimum of friction. To adjust, first slacken the nuts at the pivot ends of bars Q slightly, then remove the transverse bar S, which is secured by a central screw. Move the bars Q until the required tension is applied, tighten locking nuts and replace the transverse bar S.

The position of the two screws at this point should be such



that there is 1/16th inch clearance—this to avoid too precipitate a braking action. Closely tied with the braking action is an interlock device, preventing the mechanism being switched from function to function without first being set to "Stop". Reference to fig. 2 will make the interlock action clearer. Flap L (see also fig. 1), raises when the Stop button is depressed, carrying the angled lever M with it, applying spring tension to lever U, which is bearing against a brass bush T. The bush is free to slide along the edge of U as long as flap L is in the position shown, and lever on which bush T is mounted is as shown; this is when the flap D (see fig. 1) is raised by depression of Record or Playback button.

But when the flap D is not raised, the spring F pulls T into such a position that the mechanism can not be switched to *Record* or *Playback* until the Stop button is first pressed. Rewind switching is not affected, being merely a selection of appropriate connections to the motors. A small adjustment of the complete assembly, to prevent interlock action from fouling and delaying "Stop" application, is possible by slackening nut W.

Pinch Wheel and Pressure Pads

The other important adjustment allied to these movements is the precise engagement of the pinch wheel and pressure pad assembly, and its equally vital disengagement when the mechanism is returned to neutral. Returning to the inaugural movement, the depression of either *Record* or *Playback* button raises flap D, partly rotating pivot rod E and moving the lever T against the tension of spring H, which moves lever G, (see also fig. 1). The length of the rod H is determined by the locknut h, and it will be seen that another transmission bar J is similarly locknotted to adjust compression of its spring. Both of these adjustments are important. They should not normally need alteration from their factory setting, but if maladjustment has been done, the following procedure should be carried out:

(1) adjust nut j until $\frac{1}{4}$ inch of the transmission rod protrudes.

(2) With Record button pressed, adjust h so that about 1/32 inch free play is present on the transmission rod.

(3) Depress Stop button. Note that the rod of the record switch is just touching flap D. If necessary, slacken nut j until mechanical contact is made.

(4) Press Record and Stop buttons alternately and note that slide K springs back to its full extent. It may be necessary to tighten j slightly to ensure correct action. If so, go over the procedure again, checking clearance and clean movement.

Apropos that vital word "clean", watch for an excess of grease at these transmission bars. If some misguided serviceman has attempted rough lubrication, the end result may be sluggish action. A similar stricture applies where incorrect

(Continued on page 119)

MINIFLUX — MAGNETIC HEADS



are now being used in a great many high quality recorders throughout the World and as a logical progress towards further high quality, the Technisches-Physikalisches Laboratorium, West Germany, have developed a series of new heads for 1962 which are likely to have considerable influence on present-day equipment.

A complete new series of stereo heads type 'N' are now available. These embody improved shielding qualities and simplified mounting arrangement. The electrical qualities remain essentially the same as the well-known standard types except that the very low frequency linearity is improved.

A new series of miniature Ferrite core erase heads is also presented having single hole fixing and obtainable in $\frac{1}{2}$ track mono, $2 \times \frac{1}{2}$ track stereo and $2 \times \frac{1}{4}$ track stereo.

HALL EFFECT HEAD—it is well known that magnetic heads which use magnetic induction principles have a playback output e.m.f. which rises with frequency since the e.m.f. is proportional to the rate of change of induced flux.

The head shown alongside represents a scientific "break through" in the art of magnetic recording in that the head employs a Hall effect generator to produce an output e.m.f. which is independent of flux rate of change and gives a constant e.m.f. down to D.C. conditions. The head uses a special semi-conductor material to generate an output e.m.f. of $300 \mu V$ which is higher than the compensated natural output from an inductive type head.

The Hall effect head is intended for $\frac{1}{2}$ track scanning of $\frac{1}{4}$ in. tape and also incorporates an armature winding for recording purposes.

Complete detailed technical information and installation drawings are obtainable by writing direct to:

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TAPE RECORDER SERVICE—(continued)

grease has been used at flywheel and capstan bearings, or at the pinch wheel spindle (a popular, but inadvisable, lubricating point). A high grade graphite type of grease (or preferably molybdenised grease) should be used, sparingly, and great care should be taken to avoid infiltration of dirt.

Before leaving the description of the switch action, the cord Z and return spring R, which are part of the *Pause* mechanism, should be mentioned, and their function explained. It can be seen from fig. 2 that the pause lever is actually an extension of the brake linkage system, operated by the stop button. When it is moved toward the operator (to the right in fig. 2) the brakes are applied by a pulling motion on lever N, as previously described. This pulls the lever to which spring R is attached, swivelling it on its central pivot, and causing the cord link Z to pull the outer end of lever G, which in turn retracts the pinch wheel and pressure pad assembly from the heads.

The other relevant parts shown in fig. 1 are the intermediate drive wheel Y and spring X. Speed selection is done by rotation of a scroll spindle, a locating screw in the groove of the scroll causing the bracket to raise and lower. At the same time, a cam on the lower end of the spindle moves the idler carrier in or out, ensuring a firm contact with the appropriate step on the capstan and with the flywheel. Fine adjustment of height can be made by slackening a grub screw in the idler stem and raising or lowering the complete idler stem and oilite bearing.

Spool Height

Adjustment of spool height was mentioned at the beginning of this article, and this is one simple check that can be carried out without removing the deck from its cabinet. The makers have very kindly enabled access to the spool assembly grub screws from the top of the deckplate. A fine screwdriver is needed— $\frac{1}{8}$ in. diameter, about six-inch blade can be recommended, for this, and several other jobs about the decks. The hubs should be set to the level where the tape comes cleanly from between spool flanges, horizontally passing the guide and head system.

Drive to the spools is direct, via individual motors, selected by switch action. There is thus no bother with clutches, drive belt, or intermediate drive wheels to the spools. The *Record* or *Play* button selects switch positions to energise the capstan and take-up motors, with field coils in series. (C and B, fig 1). *Fast Forward* also energises both these motors, but this time switches the field coils in parallel on motor B, providing full torque. *Rewind* selects motor A, in a similar manner.

There is, however, one point worth noting. To obtain the reduced torque for take-up, later runs of the K10 having a 1,000 ohm, 10-watt resistor in series with the motor winding. This resistor will be found mounted on a tag strip across the base of the *Rewind* motor. If the machine is found to work correctly in *Fast Forward*, but not to take-up on *Record*, this component is the immediate suspect. Always replace with a good quality resistor, of not less than 10 watts dissipation.

Adjusting Heads

Head adjustment on this model is relatively simple, both *Record/Playback* and *Erase* heads being mounted on circular plates that rest upon two ball bearings and are held down by two screws. The vertical disposition of the gap can be altered by tightening one screw and slackening the other, and a small adjustment of height is possible by judicious slackening of both, provided the security of the head on its ball-bearings is not affected. Later models used an *Erase* head of double gap design, and an alternative low or medium impedance model is available. There was also a modification which incorporated a high impedance R/P head of improved design, but as there is no change in mounting or adjustment, the above remarks are not affected.

