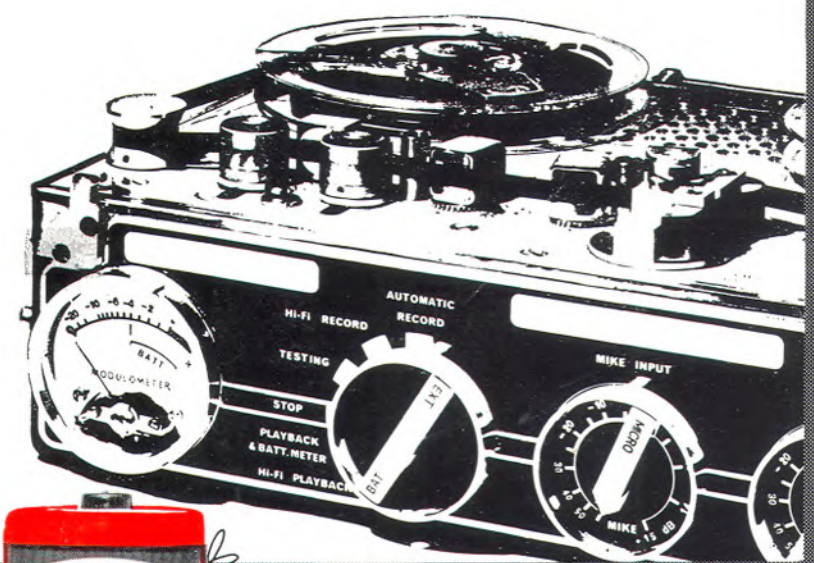
NOVEMBER 1965 TWO SHILLINGS

tape recorder

TAPE RECORDING GLOSSARY — MAGNAVOX STUDIOMATIC REVIEW
BUILD A TRANSISTOR MICROPHONE BOOSTER — EDITING HOLIDAY TAPES

EVER READY HIGH POWER BATTERIES GIVE AT LEAST 4 TIMES LONGER LIFE IN TAPE RECORDERS



In portable tape-recorders* with power requirements around 300mA a standard battery will drop below the necessary voltage to power the motor and amplifier in a matter of hours. An Ever Ready High Power Battery in the same recorder will keep up its voltage for a working life at least 4 times longer.

**Record players too.*

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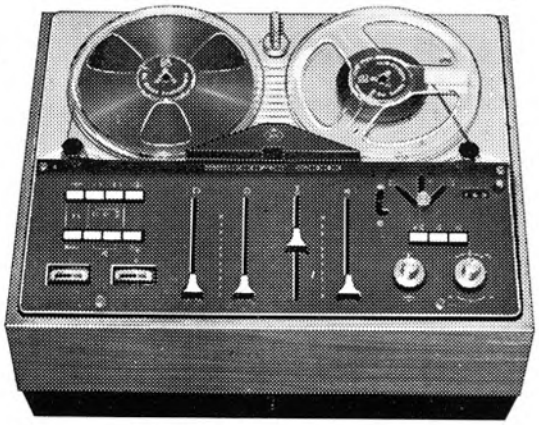

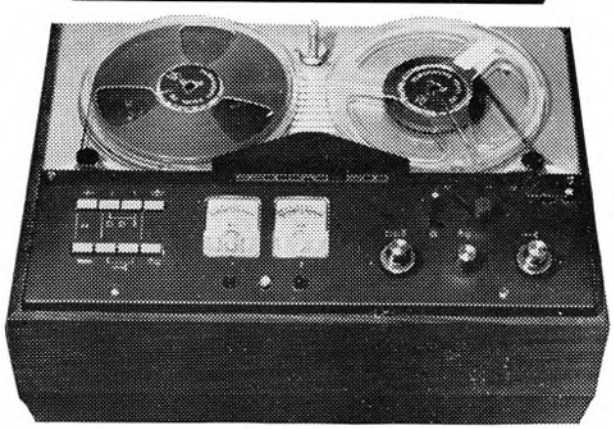

Beocord 2000 K, prize-winner at the 1964 Hanover Fair, a Supreme example of B & O audio engineering. The first all-transistor hi-fi stereo tape recorder with a professional specification which has been acclaimed in international trade and tape-amateur circles for its carefully planned design, advanced features, and outstanding performance. The BEOCORD 2000 K is the ideal tape recorder for the enthusiast whose only interest is perfection. Available in a 2-track & a 4-track version. **112 gns.**

Beocord 2000 T—The Beocord 2000 is also available as a portable model with loudspeakers built into the lid and has exactly the same technical specifications as the Beocord 2000 K. The lid can be divided; each half forming one loudspeaker unit and giving a performance fully comparable with two stereo loudspeakers. This unit is ideally suited for the enthusiast who insists on the high quality performance of the Beocord tape recorder in a transportable version. Dimensions 10¾″ high (including speakers), 17¾″ wide, 14″ deep. Price **117 gns.**

The Beocord 1500—the very latest tape recorder from Bang and Olufsen. Based on the design of the Beocord 2000 this new tape recorder is technically identical but does not have mixing facilities or an output replay amplifier and is intended for the enthusiast who already owns a high quality hi-fi system yet desires the inherent qualities of the famous B & O Beocord 2000. The Beocord 1500 is available in a choice of Teak or Brazilian Rosewood finish. Dimensions 8 1/16″ high, 17¾″ wide, 14″ deep. Price **89 gns.**

Available only through appointed dealers of quality, Bang & Olufsen products are on permanent exhibition at our new London Showroom, 70/71 Welbeck Street, London, W.1.

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A tuner requires an audio amplifier

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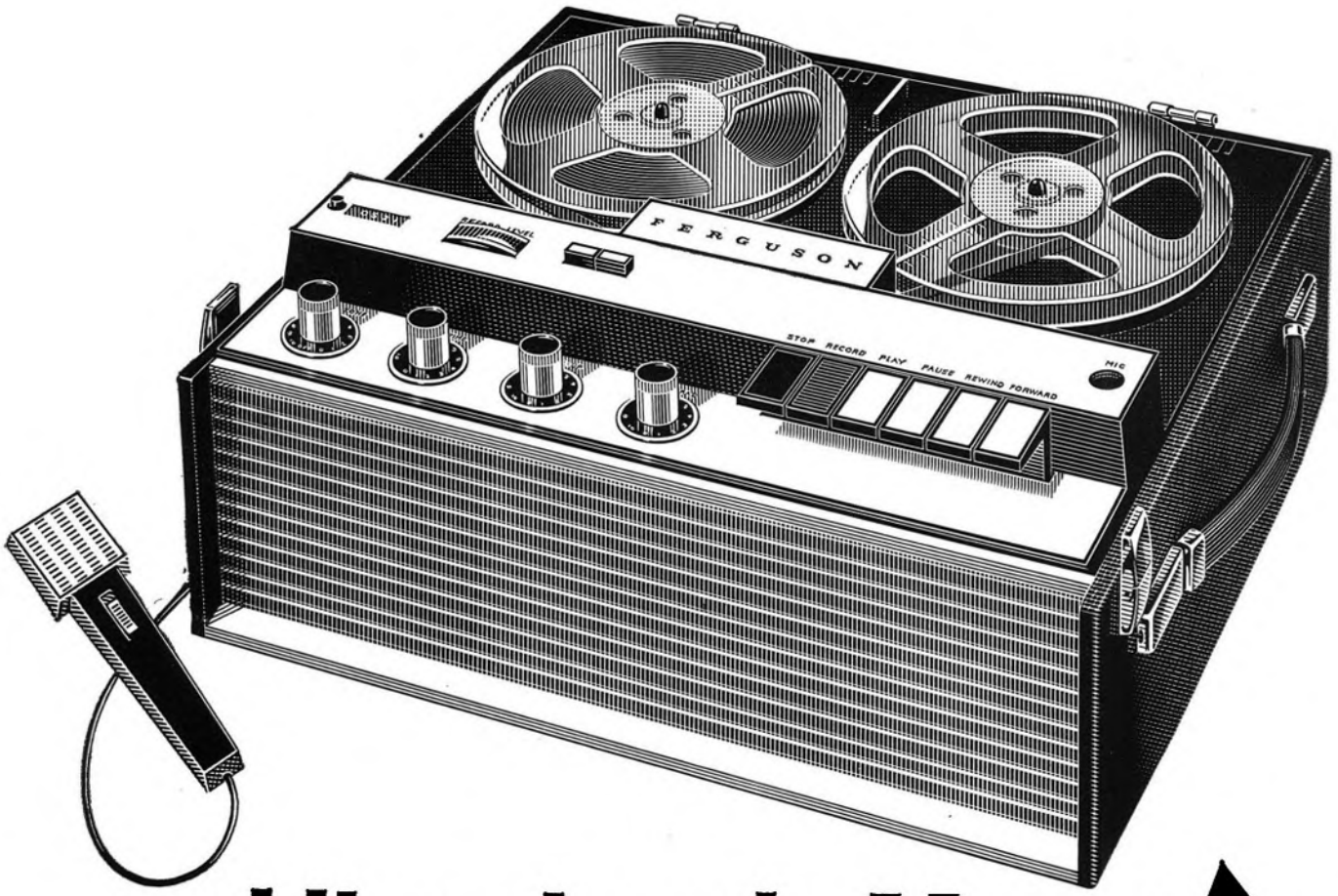
New from
FERGUSON
a tape recorder
for the real enthusiast



...and it costs only 44gns

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Great, great value. Great entertainment, too.

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Explanations and demonstrations of acoustic phenomena, sound vibrations, standing waves, fundamentals and other interesting facts about sound reproduction.

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Authentic Hungarian interpretations of Liszt's famous Hungarian Rhapsody No. 2 and Brahms Hungarian Dances. Unusual instruments, a different sound to familiar music.

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Traditional Dixieland, Tiger Rag, Sensation Rag, Clarinet Marmalade Blues, Skeleton Jangle and many others all played by dedicated men.

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Wonderful and unique performances on an accordion of Bach's Toccata & Fugue in D Minor, Ritual Fire Dance, Finlandia, Flight of the Bumble Bee and many others.

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Genius at work on the mighty Wurlitzer, Hernando's Hideaway, Song of the Islands, Tea for Two, Strike Up The Band and many others by George Wright, America's leading theatre organist.

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Fascinating percussive arrangements of Turkey in the Straw, Yanky Doodling, Easter Parade, Sleigh Ride, and many others by the New York Percussion Trio.

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Wonderful performance and recording of 1812 Overture and a choral version of the Polovetzian Dances all by the Vienna State Opera Choir and Vienna Symphony Orchestra.

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TAPE NO. 104

Fabulous Hammond Organ playing, fascinating arrangements of Heatwave, Peanut Vendor, Black Magic, Lullaby of Broadway, It's Magic, Softly as in a Morning Sunrise and many others.

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Enchanting Ray Charles sings Ain't that Fine, Honey, Honey, Can Anyone Ask For More, Sittin' on Top Of The World and many others.

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Let's face it, what could be simpler than a Grundig tape recorder.

An automatic Grundig tape recorder!

The Grundig TK23L is a highly professional tape recorder. It records on four tracks, plays back for up to six hours on a spool of double-play tape.

Yet, for all its intricate insides, it remains a simple, robust Grundig. Whether you wish to recapture a sigh or a symphony, it records what you want—with feeling.

The TK23L has a further advantage. It's automatic.

This doesn't mean you switch it on and come back to find the dinner cooked. But it means that when you're putting something onto tape, the Grundig 'Magic Ear' adjusts the recording level automatically. *Forte* or *pianissimo,* you get balanced sound all the time.

With the TK23L you can superimpose, make trick recordings too. It costs 49 gns.—comes complete with over a quarter of a mile of tape and a microphone worth seven guineas.

Listen to it soon. And in case you're a person who likes twiddling knobs while you record—relax! There's a switch that turns off the automatic 'Magic Ear.'

Grundig think of everything.

Valuable - but free if you post now!

Grundig make first-class tape recorders from 37 gns., radios from 15½ gns. Send today for a free 20-page colour book about them, called 'The Grundig World of Sound.' Post this coupon to Grundig, London, S.E.26.

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Agfa tape is produced to give perfectly balanced reproduction over **the whole tonal** range. It is manufactured in three basic types all on pre-stressed **polyester base.**

PE31 Long play with great strength and high output.

PE41 Double play. Highly recommended for 4 track and 2 **track recordings.**

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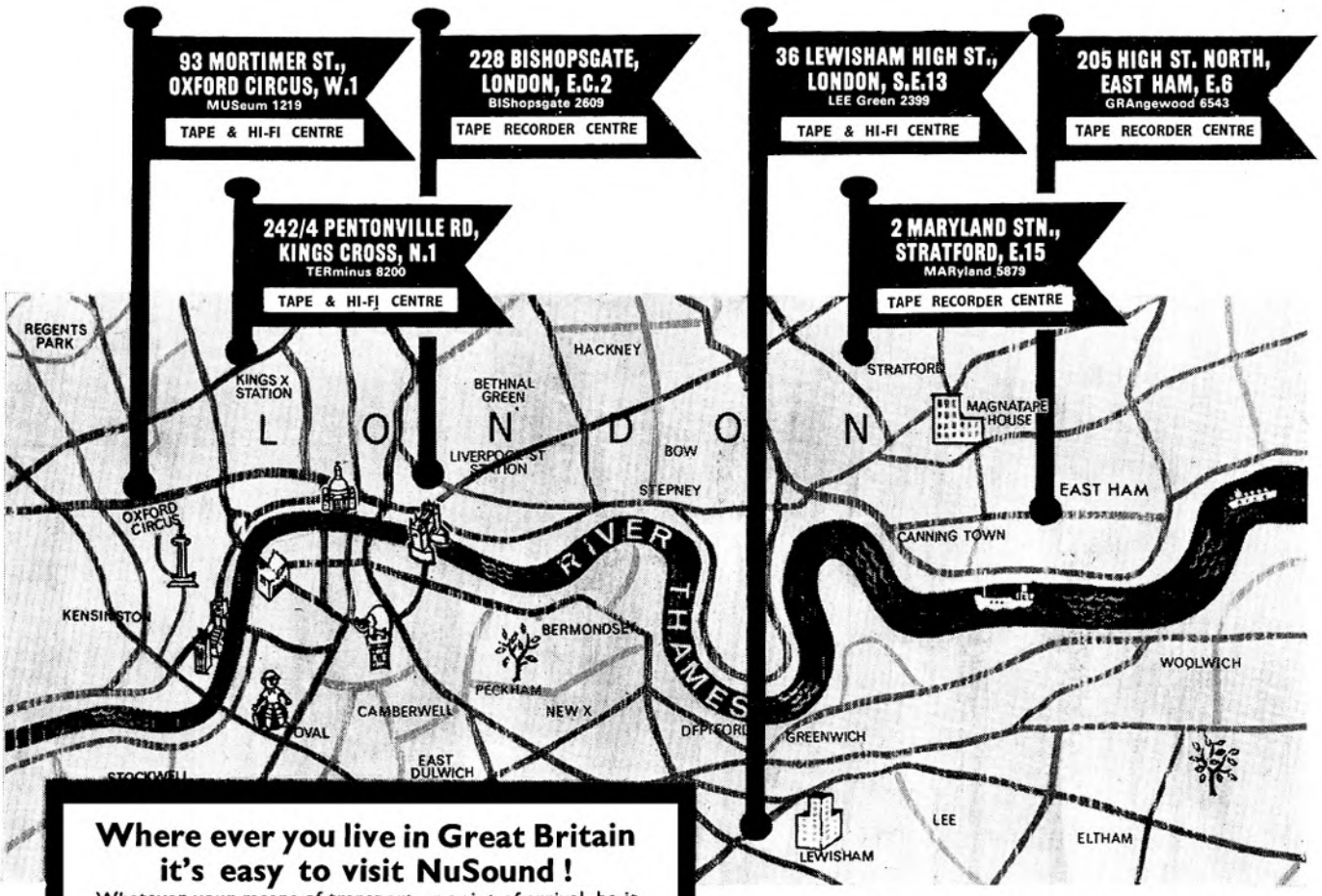

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As Britain's largest Tape Recorder and Hi-Fi sales organisation with over 10 years experience in this specialised field NuSound have built up a reputation that is "second to none".

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  In some cases you can save over 50% of the usual price.

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Does 18,000 c.p.s. at 3¾ i.p.s. sound interesting?

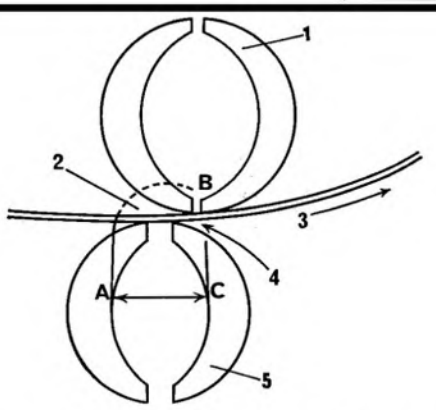
Meet the Akai Crossfield Head . . . .

Akai X4

Akai M8

. . . . the best head for sound in the business

No other tape recorders can throw about claims like full frequency range at $3\frac{3}{4}$ i.p.s. and expect to be believed! Whatever other recorders do have, there's one thing they haven't—that's the exclusive Akai Crossfield Bias Head—an advance so important that it opens a whole new world of high fidelity recording and only Akai has the key. Look at this picture.



This is the Crossfield Head—only Akai has it.
1 signal head. 2 bias field. 3 direction of tape travel. 4 signal field. 5 bias head. 6 bias head retracts automatically on playback.

On conventional heads the high frequency components of the signal recorded tend to be attentuated or erased by the effect of bias fields. On the exclusive Akai Crossfield Head the signal head and the bias head are mounted in opposition with their centres slightly off. The tape is pre-magnetized between points A and C and recorded with the signal at point B. The recorded signal is completely free from the effect of prevailing bias fields and can be retained on the tape without loss.

It will be seen from the construction of the Akai Crossfield Head assembly that, as the signal head is arranged obliquely apart from the bias head, across the tape, the amount of bias may be selected without regard to the functioning of the signal head. This means that the tape can be modulated over the entire frequency spectrum with maximum fidelity since the recorded signal is entirely unaffected by the bias field.

The maximum audio frequency that can be recorded on tape is usually around 790 c/s. at a tape speed of 1 centimetre per second, rising to about 2,000 c/s. at 1 inch per second. For Standard tape speeds: 9.5 cm/s. ($3\frac{3}{4}$ i.p.s.) —7.500 c/s. and for 19 cm/s. ($7\frac{1}{2}$ i.p.s.) —15,000 c/s.

The Akai Crossfield head makes possible the recording of a signal frequency of up to 2.750 c/s. at a tape speed of 1 cm/sec. or 7.000 c/s. per inch. In other words, the Akai Crossfield head—makes it possible to record 18,000 c/s. at a speed of $3\frac{3}{4}$ i.p.s. or 21,000 c/s. at $7\frac{1}{2}$ i.p.s. With the low speed of $1\frac{7}{8}$ i.p.s. (4.75 cm/sec.) now available on the M8 and X4 models, it is practicable to record up to 11,000 c/s.

Employing this Akai technique, it is now possible to record four continuous hours on a standard 1,200 ft. tape without the need for professional $10\frac{1}{2}$ in. reels.

That's for the real buffs! And explains just one feature of the amazing M8 and X4 Akai tape recorders. But we know you tape recorder experts—gluttons for information—especially if it's about the biggest recording advance of the decade! So we've written down everything you want to know about the Akai range, just clip the coupon and we'll send it to you.

To Pullin Photographic Ltd., 11 Aintree Road, Perivale, Middlesex. Please send me details of the Akai range.