The only other adjustment, seldom needed, is the setting of the flywheel, which should spin freely with the idler disengaged, and have no side play. An Allen set screw adjustment is provided.

* * *

● The Tape Deck described and illustrated in Part One of this series (see page 583, *The Tape Recorder*, Vol. 3 No. 12, January 1962), was an earlier model of the *BSR Monardeck*, TD1/2. Since its successful production, several modifications have been brought out; in particular, in August 1959 a more powerful motor with larger stator pack was introduced, and in April 1960 the belt between the motor and the capstan wheel was replaced by a rubber jockey pulley wheel. At the same time, the capstan bearing was changed for a shorter type.

The author apologises to readers, and the makers, for omitting to mention these modifications in the original article, and for any confusion that may have resulted, especially with regard to the pulley wheel now fitted.

It should be noted that most of the decks being described in this series were first introduced two or more years ago. They are all in widespread use. Because of their length of service, attention is more likely to be needed. If, however, readers wish to discuss problems on other, newer, machines, the author will be glad to deal with letters addressed c/o the Editor.

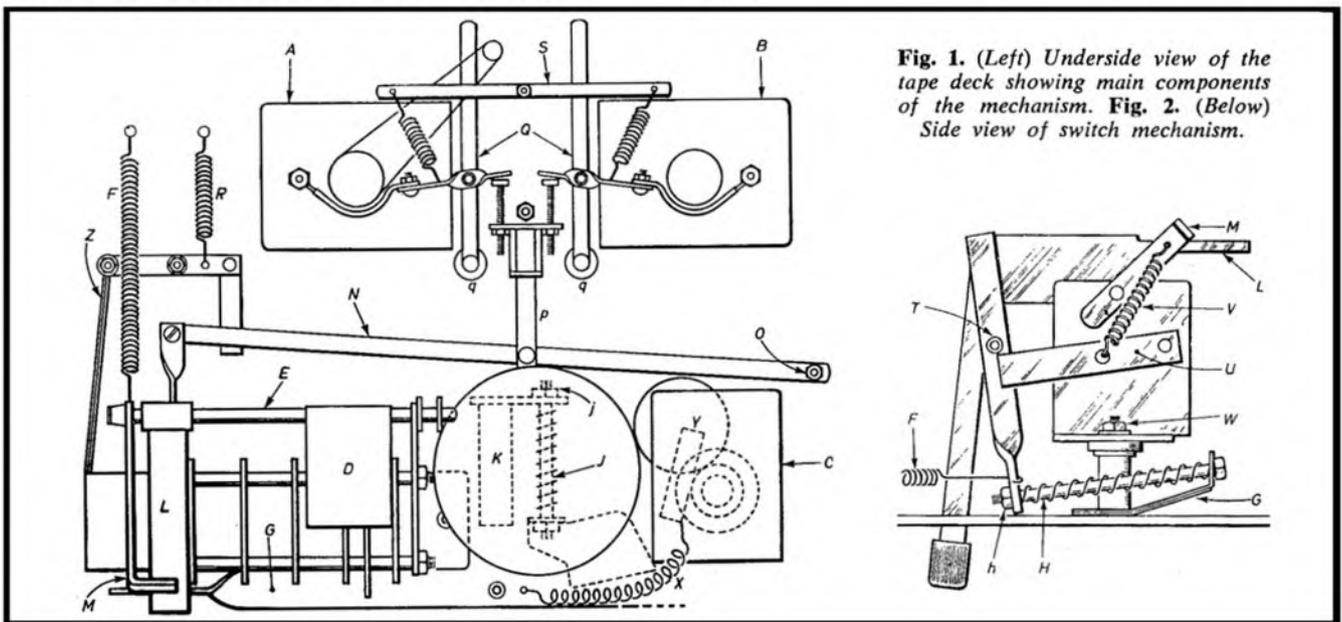


Fig. 1. (Left) Underside view of the tape deck showing main components of the mechanism. **Fig. 2.** (Below) Side view of switch mechanism.



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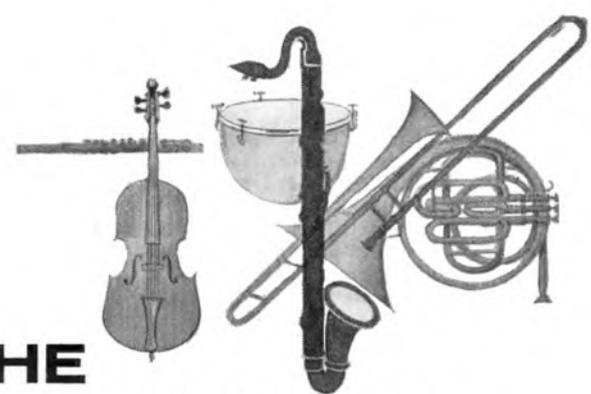


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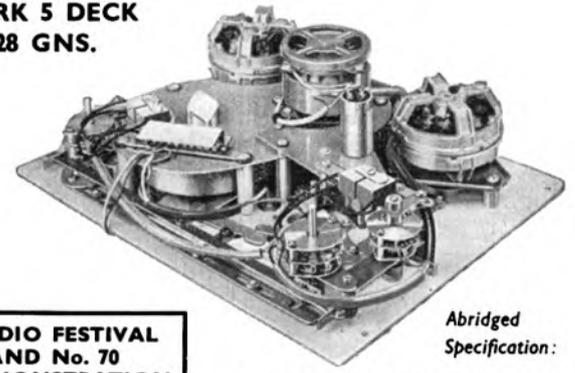
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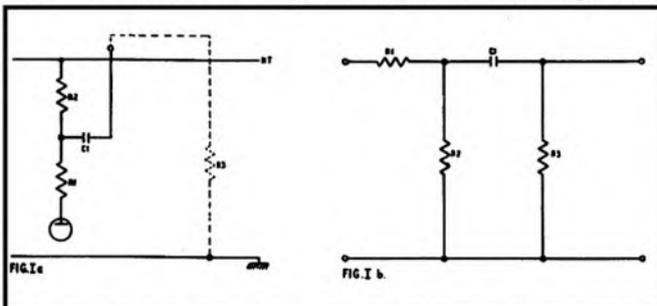
Practical suggestions for the tape handyman

by A. Bartlett Still

No. 33 CONNECTING EQUIPMENT (Part 2)

IN my column last month I tried to give some idea why practical difficulties should arise in the connection of a tape recorder to other apparatus for purposes of replay or recording, a process that, in theory, should be simple in the extreme. I explained that we were likely to meet either of two extremes, too little signal or too much, and indicated that the latter was rather more easily overcome by the enthusiast himself without outside help. I suggested that the manufacturer's advice should be sought when the signal level available was not great enough, but there is, in fact, another way in which the problem would be tackled. The use of a small pre-amplifier, which could be one of the commercially available transistorised units, would boost the signal in a simple fashion. In view of the amount of gain normally obtained from these units, however, it is likely that the problem would not be solved in this one step, but changed in character to the other extreme. This is where our simple resistive attenuator comes in useful.