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TR.1

AKAI

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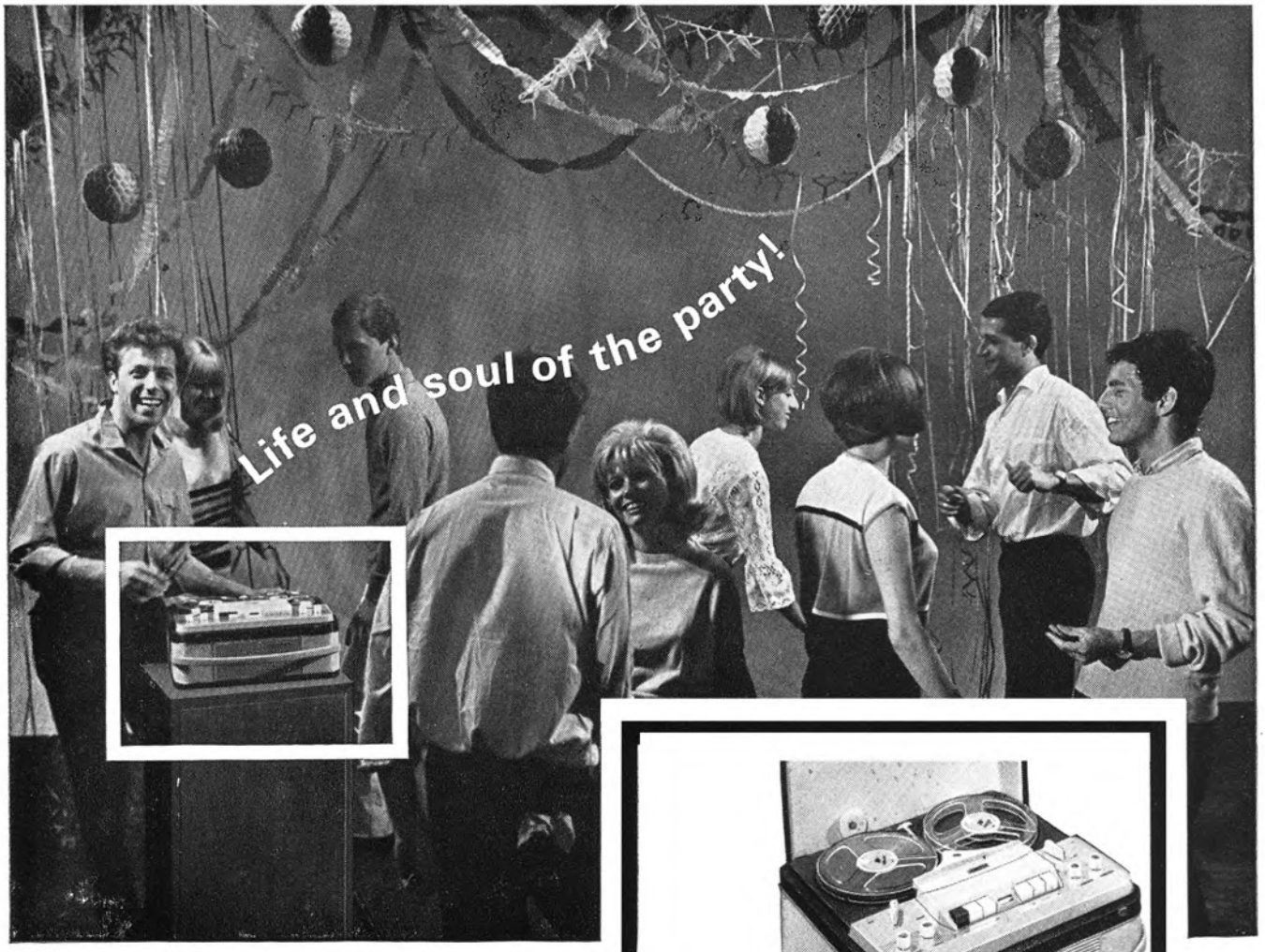


Philips de luxe Hi-Fi Tape Recorder Model EL3549: 62 gns

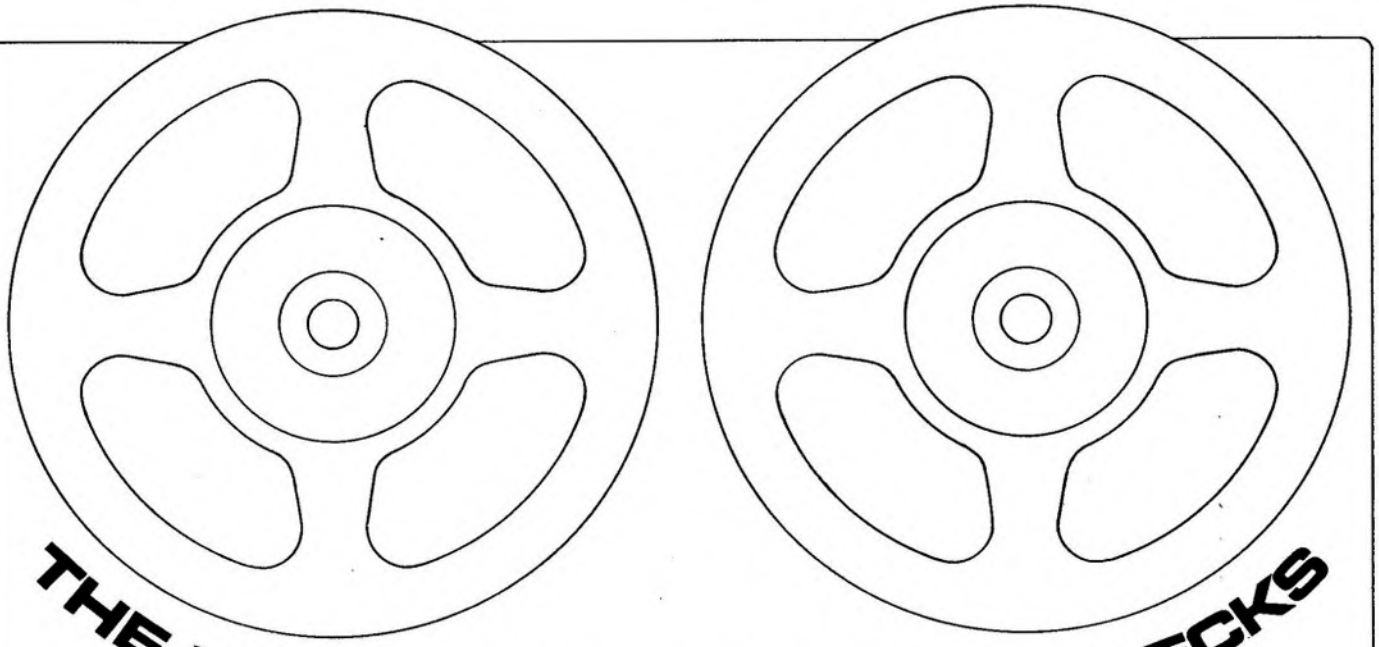
Supplied complete with microphone, 7″ reel L.P. tape, empty spool and connecting lead.

HERE'S a party that's going with a swing—thanks to Philips EL3549 Tape Recorder! The host recorded all the music needed to make this party a success, and now Model EL3549 is playing it back —superbly! And not only does it make things swing—it catches things on the swing, too! At just the touch of a button, Model EL3549 will record improvisations, songs—in fact, any sounds that are worth remembering. Find out about this and other Philips Tape Recorders—visit your Philips dealer today!

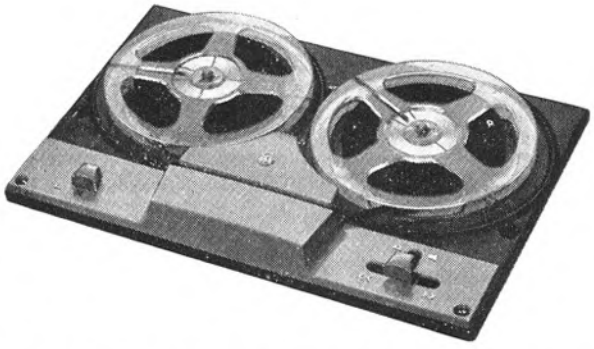
EXPERTS CHOOSE PHILIPS TAPE

Follow the example of professionals in recording and broadcasting studios all over the world—use Philips Tape, the tape that is made by the world's leading tape recorder manufacturer! A product of Philips unrivalled experience and know-how, Philips Tape has all the qualities needed to make your recordings perfect every time.

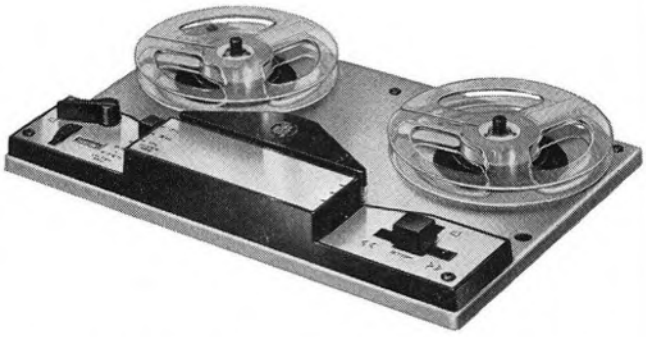
ANOTHER ENTERTAINING PRODUCT FROM PHILIPS—the friend of the family



THE WORLDS FINEST TAPE DECKS



Take a look at the precision built and quality tested T.D.2. Listen to its superb performance — only BSR can combine this proven reliability with such truly magnificent performance. Takes $5\frac{3}{4}$" reels playing at $3\frac{3}{4}$" per second.



Look, too, at the elegant T.D.10 — a tape deck of functional excellence that sounds as good as it looks and is an established favourite throughout the world. Takes up to 7" spools with a choice of 3 speeds. It has fast forward and fast rewind, a 3 digit counter and space for a third head for monitoring which is available as an extra.

BSR

Send for full technical details and illustrated leaflet.

The world's largest manufacturers of Tape Decks and Record Changers

MONARCH WORKS/OLD HILL/STAFFS

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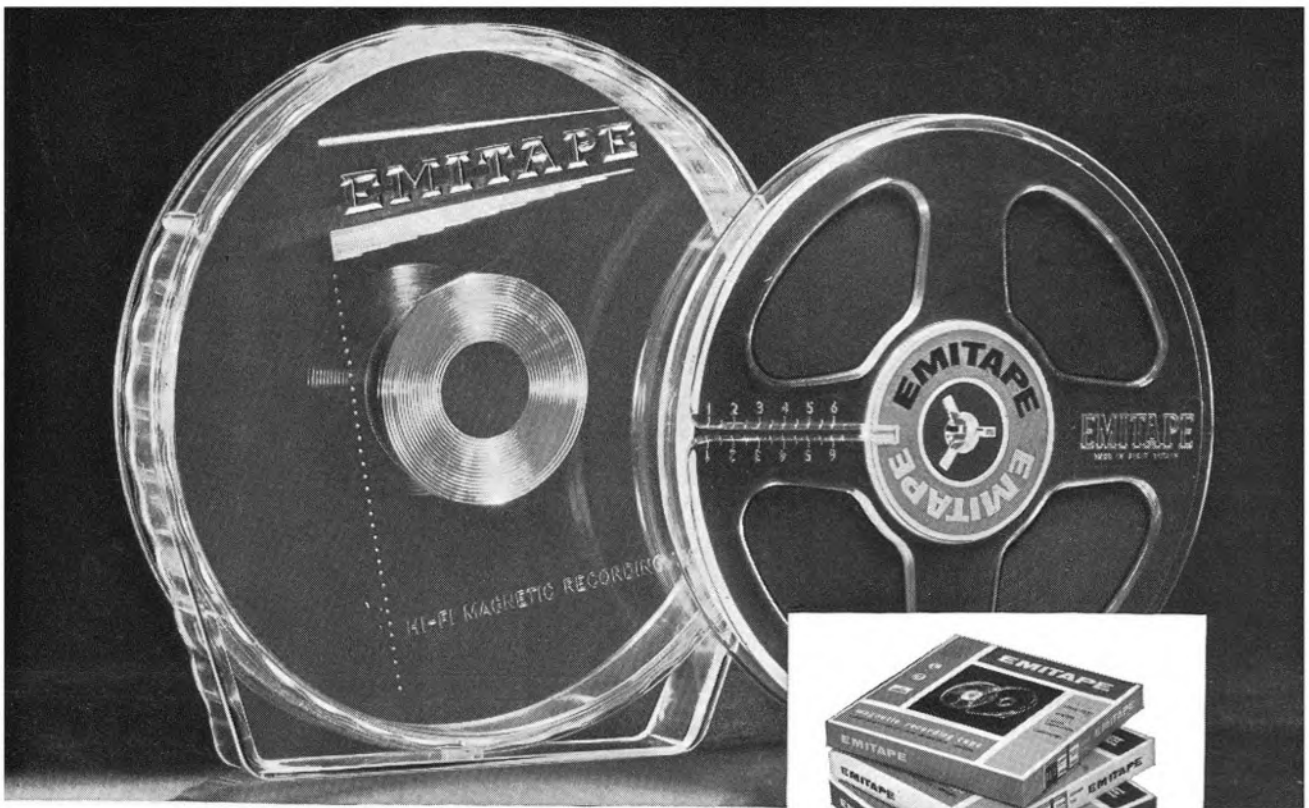

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INCORPORATING 'SOUND AND CINE'

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Editorial and Advertising offices

LINK HOUSE, DINGWALL AVENUE, CROYDON, SURREY

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editorial

SEVERAL EUROPEAN tape recorder manufacturers have instigated a new sales feature within the last year or two—that of supplying performance measurements with each machine. Though by no means new to the hi-fi side of the audio market, this 'gimmick' is one that few manufacturers have dared to adopt below the professional level and it has intriguing possibilities in the domestic tape sphere.

In many fields of commerce, manufacturing and retail bodies have combined into associations designed to protect the public from poor value and service. Travel agents, commercial photographers and coal merchants are all required to conform to a fixed high standard of operation before being allowed to join their respective associations. After a while, it is hoped, the public grows to realise the superiority of those companies that *do* belong to such organisations.

The tape recording and general audio trades enjoy one important advantage over the holiday, photographic and fuel markets, however. Even though connoisseurs might be able to select the better of two airlines, two Madrid hotels or two coach tours, one could hardly expect the general public to understand the relevance of one chemical coal structure against another, or the disadvantages of over-developing or insufficient back-lighting in a portrait. But, as readers will know, only a minimum of well-chosen reading matter is required to understand the purposes of response curves, signal-to-noise ratio, and wow and flutter. Supplying detailed performance figures for a tape recorder, amplifier, tuner, mixer, microphone or turntable enables the audio manufacturer to go one better than the coal merchant, removing many doubts from the customer's mind and, incidentally, giving the customer cold facts on which to base his choice of machine.

The possible dishonesty associated with the "frequency range: 40 c/s—20 Kc/s" type of specification could be eliminated by a moderate number of manufacturers, confident in their own products, giving such information in writing *for each machine*, and saying how a *range* is defined. After all, which manufacturer who could rightfully claim such a range or (better still) a *response* would refrain from supplying evidence to the customer when his more reputable rivals were doing so?

Extra time, greater cost and increased staff, will be among the drawbacks put forward by the less co-operative manufacturer to the measurement of, and reporting on, individual machines. But such statements would be exaggerations. On almost every tape deck and tape recorder production line, in Britain and abroad, at least one stage is devoted to wow and flutter measurement, head alignment and 'listening test'. Withdrawing slightly, the manufacturer may admit that the stages and possibly even the staff are present on his line—but what of the test equipment? For this we must look to the backroom wherein the 'boys' indulge in developing next year's models. The production engineer may take his choice of a variety of test instruments—there are usually several of each—without which it is impossible to design a tape amplifier or deck; though the boffins might not agree!

Further to encouraging the supply by manufacturers of individual test reports, we would like to see the extension of present reports to cover the all-important specificational item—'wow-and-flutter'. This, even if noise level and crosstalk were omitted, is surely essential to a tape mechanism. Why do the manufacturers currently supplying individual frequency response curves supply neither fluttergrams nor even flutter-meter readings? It is surely not because they do not possess the necessary equipment. Would it be that mechanical consistency is immensely more difficult to obtain than electronic consistency?

The answer is quite certainly yes. And yet, would not the very innovation of individual test reports help to solve this problem? Machines persistently found to be faulty would lead a trail for trouble-shooters back to the capstan grinder, the brake assembler or some equally critical section of the line, and eliminate a possible future source of trouble. In this way, the manufacturer would be assisting himself just as much as he was satisfying his customer. Perhaps this is all a wishful pipe-dream, but let us at least hope that someone will be enterprising enough to try a worthwhile idea. The spice of competition can sometimes work wonders.

NOVEMBER 1965 **VOLUME 7** **NUMBER 10**

COVER PICTURE

Another photograph from *Standard Telephones and Cables*, following hard on the heels of last month's cover, shows assembly of a **4038** ribbon microphone. The picture also shows what can be achieved by an ambitious press officer; we take this opportunity to appeal to manufacturers for attractive cover illustrations. They are, after all, free publicity!

SUBSCRIPTION RATES

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

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

If we switched
the lights off and
switched this
tape recorder on...

the sound would tell you it's Elizabethan

And surprise, surprise . . . should you decide to record as well as listen in the dark, you simply flip the track switch to 'automatic' and the amazing Automan monitors its own recording level *automatically*. Flip the switch to 'manual' and you're in charge of the monitoring again! With 4 tracks, 3.5 watts output, 7" x 4" high flux elliptical speaker, 60-10,000cps frequency response and wooden acoustic case the Automan 4 gives an outstanding performance that earns it an enviable place in the great new generation of quality tape recorders from Elizabethan. But don't just take our word for it. Try the new Automan for yourself . . . Lights on or off, you'll be more than happy with *all* you hear!

the Sound alone tells you it's

elizabethan

Automan 4, 29 gns.
Automan 2, 2 track version with trick switch for superimposing, 27 gns.

426

world of tape

SILENCING SQUEAKING TAPES

IN reply to a *Reader's Problem* published in our August issue, mention was made of *Polytetrafluorethylene* (PTFE) rod as a substance which, when positioned as a guide before the heads, acts as a lubricant and eliminates 'squeak'. Since the issue appeared, we have received numerous enquiries concerning the commercial availability of the material.

PTFE tubing is obtainable from certain chemists, while some ironmongers stock rod. It should be emphasised, however, that while PTFE is not inflammable, *it is highly toxic* when burnt or inhaled with (cigarette) smoke. One must, therefore, *not* smoke when cutting, drilling or turning the material. Also, fast-winding tape over the rod will result in oxide particles being welded by local heating to the PTFE surface, tending to destroy the lubricating effect.

NUSOUND SALES TECHNIQUE

IT appears that an item published in this column last month may have given a false impression concerning the activities of *Nusound. All six* London dealers in the group are featuring the products of the same manufacturer, to be changed on a monthly basis, though the usual stock of other models are being held and demonstrated on request.

MASTERTAPE SOLVE THE THREADING PROBLEM

ALL tapes manufactured by *Mastertape* will shortly be fitted with an electrostatic leader designed to simplify threading and to prevent loose reels flapping. *Masterstik* leader attracts itself to the take-up spool hub when touched with a finger and also holds against the fully-wound tape reel when this is removed for storage.

Manufacturer : Mastertape (Magnetic) Ltd., Colnbrook, Bucks.

TAPE TRAPS FIRE HOAXERS

UNEXPECTED use for telephone recording equipment installed recently at five divisional headquarters of the Lancashire County Fire Brigade has been to aid the trapping of fire hoaxers. All incoming emergency calls are now taped on the machines, developed over the last two years by *Philips*, to ensure that information from agitated callers is not lost. Similarly, local police have been able to track down persistent hoaxers after listening to recordings of their conversation.

The transistorised tape installation is activated automatically by incoming telephone calls, which are then transcribed to cassettes. Police and ambulance services are believed to be interested in the equipment, since they share many of the problems associated with the fire service.

SOME ERRORS AND OMISSIONS

ERRORS in the stereo tape recorder survey published in September have been brought to our notice by Messrs. *Grundig* and by a reader. The first concerns the price of the Grundig *TK46* which is £112 7s. and not £102 19s. as stated. Secondly, the *Sony TC600* was inadvertently given two entries, the latter of the two giving the incorrect price of £133 7s. This entry also gave power amplifier output figures, though the TC600 is, in fact, a tape unit.

A final point concerns the *Revox 736* review, which also appeared in the September issue. No mention was made in the specification or in the text to the effect that the machine under test was a ¼-track model.

TAPE COPYING SERVICE

DETAILS of their comprehensive tape-to-disc and tape-to-tape services were sent to us recently by *Deroy Sound Service*, 52 Hest Bank Lane, Hest Bank, Lancaster. Four-track and twin-track recordings can be handled at any speed and length. Twenty years experience, and professional copying equipment, limit the quality of the dubbings only to that of the tapes received. The service operates by post or by telephone appointment, normal delivery being 48 hours from receipt of tape, instructions, remittance and, where necessary, postage. Original recordings are returned with the tape or disc copies unaltered, unless special instructions are given for editing. The latter is 5s. per track by mechanical splicing or 10s. per track by tape transfer. Tape-to-tape copying costs 10s. per hour, excluding cost of tape but including postage.

"Nevertheless, it's cheaper than torch batteries"

Twelve-inch 33⅓ rpm microgroove discs, with a capacity of up to 24 minutes per side, cost £2 5s. (recorded on one side) or £2 15s. (recorded on both sides). Ten-inch 33⅓ rpm discs, taking up to 16 minutes of material on each side, cost £2 and £2 8s. single and double sided, respectively. Prices for 7in. 33⅓ discs are £1 2s. 6d. (single-sided) and £1 7s. 6d. (double-sided), capacity being 15 minutes per side. Seven-inch 45 rpm discs, taking up to 3 minutes of material on each side, are 18s. and £1 1s. respectively. The latter charges are also applicable to 78 rpm discs, offering up to 1½ minutes per side. Ten inch and 12in. 'seventy-eights' are also available, costing £1 1s. and £1 2s. 6d. respectively when cut on one side. The former accepts up to 3 minutes material per side, while the latter holds 4½ minutes. Double-side recordings are £1 5s. and £1 7s. 6d. in 10in. and 12in. sizes, respectively.

Transcriptions of radio and television sound programmes are 5s. per 30 minutes, plus the cost of discs, and require the permission of the broadcasters.

AUDIO DIARY NOW AVAILABLE

COPIES of the 1966 *Audio Diary* can now be obtained from our Croydon offices, price 7s. 6d. post free. Despite its small size, the Diary contains more than fifty pages of data never hitherto available in such convenient form. Further details are given in the advertisement on page 454.

Publisher: Link House Publications Ltd., Link House, Dingwall Avenue, Croydon, Surrey.

JAPANESE RECORDER SALES BOOMING

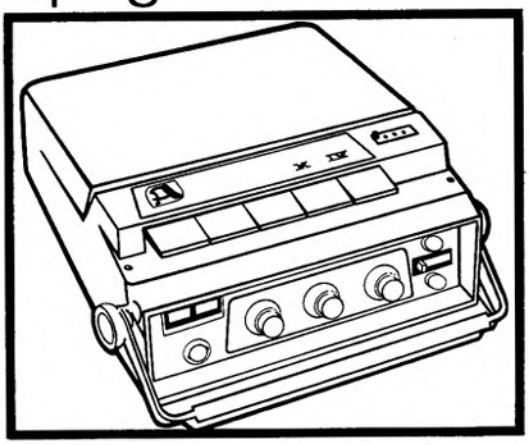
REPORTS from Japan indicate that sales of tape recorders, hit by the recession of last year, are growing more sharply than ever. During 1965 it is expected that 7½ million machines, many of them in the under £18 bracket, will be marketed for a return of £51 million. Since 1957, profits in the tape recorder field have increased from £1 million to £17½ million in 1962 and on to £34 million in 1964.

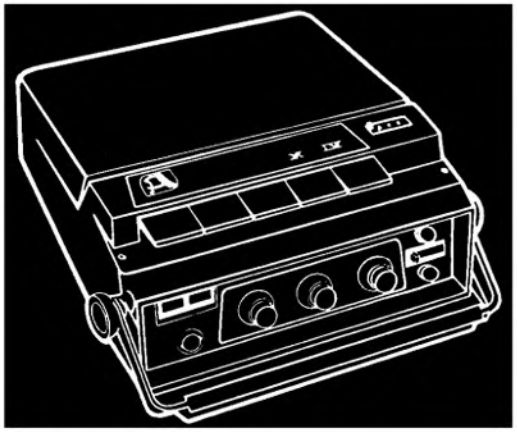
Although sales of cheap transistorised recorders are increasing rapidly, exports of higher-priced valve and semi-valve recorders rose by 77% last year, compared with the 30% increase for low-priced models during that period. An increase of 150% was noted during 1964 in sales of capstan-driven recorders. The market for high-priced stereo machines is increasing both in and out of Japan and it is expected that two million recorders will be sold in that country before the end of the year.

NEXT MONTH

TO BE PUBLISHED on Saturday, 13th November, the December issue of *Tape Recorder* will see the first of a series by Michael Gordon entitled *Battery Powered Tape Recorders*. Elsewhere in this issue the *Magnavox Studiomatic* will be pulled to pieces and analysed while H. W. Hellyer gives his views on *The Art of Audio Design*. Construction of an ingenious tape storage box will be detailed by Martin York.

towards better taping





BY GORDON J. KING

part 20

A CONCLUDING GLOSSARY

IN conclusion of this series of articles, here is a glossary of tape recording terms and jargon such as adopted by the more experienced within our ranks with complete understanding but which, owing to some lack of definition consistency, have been known to confuse rather than guide the non- and semi-technical enthusiast towards better taping.

AC ERASURE. This is the conventional method of tape erasure whereby the magnetised tape passes through a magnetic field alternately increasing and decreasing in intensity while changing polarity at a rate determined by the frequency of the AC source.