My first illustration, (fig. 1a) shows one form of circuit that is in common use to supply a Hi-Z output, R3 representing the load that is applied to the output by the second piece of apparatus be it a tape recorder or amplifier. Since the three resistors and the capacitor C1 represent an attenuator I have re-drawn this (fig. 1b) so that the circuit can be more readily considered as an attenuator network. If we considered this to be the high impedance output of a tape recorder, coupled to the appropriate input of an amplifier for replay purposes, typical values would be as follows: R1, 100 K ohms, R2, 10 K ohms, (this would be specified as a 10 K ohm output impedance) C1, 0.1 mfd, while R3, the input of the amplifier, might well be 1 M ohm. The signal available in the tape recorder is in fact attenuated by R1 and R2 while R3, shunting R2, has little effect because of its greater magnitude. One simple way

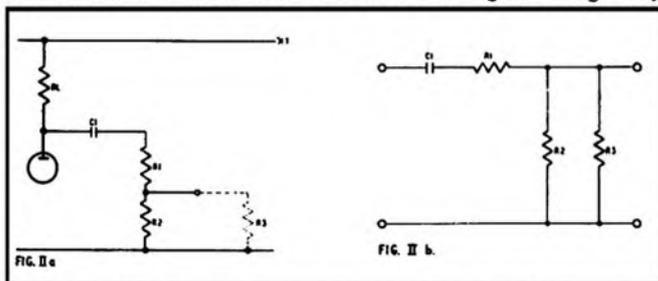


of reducing the signal level would be to reduce the value of R2. There is nothing against this, provided you are prepared to go inside the tape recorder to make a modification. Equally, it would seem that the reduction, or the shunting of, R3, would have the same effect, were this to be 10 K ohms instead of 1 M ohm the signal available would be halved due to the shunting of R2. This does introduce a danger in this particular circuit, because of the size of C1. C1 and R3 together form what is known as a time constant circuit. If this time constant, which is simply the product of the two values, is reduced below a certain level, the low frequencies of the signal waveform would be severely attenuated.

We therefore have to reduce the signal applied across R3 but maintain the load impedance seen by C1 in order that the time constant shall be kept at its correct value. The solution then is to reduce the value of R3 by means of an external shunt resistor, yet maintain the overall impedance by means of a

resistor in series with C1. Taking a typical example, supposing the signal is required to be reduced by a factor of 10, the input of the amplifier could be shunted by a resistor of 100 K ohms and a resistor of 1 M ohm should be inserted in series with the signal line between the two resistors and the condenser C1. This would satisfy all the necessary conditions for this type of circuit.

If we now turn to fig. 2a we have a similar arrangement carried out in a slightly different manner. Here the attenuator within the tape recorder (or amplifier) has been formed by separate resistors rather than a division of the anode load resistor of the valve. This again is drawn out more simply in fig. 2b and it will be noticed, by comparison with fig. 1b that the basic difference lies in the position of C1. Because C1 now appears on the other side of R1 we are less likely to influence the time constant of the circuit and so reduction in signal voltage may



be carried out by a simple shunting of the load resistor R3. Again taking the case where the signal level is to be reduced by a factor of 10, and assuming the resistor values as previously specified, a simple shunt resistor of 1,000 ohms will do the trick. With this type of output circuit the solution may still be provided in the two-resistor form of network and if you are, in fact, at all uncertain as to the type of output circuit your amplifier or tape recorder may have the first of the two arrangements should be used everytime.

I would like to close this month by saying something about the operation of four-track tape recorders, such as are becoming so popular these days. I am raising the subject because of a number of letters received recently in which readers are remarking about mysterious "dropouts" that they are noticing, even in some cases these have been apparent on new machines with brand new reels of tape. Upon investigation this is usually found to apply to tracks 1 and 4 only, i.e. the outer tracks of the tape. Any tendency for the tape to be crinkled, or any slight maladjustment of the tape recorder, can cause a loss of the intimate contact that is always required between tape and tape head, particularly on these outer tracks. There is, as far as I can see, little that can be done, other than pass the problem back to the manufacturer's service department.

It is my personal opinion, and I venture to suggest that these reports lend weight to it, that the introduction of four track tape recorders was a grave disservice to the whole field of amateur tape recording.

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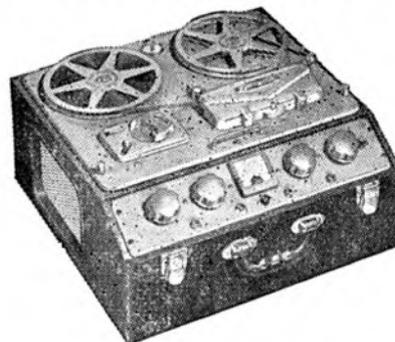
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THE CALIBRATION AND USE OF TEST TAPES

PART 2 ————— By A. TUTCHINGS

IN part one of this series we discussed the level on the tape and cleared up a few definitions. We now have to find how a recording characteristic is described in terms of a time constant of so many microseconds. It will be remembered that the surface induction of a tape defines the *r.m.s.* alternating flux density normal to the tape surface when the tape is not in contact with a magnetic material, and that it is convenient to use a recording characteristic which is asymptotic to two straight lines: a 6dB per octave line and a horizontal line. The dotted line of **fig. 1** shows such a curve, which represents the open circuit voltage from a perfect, loss free, infinitely narrow gap head when playing a $7\frac{1}{2}$ i/s C.C.I.R. test tape.

Now, such a voltage can be obtained from the circuit of **fig. 2** if the product of C in microfarads and R in ohms equals 100.

This time constant of 100 microseconds completely defines the

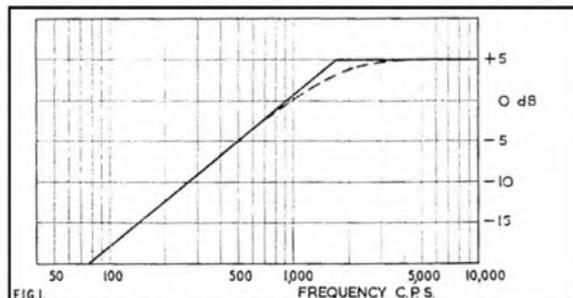
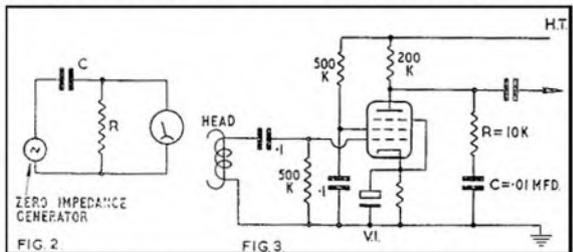


Fig. 1. 100 Microsecond Characteristic

curve and the component values could be .01 mfd and 10K, or 0.1 mfd and 1K, or even 1 mfd and 100 ohms, providing the generator impedance is low, and the input impedance of the amplifier or meter is high, compared with R. At low frequencies the impedance of C is many times higher than R and the voltage across R is low. As the frequency is raised the impedance of C falls, and the voltage rises 6dB per octave until the impedance of C approaches R. When the impedance of C is equal to R the voltage across R is 3dB below maximum: this is because the voltage across C and R are not in phase. At higher frequencies the voltage remains nearly constant as the impedance of C is now less than R.