The source is a power oscillator feeding into the erase head—arranged also to provide the bias signal—and the frequency may lie between about 35 Kc/s and 80 Kc/s in domestic machines and may be higher than this in high quality and professional machines. Noise-free erasure (that is, making the tape free of spurious signals) relies on the oscillator signal being a pure sine-wave.

The changing magnetic field completely destroys the original magnetic pattern on the tape by pulling the various aggregations of magnetised particles into random orientation.

AMPLIFIER. Two of these are required in a record/replay machine, one to amplify the very weak microphone or programme signals to a level that, when passed through the winding of the record head, produces a magnetic field sufficiently strong to saturate the tape (if required); and the other to amplify the weak signals across the head on playback to a level sufficient to work the loudspeaker. These two amplifiers, the *record* and *playback* amplifier respectively, are often integrated in some manner so that a section in one amplifier may double for a section in the other. For instance, the microphone amplifier on record may double as the head amplifier on playback and the output stage on playback may double as the oscillator on record. These changeover functions are handled by the record/playback switching in the amplifier.

AUTOMATIC RECORDING LEVEL. To avoid bad distortion, the current through the head when recording should be kept to a level below tape saturation. This is handled manually by the record level control, adjustments being made in relation to the record level indicator. Some machines feature an auto arrangement of this kind, whereby a strong microphone signal, for instance, produces a bias voltage which pulls down the gain of the record amplifier, and thus keeps the head current

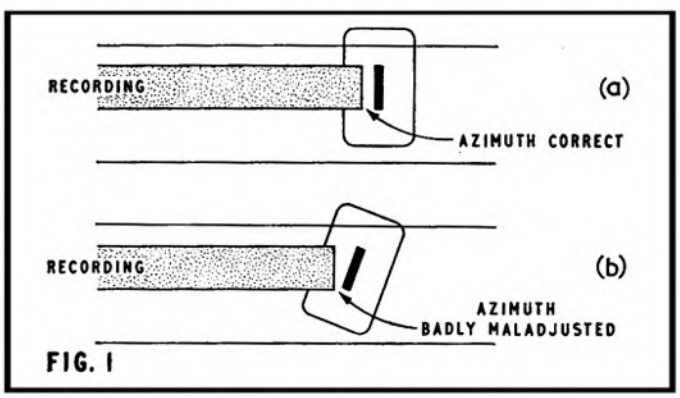


FIG. 1

automatically below the value that would cause distortion.

AUTOMATIC STOP. This facility automatically switches the machine and/or motor off at the end of the tape. There are several methods of operation. One makes use of a micro-switch mechanically coupled to a spring-loaded arm which is held in the 'on' position by the drag of the tape. When the tape runs out, the spring pulls the arm back, an action which clicks the switch off. An *auto on/off* control is sometimes featured to bypass the micro-switch in the *auto/off* position.

Other methods utilise a foil at the end of the tape which completes a circuit across two contacts and a relay winding, the relay then energising either to release a holding solenoid on the pinch roller or to switch off the capstan motor. The material on the tape is sometimes used to produce a steady DC voltage, thereby holding off a relay. At the end of the tape when the sound ceases, the relay comes on (because the DC voltage collapses) and performs the required switching.

AZIMUTH. This relates to the angle between the axis of the playback head gap and the axis of the record head gap. When these two axes coincide and the angle is zero, the azimuth is optimum and the best

reproduction of the higher frequencies results. As the angle increases, so the treble response of the system falls.

As the record head generally doubles as the playback head, the angle is always optimum when playing back a tape made on the same machine. However, the angle could be well off optimum when a tape record or a tape made on a different machine is played (see **fig. 1**).

Adjusting screws are often provided to vary the 'tilt' of the gap from the vertical, to the right or to the left. Optimum azimuth is when the line of the gap is at right-angles to the length of the tape, assuming that the tape has been recorded on a machine whose record head azimuth is likewise adjusted. Adjustment is generally made during playback of a standard test tape of high-frequency tone recording. The angle of the axis of the replay head being adjusted for maximum output of the high-frequency signal.

BATTERY POWERED. This implies that the machine as a whole obtains its power from batteries. These are usually contained within the machine and may be either of the 'all-dry' flash-lamp variety or of the rechargeable type. In the latter case, some means of charging is featured, either in the machine or as a separate unit for connection to the mains supply.

Some battery powered recorders employ transistor circuits and a small DC motor, the speed of which is maintained reasonably constant by a centrifugal governor. In early and inexpensive models, this has a relatively short life due to arcing across its contacts, but more recent, though more expensive, models employ a transistor-controlled motor. To avoid wow when the recorder is moved during recording or playing back, some battery powered models use twin, contra-rotating flywheels as, for instance, the *Telefunken Magnetophon 300*, released in 1964.

BIAS. In tape recording parlance, this generally refers to the high-frequency sine-wave signal that is applied to the record head along with the programme signal. The term sometimes used is "high-frequency (or HF) bias". This distinguishes it from the term "bias" implying an electrical bias applied to the control grid of a valve or to the junctions of a transistor in the amplifier itself. The action of the bias linearises the tape transfer characteristic and thus eliminates the distortion which would otherwise be present.

The amplitude of the bias (that is, the strength of the bias signal) is important, and some machines feature a preset bias control for optimising the amplitude to suit different tapes.

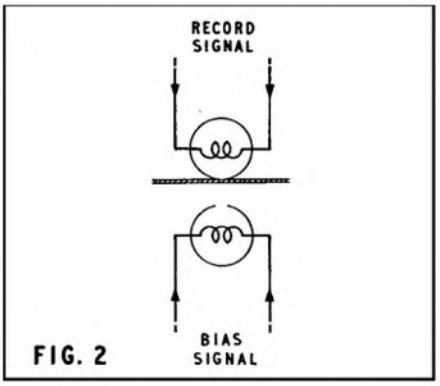


FIG. 2

The frequency of the bias should be at least four times the top frequency handled by the machine. As the bias is derived from the same oscillator as that providing the erase signal, its frequency ranges from about 35 Kc/s to about 80 Kc/s, or higher than this in some professional models. One of the problems of direct bias lies in impairing the top frequency response (see under CROSS-FIELD RECORDING).

CAPSTAN. This is the drive from the motor to the tape. The tape is transported at constant speed between the capstan and a rubber roller (called the 'pressure roller' or sometimes 'pinch wheel') under spring tension against the capstan. This method of drive is the best for economic constant tape speed, since the drive, in effect, comes direct from the motor spindle, which itself is 'buffered' against speed variations by virtue of a heavy flywheel. The drive is released by the pressure roller being moved away from the capstan. This occurs on 'standby' and rewind.

CLUTCH. Clutches are sometimes employed to couple the tape spool spindle to the spool drive. Clutching may be frictional or electro-magnetic (or both), and is required to keep the tape at a reasonable tension between the spools during play, record and wind. This is achieved by the two spools being clutched in opposing directions. The amount of clutch action is sometimes proportional to the weight of the tape on the spool, thereby giving greater frictional coupling when the spool is full of tape than when it is almost empty. On 'wind', the take-up spool is given a more direct drive against the supply spool either mechanically or electromagnetically. In the Grundig TK9, for instance, the clutch solenoid is fully energised on 'fast wind', so that full torque is applied for this function.

CROSS-FIELD RECORDING. This is a fairly new technique whereby the HF basis is applied to the tape during 'record' from an extra head mounted directly in opposition to the record head, as shown in **fig. 2.** The extra head does not actually touch the oxide. This method of applying HF bias is employed in certain models of the *Akai* series of tape recorders.

When the HF bias is applied to the record head along with the record signal, it tends to have a neutralising effect on the higher frequencies. The cross-field recording technique, however, does not neutralise the higher frequencies in this way. This means that excellent treble performance is possible at tape speeds which hitherto were considered suitable only for dictation. The Akai Model X4 battery portable tape recorder, for instance, is claimed to have a response up to 11 Kc/s (±3dB) at a tape speed of $1\frac{7}{8}$ i/s with the cross-field system. The response is even up to 5.5 Kc/s at $\frac{15}{16}$ i/s, and up to 20 Kc/s at $7\frac{1}{2}$ i/s.

The field from the record head proper and that from the bias head interlink across the tape and the transfer characteristic is linearised, as with the conventional method of biasing the tape. On playback the oscillator is muted, as in the ordinary way, and the bias head is swung clear of the tape.

CROSSTALK. This applies to the inter-coupling between the two channels of a stereo system. That is the left-hand signal appearing in the right-hand channel, and vice versa. The amount of breakthrough from one channel to the other is specified in decibels (dB), and is somewhat governed by the frequency of the signal. Crosstalk (sometimes referred to as its reciprocal *channel separation*) should not fall much below 100 : 1 (40dB) at all frequencies. It is often given at a frequency of 1 Kc/s, where its value may be as high as 60dB (1,000 : 1 voltage ratio).

DEMAGNETISATION. This is when a magnetised medium is made to give up its magnetism. This applies to tape, after erasure and to the various pieces of metal-work on a tape recorder that can become magnetised. These are demagnetised by a device known as a *demagnetiser* (or sometimes *defluxer* or *degausser*). In its simplest form this consists of a mains-powered solenoid with a metal core terminating to a convenient 'probe', allowing the field produced by the mains to be concentrated in proximity to the item to be demagnetised. The effect of the 50 c/s (or 60 c/s) mains field destroys the orderly pattern of the molecules of the magnetised metal and hence the magnetism.

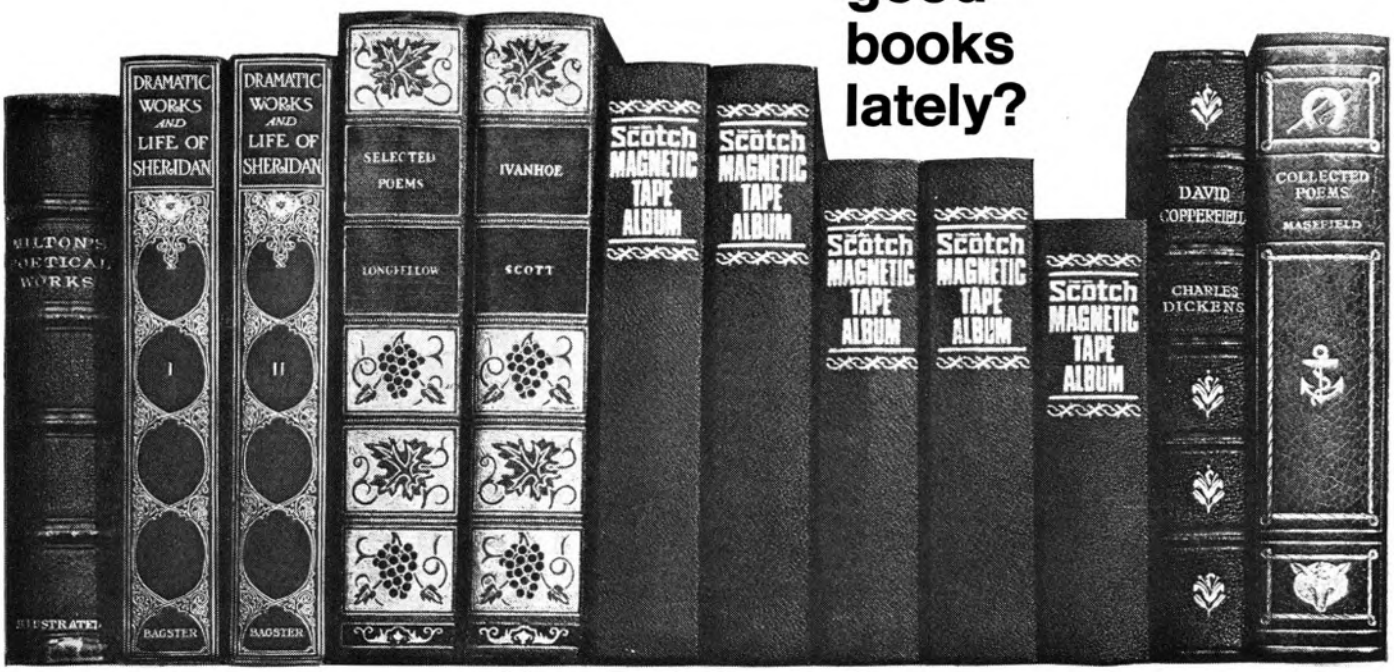
In the circuit of the recorder, there is often a fairly large value electrolytic capacitor on the HT circuit to the bias/erase oscillator. Thus, when the machine is switched from 'record', the oscillator signal gradually decays (as the electrolytic relatively slowly discharges), and in that way any residual magnetism in the erase and record head is removed. Sudden switching of the oscillator could incite residual magnetism, which is one of the reasons for abnormally high background noise and loss of treble.

DISTORTION. This refers to the quality (or purity) of the programme signal in the record/replay channel. The amount of distortion on a signal is given as a percentage relative to the rated output of the playback amplifier. Distortion of 10% (which is too high for hi-fi) from an amplifier would mean that a tenth of its signal is absolute distortion, not present on the original signal, but introduced by the amplifier itself.

The most troublesome is harmonic distortion, and all the spurious harmonics generated by the system are generally summed to give a value equal to the "total harmonic distortion". In good equipment this should not exceed 2% to 5%, but it is affected by the maximum recording level chosen. Harmonic distortion rises rapidly when the record signal is so strong as to push the tape towards saturation. This is why the record level indicator should never be allowed to exceed the 'maximum record level' mark.

DOMESTIC TAPE RECORDER. This term is often used to distinguish the medium-price tape recorder extensively used in the home from the more expensive machine used mainly by professionals in the field of sound recording.

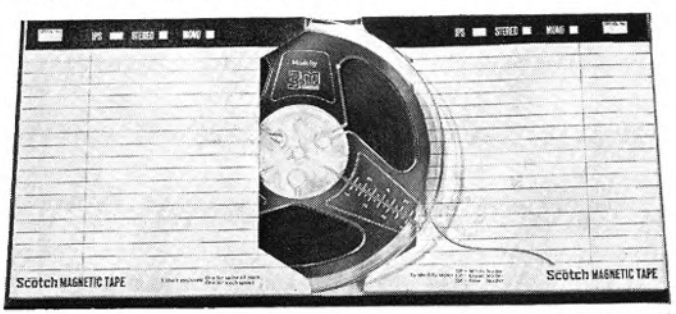
(*Continued on page 431*)



Inexpensive New Trade Mark Scotch Magnetic Tape Albums look good-store tape perfectly

Not just a pretty cover, but sensible with it. These new Album packs, luxuriously bound in green leatherette with real gold block lettering, store your tapes in the correct position, upright. Built like books, to last a lifetime, their strength will give more protection to your precious recordings. Each Album contains one reel of 'SCOTCH' Magnetic Tape with space for another, plus a set of labels for spine and spool identification. For all this they cost just marginally more than usual. Available in 5″, 5¾″ and 7″ spool sizes for all types of 'SCOTCH' Magnetic Tape.

And don't forget the complete range of 'SCOTCH' Magnetic Tape is still available in the familiar standard packs. All 'SCOTCH' Magnetic Tape (except type 111) has Superlife coating, to give improved frequency response, less tape recorder head wear, great reduction of 'rub-off' and increased tape life. **Start building your 'Scotch' Magnetic Tape Library now.**



Minnesota Mining and Manufacturing Co. Ltd., 3M House, Wigmore St., London, W.1. *3M and SCOTCH are trademarks of Minnesota Mining & Manufacturing Co.*

3M COMPANY

EQUALISATION. This is a process of 'signal tailoring' undertaken by special circuits in the recorder to counter certain shortcomings in frequency response. For example, it is necessary to apply equalisation to the playback channel to counter the rise in output voltage with increase in frequency from the playback head. The amplifier is arranged, in this case, to have a falling amplification with increasing frequency. The net result is then an output from the amplifier which is in frequency balance. Similarly, loss of treble due to head, tape and circuit shortcomings is equalised by other circuits.

Equalisation is generally to the agreed European standard of CCIR, so as to permit the interchange of tapes. Expression may be in terms of a time-constant for the various tape speeds, these being 140 micro-seconds (μS) for $3\frac{3}{4}$ i/s, 70 μS for $7\frac{1}{2}$ i/s and 35μS for 15 and 30 i/s, though an older standard specified 200μS and 100μS respectively for $3\frac{3}{4}$ and $7\frac{1}{2}$ i/s.

American recorders are often equalised to a slightly different standard, namely, NARTB. Such tapes played on CCIR equalised machines may have rather predominant treble.

ERASURE. (See under AC ERASURE.) Apart from AC erasure, a tape can be wiped clean by energising the erase head with a direct current (DC erasure) and by the use of a permanent magnet, the field of which is brought close to the tape when erasure is required.

Both DC and permanent magnet erasure result in excessive background noise compared to AC erasure and a pure sine-wave signal. However, in the *Walter Metropolitan*, introduced at the 1960 Radio Show, a patented PM erasure system was used for which a noise performance comparable to that of AC erasure was claimed. Here a small bar magnet is held at a 5° angle to the tape so that the field tapers off in the direction of the tape motion. While the angle of incidence is somewhat critical, once set, results are very good. In spite of this, the AC system is still well favoured.

Erasure of a complete spool of tape is achieved by a so-called *bulk erasure*. This consists of a large electromagnet energised from the mains supply. The spool is placed on top of the device and is subjected to a powerful field initially, which gradually falls to zero as the tape is removed, at which stage the tape is adequately erased.

FOUR-TRACK. This term is often used to describe the recording/playback system in which the tape is divided into four tracks, each track carrying either full mono or half stereo information. For stereo, two tracks are used simultaneously, one for the right channel and the other for the left.

FREQUENCY RESPONSE. This is the measure of constancy of output signal over the audio spectrum with a constant input signal. A 'flat response' is one where the output signal remains at a constant amplitude at all frequencies. In practice, the response is rarely absolutely flat. It falls at the bass and treble ends and may vary a little in the middle of the spectrum.

GAIN. Is the amount of 'lift' given to a signal applied at the input to an amplifier, at the output. It is given either as a direct ratio or in terms of decibels.

GAP. Refers to the spacing between the two pole faces of the various heads. The smaller the gap of the playback head, the better the treble response. The gap dimension of the record head is less critical, but is assuming greater significance with the advent of cross-field recording.

HEADS. Domestic machines usually feature two, one for record, doubling on playback, and the other for erase. Professional machines may have an extra 'monitor head'. With cross-field recording, an extra head is used for the bias signal.

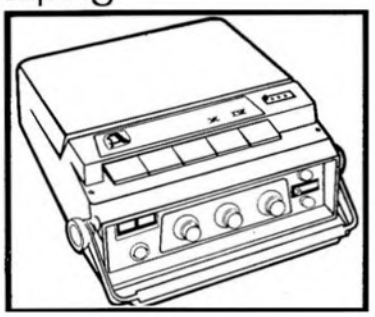
INSTANT STOP. Is a device whereby the motion of the tape can be halted instantaneously. This is often achieved on playback and record by a mechanical arrangement releasing the pressure roller from the capstan and simultaneously braking the take-up spool. Instant Start is the opposite action.

MAGIC EYE. Is a cathode-ray indicator in which two sections (or a variation of fluorescent display) vary in distance between each other in accordance with the level of the signal in the record amplifier (operative sometimes also on the playback amplifier). The device is used as a record level indicator.

MODULATION. A term used to signify the depth of recording on the tape.

MONITOR. When the record or playback signal is listened to at a low-level point in the system either through a pair of headphones or from a small loudspeaker. In this way the quality of the signal can be checked and corrected if necessary. The actual material recorded can almost instantaneously be monitored by a special playback head placed a little after the record head. The signal from this head is

towards
better
taping



equalised, amplified and then fed to a pair of 'phones or a speaker.

MUTING. This applies generally to shorting the internal speaker during recording from a microphone to prevent the howl which would otherwise be established due to *acoustic feedback* between the microphone and speaker.

NOISE. This generally refers to any spurious output from the speaker apart from that of the programme sound, and includes the noise 'hiss' produced by the valves or transistors of the amplifiers and their components and circuits, the noise produced by the tape itself and any mains hum that may be present at the output. Noise from the tape is sometimes called *modulation noise*, and the general condition of the tape, including how well it has been erased, has a bearing on this noise. The narrower the tape track, the greater the noise output relative to signal.

PAUSE CONTROL. (See INSTANT STOP).

PRESSURE PADS. These come into contact with the tape to ensure its intimate contact with the heads. Wear in these items can impair the treble response owing to the oxide side of the tape losing intimate contact with the heads. Too great a pressure, however, will result in premature head wear.

RESIDUAL MAGNETISM. Is the magnetism picked up by a piece of metal due to the proximity of the field from a DC electromagnet or permanent magnet. When the influencing field is removed, a residue of magnetism remains. On heads, tape guides and the like, this can impair the signal-to-noise ratio. A demagnetising device is required to remove residual magnetism.

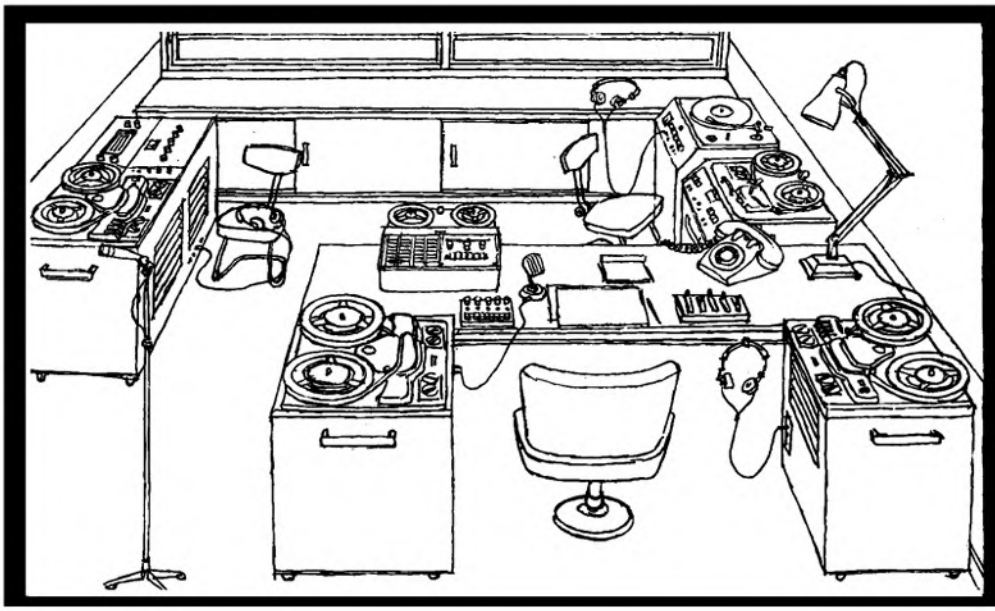
SIGNAL-TO-NOISE RATIO. This is the ratio between the wanted signal and the noise in the system. The ratio is generally taken at 1 Kc/s relative to a tape recorded at 'full modulation' and is expressed in decibels.