A time constant curve can be drawn very simply by making the two lines intersect at the frequency where the impedance of C is equal to R, dropping a point 3dB below the intersection, and then drawing a smooth curve to pass through the 3dB down point. The 3dB down point is known as the turnover frequency, and this is 1,600 c/s for a time constant of 100 microseconds.

A theoretical advantage of using a simple time constant recording characteristic is that the playback response can be



made the exact inverse of the recording characteristic by using the same time constant in a different circuit configuration.

Fig. 3 shows one way of using R and C in a playback amplifier. The impedance of C is high at low frequencies and almost the full possible gain of the amplifier is available to boost the low output of the head at these frequencies. The impedance of C falls with increasing frequency reducing the gain of the

amplifier to compensate the rising output of the head. At the turnover frequency the output is up 3dB, and at high frequencies the gain is controlled mainly by R, and remains sensibly constant. **Fig. 4** shows the response of the amplifier circuit of **fig. 2**.

In practical recorder design the equalising time constant may be appreciably different from that of the recording characteristic because of head losses and wavelength effects which will be discussed later. This popular fallacy—that it is only necessary to use the recording time constant in the playback amplifier, must be firmly squashed. It is only valid for a non-existent, perfect head, and one of the prime functions of a test tape is to ensure that the amplifier equalisation compensates for the combined response of the tape and the head.

C.C.I.R. standards for professional recorders are: 35 microseconds (3.5 Kc/s turnover frequency) for 30 and 15 i/s, and 100 microseconds (1.6 Kc/s turnover) for $7\frac{1}{2}$ i/s.

N.A.R.T.B. use a 50 microsecond time constant (3 Kc/s turnover) for all professional speeds: 30, 15 and $7\frac{1}{2}$ i/s.

C.C.I.R. recommendations for the lower speeds are 200 microseconds (800 c/s turnover) for $3\frac{3}{4}$ i/s and 400 microseconds (400 c/s turnover) for $1\frac{7}{8}$ i/s. These time constants now seem to have been adopted in the U.S.A. also for the lower speeds, although earlier pre-recorded tapes used fiercer recording pre-emphasis which gave recorded time constants of 100 and 200 microseconds for $3\frac{3}{4}$ and $1\frac{7}{8}$ i/s respectively. These latter standards are still used by the designers of many low speed continental recorders.

With further improvements in tapes and heads, recording characteristics are being re-considered, and the latest B.S.I. recommendation is 70 microseconds for $7\frac{1}{2}$ i/s and 140 micro-

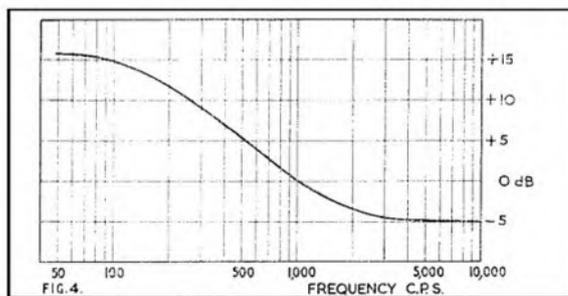


FIG. 4.

seconds for $3\frac{3}{4}$ i/s. This at least has the merit of lining up with the 15 i/s 35 microsecond standard so that, theoretically anyway, the same test tape could be used at all speeds, and the frequencies halved or doubled according to the speed.

Head Losses

So far we have been discussing the surface induction characteristic of the test tape when it is out of contact with a playback head. We should now see what happens when we put the two together. There are two kinds of head loss which may modify the response considerably from the surface induction characteristic of the test tape. They are (i) *frequency losses* and (ii) *wavelength losses*. The frequency losses of a head can be measured independently of a tape in several ways. A simple, but not absolutely accurate, method is to measure the impedance of the head over the frequency range, and to note the deviation from the 6dB per octave line which would be obtained from a pure, loss-free inductance.

A more accurate method is to feed an alternating flux into the head gap, by placing it near a current carrying conductor or a loss-free, ferrite head fed with a constant current at all frequencies, and again measuring the deviation. **Fig. 5** shows such a loss curve for a typical head, and **fig. 6** shows the output of this head when playing a 100 microsecond test tape.

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THE USE OF TEST TAPES—(continued)

Wavelength losses mainly affect the ends of the frequency spectrum and they depend on dimensions of the head and gap.

Gap losses are perhaps the easiest to understand. A head with a 1 thou' gap can not "see" a 1 thou' wavelength on the tape because such a wavelength, or cycle, consists of two elementary magnets a N-S followed by a S-N for example. These exactly cancel within the gap length, and the flux around the head magnetic circuit is zero. In the same way a 1/2 thou' gap will give zero output at 15 Kc/s at 7 1/2 i/s, or 7 1/2 Kc/s at 3 1/2 i/s. Most

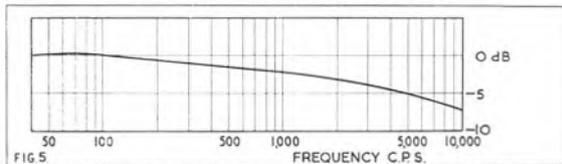


Fig. 5. Frequency losses for a typical head

modern heads try for a 1/4 thou' gap, but manufacturing tolerances sometimes let through the odd one which is nearer 1/2 thou'.

Another gap trouble can show up if the gap is not absolutely straight, or if the sides not parallel. Thus the playback equalisation may have to include a certain amount of top lift to compensate for the short wavelength losses in the head. The only foolproof way of measuring and dealing with such effects is to play a good quality test tape and to alter the equalisation until a level playback response is obtained over the desired frequency range.

Long wavelength losses are not so well-known, and are less easy to explain. It is obvious that if the total pole face length of a head is, say, half an inch, then it cannot pick up very much flux from a two-inch magnet on the tape, so that every head has a low frequency cut off which is a function of the tape speed and the biggest dimension of the head. Such a roll off only occurs when the profile of the head is smooth and roughly semi-circular in shape. If the pole pieces have any abrupt discontinuities or corners, then a much more serious effect can occur in the form of large peaks and dips in the low frequency response of the head. These are caused by the "corners" of the

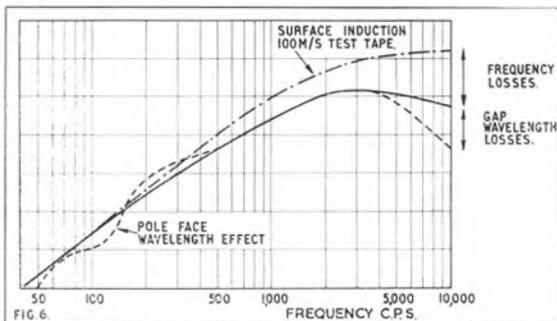


Fig. 6. Typical head response

head acting as a secondary, long wavelength gap which suffers the same maxima and minima effect as the normal gap, but which can in addition add or cancel the output of the short wavelength gap to give a ragged response which extends well into the middle frequency range of the recorder.

A sure way of identifying any wavelength effect, which is a function of the "geometry" of the head, is to see whether it moves up or down the frequency response with corresponding changes of tape speed—i.e. if halving the speed of a recorder causes a peak or dip to recur at exactly half the original frequency, then it is certainly a symptom of "wavelength wiggles".

It should be clearly understood that such effects only occur during the playback of a tape. Frequency losses in a head, however, affect both recording and replay.

It will be seen, therefore, that a properly calibrated test tape can give complete information on the playback characteristics of a recorder, and that, in addition it can help indirectly in recording equalisation and volume indicator calibration.



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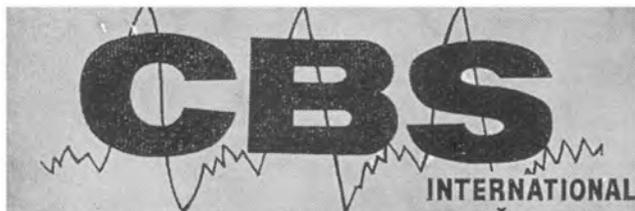
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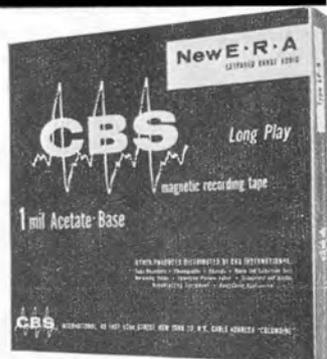
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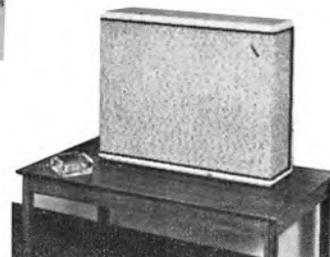
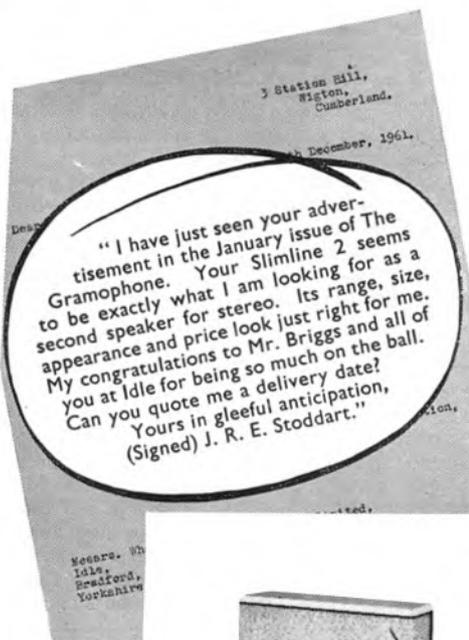
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our readers write

. . . about pre-recorded tapes

From:—S. A. Ciser, 637 Upland Road, Louisville 6 Kentucky, U.S.A.

Dear Sir:—To comment on Mr. George's letter that there are a wealth of pre-recorded tapes at $3\frac{1}{2}$ i/s stereo on the Continent and the U.S. I fear he is operating on an illusion.

Having spent almost three months in 10 countries from Moscow to Portugal running down pre-recorded tapes in Europe I can honestly say that England has the greatest variety available in the continental scene. Only about 12 were found in Germany, none in Russia, about ten in Scandinavia, none in France, Austria, Holland, Belgium, Portugal, 5 in Switzerland. This does not include some of the American titles being sold abroad. Just originals. Most of these were at $7\frac{1}{2}$ i/s and were very high priced.

In the U.S.A. the use of $3\frac{1}{2}$ is about out of the picture. Only about 100 titles are available on the RCA and Bel Canto catalogues and these are on cartridges for the slower speed. Virtually no two-track $7\frac{1}{2}$ stereo tapes are being produced any more. Everything is four track stereo at $7\frac{1}{2}$, and this appears to be the speed for the future, barring any unusual new technical development which has not appeared on the horizon. The early rumours of a $1\frac{1}{2}$ i/s cartridge has not been borne out by any production or announcement of plans. So, quality of sound still needs in most makers' opinion the $7\frac{1}{2}$ speed.

The variety of items available in the English tape catalogues is only matched by the American catalogues, and because of music copyrights and recording society problems, many of these are not available for sale overseas, although the curtain is lifting slowly with the arrival on your scene of the Audio Fidelity, Concertapes, and some Capitol items through new English distributors. Meanwhile, the U.S.A. has no imported tapes of any number or quality, apparently because none are being produced except in England.

So, Mr. George, look to your own stores to supply you with a larger variety of the $3\frac{1}{2}$ i/s speeds than the U.S. can or will.

Yours faithfully,

. . . about a recording 'den'

From:—T. Robinson, "Crepello," 17a St. Anne's Road, Whitstable, Kent.

Dear Sir:—I am seriously considering having a small recording "den" built at the end of my garden. The maximum width can be 6 ft. and the maximum length 12 ft.

I shall be interested to hear whether any of your readers have attempted a similar project, and shall be very grateful for any advice and assistance which may be available in the light of experience. I am thinking in particular of the most satisfactory methods of construction, i.e. timber, brick, concrete blocks etc. types of most suitable flooring and internal wall finishes; the best method of sound insulation at a reasonable cost, and suggested layout of equipment. My main set-up will still be indoors, but I am thinking of a small type amateur studio, with recorder, gram, FM/TV tuner, mixers etc. and associated facilities—in other words, a little studio where I can disappear from the overpowering competition of children and television to do a little peaceful tape exchanging, documentary, copying, and all the 101 other recording jobs which require a little peace and quiet.

Yours faithfully,

. . . about 4-track recording

From:—D. Casburn, 63 Roseville Road, Leeds 8.

Dear Sir:—I feel I must reply to Mr. A. Bartlett Still's letter in the November issue of *The Tape Recorder*, on the subjects of 4-track recording and playing time.

To many people, such as myself, playing time is extremely important and not merely a "fetish" as Mr. Still calls it. I admit that some manufacturers have overdone things rather by

introducing 15/16 i/s, but I think a fairly slow speed such as $3\frac{1}{2}$ i/s, is necessary on many occasions. As a music-lover, my only interest in tape recording is in building up a library of symphonic music on tape. Now many symphonies last for well over an hour.

What should I do if I had Mr. Still's "ideal" recorder which he mentioned— $7\frac{1}{2}$ i/s full track—, and wanted to record say, Beethoven's Choral Symphony? (which lasts from anything up to 70 minutes and possibly longer according to whichever conductor happens to be in charge). Even with double-play tape on a 7 in. spool, it would give me only 64 minutes recording time, and I would run out of tape before the end. Some works last longer than the example given. In cases like this, $3\frac{1}{2}$ i/s is absolutely necessary to ensure sufficient unbroken recording time, though I record at $7\frac{1}{2}$ i/s whenever possible.

Then there is the question of expense. My tape library at present consists of well over 100 works, and is constantly being added to. Most of the recordings are $\frac{1}{2}$ -track, but my more recent ones are $\frac{1}{4}$ -track. Altogether, I have about 40 reels of tape (mostly 1,200 ft. and 1,800 ft.), which have cost me a small fortune.