The noise may be *weighted* so as to bring it into focus at those frequencies at which the ear is most sensitive. Most specifications are *unweighted*, however, a reasonable ratio being in the order of 55-60dB. Noise can be troublesome at ratios around 40dB and less.

TAPE SPEEDS. The standard speeds are 30, 15, $7\frac{1}{2}$, $3\frac{3}{4}$, $1\frac{7}{8}$ and $\frac{15}{16}$ i/s. The highest speed is used only for very high quality studio work, and the lowest for dictation.

SUPERIMPOSITION. This refers to the technique of putting a second recording on an already recorded track. It is achieved by cutting off the erase signal and (preferably) reducing the level of the record bias signal. The level of the superimposed recording should be below that of the original recording for the best result.

(*Continued on page 435*)



RADIO TIZARD

a complex amateur entertainment system described by

D. G. BISHOP

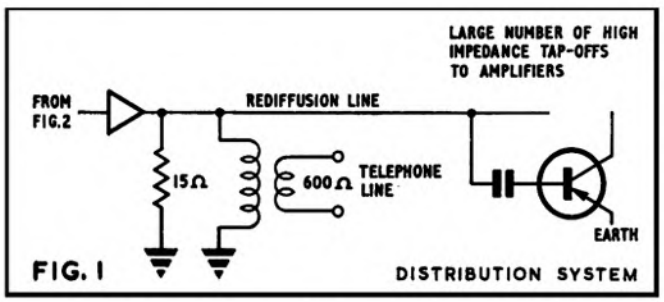


FIG. 1 DISTRIBUTION SYSTEM

BROMPTON clock chimes the hour, and the sound of *Snap and Whistle* can be heard over the Kensington mews. The music fades: "Good evening southside, this is Wonderful Radio Tizard, coming to you . . . . . "

WRT was born in February this year. Since then it has mushroomed to a potential audience of 500. Distribution to subscribers, who pay nothing for their programmes, is by single cable with mains earth return. The signal is originated at 15 ohms from a loaded loudspeaker output, and subscribers can tap off at any point on the system, feeding into a high impedance input of their amplifier (**fig. 1**). There is therefore no loading on the line by the subscriber, and hi-fi signals can be sent out with no treble loss and no hum pick-up. The quality can be superior to BBC-FM, and even though the subscribers' equipment ranges from tiny transistor radio amplifiers to medium hi-fi set-ups, the transmission equipment is capable of providing highest quality sound, as a quick glance at **fig. 2** will show.

The two *Revox* machines were selected for their superb reproduction and for the tremendous flexibility of the switching. When needed, they can be used for remote solenoid quick-start, and can be switched rapidly to provide flutter-echo on live programming. One of the Revoxes has been modified, so that all the inputs and outputs are brought to a 10-way jack strip on the front of the machine, which makes for quick connection of auxiliary equipment, and, incidentally, shortens the internal wiring. This modification can only be done on the *F36* (not on the *736*); the whole deck unit is slid back ¼in. and re-located, leaving a space in front of the loudspeaker, where the jack strip can be screwed. The whole unit can still be removed from the case for repairs, etc., as before. Anyone who has fiddled with the phono sockets at the back of a Revox will see the advantage of this simple modification.

The *Stella* tape recorder is used only for playback of tapes recorded on-location by our battery-portable, carried by the out-of-doors crew, who roam around London. Tape extracts can easily be held on the PAUSE control, for instant insertion. One of the prime needs for our programming is 'instant sound' from tape, disc, or microphone. This can readily be seen in **fig. 2**, where all the signals can be pre-monitored and lined up, while sound from another section is being sent out. At any time the telephone (INT 3335) can be switched into the circuit to include any interesting conversations, pick-up being obtained by induction from the receiver. If needed, the conversation may be delayed, using tape delay. The bell is equipped with a muting switch. Requests are taken for live music, or points of view on topical matters can be sought at the twist of the dial.

Two microphones are shown in **fig. 3**, the *AKG D12* and *D19* (60-ohm). A muting switch was required for the D12, so that the microphone became instantly alive, or was shorted to earth. The most suitable switch was a cheap *Woolworths* light switch, with rocker action, which was both mechanically and electrically silent. The D19 is already equipped with a slide switch. It is mainly used for interviews, live music or news inserts, providing a subtle change of acoustic and giving a slicker change of voice impossible to achieve with a lone microphone.

The *Garrard* turntable with *Decca* pickup is fitted with a simple but effective quick-start device. This may be of use to readers who have the problem of never really knowing when a record is going to begin. It is a piece of cardboard in the shape of a London Transport sign, being a 7in. disc with two 'ears' diametrically opposed, and a hole in the centre for the spindle. The record is put on to this device, on the turntable, and the pickup lowered. When the music starts the card-

board device is stopped by catching a finger on one of the ears, the record coming to a dead halt with the pickup still in the groove. The main turntable continues spinning at full speed. The record is then rotated by hand so that the stylus is in the groove a quarter of a turn before the music starts. The signal can then be switched through to the main mixer, and when the finger is removed the record starts immediately, with no time taken getting up to speed, and no slip.

The signals can be monitored at all stages by selective switching, and, because all the programming is created live, the total output is recorded on a *Ferrograph*, which is put across the line. This enables the performers to hear the programme afterwards. The signal is split three ways, one part going direct to the rediffusion system, the second part going via suitable transformers through the telephone lines to 'Radio Beit', and, experimentally, the remaining part was cautiously remodulated, so that a transistor radio within about ten feet of the rediffusion wire could pick up the signal on 1380m LW. However, even though the transmission was at very low power, this method was discontinued with a view to possible legal difficulties.

The listener is not concerned with the equipment that brings the programmes to him. He is more interested in the sounds that he hears, and it is the programme content that interests us most of all. It presents a challenge to us because we are not professionals and we do not have the resources of the BBC. We know that we can better the programming of the pirate radio stations, and 'Fun Till One' draws an audience similar to that attracted in the 2LO days by Savoy Hill.

Our approach is one of spontaneity. We begin the programme with no fixed sequence in mind. We have all the ingredients on tape, on disc, on paper, or in our minds. From there we 'play it by ear'—literally! The production team consists typically of an announcer, a disc operator, a music selector, and a second announcer. There is no one producer, but the main programme decisions are made by the first announcer, who cues in records, starts tape, and cues in the second microphone. We have an abundant supply of non-copyright music on tape and disc. Recording sessions throughout the years have given us a variety of popular musical selections, and in the studio the guitar of Bob Saxton is available for telephone requests.

The recording sessions for groups usually take a weekend to produce acceptable results, using multi-microphone techniques. We use two *Vortexion* mixers (8 way), and microphones from our mike-pool; two *AKG D20's*, two *AKG D12's*, *AKG D19*, *Ball-and-Biscuit*, and several *Reslos* and *Film Industries M8*'s. On one occasion we even were able to use two *B & K* Laboratory Condenser microphones—flat to 40 Kc/s and above; they added zing to the cymbals, and life to the piano. The sessions have resulted in three LP's and three EP's, and when possible we use these for supplying the music, because disc is always easier to handle for quick starts and for cueing. That is why we have the disc facilities in the system. We also play records brought over from the USA and Canada, from radio stations who produce syndicated non-copyright music and advertising discs. We have a supply of the more entertaining Canadian radio commercials on tape, and we make our own commercials for current local events, as the promoters require.

Music is not the main ingredient of 'Fun Till One'. The standard of our performers cannot compete with the BBC, so we concentrate our activity on 'actuality' recordings and on live features which are sometimes scripted. Interesting items from magazines, newspapers and books are used, and topical issues are covered by live microphone interviews or by telephone interview. Comments and recommendations on local eating places and current films are supplied, but the total format of the evening's programme is not known until it happens! This gives us the spontaneity that we seek, and provided we can back

(*continued on page 435*)

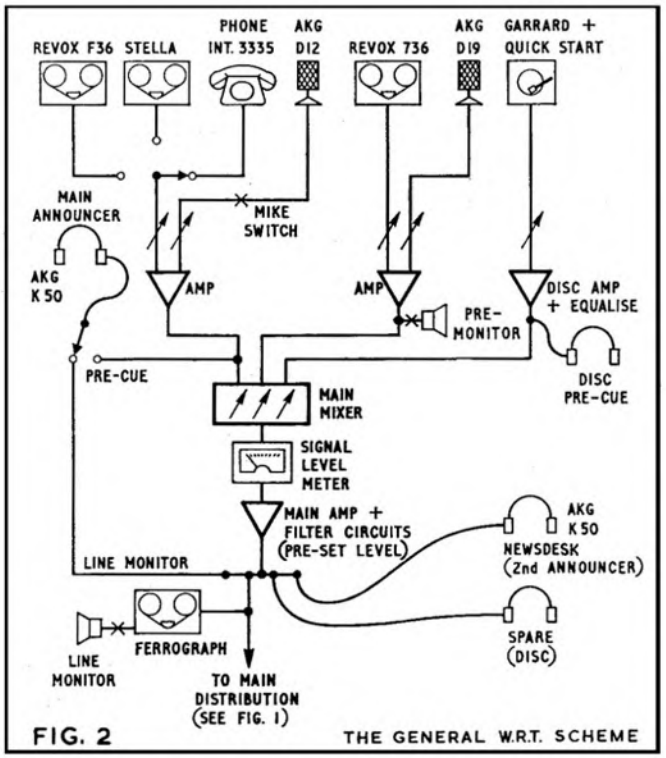
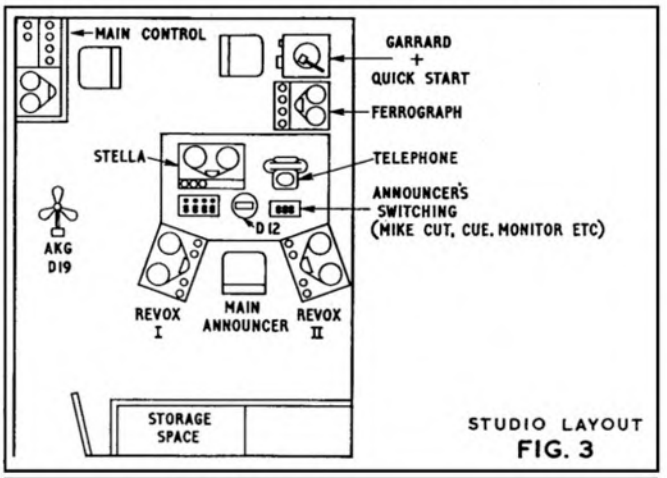


FIG. 2 THE GENERAL W.R.T. SCHEME



STUDIO LAYOUT
FIG. 3

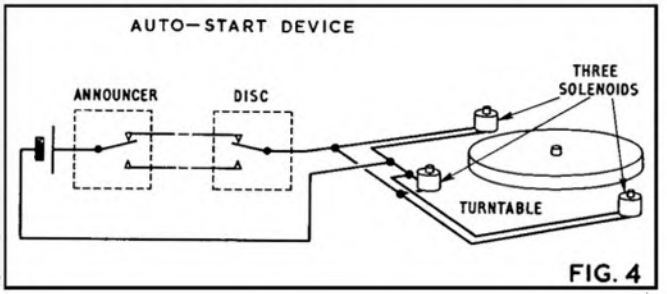


FIG. 4

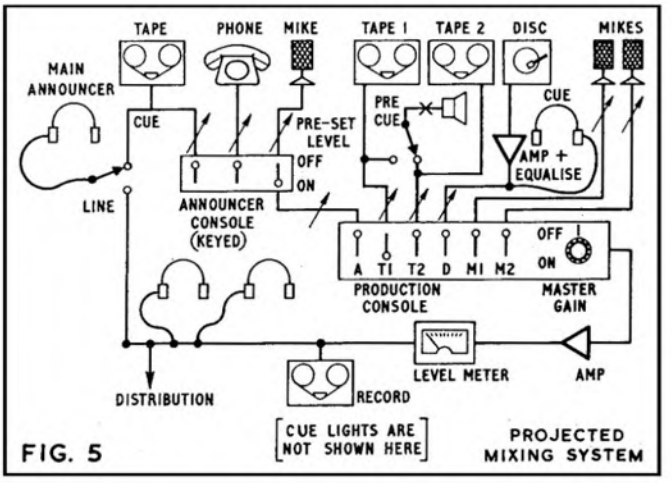


FIG. 5 PROJECTED MIXING SYSTEM

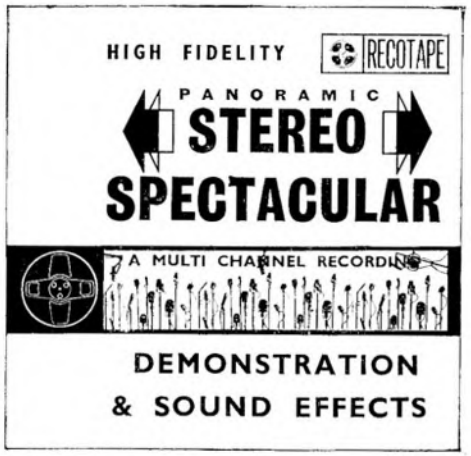
NEW FOR STEREO ENTHUSIASTS

AT LAST! A REAL BREAKTHROUGH

WITH RECOTAPE

STEREO TEST-TAPE..

All the boffins have talked about producing this kind of tape, but no one has done up to now. Everyone with a STEREO recorder needs to have this tape ; it is not just a technical test tape, but a fascinating musical entertainment at the same time. This is the tape that will tell you all you want to know about stereo and the effects you are, or are not, getting, it will show you how to get the very best out of your equipment. Part one deals with the perfection of balance, a sine wave test tone, at high and low frequencies. A sweep test tone, then it deals with phasing and finally an interesting channel separation check. Part two brings spectacular performances and breathtaking stereo in such items as Rakoczy March, March from Aida, Polotsian Dances, March from le Coq d'Or and Russian Sailors' Dance.



STEREO SPECTACULAR

Recotape is first again with this most fabulous tape, something which every stereo owner has dreamed of. It brings a spectacular series of twenty-seven different startling stereo effects from Drumbeats, Sound Effects, Bands and Orchestras to Jets, Cars, Underground trains, a Bullfight, an Escalator and ten magnificent musical items produced by a wide variety of musical instruments. Here's a must for every stereo owner.

Every tape is unconditionally guaranteed against processing faults.

4 TRACK STEREO 7½ IPS 50/- | **2 TRACK STEREO 7½ IPS 65/-**

TRADE ENQUIRIES INVITED

This tape for 15/- to all who buy STEREO TEST TAPE and STEREO SPECTACULAR

Fill in the coupon if you require this tape

POST THIS COUPON TO DAY

Please forward the tapes noted below for which full remittance and postage charge is enclosed. State in BOX whether 2 Track or 4 track is required.

STEREO TEST TAPE ☐

STEREO SPECTACULAR ☐

SOUNDS SPECTACULAR ☐

Transatlantic Music Tapes (Distributors) Ltd., 250 Grand Buildings, 1 Strand London, W.C.2.

Please mail to me the tapes selected in the boxes on left. I enclose £..... including 1/6 packing and postage for each tape ordered.

Name .....

Address .....

.....

.....

TR965

this up with technical competence this gives the most 'dynamic' programming—programming to suit the mood of the studio. One of our number, who writes poems, might stroll in during transmission, and if the mood is right he will read.

Specially written scripted features play an important part in our programming, some of the scripts being written originally for closed circuit TV cabarets produced for local formal functions by *CGTV*. An interesting aspect of our activities is the outside feature coverage. Armed with a battery portable, an AKG D19 and a Triumph Spitfire, our team have brought back interviews, experiences, and other actuality recordings from various parts of London. They have visited Speakers' Corner, Trafalgar Square, Petticoat Lane street market on a Sunday, Soho, and Battersea Fun Fair. They hand the reels of tape to the production team, with a sequence-by-sequence list of items. The best items are transcribed on to another tape, ready for the Sunday programme. If time is short the pieces are sorted as the programme evolves and are mixed in with any minor items they may have recorded on their travels. These may be conversations with local restaurateurs, novelty sounds, interesting views of the general public, or brief comment on some aspect of the locality.

The recording of the outside items presents many difficulties. It is not always possible to get the microphone as close to the subjects as we would like. The D19 has a cardioid characteristic, but background noise can still mask recordings at times. It is not easy to monitor the recordings 'on location', and 90% must be right first time, with no rehearsal and with little opportunity for getting the balance correct. When recording at night, such as in the dark streets of Soho, it is not always possible to see the meter on the recorder. Recordings made on-the-move are subject to the intrusion of wind noise. There is no wind-shield for the D19, and so special precautions must be taken to prevent noise. We have been trying to develop a radio-microphone for use on these sessions. At the present time we have been able to transmit about ten yards, which is not much further than the length of the microphone cable. If any reader has a working design for an FM radio-mike, we would be very glad to hear of it.

The layout of the WRT studio is shown in **fig. 3,** and it can be seen that tape plays an important part in the programming. The majority of the commercials are pre-recorded and are mainly concerned with local events. The start and finish points are marked in black on the back of the tape, using a felt-tip 'Magic Marker'. This avoids excessive cutting of tape and yet it has the same advantages as the conventional leader tape. Cueing is accurate, the black mark being positioned against a point on the deck. The digit counter on the recorder can give a rough indication of the position. The music tapes, which are on the other Revox, have leader tape between numbers. On some of the more recent recordings we have used the black-mark method, and we have found it to be just as good.

The Stella, standing on the announcer's desk, is used for play-back of the outside recordings. The D19 is shown mounted on a floor-stand, from which it can be easily removed for informal interviews. When on the stand, it picks up 'Sound of Saxton', giving us late-night folk song. In the corner, ready for use when needed, is the Garrard turntable and arm. At present, accurate cueing depends on a close liaison between announcer and disc-man, amounting at times to an almost psychic link between them. **Fig. 4** shows an auto-start device designed to fit around a Garrard 301. The three solenoids have rubber tips to them. The record is placed on a light aluminium disc which is lifted clear of the turntable by the solenoids, the start of the groove being located by hand. The double switching system then allows the announcer to start the disc whenever he pleases, from a switch on his desk—down go the solenoids, and down goes its disc, record and all!

We have a healthy connection with a Baker Street recording studio, and we receive professional help and advice for the WRT music recording sessions, which were mentioned earlier.[5] The biggest problems are presented by the Big Band and the Beat groups. Orchestral recordings are easily made, and trios, duos and soloists present no difficulties. But Beat groups will insist on trying out a new arrangement, to take advantage of the various effects that our set-up presents to them, such as double-tracking and echo (yes, a real echo chamber). Using cardioid microphones, careful screening, and vibration-free microphone suspension, tight separation of the various instruments can be achieved, so that good balance can be made. The vocal track is usually added after the backing has been recorded, because previous experience has shown that voices can tire easily. The difficulties of balance with an eight microphone set-up used for the Big Band can often only be resolved by getting the *arranger* to supervise the mix, as he then cannot complain at the final sound.

But what of the future? A new mixing and switching console is being designed and should be operational by the time that you read these words. It will probably be of the form shown in **fig. 5.** The aim is to remove programme control from the main announcer, as the present task is too great for one person. The design will leave him with three individually keyed inputs, each with pre-set volume controls, and thus he has only to switch 'On' or 'Off'. He will control the main mike, telephone, and commercial announcement tape recorder, which he can pre-monitor for setting up. The output from his panel goes to the Production Mixer, which has six pre-set keyed inputs and a master gain control, so that the programme level can be set on the meter. The other five inputs would be disc, taped music, taped outside recordings, and two microphone circuits.

The pre-set gain controls on the Production Mixer will still allow music under voice, and fades, when needed, but the keying system allows for instant sound. It is hoped that low voltage cue lights will be run from spare contacts on the keys, so that a circuit user will know when his circuit is dead, in order to set up his next cue. Live-mike condition will then also be clearly indicated. A rewiring of the rediffusion system is planned to include more subscribers.

The future progamming calls for new music recording sessions in the winter months. Members of the WRT team in America at the time of writing are on the look-out for interesting material from that source. Members of the group who have moved away will be able to send in reports from various parts of England; at least one person will be spending a year in Canada. At home, we have the London-to-Brighton Run, the Lord Mayor's Show, Carol Singing and Christmas Shopping. In the 'personalities' field a member of the WRT group has already visited the majority of big names in the Pop Music world, when promoting a charity disc through the *New Musical Express*, and many seemed willing to help. In the more serious sphere, Harold Wilson, Edward Heath, Dr. Beeching and Sir John Hunt have all visited us in recent years. Those who follow them will offer equally interesting comments.

So it looks as though it's all going to happen on WRT, and going out free to the subscribers who find free-lance 'Fun Till One' a good substitute for BBC for their late night Sunday listening. This is Wonderful Radio Tizard.

TELEPHONE ADAPTOR. This is essentially an electromagnetic pick-up coil which responds to the field produced in the transformer of the telephone during a conversation. There is no direct connection to the telephone system, as this is not permitted by the GPO. The adaptor is fixed to a suitable point on the case of the telephone by a suction cup, and the EMF in the winding is applied to the microphone (or other low-level) input of the recorder. It is generally necessary to have a high gain setting for good results.

TWO-TRACK. This term is often used to describe the recording/play-back system in which the tape is divided into two tracks, each one almost a half tape width (making allowances for guard bands between the tracks and at the top and bottom of the tape). Each track carries either full mono or half stereo information. For stereo, the two tracks are used simultaneously for the left and right channels.

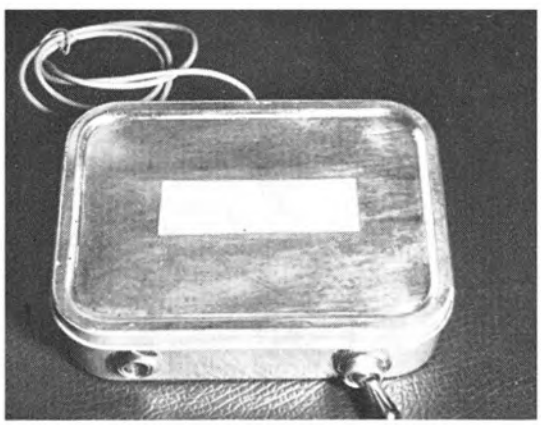
WOW AND FLUTTER. These effects are produced by lack of constancy of tape drive. Wow describes relatively low speed changes of a cyclic nature, while flutter is produced by more rapid, random or cyclic, speed changes from about 20 c/s to 200 c/s.

Both symptoms arise from maladjustment of the mechanical conditions of the machine or from poor design. It is impossible, of course, to delete these factors completely, but on good machines they are at a low level, depending on the tape speed. The greater the speed, the smaller the effect. Expression is usually in terms of a percentage RMS value. A value less than 0.2% is barely discernible.

This, then, brings us to the end of this selection of terms, of which there are many more both realistic and mystic, and also to the end of this series, which I have had great pleasure in preparing. It is hoped that the series has helped some towards better taping.

transistor microphone booster

BY GORDON J. KING



MANY of the inexpensive tape recorders purchased by beginners come complete with a high impedance microphone. Invariably, there is just the one high-impedance socket to accept this kind of microphone. This is fair enough, and there is nothing particularly bad about the high impedance microphone apart—perhaps—from its high impedance !

Actually, high impedance microphones usually generate a greater signal voltage than their low impedance counterparts. This is a desirable characteristic so far as the designer of the tape recorder, with economics very much in the equation, is concerned, for it means that he can probably get away with one stage less in the amplifier than if he had to accommodate the relatively low output from a better class low impedance microphone.

Moreover, the high impedance microphone can be connected direct to the control grid circuit of a valve, while a low impedance microphone demands a transformer or some matching arrangement to translate its low impedance output to the high impedance of a valve grid circuit.

Outweighing these attributes of the high impedance microphone are the disadvantages, such as hum pick-up in the high impedance connecting cable from the microphone to the recorder and problems related to cable length, and the fact that a recorder designed for a high microphone impedance cannot be used direct with a lower output, low impedance microphone that may well deliver better quality sound signals than the inexpensive microphone which partnered the recorder when it was purchased.

This question of impedance often confuses the non-technical of our ranks and a word or two about this would not be amiss, therefore, before dealing with the construction of an impedance-matching booster.

Impedance is a complex subject demanding the abundant use of mathematics for analysis, and it is not proposed to look at it anywhere near as deeply as this. From our point of view we can consider it as 'resistance' in an AC circuit. It is measured in *ohms* like ordinary resistance, but its exact nature and value are governed by the type of circuit in which it acts and on the frequency of the AC (signal, in our case).

The impedance of a microphone is often specified at one particular frequency (sometimes 1 Kc/s), and it is this value which is the one considered, in spite of the fact that the impedance may differ (increase or decrease) at other frequencies. To some extent, the same applies to the microphone input circuit of a tape recorder. Here, however, the impedance is less prone to vary with frequency.

The grid of a valve, for example, has a very high impedance, indeed. It is in the order of many millions of ohms (Megohms), but in practice it is reduced to a usable value by the grid resistor, which itself may be up to several Megohms.

Now, if we connect a low impedance microphone across such a high impedance we get what is called a 'mismatch'. A mismatch of this kind, curiously, may not be the direct cause of failure of response from a low impedance microphone when connected direct to the high input impedance of a valve amplifier. The fact that the microphone is low impedance means that it generates a greater signal *current* than signal *voltage* (this follows the normal laws of greater current flow in a low resistance circuit than in a high resistance circuit, at a given *power*).

Thus, by comparing two microphones that deliver the same signal power from a given sound source, we find that the high impedance microphone produces a greater signal voltage and smaller signal current than the low impedance microphone. A high impedance

matching low impedance microphones with high impedance amplifiers

circuit, like the grid circuit of a valve, wants voltage and not current to work it. Hence the reason for a high impedance microphone here.

We could get an impedance match from a low impedance microphone to a high impedance valve grid circuit simply by connecting a resistor of suitable impedance in series with the microphone, as shown in **fig. 1.** This would not help matters from the signal voltage aspect, however, and the conditions would be almost the same as before. Actually, the grid would receive even less voltage, since the series resistor and the value of the grid resistor would form a potential-divider, reducing the microphone signal voltage at the grid even more; which is the opposite to our requirement.

The problem is often solved by the use of a microphone transformer, as shown in **fig. 2.** This transformer has a step-up ratio from the microphone to the amplifier, and thus increases the signal voltage and decreases the signal current by an amount governed by its ratio. Here, then, is exactly what is wanted. The valve grid circuit now receives a stronger signal voltage and a correspondingly smaller signal current.

The turns ratio of the transformer is often worked out in terms of impedances. The turns ratio is equal to the square-root of the impedance ratio (amplifier impedance divided by the microphone impedance). Let us suppose that the microphone is 100-ohms impedance and the input of the amplifier 1 Megohm, then, 1,000,000-ohms divided by 100-ohms gives 10,000 and the square-root of 10,000 is 100, which is the turns ratio. This means that the voltage of the signal generated by the microphone will be stepped up 100 times at the

amplifier input. Conversely, it means that the output *voltage* of a low impedance microphone is about 100 times below what it should be fully to drive a high impedance circuit. Little wonder, therefore, that a low impedance microphone connected direct to the grid circuit (or high impedance amplifier) fails to work.

The microphone transformer can be installed either in the microphone itself or in the amplifier at the recorder. Installed in the microphone, as is often the case, means that the tape recorder still has to feature a high impedance input. This makes it versatile, since then any type of microphone can be plugged in. That is, a crystal or ceramic or any of the low impedance types, via a suitable transformer. Installed at the recorder, however, it limits the input to low impedance microphones only.

In the latter case, though, a low impedance cable can be run from the microphone to the recorder, which is sometimes desirable from the aspect of minimum hum pick-up on the cable. On the other hand, unless properly designed, a microphone transformer at the amplifier can itself pick up a lot of hum, especially on high-gain microphone circuits.

signal is taken from the collector, via the coupling capacitor C4 and resistor R8.

Now, let us look at all this in greater detail. The common-base mode of Tr1 was chosen because the input impedance at the emitter of this kind of circuit is pretty low (up to about 100-ohms), and thus matches nicely to a low impedance microphone direct. This means that there is maximum transference of signal current from the microphone to the emitter/base junction of the first transistor. The transistor is thus working under its best signal/noise ratio conditions. To facilitate the signal coupling here, the microphone is connected direct (via C1) between the emitter and base, with the base of the transistor being direct to metal chassis of the case.

DC feedback is applied from the emitter of Tr2 to the base of Tr1, via R6, R5 and R4. This stabilises the DC working point of the transistors. The AC feedback provided by the unbypassed R6 increases the impedance at the base circuit of Tr2 above its nominal value and thus presents a reasonable match to the relatively high impedance at Tr1 collector.

The output signal is taken from Tr2 collector, as mentioned earlier.

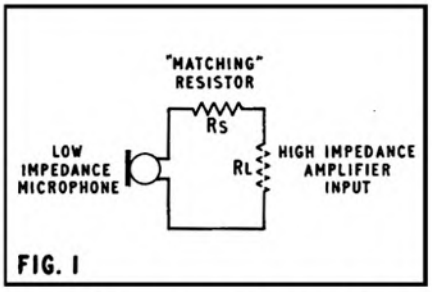


FIG. 1

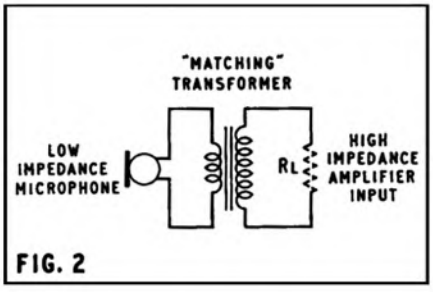


FIG. 2

Fig. 5 (far left) provides an inside view of the prototype amplifier. **Fig. 6** (centre) shows amplifier with lid on. Screening, in this condition, is highly effective. **Fig. 7** (immediate left) shows *STC4114* 250-ohm moving coil microphone connected to amplifier and thence to oscilloscope. Signal from alarm clock is displayed on screen with 2 cm peak-to-peak amplitude. This corresponds to 2V peak-to-peak output. No clipping or distortion is visible.

matching low impedance microphones with high impedance amplifiers

With all these things in mind, the author set out to design a versatile impedance-matching unit, which is capable also of boosting the signal from some of the low output microphones, thereby making them suitable for use with the average type of 'domestic' tape recorder.

The circuit of the device is given in **fig. 3.** This, as will be seen, uses two Mullard transistors and runs from a simple 9V Ever Ready PP4 or equivalent battery. The circuit is built into a two-ounce tobacco tin, and its construction will be explained later.

Now, transistors differ from valves in many ways, but the chief one is that they require signal *current* as distinct from signal *voltage* to operate them. They are thus ideal for use with low impedance microphones which, as we have seen, produce more signal current than signal voltage. Indeed, under certain conditions, low impedance microphones can be connected direct to transistors without a transformer and its attendant hum problems.

Like valves, transistors can be connected in three ways: in the common-emitter mode (equivalent to the ordinary valve circuit), in the common-base mode (equivalent to the 'earthed-grid' valve circuit) and in the common-collector mode (equivalent to the cathode-follower valve circuit). The first transistor, Tr1, in **fig. 3** is, in fact, connected in the common-base mode. That is, the base is 'earthed' to signal, the microphone signal is applied between the emitter and base and the output signal is obtained from the collector.

The second transistor, Tr2, is in the common-emitter mode, and the signal at Tr1 collector is directly coupled to its base. A little feedback is provided by the unbypassed R6, in the emitter circuit, and the output

The impedance here is fairly high, though probably not as high as the input impedance of a tape recorder, designed to accept a high impedance microphone. This does not matter from the matching point of view particularly, since the signal *voltage* at the output is adequate fully to drive the microphone circuit of even the lowest sensitivity record amplifier.

Nevertheless, there are times when the response of the microphone circuit may be affected by too low a source-impedance, in which case R8 should be adjusted in value to suit the input impedance of the recorder's microphone circuit. R8 may also require adjusting if the output signal from the amplifier causes the tape recorder to overload. Resistor R9 was not included in the prototype, but is shown in case the charging effect of C4 affects the microphone amplifier of the recorder. R9 simply discharges C4 and bypasses any C4 leakage current from the record amplifier.

Fig. 4 shows the layout of the components in a two-ounce tobacco tin. All the components are supported by tag strips, as shown. This was found to be a better idea than making up a printed circuit or mounting the parts on a plastic laminate.

The tag strips have one, two or three earthing tags with 'feet', and these feet are soldered direct to the base of the tin, thereby avoiding drilling and nuts and bolts for fixing. The only drilling necessary are three holes round the edge of the tin to accommodate the input jack for the microphone, the on/off toggle switch and the rubber grommet for the screened signal lead-out cable. The arrangements of the components are not unduly important, and **fig. 4** may be taken as a guide only. However, it may not be prudent to alter the position of the components too much, as positive feedback may then be troublesome. The accompanying pictures give more idea of the actual construction of the prototype. *(continued overleaf)*

For optimum noise performance, all resistors should be of the cracked carbon type, but it was found in practice that ordinary ½W insulated carbon type are very reasonable. These, of course, are cheaper than high-stability versions.

The unit takes a little over 800μA, so the PP4 battery should have a very long life. Across 1M output load, the unit can produce a signal in excess of 1V RMS with very small distortion. Clipping starts when the output signal reaches about 6V peak-to-peak, just a little over 2V RMS.

Clearly, then, precautions must be taken to see (a) that the microphone signal does not overload the amplifier and (b) that the amplifier signal does not overload the tape recorder. With regard to (b), the value of R8 should be increased if the record level control is below half to full for optimum record level at normal speech level at a distance of 12in. from the microphone; (a) would be revealed by distortion on heavy peaks of sound after satisfying (b). This could be overcome easily enough, simply by including a resistor between the input jack and C1. The value of this resistor (up to about 250 ohms in normal circumstances) would have to be adjusted to suit the characteristics of the microphone in use.

The great sensitivity of this unit makes it ideally suitable for establishing a very high gain microphone channel, for recording distant bird songs, as well as satisfying the requirements for which it is designed.

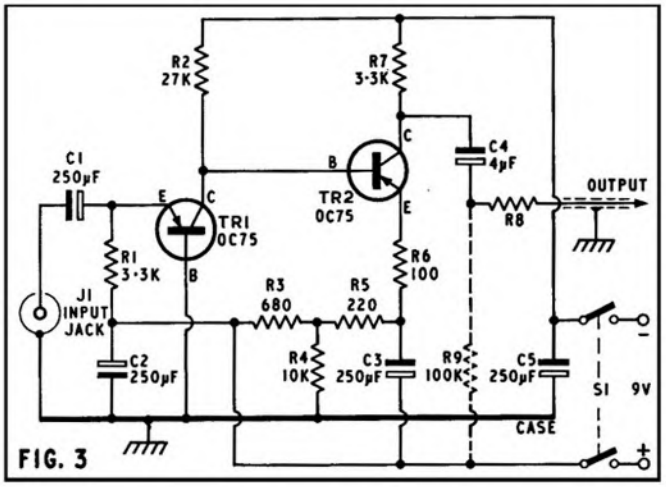


FIG. 3

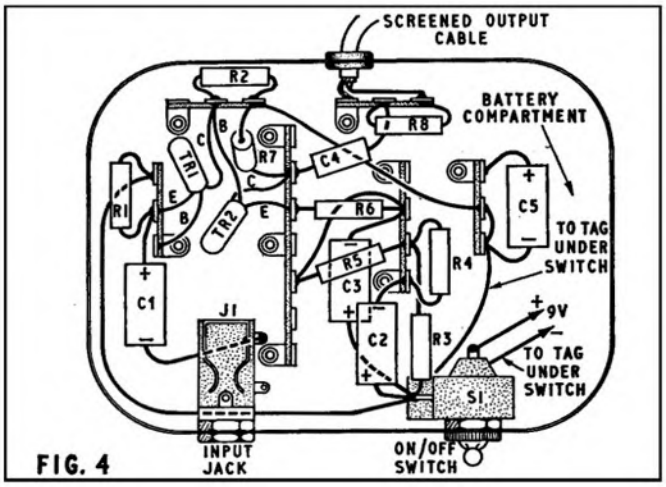


FIG. 4

book reviews

TAPE RECORDERS—HOW THEY WORK by Charles G. Westcott and Richard F. Dubbe, 224 pages, illustrated. Price 26s. Published by *Foulsham-Sams Technical Books Ltd.*, Slough, Bucks.

THE blurb on the dust-cover of this book begins: "Service technicians, hobbyists, *and even professional recordists* can all perform their job or pursue their hobby better if they understand the basic principles of tape recorders".

The italics are mine, but readers of *Tape Recorder* need no reminding that theirs is a field in which the amateur can more than hold his own. He is helped by books such as this, which present a well-balanced mixture of theory and practice, example and precept, in an eminently readable manner.

For the deeper theory we may turn to Spratt; for the practical aspect, to one or other of the handbooks produced by leading tape recorder manufacturers. For down-to-earth advice on what to do when your machine develops the jitters, there is only one recourse, ask the experienced serviceman. A careful read through the pages of this volume makes it clear that Messrs. Westcott and Dubbe know their subject and can expound it.

Beginning with a chapter on the history of magnetic recording, and another on basic theory, they plunge straight into the mechanics of the matter with a succeeding two chapters on transport mechanisms and motors. The recording level indicator receives attention, although, as might be expected from an American publication, much weight is given to the VU-meter and little mention made of PPM systems. Chapter 6 is worth special attention for its discussion of HF bias with some very good explanatory diagrams and circuits. There follows a short chapter on equalisation—again with no mention of any system except their own, which is the sole shortcoming of the book. NAB standards are quoted throughout, and even the spool details given later in the book are to NAB regulation. This is a defect which a little extra work on the part of authors and publishers might have avoided.

The chapter on the record/playback amplifier includes notes on transistorised preamplifiers and the next chapter goes into fairly satisfactory detail about heads, with plenty of illustration. A chapter on tape, another on test procedures and a final look at special applications rounds off a very comprehensive book. The appended glossary covers the field very concisely and the index is a little more ambitious than is ordinarily found.

Despite this being an American publication, very little re-thinking is needed to translate any of the text to British standards. The short preface by W. Oliver (G3XT) which purports to put the British reader in the picture is, in fact, quite superfluous. There must be very few of us nowadays who do not realise the American style is to call valves 'vacuum-tubes' or that transatlantic supplies are 110V, 60 c/s.

This reader found no difficulty in reading the book and appreciated greatly the lavish line and photographic illustrations. Certainly, this is an asset to the den or workshop and, for all those who find Spratt too deep and the Grundig book too facile, this volume should be well worth buying. **H.W.H.**

AUDIO - VISUAL HANDBOOK by Ralph Cable. Price 9s. 6d. Published by *University of London Press Ltd.*, Little Pauls House, Warwick Square, London, E.C.4.

THIS modestly priced, slim volume should find its place in school and training college reference libraries. The whole field of audio-visual aids is covered, from the non-projected visual aids such as blackboard wall charts and mobiles, right through to the tape recorder and television.

Information about the installation, operation and maintenance of tape recorders is clearly and simply presented. In addition, there are two pages listing some of the many classroom applications of the recorder. A separate section, usefully illustrated, deals with microphone positioning relative to recording school activities.

Altogether a very useful little book, written by an experienced teacher, and very attractively produced. **T.F.**

OUR READERS WRITE . . .

. . . about an absorbing subject

From : A. Campbell Gifford, 10 Wells Avenue, Southend-on-Sea, Essex.

DEAR SIR, Mr. Rubin's article on sleep learning (March 1965) was most interesting, as have been the comments of Mr. Stocker and Mr. Garner.

The impression given is, of course, that this is a relatively new idea, which is hardly the case. The writer was involved in sleep learning techniques during the last war and before. The basic application has changed very little over the years. I would go so far as to say that those now involved in it commercially still have a lot to learn and it is hoped that they are aware of the dangers which beset their path when attempting any kind of treatment.

Some very interesting results have been obtained in Russia in the treatment of certain types of criminals—this is not to be confused with 'brainwashing' techniques. There can be no doubt that industry will, in time, get round to using these techniques for short-term courses of all kinds. At the moment the only examples I know are where language tuition is handled this way.

As long ago as 1960 the writer produced a whole series of courses on speech therapy, and even selling techniques, which were well received in the USA but looked at somewhat unhappily in this country, where the writer was regarded as a somewhat sinister character at the time.

It is hoped that your publication will continue to give space to this absorbing subject from time to time. *Yours faithfully*

. . . about a recurring subject

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

DEAR SIR, Over the years of reading your magazine I have grown just a little tired of the recurring subject of bad service to tape recorder owners, true as this may be. Why, oh why, cannot purchasers discriminate between sellers of apparatus and those who have a genuine service facility of their own, or alternatively who can return machines to manufacturers with service depots.

In my long experience I have learnt that there are but a few manufacturers prepared to undertake after-sales service, most being interested only in sales charts. I would warn readers though, that manufacturers' service is not cheap—you will pay, it will hurt a little, but at least the job will be done and a useless lump of machinery will become an asset once more. *Yours faithfully*

. . . about continental copyright

From : A. V. Townsend, Boite Postale 29, Monaco, Principaute.

DEAR SIR, In contrast to Britain, where the recording of music from the radio is frowned upon by copyright protection bodies, French tape amateurs are encouraged and helped to record such material, the exact playing time of musical items being published beforehand in minutes and seconds. *Yours faithfully*

. . . about the dangers of sleep learning

From : W. A. Smith, 3 Parsonage Chase, Minster, Sheerness, Kent.

DEAR SIR, I was very interested in the article on sleep learning which appeared in your March edition ; this method of learning would seem to have much to commend it.

Before going further in the matter, however, I would be grateful if you could amplify your warning note at the end of the article regarding stopping the recorder by means of a time switch.

Yours faithfully

Our technical staff comment : The note at the end of the article echoed, quite correctly, the warning given by many manufacturers that rubber wheels, jockeys, idlers and pinch wheels should not be left engaged when the machine is not in use. This practice tends to cause 'flats' on the circular wheels due to the concentration of pressure at one point of the periphery. Such a flat can cause wow or a 'knock'.

It takes quite a fair amount of such pressure over a considerable period, in one spot, to induce such deformation. The warning really applies to machines left unused for days, rather than hours. As it is unlikely that the same spot on a pinch wheel would be affected on each occasion of switching off, using most machines for the purpose of sleep learning, where these could be mechanically neutralised by operating the STOP control as soon as one wakes, would hardly have a bad effect. We say "most machines" guardedly, for there are one or two using very soft rubber idler wheels or jockey pulleys which may suffer by such a practice.

Therefore, in general, it can be stated that a belt-driven machine could be used in this way, as the pinch wheel is not likely to be deformed in a period of eight hours or so. Idler-pulley machines are better not so used.

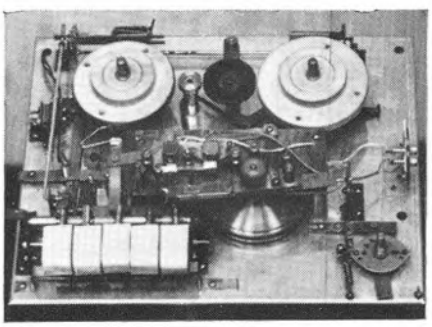
. . . about improvising stop-foil

From : G. W. Waters, 1 Cavendish Road, Summertown, Oxford.

DEAR SIR, May I put forward the following suggestion which other readers may find useful?

As commercial stop-foil for tape recorders is rather expensive, I have found a cheaper method of making my own. A length of $\frac{7}{32}$in. splicing tape is simply stuck on to a piece of aluminium cooking foil. A razor may then be used to cut along the edge of the splicing tape. This produces a strip of stop-foil which may be spliced to tapes in the usual way. *Yours faithfully*

. . . about a home-built tape deck



From : S. Webb, Basement, 16 Weston Road, Southend-on-Sea, Essex.