Think how many more reels of tape I should have needed to buy, if I had been unfortunate enough to possess Mr. Still's $7\frac{1}{2}$ i/s full-track machine!

My four-track recorder has been a great boon to me. By halving the cost, it has enabled me to record unfamiliar musical works—which I otherwise would never have thought of recording because of the expense of $\frac{1}{2}$ -track work—and so has been of considerable educational value to me. Though $\frac{1}{4}$ -track recording has some disadvantages—the most serious to my mind, being that defects in the tape itself are more liable to show themselves in the form of "drop-outs"—I am glad to say that most of my $\frac{1}{4}$ -track tapes have turned out extremely well. All of them have been recorded from my V.H.F. tuner; and when played back through my high-fidelity equipment, they give excellent quality—far better, in my opinion, than the quality obtained from most commercial disc recordings, which have far too much top, too little bass, and very likely, surface crackle into the bargain.

No Mr. Still, unless the tape recording fraternity consists mainly of millionaires who can afford vast quantities of tape, I am afraid that $7\frac{1}{2}$ i/s full-track recording, is not likely to prove very popular.

Yours faithfully,

. . . about imperfect erasing

From:—Rev. D. W. Bell, The Presbytery, 5 Station Road, Stone Staffordshire.

Dear Sir:—With reference to B.E.C.J.'s problem of imperfect erase (December, 1961, p. 528), a similar experience of mine allows for another possible solution.

Getting at the "viscera" of the Spectone 161 is a simple and straightforward matter—one removes eight screws, lifts upwards from the front, and everything is displayed for inspection: rest the two back corners on the supporting ledges, prop the front edge against a suitably-firm object, and you may work unhindered. However, in doing all this one may pull taut the thin leads connected to the panel of jack sockets set in the rear of the case, and so snap one off.

After getting inside to change a resistor (for using a different microphone), I found that erase was incomplete: the answer, after frantic cleaning of heads, etc., turned out to be a broken lead on the "Erase Cut-out" socket! (Presumably the partial erase was from the bias voltage in the "Record" head.) Yours faithfully,

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TAPE, RECORDERS & ACCESSORIES

FIRST DETAILS OF NEW PRODUCTS

● We remind our readers that notices of equipment listed and illustrated in this monthly feature are in no sense reviews. When figures, specifications and diagrams are published, these data are extractions from manufacturers' lists. When samples of this equipment are submitted for test, they are passed to our technical contributors, whose reports are published in a separate section.



*
**WYNSOR
 INTER-
 NATIONAL
 FOUR-TRACK
 RECORDER**
 *

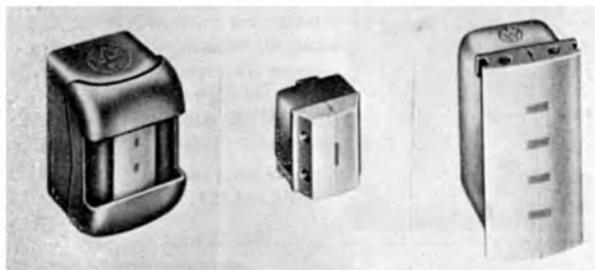
WYNSOR RECORDING CO. LTD., have produced a new model for this year's Audio Festival—the International Recorder priced at £78 15s., with microphone.

The layout is a breakaway from the conventional design in so far that the deck is in the vertical position. The specification states that it is a four track, two speed recorder ($7\frac{1}{2}$ and $3\frac{1}{2}$ i/s) with a frequency response of 40-20,000 c/s ($7\frac{1}{2}$) 40-12,000 ($3\frac{1}{2}$) both ± 3 dB. A recording level meter is fitted together with separate bass and treble controls, 8 in. speaker, facing the rear of the machine, three inputs and three outputs, monitoring through internal speaker. Pause control with lock and tape position indicator.

A ribbon microphone can be applied for the price mentioned above but enthusiasts already well stocked with microphones may purchase the machine for £72 9s.

Further details of the International may be obtained from the manufacturers WyndSOR Recording Co. Ltd., WyndSOR Works, 2 Bellevue Road, Friern Barnet, London, N.11.

*
 Three New Miniflux Heads
 *



The photograph shows left to right: Type N Stereo Head, Hall effect head without shield, and a four-channel head.

DETAILS of three further Miniflux magnetic heads have now been released. The most interesting of these is a record/playback head in which the output EMF is not obtained by the normal electro-magnetic induction principles, but is dependent on a phenomenon known as the Hall Effect.

As is well known, the normal magnetic head gives an output EMF which is dependent on the rate of change of induced magnetic flux from a moving tape and the output thus rises with frequency until various losses take over and the output drops. With the Miniflux head type HK 3/3ON, an output EMF is obtained which is independent of this effect and will give a D.C. output from a stationary recorded tape. The head is also provided with normal windings for recording purposes.

Of more general interest will be the new series "N" stereo heads for domestic and professional applications. These heads which are shorter than the previous types are provided with two screw bosses at the rear of the mu-metal housing for mounting on a simple bracket for azimuth adjustment.

The third type available is a four-channel head designated as Type WN /05/4K which is adaptable to provide 4, 8 or 12 channels on $\frac{1}{2}$ in. wide magnetic tape.

Production has now commenced on these new heads at the Technisch-Physikalisches Laboratorium, Munich, who have also developed a new range of full track heads (0.25 in.) which will be available in production quantities later this year. Further information can be obtained direct from: Miniflux Electronics Ltd., 8 Hale Lane, London, N.W.7.

*
 Tape Height Adjusters
 *

DETAILS were given in last month's issue of Tape Height Adjusters. These ensure that tapes are not damaged due to contact with the spool rim. Manufacturers: Rawson and Panton Ltd., 107a Lion Road, Bexleyheath, Kent.



*
 A New Fi-Cord
 *

FI-CORD announce a new recorder—the 202. This is a mains battery machine with speeds of $7\frac{1}{2}$ and $3\frac{1}{2}$ i/s and is the successor to the Fi-Cord 1A. Other features of the 202 include: fast forward and rewind, Vu-meter, four inch spools, resettable counter, manual and automatic volume control, built-in loudspeaker and low and medium impedance input sockets. The batteries are loaded into a easy-to-remove cassette and a warning light indicates when the batteries should be replaced. A safety record switch is fitted and the machine may be remote controlled if required. Accessories available include carrying case, choice of microphone and power packs for mains and car. The price, £69 6s., includes long life mercury batteries and tape. Makers Fi-Cord International, 40a Dover Street, London, W.1.

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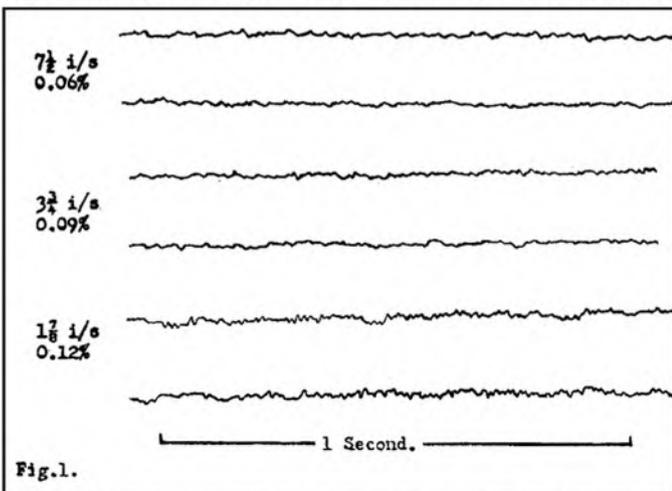
EQUIPMENT REVIEWED



★
**THE TANDBERG
 SERIES 6
 TWO TRACK
 STEREO
 RECORDER**
 ★

Specification: Tape speeds: $7\frac{1}{2}$ i/s, $3\frac{3}{4}$ i/s and $1\frac{7}{8}$ i/s. **Speed accuracy:** relative accuracy, repeated playback $\pm 0.2\%$ or ± 3.6 secs in 30 mins. **Absolute speed tolerance:** $\pm 1\%$. **Frequency response:** $7\frac{1}{2}$ i/s, 40-16,000 c/s ± 2 dB, $3\frac{3}{4}$ i/s, 40-10,000 ± 2 dB, $1\frac{7}{8}$ i/s, 55-5,000 c/s ± 2 dB. **Signal noise ratio:** 53dB for 3% tape distortion, 58dB for 5% tape distortion. **Recording amplifier distortion at peak recording level:** below 0.5%. **Crosstalk:** better than 70dB at 400 c/s, better than 30dB at 50 c/s. **Wow and flutter:** Better than 0.15% at $7\frac{1}{2}$ i/s, better than 0.2% at $3\frac{3}{4}$ i/s, better than 0.3% at $1\frac{7}{8}$ i/s. **Output:** a tape recorded to 3% distortion will give 1.5 volts out. **Inputs:** Microphone 1.25 milli volts at 5 meg. impedance, low level input 5 milli volts at 100K impedance high level input 50 milli volts at 1 meg impedance. **Heads:** three heads for erase, record and playback respectively. Erase and bias frequency: 78 ± 2 Kc/s. **Motor:** Hysteresis synchronous motor, system Papst. **Wind:** approx 2 mins in either direction for 1,200 ft. of tape. **Dimensions:** teak cabinet $16 \times 12 \times 6$ in. **Weight:** 25 lb. **Retail price** £115 10s. from **Elstone Electronics Ltd.,** Edward Street, Templar Street, Leeds, 2.

THE four track version of this machine was reviewed in the February 1961 issue of this magazine and it is interesting to see how closely the replay and record-replay responses agree on two models spaced nearly a year apart in production. The signal noise ratio is improved by 3 to 6dB because of the wider

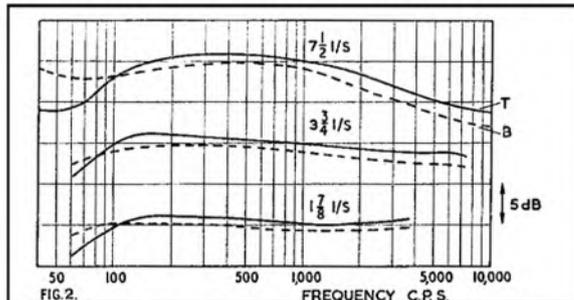


track width, but meter readings do not tell the full story, and it is necessary to listen very carefully to the reproduction and background noise to appreciate the subtle improvement provided by the wide track.

In the early review I mentioned that that almost the only effect of switching to the lowest speed was a slight increase in the "grain" of the noise; now this clue has almost disappeared, and operation of the A-B switch, which gives an immediate compari-

son between the original and recorded signals, simply limits the bandwidth by about one octave, i.e. from 10 Kc/s to 5 Kc/s, at $1\frac{7}{8}$ i/s. If wow, flutter and inter-modulation are sufficiently low it is amazing how many programmes "get by" with the curtailed frequency response, and I would like to shut up a few dozen advertising copy writers in a room with this machine for a few hours to demonstrate to them that frequency response is *not* the most important factor in a high quality tape recorder.

For readers who did not see the original review, let me explain that this is a two track stereo recorder with separate record and replay amplifiers and heads, but with no power amplifiers or



inbuilt loudspeakers. Cathode follower outputs provide up to 1.5 volts *r.m.s.* output for feeding external power amplifiers. The incoming programme can be compared directly with the recorded signal by operation of the A-B switch, and facilities are provided for cross recording from one track to the other so that very complex tracks may be built up without degrading the quality by crude superimposition.

Wow and Flutter

The fluttergrams of fig. 1 show that the short term speed constancy far exceeds the specification, with total wow and flutter readings of 0.06, 0.09 and 0.12% *r.m.s.* at the three tape speeds of $7\frac{1}{2}$, $3\frac{3}{4}$ and $1\frac{7}{8}$ i/s. Two pen traces are given for each speed, one at the beginning of a reel and one near the end. There seems to be no speed disturbance due to any rotating component, and there was no trace of the usual adding and cancelling effect as the recorded and replay flutters came in and out of step. The integrated meter readings were rock steady and repeated exactly each time the machine was switched on. Once again, tribute must be paid to the Papst external rotor hysteresis synchronous motor and to the superb finish of the capstan and bearings of this machine.

The absolute speeds were checked and found to be exact within the confidence limits of my test equipment which is well within plus or minus 0.5%! A glance at the service manual shows why the mechanical performance is so good; no less than 10 pages are devoted to the exact alignment and setting up of each component of the tape transport system.

Play only Responses

The curves of fig. 2 show the responses from 100, 200 and 400 microsecond test tapes at the three speeds of $7\frac{1}{2}$, $3\frac{3}{4}$ and $1\frac{7}{8}$ i/s. The 6dB fall in high note responses at $7\frac{1}{2}$ i/s indicates that the playback equalisation is matched to the *N.A.R.T.B.* 50 microsecond characteristic at this speed, but that the lower speeds conform to the *C.C.I.R.* recommendations of 200 and 400 microseconds.

It will be seen that the bass response of the top track channel (solid curve) falls below 100 c/s, but that the bottom track response is more level.

Fig. 3 shows the overall record-replay responses. The same bass cut persists on the top channel, and as the difference re-

(Continued on page 133)

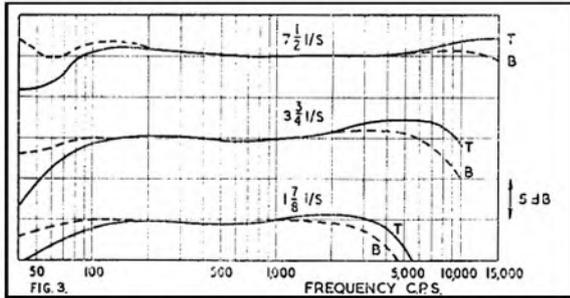
EQUIPMENT REVIEWED—(continued)

mains roughly constant at all three speeds, it would seem to indicate an amplifier rather than a head effect. The high note fall on the lower track is, however, obviously a wavelength effect and, as it does not show on the test tape responses, can only be due to recording pre-emphasis or bias. I would guess that a slight reduction of bias on the bottom track would match the responses very closely.