DEAR SIR, It occurred to me that some of your readers might be interested in seeing a home-built tape transport system for a change, built on a 2½in. lathe. The spool holders are made of Ramin wood, while the fast rewind, braking, and pause control are from a *Grundig* design. Fast forward drive is my own arrangement. The start control for record/play operates an interlock in the record position. The spool holders are supported in the fashion of the *BSR* deck, tape speed being 3¾ i/s. *Yours faithfully*

. . . about satisfactory service

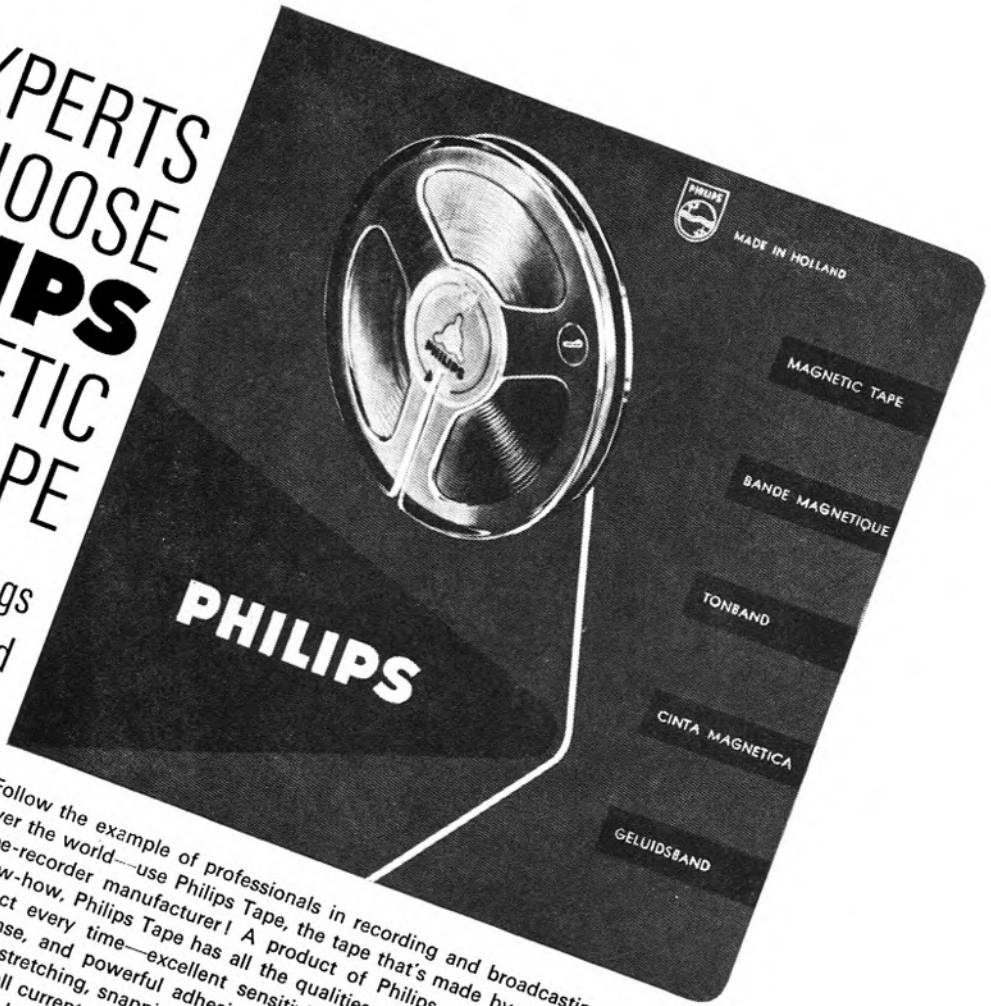
From : Sgt. R. Dyke, 55 Lethe Grove, Colchester, Essex.

DEAR SIR, As an army man I travel around quite a lot, therefore I have to do a lot of my own servicing. Recently I had snags with my *Reps R10* and *Grundig TK23L*. I wrote to both these firms and by return of post had the answers and advice from both. It is a wonderful feeling to know that should anything go wrong I can call upon the technical department of these firms and get 100% satisfaction. Through your magazine I would like to give my thanks to them.

Yours faithfully

EXPERTS CHOOSE PHILIPS MAGNETIC TAPE

—for perfect recordings of every sound



Follow the example of professionals in recording and broadcasting studios all over the world—use Philips Tape, the tape that's made by the world's leading tape-recorder manufacturer! A product of Philips unrivalled experience and know-how, Philips Tape has all the qualities needed to make your recordings perfect every time—excellent sensitivity, low noise level, uniform frequency response, and powerful adhesion of the magnetic coating. It's tough, too—resists stretching, snapping and tearing. Philips Tape is available in four types and in all current reel sizes; apart from the special Audio Letter message tapes all types have metallized switching foil and leader tape with writing surfaces. What's more, each type comes in a colour-coded box for easy identification. Ask for Philips Tape next time *you* buy a new reel.

GREEN for standard
RED for longplay
BLUE for doubleplay
GREY for tripleplay

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ELECTRO-ACOUSTICS DIVISION,
CENTURY HOUSE · SHAFTESBURY
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abc
of tape recording

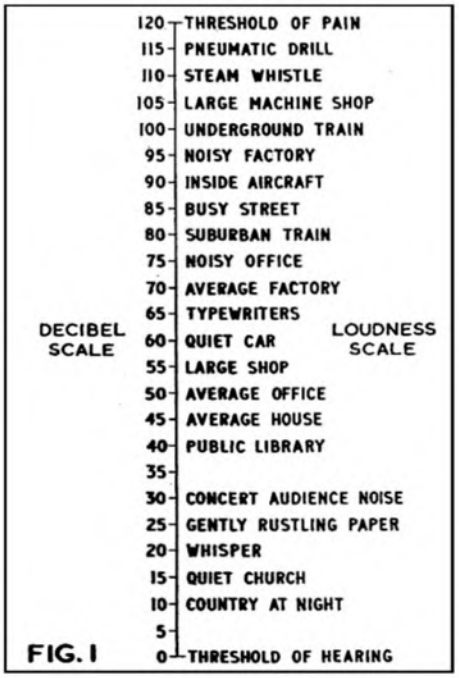


FIG. 1

part eight

THE DECIBEL

BY DAVID KIRK

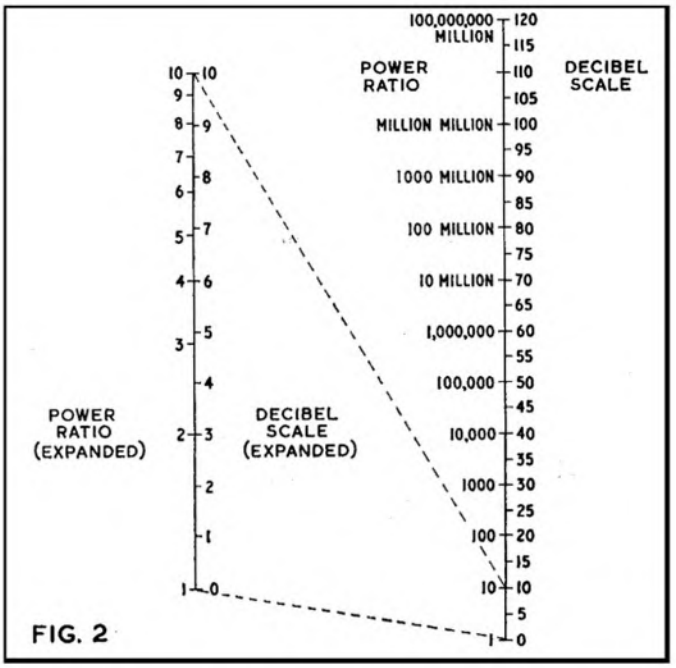


FIG. 2

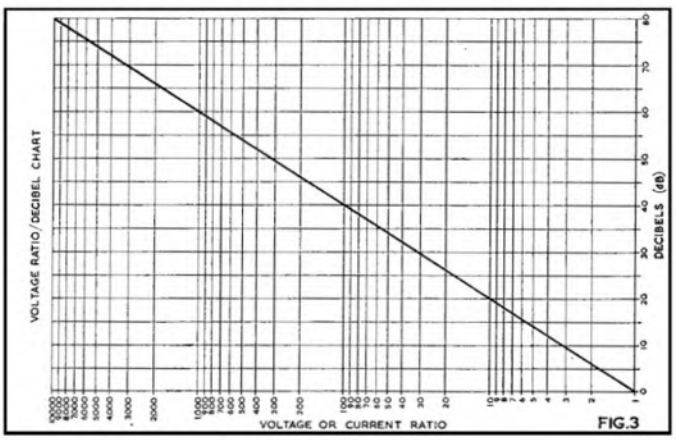


FIG.3

DEFINING the Decibel without recourse to mathematics is not the easiest of tasks. To begin with, the Decibel is not a unit in sense that Volts, Amps or Watts are, but a means of measuring ratios.

The most popular use of the Decibel (and the easiest to understand) is its employment as a measurement of sound volume. It is, however, not possible to state that a certain sound is '90dB loud' or '3dB soft'. A *ratio* is, of course, a means of expressing two quantities. If an acquaintance possesses twelve spools of tape while we only have six, our properties are divided by a ratio of two-to-one, expressed, for convenience, as 2:1. Similarly, if we have 60 tape-clips and our friend has 15, the ratio, presuming we don't lose any of the infernal things in the meantime, is 4:1.

It is easy to understand that sounds could be compared, in loudness, in terms of ratios. One might suggest, for example, that the noise created on the average factory floor is twice as loud as the noise inside a motor car. Similarly, one might consider a public library to be twice as noisy as a concert audience between performances. Obviously, the difference in power of factory and motor car noises is substantially greater than between library and concert audience. Nevertheless, both are separated by some 10dB on the loudness scale. For convenience, zero dB is normally applied to the lower limit of human hearing, though it can be proven with sensitive microphones that this by no means corresponds to zero acoustic disturbance.

The table in **fig. 1** shows the results of loudness measurements taken at various locations and times. Anyone who has passed close by a pneumatic drill, or attempted to record a jet aircraft at close quarters, will have a fairly good idea of the term *Threshold of Pain*. Similarly, those forced to calculate that, for example, a steam whistle is eight-and-a-half times louder than gently rustling paper, will appreciate the advantages of the linear Decibel scale.

Moving, now, to another use of the Decibel, we find ourselves comparing the apparent loudness of a tape recorder output with the electrical power (measured in Watts) at the loudspeaker terminals. Most tape recorders are limited to fairly low output levels which, despite the manufacturer's claims, rarely exceed 2W. Since we shall be discussing wattages substantially greater than this, we will assume that a more powerful amplifier has been connected to the recorder. Many audio enthusiasts use such external amplifiers, since they are capable of improving moderate-quality domestic recorders considerably.

Having connected our recorder, then, to an amplifier capable of delivering—and a loudspeaker capable of accepting—up to 10W of power, we set the machine to play, turning up the volume until the sound is at a comfortable level. By applying a wattmeter to the loudspeaker terminals (and hence the amplifier output) we are able to measure the actual power being delivered. Perhaps our experiment is being performed late at night and we keep the volume down to a level low enough to avoid disturbing the rest of the household. The output signal—recorded speech played very quietly—might be found to be in the order of 1mW (one milliwatt, or a thousandth of a watt). Disregarding the feelings of those that sleep, we next increase the gain control until the tape is being played at twice its original *loudness*. Reference to the wattmeter shows that the output power has increased —not two-fold to 2mW but *ten*-fold to 10mW (one hundredth of

(*continued overleaf*

a Watt). This ten-fold signal increase has not, however, resulted in a particularly large increase in loudness so the amplifier gain control is advanced further until loudness has been doubled yet again. Now at moderate listening level, we find that we are using only 0.1W (one tenth of a watt). Thus, if we wish, we can double the loudness yet again, increasing output ten-fold once more to 1W.

In fact the actual amount of noise that will be obtained from a given signal wattage will depend on the loudspeaker. Mechanical and electrical inefficiencies mean that most loudspeakers waste more than 95% of the signal put into them. Few indeed are capable of better than 3% efficiency. This power wastage is, of course, by no means restricted to loudspeakers. Most of the petrol in a motor car, the electricity in a light bulb or valve, and even the energy in a pedal cyclist is wasted in producing heat or overcoming friction. Thus, while 0.1W may give moderate or loud noise with certain speaker designs (in particular those based on horn principles) it may be less than adequate for others.

It is so easy to confuse the two tasks performed by the Decibel in measuring sound loudness and amplifier power that a few sentences summarising these points might be worthwhile. On the *loudness* scale (**fig. 1**), an increase of *10dB* refers to a *two-fold* increase in *loudness* (as judged by the average listener). On the *power* scale, however, (**fig. 2**) an increase of *3dB* shows that power (or wattage) has been pushed up *two-fold*, so it is clear that very much more than a change of 3dB is needed to double the loudness as heard, even though the power has doubled.

The left-hand scale in **fig. 2** should give some idea of the relationship between decibels and output-power. Firstly, *Power Ratio* refers to wattage and should not be confused with the loudness ratios of **fig. 1.** An increase of 3dB at any point on the decibel scale will be registered as a very nearly two-fold increase on the power graduation. Thus a doubling in wattage from 1W to 2W registers as 3dB (zero to three) as does a doubling from 2W to 4W (three to six) and further doubling from 4W to 8W (six to nine). The difference in increase rate is brought about by the logarithmic nature of the power ratio.

Moving over to the right-hand scale in **fig. 2,** we find a scale of different magnitude. From this, it can be seen that doubling power yet again (nine to twelve dB) would take the amplifier well beyond its capabilities, requiring an extra 8W—making a total of 16W. The colossal power requirements beyond this point, quickly reaching millions of watts, share the mathematical origin of the progressive pay system said to have been devised by a young newsagent's assistant. His employer agreed to pay 1½d. on the first day, 3d. on the second, 6d. on the third, progressively increasing over the four-week engagement. This seemed cheaper, to the newsagent, than a regular weekly sum. Imagine his surprise, at the end of that period, to find a bill of some £1,600,000 for services rendered !

Which conveniently brings us to the mathematical origin of the Decibel. To calculate the decibel equivalent of a power ratio, we fall back on logarithms—the ten-based tables widely used as a short-cut round lengthy multiplication and division calculations. Taking the ratio to be converted to dB as 2:1, we use the following formula :

$$\text{Log. } P \times 10 = \text{XdB.}$$

where P represents power ratio.

Thus, inserting the logarithm of 2 (2 being, in this case, P) we have the following :

$$0.301 \times 10 = 3.01\text{dB.}$$

This shows that a 2:1 increase in power (or wattage) corresponds to an increase of 3.01dB. Turning, now, to variations in voltage and current, we find the decibel behaving in a different fashion. Whereas a two-fold rise in power caused an increase of approximately 3dB, a two-fold rise in voltage or current causes an increase of double this amount—namely 6dB. This entails only a slight alteration to the above formula. It is simply necessary to square the voltage ratio (easy enough with voltages or current figures in the order of 2 or 4 units) but more practically achieved by doubling the logarithm of those figures. Thus :

$$\text{Log. } Y \times 10 \times 2 = \text{XdB.}$$

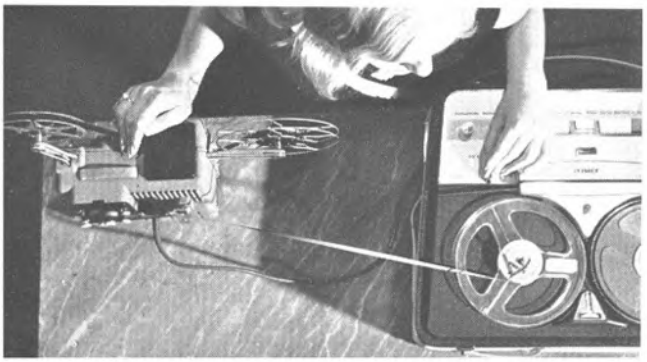
where Y represents voltage or current ratio.

For 2V this gives :

$$0.301 \times 20 = 6.02\text{dB.}$$

Visual indication of the relationship between voltage or current ratios and decibels is given in **fig. 3,** which was originally prepared for the *Audio Diary* (details of which are given, incidentally, on page 427).

SOUND AND CINE
cues and commentaries



Above: *Philips* tape recorder controlling speed of *Eumig* projector through Eumig *Phonomat* attachment. **Below:** Basic set-up for recording commentary at a distance from the projector and recorder. Microphone is positioned a foot from the commentator on sungun camera bar. In front of her is cue lamp, controlled by projectionist.

BY ANTHONY WIGENS

DON'T underestimate the complexity of a film recording session. Once you have mastered the technical set-up of synchronising your projector to the tape recorder—or of operating a magnetic sound projector—allow a whole evening for your first trial run.

Anyone who makes films on his own ends up with *some* of the talent of a whole professional studio team, but for a recording session at least one keen helper is invaluable. Without that extra pair of hands, stick to commentary alone. But if you have a helper, and your recorder or sound projector has more than one input, then it is reasonable to mix music through the high level input and commentary via the low level (microphone) input.

With only one input for recording, you will either need to employ a mixing unit, or play the music on a record player close to the microphone the commentator is using. If the projectionist is operating the record player and his assistant is commentating at a distance from the projector to avoid picking up the sound of its running, the latter alternative is out.

It is worth noting, however, that the *Eumig Mark S* sound projector has automatic volume control, with the possibility of eliminating background noise. Combined with close use of the microphone, it permits recordings to be made close to the projector. With this machine, a voice input automatically suppresses the volume of simultaneous music recording through the gram input, with a gradual return to full music volume during the seven seconds following the end of that piece of commentary. This tapered return to full music volume eliminates music fluctuations during short pauses between sentences.

On a conventional recorder or sound projector, you will need to bring the grams down and up again manually to give emphasis to the commentator's voice and eliminate competing sounds. As you will need to regulate the microphone input by watching the recording level indicator, the music volume is varied with the record player's volume control. Without headphone monitoring the degree to which you drop the sound must be a matter of experiment.

At least one 'dry run' of the recording session is absolutely essential, especially if your assistant is unfamiliar with the film or the script. Script preparation will be dealt with more fully in a subsequent article, but for the moment it is sufficient to have typed out (double spacing at least) a commentary to the film, with a brief description of the associated picture in the adjoining column. You will have read the script against the film running-time to ensure that there is no need for the commentator to gabble to get it all in.

Last month I described a method of using one track of a ¼-track recorder to give timed cues, but for this example we will not assume that you own a ¼-track machine, or that you are going to build the sound track section by section. It is an all-in-one-go effort, with no risk of sync loss through stopping the tape, no risk of clicks on the track through use of the pause control—in fact plain sailing so long as the commentator does not fluff his cues!

The best way to keep projector noise off the sound track is to park your commentator in another room. You can then project through the doorway to give him his picture cues (better still if you have a glass door with clear panels to project through), or run a cue light under the closed door and flash him a light signal at each fresh cue, with a switch by the projector.

The microphone should be about a foot away from the commentator. To improve the acoustic quality of the recording there should be carpet on the floor, plenty of furniture and soft furnishings in the room, and the curtains should be pulled.

You can muffle the sound of a script being turned over by stapling each page to a sheet of blotting paper.

The sequence of events for your recording session is as follows:

1. Run projector and tape recorder motors for several minutes to warm up.
2. Lace film in projector with sync mark in the gate. Then arrange for tape sync by whichever method you employ.
3. Start practice run with record player turning, but volume down. Autoplay models are a definite handicap, as you can time the start of a record more accurately by dropping the pickup into the groove, or using a special cueing device.
4. Start projector and recorder in sync, with RECORD button down.
5. Play background music and fade in on player volume control.
6. Watch script and cut volume of background music immediately prior to cueing commentator. Watch recording level indicator and adjust recording level so that the signal is not overloading on peaks.

With unfamiliar equipment, the most likely adjustments required after a critical listen to the trial run are to the extent of music fading, and the optimum adjustment of recording level. You may then want to give some advice to the commentator which could improve his performance, or accept some suggestions from him for modifying your script, shortening it possibly, or rewording some tongue-twisters.

A four minute film should give you plenty to work on for the evening without ever getting round to sound effects!

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THE end of the holiday season heralds those long, cosy evenings round the fire when our genial host wedges us firmly into an escape-proof armchair and produces (according to his means) his holiday snaps, slides or cine films.

It has been said that to ensure rescue from a desert island, one should always carry a photograph album. Open it at random, then attempt to turn a page. A finger will immediately shoot over one's shoulder and an enthusiastic voice breathe in one's ear . . .

"That's Auntie Flo, the day before the chimney caught fire. The chimney is just off the picture to the right . . . and her face . . . all covered in soot . . . you should have been there!"

All very well as a rescue method, but on less dramatic occasions, do we ever get to see Auntie Flo covered in soot? Or even a picture of the chimney? No, merely the assurance that if only we had seen it, we should have been very amused indeed.

SOUVENIRS IN SOUND

SOME NOTES ON EDITING HOLIDAY TAPES

BY MARTIN YORK

To the menace of pictorial boredom, science has recently added a powerful new weapon—the portable tape recorder. In the hands of an experienced bore this device can be to the camera as the rifle is to the crossbow. Conversely, it can achieve the same status in terms of sheer entertainment value, both to the audience and to the owner—if he wants it to.

A photograph is a photograph and cannot be appreciably altered: a tape, on the other hand, can be 'tailored' to almost any purpose; to amuse, to impress, to enlighten its hearers—and the tailoring itself can provide hours of challenge and enjoyment for its owner. He can, for example, load the London Symphony Orchestra into a bus, fly them to Majorca and let them accompany a violent argument between two native fishermen. Try that with a camera, Mr. Hitchcock!

This article, then, is to suggest some ways in which your holiday tapes can be made fit for human consumption. Heed it well, for your cherished portable can enhance or destroy your reputation.

It is assumed that the 'portable' owner has had the good sense to acquire first a domestic machine, for a portable by itself has many of the disadvantages of a camera and few of its virtues.

The first golden rule is to free the mind from the shackles of convention. Let time cease to exist: if a bit of Friday's recording provides a useful introduction to a scene which occurred on Thursday, by all means edit it that way. If you must keep a chronological diary, do it on another tape; why sacrifice the esteem of your audience merely to gratify your tidy mind?

Secondly, *listen* to your tape. It is surprising how much material is supplied by your memory—a memory which the listener may not share. Remember that he 'should have been there' but can only form mental images from the sounds which are emitted from your loudspeaker.

The performance will be smoother if those sudden jumps from one 'scene' to another can be avoided. This is where good linking is important. If one 'exposure' can help to set the scene for another, edit them in suitable sequence. Suppose, for example, that Uncle Egbert suffered an unfortunate but amusing experience on a coach trip and on his return vowed he would not set foot on one of those vehicles again. Why not switch events round a little . . .

Auntie Mavis : Let's go on a bus trip tomorrow.

Uncle Egbert : I'll never set foot . . . etc.

Commentator : . . . and so, the next morning . . .

Fade in sound of bus engine, Auntie M. and Uncle E. conversing. Continue with actual recordings of sounds made on the trip.

In giving examples from the York Collection, I am not inviting you to force your own material into this particular form—merely suggesting ways in which sounds with an appeal only to their originator can be brought to a wider audience. Original material—that is, the recordings which form the basis of the performance—are indicated with an asterisk(*).

The theme of a Boy Scout camp is chosen, not for any subtle propaganda reasons, but because it offers some good examples of the value of thoughtful editing.

Fade in : Record of Ralph Reader's Gang Show singing . . .

"These are the days we shall dream about,
And we'll call them the Good Old Days."

Volume down. Mix microphone in.

Commentator : Yes, we shall indeed call them the Good Old Days, for our camp at Snoddington was one of the most successful we have ever enjoyed.

(Speech timed to fit middle couplet of song)

Volume up. Run through last couplet of song (a repeat of first couplet). *Fade out* at end.

Fade in car engine background. *Superimpose* commentary.

Comm : A car engine? Why not? Many hundreds of miles were covered in looking for just the right site. One of the most active was Jan, who drove Skipper on many a journey—with varying success! *Fade out.*

Fade in (*) recording made in car with Jan and Skipper. (Actually made on quite a different occasion, but including an amusing map-reading error and some discussion on camp sites.) *Fade out.*

Pause of three seconds.