The magic eye beams closed at a recorded level 11dB above test tape level and the input signal could be increased by a further 3dB before the tape distortion reached 5%.

Signal noise ratio

Hum and noise, with no tape, was 43dB below test tape level on the top track, and 46dB below test tape level on the bottom



track. Thus the channel with the better bass response also gives the best signal noise ratio. Listening tests and visual examination of the noise on a cathode ray tube showed that hum and noise were present in almost equal proportions, but that the main background noise was due to very low level microphony in the input stages of each amplifier. If we add the 12dB margin between test tape level and the 3% peak recording level we obtain the very satisfactory figures of 55dB and 58dB for the top and bottom channels respectively. The composition of the residual noise is of academic interest only and I only mention it to indicate that valve hiss was of completely negligible proportions.

I could measure no difference between bulk erased tape noise and the noise of tape recorded on the machine, in fact most of the latter readings were a fraction of a dB lower, but this probably only means that a little hum or microphony was recorded and cancelled a little of the playback noise. This "splitting of hairs" on the last remnant of the noise only underlines the fact that it has been reduced to the absolute limit and is an order of magnitude lower than a normal domestic recorder with a signal noise ratio of 40dB or so.

General Summary

Comment: This machine can be inserted between a V.H.F. tuner, or hi-fi control unit, and the widest range amplifiers and loudspeakers and you literally "do not know it is there" at a tape speed of 7 1/2 i/s. At 3 3/4 i/s there is a just discernible "thickening" of complex high frequency programme content, due almost certainly to intermodulation in the recording medium, the tape itself. Even at the lowest tape speed of 1 7/8 i/s it needs a sharp ear and a really good programme source to be sure, every time, whether you are listening via tape or directly.

The only snag I can see in owning such a machine is that you would have nothing left to look forward to in the way of actual recording improvements—better recording tapes perhaps—or better microphones or auxiliary equipment—but the little A-B switch would always convince you that the recorder itself was blameless!

Has it no vices then? Yes, one very little one: If you thread a tape through the recording channel and into the take-up reel slot, and then try to take up the slack by rotating the take-up reel, you find that the supply reel rotates in the other direction and promptly pulls the tape clear of the right-hand reel. Even so I think I could learn to live with it! **A. Tutchings.**

★
**SHURE
UNIDYNE III
MODEL 545
CARDIOID
DYNAMIC
MICROPHONE**
★



Manufacturer's Specification: Type: Dynamic. Frequency response: 50-15,000 c/s. Output level: Low, -77dB. High, -55dB (0dB=1 volt/dyne/cm²). Impedance: Dual, choice of 50-250 ohms or high. Polar pattern: Cardioid, uniform, with frequency, symmetrical about axis. Magnetic circuit: Uses Alnico V magnet. Case: Die cast zinc and "Armo-Dur". Finish: Satin chrome and black. Cable connector: Equivalent to Amphenol MC4M plug. Cable: 18 ft., 3-conductor shielded. Dimensions: Length 5 1/8 in.; diameter 1 1/4 in. Nett weight (less cable): 1/2 lb., packaged weight 2 1/2 lb. Furnished accessories: A25B swivel adaptor. Optional accessories: A86A cable type transformer, S33B desk stands. List price: £28 6s. 8d. From Shure Electronics Ltd., 84 Blackfriars Road, London, S.E.1.

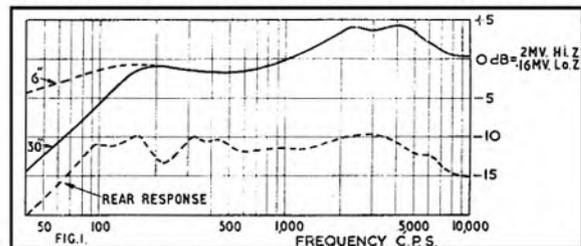
THIS is a single element cardioid microphone which works on the moving coil principle. Both sides of the diaphragm are open to the sound field, but sound only reaches the back of the membrane after passing through a resistive phase changing network. The force moving the coil is proportional to the difference in sound pressure between the front and back of the diaphragm.

Operation

A logical point to start an analysis of this microphone is at 200 c/s, where the mass of the diaphragm tunes with the compliance of the surround to give maximum coil velocity for a given applied force. Above this frequency the force moving the diaphragm must increase linearly with frequency to overcome the mass reactance of the moving system. This is achieved by making the path length from front to back of the diaphragm small compared to the wavelength of the incident sound so that the phase difference, and therefore the pressure difference, rises with frequency to maintain a constant coil velocity at all frequencies. Below resonance the response falls when the microphone intercepts a plane wave front, but if the wave front is spherical, as in close talking, the phase difference is increased and the response is nearly level.

Response

The top curves of fig. 1 show the frequency response for normal and close talking positions. The dotted lower curve



shows that the output for sound approaching the rear of the microphone is down 10 to 12dB over most of the frequency range. This is because the phase change in the acoustic resistance

(Continued on page 135)

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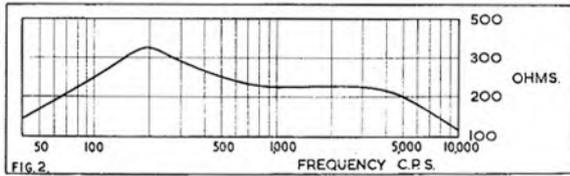
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element is almost exactly matched by the phase change suffered by the sound on its way round to the front of the diaphragm. Thus the sound pressure difference on either side of the diaphragm is almost zero for sounds reaching the back of the microphone, and the output level is also low. Conversely, the pressure difference acting on the diaphragm is high for sound striking the front of the microphone because the acoustic network phase change adds to the path difference phase change. The lower curve of fig. 1 was the actual measured rear response in my laboratory, where there was quite appreciable reflection from the walls which probably obscured the exact degree of cancellation, but it does give some indication of the practical usable front to back ratio.

Impedance

Fig. 2 shows the measured impedance over the frequency range on the low impedance output; the rise in impedance at 200 c/s confirms the diaphragm resonance at this frequency. The rise in impedance would indicate that the microphone should work into a bridging impedance which is high compared with



that of the microphone, and that a low loading impedance could alter the frequency response from my open circuit measurements. The mid low resonant frequency could make the microphone very sensitive to stand and handling noise, but the actual microphone capsule is rubber mounted on the main body of the microphone and, in fact, the unit can be handled normally with no perceptible disturbance.

Sensitivity

The sensitivity was measured and found to be 2 millivolts per microbar on the high impedance outlet and 0.16 millivolts per microbar for the low impedance line. This corresponds to levels of -54dB and -76dB below 1 volt/dyne/cm², respectively, which agree with the specified output levels within the confidence limits of my test equipment, or about 1dB.

Comment: Objective tests show that the low note roll-off has been nicely chosen for normal speech pick up to avoid bass accentuation due to "proximity effect", and that the quality is well balanced and free of room effects at distances up to 3 or 4 feet. More distant sounds are slightly "thin" due to the plane wave response, but the compromise response is a good choice for announcing and interview work. **A. Tutchings**

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Recording Tape. See my advertisement on page 132. Nobody has yet asked for his money back.—Villiers.

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(Continued on page 138)

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