Fade in (*) sound of tent pegs being hammered in.

Superimpose Comm : Setting up camp went almost without incident, but I wonder if Mike's toe really did look like a tent peg.

(*) Thud of mallet on toe and a loud yell.

Comm : Patrol sites were soon completed and the Hawks took points for the best performance, to the acclaim of the multitude.

CUT IN derisive applause ('stolen' from TV wrestling programme).

Comm : The aerial ropeway was erected over a magnificent span, covering a chasm of frightening depth and in obedience to tradition, the Scoutmaster took the first ride . . .

(*) Sound of block and tackle, raising S.M. to top of ropeway.

Comm (who was also the S.M.) : The ground looked very far away, but the intrepid Tony faced his fate with a merry song on his lips . . .

Fade in recording of 'pop' star bawling his latest hit. *Fade out.*

Comm : The Troop soon put a stop to that!

(*) Cries of "Let her go", followed by sound of ropeway in action, fading into distance.

Comm : . . . after which, his gaiety was rather more subdued.

Fade in same 'pop' record, fainter and, if turntable speed is variable, reproduced at slightly lower pitch.

As has been said this was our own particular treatment of this one particular tape. The rather naive humour was intended to appeal to a troop of Boy Scouts and achieved its object. The important point here is that the very same original tape could be re-edited for the annual Parents' Evening (with a cautious eye on copyright), or again for a permanent record of the events. The possibilities are endless.

Regarding copyright and performing rights, you are unlikely to run into trouble if you remember that every sound culled from records, radio or television is somebody else's property, and treat it as such. For use within your family circle a vast reservoir of background material exists but do use your common sense. The law requires that even to print the two lines of a song in this article, I have had to obtain permission.

Finally, although the examples given are mainly humorous, it is by no means essential to make everything funny—indeed, humour can sometimes be quite out of place. You should also think of the victims of your editing. To present Mum, singing at her housework, superimposed over clinking glasses and general Pub noises, may be very funny inside the family, but . . . !

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Tape Speed:	**3¾ i.p.s., 1⅞ i.p.s.**
Frequency Response:	**100-7,000 c/s at 3¾ i.p.s., 100-4,000 c/s at 1⅞ i.p.s.**
Recording Level Indicator:	**VU meter.**
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Dimensions:	**3¼" x 9" x 12½".**
Weight:	**5 lb. 14½ oz.**
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tape recorder service

NO. 47 PHILIPS EL3300

BY H. W. HELLYER

THIS contributor does not wish to enter the spool versus cassette controversy. From the servicing point of view, cassettes obviously add a few problems, and need extra care in testing. On the other hand, the long-suffering engineer will have learned to take problems as they come: this machine has touchy brakes, that one's push-buttons stick, the other hums like a beehive . . . what's a cassette machine more or less?

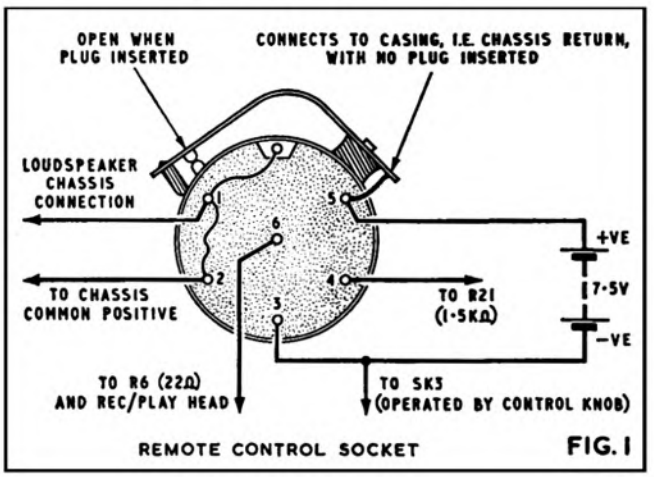
The user's point of view has been adequately covered in the Field Trial carried out by David Kirk and published in the August 1964 issue, and underlined by A. Tutching's Review of November 1964. For correspondents who want full specifications published with every servicing article, pages 275 and 417 of Vol. 6 are recommended.

I must confess that the advance publicity for this machine sent a *frisson* of apprehension up my spine. "Now for a load of trouble," more than one of my colleagues forecast. In the event, the year or so of sale and use has brought only a few to the workshop, and those have had the kind of random fault that could happen to any piece of mass-produced electronic equipment.

One problem that does not worry the professional serviceman, with his bench power supplies, but which could give difficulty to the enthusiast who is attempting to tackle his own machine, is the battery mounting method. The five cells fit snugly in a leatherette cradle, with the correct polarity very clearly and, praise be !, indelibly marked. But when the machine is dismantled for servicing, it is easier to rig up an external supply. Our own simple method is a bank of cycle batteries, strapped in a 12V block with flyleads terminated at each end by crocodile clips. The leads are coloured red and black and the black, negative, lead has larger croc clips as a precaution against inadvertent reversal of supply. By tapping along the series connections at the top terminals of the batteries, any combination from 3 to 12V in 3V steps can be chosen, and for intermediate values, as for the 7½V supply of 3300, a single torch cell added to the pack will suffice.

If you want to do things the hard way, it is possible to operate the machine electrically by removing the drive belt, swinging out the printed circuit panel (see below for details) and remounting the chassis in the case with the battery cover holding the cells in and itself secured by an elastic band. Of course, a lot of this bother is saved by provision of the external mains supply unit. The point worth mentioning is that the socket into which this unit, and the remote-stop/start control, connect has an inbuilt switch. The details of the wiring to this socket are shown at fig. 1, providing a sparking-off point for some more of the 'adaptor' ideas that our readers contrive with ingenious regularity.

The remote control unit is, of course, part of the microphone assembly. As the Mic plug is a five-pin type and the remote control a six-pin (both DIN), there is no chance of confusion and the makers very sensibly clip the leads so that the fleeting moment is not lost as we untangle skeins of cable. As the remote control switch is completely separate, only clipping neatly to the side of the microphone, it can be used on its own. The only thing to remember is that when the remote control button is moved upwards it simply disconnects the positive pole of the supply. The control knob on the tape recorder should also be operated to neutralise the mechanism, if you value the longevity of your pinch-wheel.



REMOTE CONTROL SOCKET FIG. 1

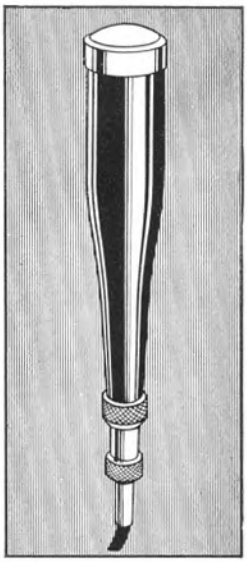
Observant readers will immediately jump on me for the foregoing remark—thrown in as sop to the makers, who take the trouble to emphasise it in their literature. My personal view is that it takes an awful lot of applied constant pressure to indent the material of a modern pinch wheel or idler wheel tyre—something like months of disuse. It would be interesting to see some experiments carried out in a well-equipped laboratory.

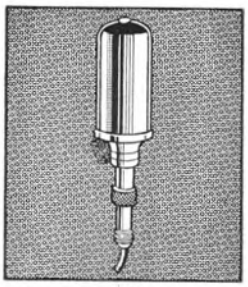
Dismantling is not a difficult task with the 3300. First, remove the cartridge and batteries, then the lower part of the case, which is held by two captive screws. Then pull off the tape transport knob with a direct upward movement and remove the screws. There are five of these; four which hold the chassis to the upper part of the case and one, not so obvious, between the turntables. When re-assembling, it is helpful to put this one back loosely before lining up the other four. Similarly, when dismantling, hold the chassis and case together in the left hand while unscrewing the centre screw with the right.

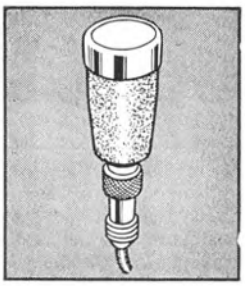
The printed circuit panel is held by three screws, and by the leads which are tied to it. One of the screws lies between the control knobs and is easily overlooked. After the leads have been freed, the panel can be swung aside at right angles to its mounting position, sufficient for normal servicing. The only point that needs particular attention is the engagement of the switch slider with the lever that goes down through the deckplate and also through a leaf-spring operated by the

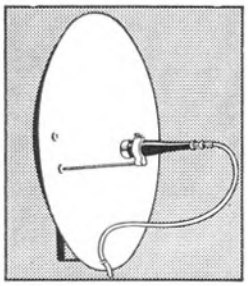
(*Continued on page 449*)

Here's a family of many talents









The family resemblance shows in the workmanship, the efficiency, the downright reliability, the integrity that's a feature of every Grampian microphone. There's the DP/4, sensationally successful in the medium price range, now world famous. The Grampian Ribbon Microphone is rightly considered one of the finest of its kind on the market today. The DP/6, too, finds ever-increasing favour—wherever a high grade but amazingly small microphone is required. For further details about them and about the stands, transformers, matching units and the Parabolic Reflector, which are available, ask your Grampian Dealer, or:—

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record button. To remove the panel completely, connections can be unsoldered from various posts and switch tags, and are not difficult to identify for re-connection. There are a dozen leads, of which seven go to switch solder points. An iron with a fine bit is needed for clean connection of a couple of these.

Further dismantling follows normal printed board procedure but it is pleasing to note that the modulation level and volume controls are robust components locknutted to their sub-plate. Removing multi-tagged components needs a little extra care and, if the component is to be preserved, should be done with a solder-removing tool. When the tags of controls are simply inserted through holes in the print and soldered on one side, it is fairly easy to wipe off the heated solder with a sharpened non-metallic instrument. (A high-flown euphemism for a match!) The simple device of a sharpened matchstick is also handy to clean out holes in panels, without damaging the foil or raising it from its bonding, while heat is being applied. This method should be used before attempting to insert component wires or tags.

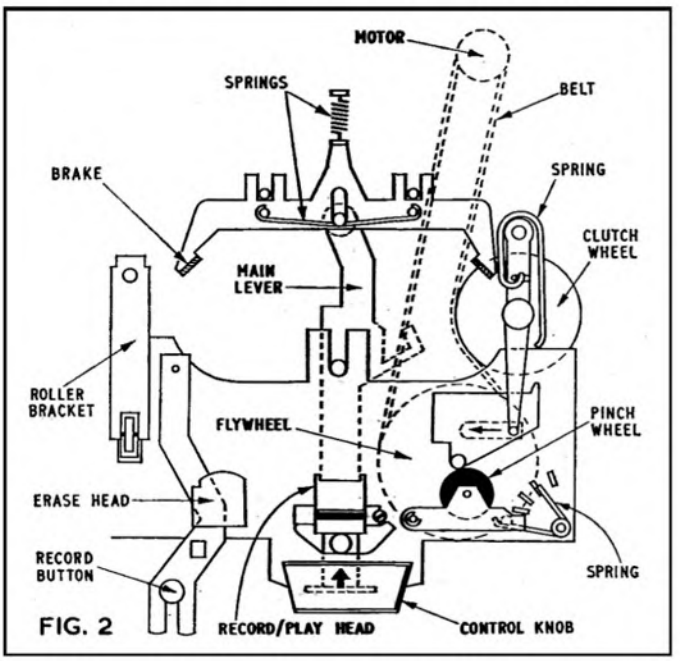

FIG. 2

After which digression, drive belts. On this model, the main drive belt simply couples motor pulley and flywheel, bearing against the side of the clutch assembly as it does so. The motor is a 3,000 rpm DC type and the flywheel turns at 6 c/s, giving a tape speed of 1 7/8 i/s. During playback or recording, the motor revolves anti-clockwise, in plan view, see (fig. 2.) driving the clutch mechanism clockwise. The small central portion of the clutch mechanism engages the tyre of the right-hand clutch and provides take-up : the belt slippage from this type of contact allows sufficient clutch action and the groove in the clutch bracket ensures correct alignment—always provided the flywheel is correctly refitted when removed or adjusted in any way.

This is quite important. The groove in the flywheel must be level with the motor pulley so that the drive belt is parallel to the chassis. To remove the belt, it is necessary to take off the flywheel bottom bearing, held by three screws at the right side of the chassis, and the bottom plate of the motor. This last is only held by a single screw, and the other screws in the motor screening can help to hold the assembly in place, a rubber sleeve and a rubber spigot or buffer piece on the bottom plate doing the rest. A number of machines have had motors changed for speed variation when in fact the trouble was probably incorrect belt or motor setting, or even a binding clutch imposing too great a load on the drive now and then. When this last happens the tape usually spills, curls and binds in the cartridge housing. It is no great problem to run the tape back onto the other reel but if the worst ensues the cartridge assembly is only held together by five bolts and nuts and bolts, although the makers do not recommend dismantling it, this tape is not 'spooled' in the conventional way, but very cleverly makes use of all available space by the seesaw effect of filling and emptying reels accurately positioned by the two guides and the flat surfaces of the moulding.

The turntables lift off, once the top cap has been removed. The clearance between these and the brakes should be 0.3mm during record or play, the brakes being merely lugs on the brake bracket which engage the turntable tyres, and the bracket being held off by a spring which attaches to the lug above the cartridge retaining piece. Two stop pins on the chassis limit its travel and there is really very little in the way of adjustment except to bend the lugs slightly. Do not attempt to adjust by bending the main lever as the pin and spring movement at its extremity allows far more laxity than the brake lever needs.

Engagement of the function knob in this forward position performs all the necessary operations as the important part of the assembly is the main plate on which heads and pressure roller are mounted.

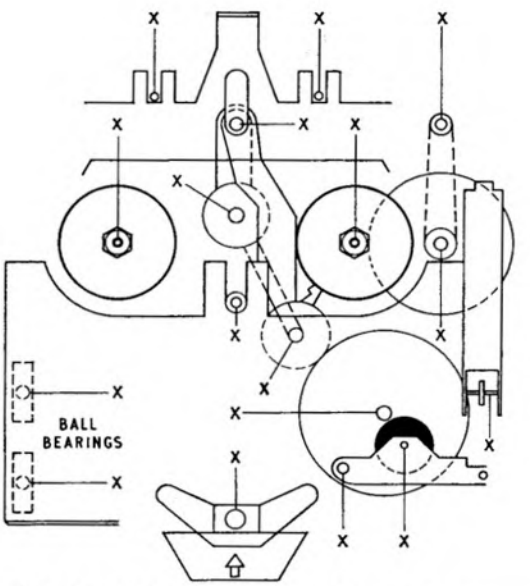

FIG. 3 PRINCIPLE LUBRICATING POINTS

The main lever has a guide roller, held by a nylon circlip, which pushes the plate forward. The plate sits on ball-bearings in small channels of the deck plate and its position is regulated by two spring rollers (see fig. 2) which engage in cut-outs of the moving plate. Possible faults here are loss of ball-bearings after over-enthusiastic dismantling, loss or incorrect remounting of rollers, looseness of spring clamps and just plain breakage due to an attempt to increase tension by bending.

There is no conventional pressure pad as the tape is mounted 'inside out' and the actual pad is mounted on a spring leaf in the cartridge. The heads press forward into correct position with the movement of the main plate. The only adjustment is the right-hand spring-loaded screw of the record/play head for correct azimuth setting. And as the Philips EL3300 is in effect a ¼-track machine—i.e. two tracks on ⅛in. tape—the azimuth setting is not really very critical.

One of the most important adjustments on this machine is the inward pressure of the pinch wheel. The rubber wheel is mounted in a pivoted bracket, with inward pressure applied by a torsion spring whose upper leg is held against a grooved post of the bracket. To adjust the tension to the required 155-175 gms, the lower leg of the torsion spring can be hooked in any one of the four securing holes. Excessive inward movement is prevented by the small pin against which the inner edge of the pivot bracket is mounted.

Another important factor is the clutch adjustment, which consists of bending the long U-spring whose free end rests against the roller

(*Continued on page 459*)

NEW PRODUCTS NEW PRODUCTS NEW PRODUCTS

● **Despite the cancellation of the Radio Show, this autumn has seen the introduction of many new recorders, some making their debut at London trade exhibitions. The New Products column, therefore, has been expanded this month to include the bulk of these new arrivals.**

FIDELITY PLAYMATIC

DESIGNED round the *BSR TD10* tape deck, the semi-transistorised *Playmatic* tape recorder is available with either ½-track or ¼-track heads, priced £29 8s. and £32 11s. respectively. An unusual feature for a mains recorder is the layout of amplifier controls on the vertical front panel. These are located alongside the forward-facing 7×3⅝in. speaker and comprise input gain controls, automatic/manual recording level buttons, track selectors and separate bass and treble controls. An erase cut-out is also included. The 16¼×7½×13¾in. cabinet is finished in polished teak with metal trim and detachable plastic cover. The Playmatic weighs 20lb. Fully transistorised versions of the single speed *Playmaster 2* and *Playmaster 4* recorders were also introduced this autumn, the former (½-track) being 3 gn. cheaper, at £23 2s., than the (¼-track) latter. A rotation counter is available for the Playmaster 2 as an optional extra, for another 2 gn.

Manufacturer: Fidelity Radio Ltd., Olaf Street, London, W.11.

SONY GO AUTOMATIC

AUTOMATION of recording level and tape threading are featured on models in the new *Sony* range. The *TC357-4* (top right) offers ¼-track mono recording and can probably claim to be the easiest spool-loading machine to operate, since a retractable pinch mechanism and self-threading reel eliminate all need for dexterity. Recording gain is automatically controlled, though a VU indicator is included close to an instant-reset rotation counter. Spool capacity is 7in. and operating speeds are 7½, 3¾ and 1⅞ i/s. Price has yet to be finalised but will probably be £65 2s.

Intended for use with external amplifiers and speakers, the *TC250A* ¼-track stereo tape unit is mounted on a wooden plinth and may be operated horizontally or vertically. Speeds are 7½ and 3¾ i/s and maximum spool size is 7in. The unit incorporates transistorised circuitry and is illustrated below. Approximate price is £57 15s.

Powered by batteries, or direct from the mains, the *TC-900* portable plays at 3¾ and 1⅞ i/s, handles spools of up to 3in. diameter and is shown above. This model, too, features automatic gain control but includes no modulation indicator. Recording bias is AC (30 Kc/s) and weight is 4½lb. Supplied complete with tape, microphone and carrying case, the recorder is expected to sell for £33 12s.

Little larger than the above, the *TC135* mains portable has only three controls. Recording gain is automatic and speeds are 3¾ and 1⅞ i/s. Weighing 7½lb., the *TC135* operates on two tracks and takes spools of up to 5in. diameter. Complete with accessories, it will probably cost £29 8s., making the recorder the cheapest in the Sony range.

Distributor: Debenhams Electrical & Radio Distribution Co. Ltd., Eastbrook Road, Gloucester.

TWINTONE STEREO RECORDER

ENTERING the stereo field for the first time, *Sanyo* have lately introduced a ¼-track transistorised recorder—the *MR909 Twintone*. Supplied complete with a pair of 200-ohm cardioid dynamic microphones and detachable speaker enclosures containing 4in. drive-units, the Twintone operates at 7½ and 3¾ i/s, with frequency ranges from 30 c/s to 15 Kc/s and 70 c/s to 9 Kc/s respectively. Peak output power is 3W per channel, a 1K line output being included for external amplification and 10K output for monitoring. Microphone and Auxiliary input impedances are 25K and 100K respectively, overall dimensions being 14¼×12¾×11in. The Twintone weighs 31 lb. and sells for £75 12s.

Distributor: Marubeni-Iida Co. Ltd., Moor House, London Wall, London, E.C.2.

THREE-SPEED FERGUSON

SPEEDS of 7½, 3¾ and 1⅞ i/s, a 7in. spool capacity, two-channel mixing, and relay-controlled auto-stop and remote pause facilities are offered by the *Ferguson 3214*, price £46 4s. A ¼-track machine, the 3214 features the latest *Thorn* tape deck, employing a four-digit instant-reset rotation counter, record level meter and piano-type controls. The latter govern, from left to right, STOP, RECORD-INTERLOCK, PLAY, PAUSE, REWIND and FAST-FORWARD. Four graduated rotary controls located on the front facia operate tone, volume, low and high-level inputs respectively, again from left to right. Push-button head-switching permits replay of upper and lower tracks independently or together. Replay of pre-recorded stereo tapes is also possible using the accessory amplifier also described on page 453.

Wow and flutter is 0.15% at 7½, 0.2% at 3¾ and 0.25% at 1⅞ i/s and output power, through the 7in. elliptical forward-facing speaker, is 3W. The wooden cabinet is finished in black leathercloth with satin silver grille and measures 16×8×14in. Space for microphone, connecting lead and accessories is provided at the rear.

Manufacturer: Ferguson Radio Division, Thorn Electrical Industries Ltd., Thorn House, Upper St. Martins Lane, London, W.C.2.

(Continued on page 453)

STB2-STB2-STB2

ANOTHER BRILLIANT DESIGN from BRENELL

The STB2 is a masterpiece in mechanical engineering and electronic circuitry. It is a versatile mono/stereo tape recorder and has been designed with high fidelity stereo installations particularly in mind.

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*Butoba	59 gns.
*Fi-Cord 202	66 gns.
Philips EL3300	25 gns.
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CAMERA-STYLED STELLA PORTABLE

AN unusual virtue claimed for the new *Stella ST472* battery recorder is that of camera styling. Weighing only 3lb., the machine is the smallest ever to appear under the Stella brand name and is said to be indistinguishable from a camera or portable radio when the hinged lid is closed. The black polystyrene cabinet is finished in a mock leather covering and is completely weatherproof.

Microphone and remote-power-switch cables are integrated with the shoulder strap to overcome the inconvenience of trailing connecting leads. A roller device allows the microphone to be held to arm's length from the strap, loose cable being automatically pulled back by the tape recorder which acts as a counterweight. Another original feature is the accidental erasure system overcoming one of the major drawbacks of the domestic tape recorder which even the 'interlock' failed to cure. The ST472 uses cassettes similar in style to those designed for the Philips EL3300. Removal of two 'knock-outs' (one for each track) makes it impossible to record inadvertently over prized material. The ST472 costs £27 6s.

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

SUPERSOUND THREE-HEAD RECORDER

OFF-TAPE monitoring, inter-track recording, echo and mixing of microphone and high-level signals are possible with the *Supersound* ¼-track tape recorder, price £57 15s. Based on the three-speed *BSR TD10* deck, the machine incorporates separate record and replay heads and has a response characteristic boosted between 3K and 5K to give improved intelligibility when used with magnetic stripe cine equipment. Overall frequency range is 30 c s-14 Kc/s at 7½ i/s with 0.15% RMS wow and flutter. Other speeds are 3¾ and 1⅞ i/s with 0.25% RMS and 0.35% RMS wow respectively. Headphone monitoring and the connection of external loudspeakers is possible through separate outlets while connection of monitor cutput to gram input allows echo effects to be recorded.

Manufacturer: Supersound Electronic Products, 114 Mount Pleasant Road, Hastings, Sussex.

THORN ACCESSORY PLAYBACK AMPLIFIER

DESIGNED for use with all *HMV*, *Ferguson* and *Marconiphone* tape recorders, the *Thorn SA100* transistor amplifier is now being marketed for £13 2s. 6d. The unit permits playback of pre-recorded stereo tapes (and in the case of the *3006* record-player, stereo discs) and cross-track recording when used with any of the above ¼-track machines. The second channel may also be employed in the manufacture of cine commentaries. The unit is complete with 8in. elliptical loudspeaker and connecting leads and is powered directly from the mains.

Manufacturer: Thorn Electrical Industries Ltd., Thorn House, Upper St. Martins Lane, London, W.C.2.

SCOTCH TAPE LIBRARY

TWO years of development by *3M* has culminated in the introduction of the *Album Pack*, designed to ease the problem of tape storage. Available with *Scotch* tape purchased in 5, 5¾ and 7in. sizes, the packs cost little more than tapes bought in conventional boxes. Attractively finished in dark-green simulated leather, each album

contains one tape and a spare compartment for an existing reel. Adhesive labels for spools and spine are supplied with each album.

Manufacturer: Minnesota Mining and Manufacturing Co. Ltd., 3M House, Wigmore Street, London, W.1.

ADDITIONS TO UHER RANGE

THREE new recorders have been added to the *Uher* range, including a successor to the *4000 Report-S* battery portable. The *4000 Report-L* is of similar appearance to its predecessor but features a three-digit instant-reset counter and an improved motor claimed to give quieter running and greater speed stability. Spool capacity is 5in. and speeds are 7½, 3¾, 1⅞ and 1⅞ i/s. Respective frequency ranges are 40 c/s to 20 Kc/s, 16 Kc/s, 10 Kc/s and 4.5 Kc/s. Output power is 1W to an internal monitor speaker with muting switch. The ¼-track machine can be operated from five cells, rechargeable battery or mains (the mains unit serves as the charger). Solenoid remote pause switching from a control on the microphone is also featured. The new machine is about £4 dearer than its predecessor, selling for £108 3s.

The Uher *724* should find a ready market at £79 15s., offering as it does ¼-track stereo recording at two speeds. Similarly styled, but substantially more versatile, the *22* and its ¼-track equivalent — the *24* — sell for £156 9s. Operating at 7½ and 3¾ i/s, the recorders incorporate switchable equalisation (CCIR and NARTB) separate record and replay heads, and a combined tape tensioning and cleaning device. Recording level is indicated by two VU-meters, gain being controlled independently on each channel. Each machine is supplied with a frequency response curve sheet produced on *Brüel & Kjaer* test equipment. Claimed frequency range is 20 c/s-20 Kc/s at 7½ i/s, with wow and flutter of ±0.08% RMS. At 3¾ i/s figures of 20 c/s-15 Kc/s with ±0.15% RMS are specified. An original feature of the *22*, which is illustrated overleaf, is a vernier control set in the head cover with which the playback head azimuth can be altered. Microphone input characteristics are 0.15mV at 5K (for 1 Kc/s), terminals for one stereo or two mono microphones being included. Radio and

(*Continued on page 455*)

diode inputs are also provided, with sensitivities of 1.7mV at 47K and 40mV at 1 Meg. Dynamic range of the *22* at 7½ i/s is 56dB, and of the *24*, 52dB. Dimensions, including removable Plexiglass cover, are 15½ × 6½ × 13in. approximately.
Distributor : Bosch Ltd., 205 Great Portland Street, London, W.1.

PERDIO THREE-SPEED RECORDER

VENTURING for the first time into the tape recording field, *Perdio* have just introduced a new tape recorder, the *T.26*. Speeds are 7½, 3¾ and 1⅞ i/s with a frequency range from 60 c/s to 13 Kc/s at 7½ i/s. Maximum spool size is 5¾in. and overall dimensions are 15 × 14 × 7½in. The ½-track T.26, which weighs 19lb., sells for £30 9s. while its ¼-track equivalent, the *T.46*, costs £34 13s.
Manufacturer: Perdio Electronics Ltd., Perdio House, Bonhill Street, London, E.C.2.

NEW RECORDERS FROM PHILIPS

CONFORMING to the current trend of designing domestic tape recorders capable of blending with modern home surroundings, *Philips* have produced a new range of machines following the pattern set by the *EL3552* in terms of external appearance. First of these is the *EL3552* which, for £37 16s., offers ¼-track recording at 3¾ and 1⅞ i/s, and two-channel input mixing with monitoring through headphones or loudspeaker. Inputs for microphone, pickup and radio are provided, with outputs for external amplifier, stereo playback preamplifier (model *EL3787/00A* is available for this purpose), headphones and external loudspeaker. Output power is 1.8W to the 8 × 3in. internal loudspeaker and spool capacity is 7in.

Model *EL3552* is similar to the above, but also features automatic gain control. A three-position switch permits manual gain control when switched forward, automatic microphone gain in central position and automatic radio gain when switched to the rear. Price is £44 2s.

Described as a successor to the *EL3549*, the new *EL3556* offers the same facilities as its predecessor, plus separate playback bass and treble controls, increased output from a semi-transistorised printed-circuit amplifier and a completely new tape transport mechanism. Speeds are 7½, 3¾, 1⅞ and 15/16 i/s. Wow and flutter is claimed to be within ±0.3% at 3¾ i/s and signal-to-noise ratio better than 47dB. The EL3556 sells for £65 2s.

Finally from the Philips stable comes the *EL3794D/00 Car Mounting Unit*, an accessory permitting installation of the *EL3300/1* cassette recorder in a motor vehicle. The device can be mounted in any convenient part of the vehicle and will record from microphone and car radio, replaying through its own speaker or through the amplifier stage of the radio. Power supply is from 6V, 12V or (in modified form) 24V DC car battery. Mounting brackets are supplied with the unit, which measures 12 × 8¾ × 3¾in. when fitted and wired and costs £12 10s. Finish is in dark grey hammered metal with matt silver escutcheon. The unit may also be purchased complete with EL3301 recorder and four cassettes in *Car Tape Recorder Kit NP1630* for £42.
Distributor: Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.2.

A NEW ULTRA

BASED on the *Thorn Mk II* tape deck, the new *Ultra 6204* features two speeds, 3¾ and 1⅞ i/s, tape inching and solenoid remote pause and stop controls. Frequency range at the faster speed is 60 c/s—10 Kc/s, with 0.2% RMS wow and flutter. Spools of up to 5¾in. can be used and weight is 19lb. Solenoid mechanical controls provide autostop facilities on fast wind, play and record functions when metallic foil is used. Remote pause can be accomplished using a switch on the microphone. An auxiliary socket mounted in the rear storage compartment enables connection of alternative remote pause and stop switches, monitor headphones, an accessory power supply (—32V at 50mA) and the disused ¼-track head segment. The 6204 costs £35 14s.
Manufacturer: Ultra Radio and Television Ltd., Television House, Eastcote, Ruislip, Middlesex.

ALBA SINGLE-SPEED RECORDER

ALBA have just introduced a new recorder using the 3¾ i/s *BSR Monardeck*. Available in ½-track and ¼-track versions, designated Models *R16* and *R17*, the machines cost £25 14s. 6d. and £28 7s. respectively. A three-valve amplifier gives 3½W output to an 8 × 2¾in. speaker and is said to operate between frequencies of 100 c/s and 9 Kc/s. Signal-to-noise ratio is 47dB, with 70dB erase damping at 1 Kc/s. Mixing of high and low-level inputs is possible using two rim-operated controls which serve, on replay, tone and volume functions. A rotation counter is included to the rear of the deck, spool capacity of which is 5¾in.
Manufacturer: Alba (Radio and Television) Ltd., Tabernacle Street, London, E.C.1.

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Akai M8	23 0 0	10 17 2	146
MAINS 2-TRACK			
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Fidelity Playmatic 2 ...	4 8 3	2 1 8	28
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Grundig TK17L	6 15 6	3 4 0	43
Ferguson 3214	6 19 0	3 5 5	44
Grundig TK400	7 9 0	3 9 10	47
Grundig TK23L	7 14 6	3 12 11	49
Tandberg 843	9 6 0	4 7 9	59
Philips EL3556 Teak ...	9 15 6	4 12 3	62
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Ficord 202A	10 8 0	4 18 2	66
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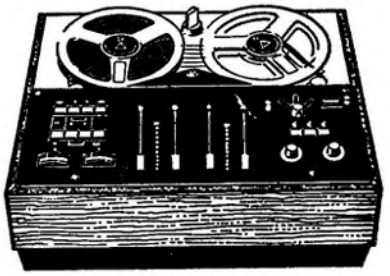

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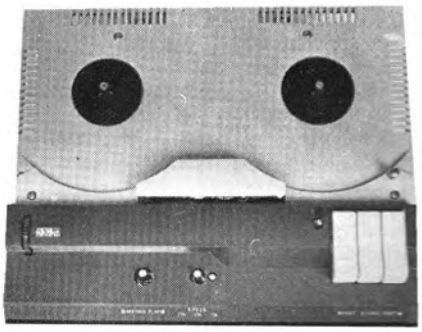

MAGNAVOX 363 TAPE TRANSPORTER

MANUFACTURER'S SPECIFICATION: Three speed tape deck. **Tape Direction:** Left to right only. **Tracks:** Two or four according to head types. **Motor:** Single four-pole induction, fully screened. **Rewind Time:** 120-150 seconds per 7in. spool of 1,200ft. **Wow and Flutter:** 0.15% at 7½ and 0.25% at 3¾ i/s (no figure quoted for 1⅞ i s). **Operating Plane:** Horizontal. **Dimensions:** 13½ x 11 x 5¼in. **Weight:** 10lb. **Price:** £14 19s. 6d. **Manufacturer: Magnavox Electronics Co. Ltd., Alfreds Way, By-Pass Road, Barking, Essex.**

ALSO known as the *Magnavox Studiomatic Tape Deck* the Magnavox *363 Tape Transporter* will be the subject of a feature entitled 'Tape Decks Analysed' with photographs of its many interesting mechanical features in the December issue. I will content myself, therefore, with a very brief description of its mechanical design followed by a more detailed test report.

The Studiomaster is a single-motor, three-speed deck with the usual movable idler wheels to couple the motor shaft to the reel hubs for fast wind and rewind. A novel feature of the machine is the 'rocker' type of control key. Instead of pushing down against a spring and releasing by pressing a stop-key or bar, each key must be returned to its original position by pressing the other end of the 'rocker'. A system of interlocks prevents two keys being down together. One result of this design is that operation of the controls is lighter and much quieter than earlier decks where an almighty clang announced the switching to a new mode.

SMOOTH TAPE HANDLING

Tape handling is smooth and quiet with no loops or over-stretched tape when it is halted at any speed.

Mechanical running noise seemed fairly high on the open deck, but proper cabinet mounting and fitting of the plastic dress covers will probably bring it down to a reasonable level.

Long-term speed stability was good and remained within 1% of the nominal speeds of 7½, 3¾ and 1⅞ i/s under all conditions of tape loading.

The short-term speed stability was not so satisfactory as will be seen from the one-second fluttergrams of **fig. 1.** At 7½ i/s the RMS readings ranged from 0.14% to 0.15%, with most of the flutter at motor rotation frequency of 25 c/s (1,500 rpm.). Wow was negligible at this speed. At the commonly used speed of 3¾ i/s, a wow at 3 to 4 c/s was fairly obvious on a sustained tone, together with a 16 c/s flutter which proved to be due to the idler wheel which drove the capstan. At a speed of 1⅞ i/s, 2 c/s wow was very obvious on most musical tones.

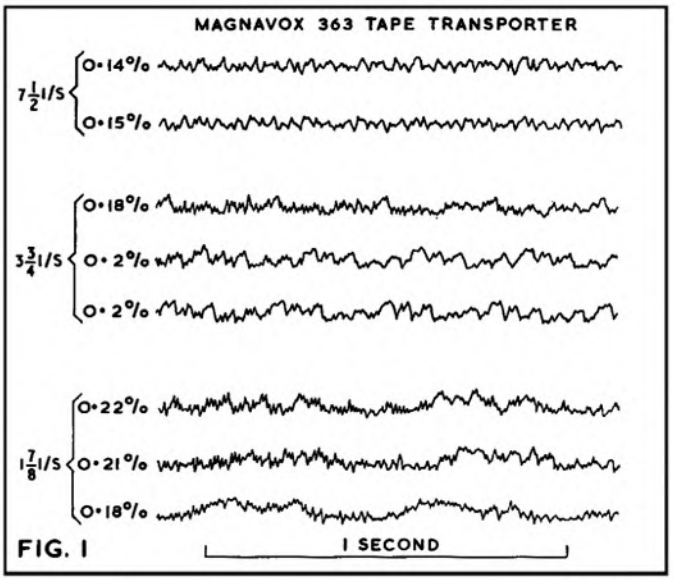

FIG. 1

Investigation with a clock micrometer showed that both the stepped motor pulley and the capstan idler wheel were out of true by a little over one thou. The pressure roller and the flywheel/capstan showed little eccentricity, and the flywheel showed evidence of having been dynamically balanced.

The deck can be supplied fitted with a range of ½ and ¼-track heads. The heads fitted to the deck submitted for review were of the *Bradmatic* ½-track type.

The open circuit voltage of the playback head was measured on a sensitive valve voltmeter at 7½ i/s and 3¾ i/s, using test tapes of 70 and 140 μS respectively. The very slight iron loss in the head introduced a loss of approximately 1dB-per-octave, so that the theoretical 6dB-per-octave rise was modified to 5dB-per-octave and the turnover points lowered slightly. Nevertheless, the curves are smooth (**fig. 2** and **3**) and can be fully equalised by choice of the correct time-constant in the replay circuits (not necessarily the *recording* characteristic time-constants).

COMMENT

This is a well designed tape transport mechanism but, like all new products, it will have to go through a period of settling down while production tolerances are tightened up to the required limits. In this case, the one thou. errors in the idler wheel and stepped pulley will have to be reduced to at least a quarter of this figure if the deck is to compete with the wow and flutter performance of imported continental machines, which consistently maintain total wow and flutter figures at well under 0.1% at all speeds. **A. Tutchings.**

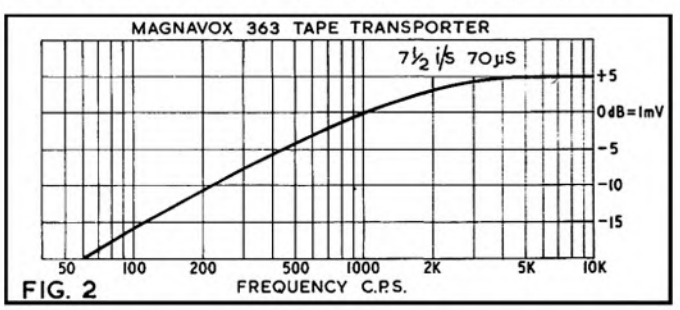

FIG. 2

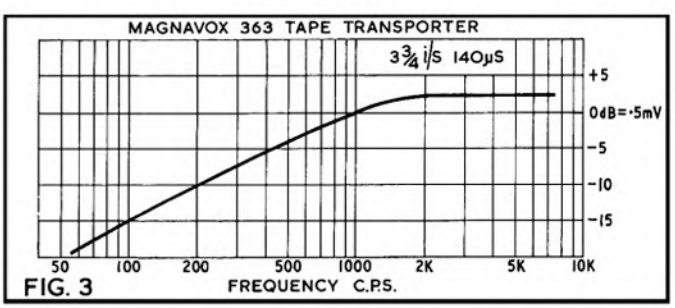

FIG. 3

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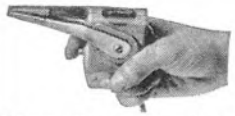

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clamp fixing screw. The clutch should have a pressure of 120 to 150 gms against the right-hand turntable.

Springs also come into the winding roller adjustment where a second, small, flat belt is used between a drive pulley which engages the flywheel and a roller which is pivoted to engage either turntable. To obtain the clockwise drive for fast rewinding, the supply connections to the motor are reversed, and this is also par of the same action. A moulded toggle piece actuated by the main lever closes the appropriate contacts of a leaf-spring switch. It must be noted that there is clearance between all contacts when the machine is in the neutral position, and the setting of the switch-block must be correct to allow the moulding an even travel as the main lever is moved left and right. If these things are correct, it may be necessary to bend the contact leaves slightly—but take care with this adjustment. Leaf spring contacts can seldom be re-shaped into correct position or tension.

The vital spring of this assembly is that mounted on the bracket, which should just touch the bush of the mounting in either rewind position and not reach the nearby bush or pillar which is part of the case mounting. During play, the spring touches this pillar but should not touch the mounting bush. The action during fast winding soon shows any discrepancy, and again, a judicious bending of the spring should quickly put matters in order. To remove this assembly for servicing, it is necessary to take off the left-hand turntable, switch to playback, swing the printed panel out of the way, and release the mounting bracket by taking off the nylon circlip. The assembly can be twisted slightly anti-clockwise (as viewed) and lifted from the mounting spindle.

One stricture made by Philips which needs underlining is—to paraphrase—Don't oil the motor. DC motors, with their brushes and commutators and small, sealed construction, do not take kindly to indiscriminate oiling. Lubrication can be limited to a very occasional smear of graphite oil at the points marked in the accompanying diagrams. The ball-bearings and those sliding surfaces of the main plate are about the only places needing anything heavier, and a touch of medium grease will do the trick.

Electrically, there is not a lot to say. The circuit consists of a seven-transistor line-up, with low-noise preamplifier, two-stage amplifier with feed-back, equalised, driver-cum-head amplifier stage with a push-pull output stage which becomes an oscillator during recording. The final transistor is diode-connected as rectifier for the modulation level indicator. This last is a meter, with very clear red and green markings, also used as a battery level indicator. Its main problem is the mounting bracket which allows some movement and can cause displacement of the meter during re-assembly, with subsequent damage.

Another point to watch is the placement of the green wires to the erase head. If the 'hot' wire becomes chafed through careless assembly, the symptoms are No Record—High Current Drain—Playback Normal. Also, when re-assembling, don't forget that record switch toggle, the brake spring, and the re-tying of the cables to prevent the switch action being impeded.

In some machines, the first three transistors and the diode are changed to AC125, but the driver transistor is still an AC126. Some component values have also been changed—the 100 ohms resistor in the lower (chassis) leg of the feed to the secondary of the driver input transformer is reduced to 47 ohms ; the decoupler of the main amplifier and driver stage negative feed is increased to 200mF and the decoupler of the negative feed to the output stage to 400 mF. These are not the sort of modifications that some makers bring out, as development improvements. Any replacement should be made with identical parts to those removed.

POSTSCRIPT

The EL3300 is already out of date, having been superseded by the *3301*, which has minor improvements but is basically the same.

On this latest model, the headphone monitoring facility that David Kirk requested in his Field Trial has been added. Stereo headphones have been adapted for the purpose, and these, with correct terminations for the EL3301, costs £3 10s. in my local hi-fi dealer's establishment. It may interest waverers who regard anything pocket-sized as *infra-dig* that this model is the only one that my local man will condescend to discuss !

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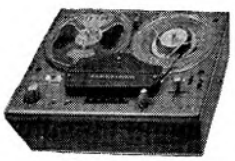
"WHENEVER THE DEMAND IS FOR PRECISION RELIABILITY AND NATURAL SOUND REPRODUCTION —THE CHOICE MUST BE **TANDBERG**"

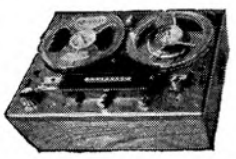
SERIES 6



Model 64 4 track
Model 62 2 track
Price 110 gns. each.

Semi professional Stereo/mono tape recorders with cathode follower output. Three speeds — Three heads — Four amplifiers — "Sound on Sound" etc.

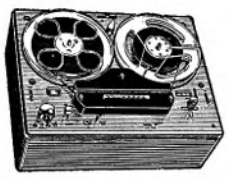
SERIES 7



Model 74 4 track
Model 72 2 track
Price 93 gns. each.

Build-it-in or carry-it-around. Complete stereo/mono record and playback with own power amplifiers and speakers. Three speeds — dual record indicators — output for hi-fi pre-amps — centre channel for language teaching or cine work.

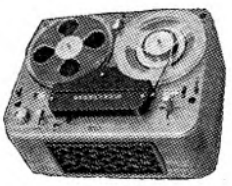
SERIES 8



Model 823 2 track (teak case) **54 gns.**
Model 822 2 track (Portable with lid) **57 gns.**
Model 843 4 track (teak case) **59 gns.**
Model 842 4 track (Portable with lid) **62 gns.**

High class monaural tape recorders suitable for home, business, education, photo sound, etc. ($3\frac{3}{4}$ and $1\frac{7}{8}$ I.P.S. speeds — 7″ reels).

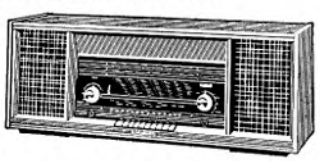
SERIES 9



Model 92 2 track only (teak case) **69 gns.**

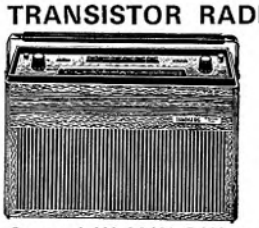
High class monaural 3 speed ($7\frac{1}{2}$, $3\frac{3}{4}$, $1\frac{7}{8}$ I.P.S.) tape recorder, with quality comparable to the famous Stereo models. Extremely reliable machine recommended for all home and educational purposes, etc.

HULDRA RADIO



Model 7-41 without speakers **80 gns.**
Model 7-42 with speakers **87 gns.**
Incorporate stereo amplifiers (for series 6 recorders) and outstanding radio performance so necessary in Scandinavia. F.M. and L.W. M.W. S.W.1. S.W.2. A.M. bands. Novel "Baby Sitter" circuit.

TRANSISTOR RADIO

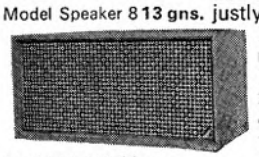


Model TTR/AUTO **49 gns.**

Covers L.W. M.W. S.W. and F.M. bands Special facilities for car radio use (special car accessories available) Handsomely styled in walnut. Fine performance and quality sound reproduction, separate bass and treble controls.

LOUDSPEAKERS

Model Speaker 8 **13 gns.**



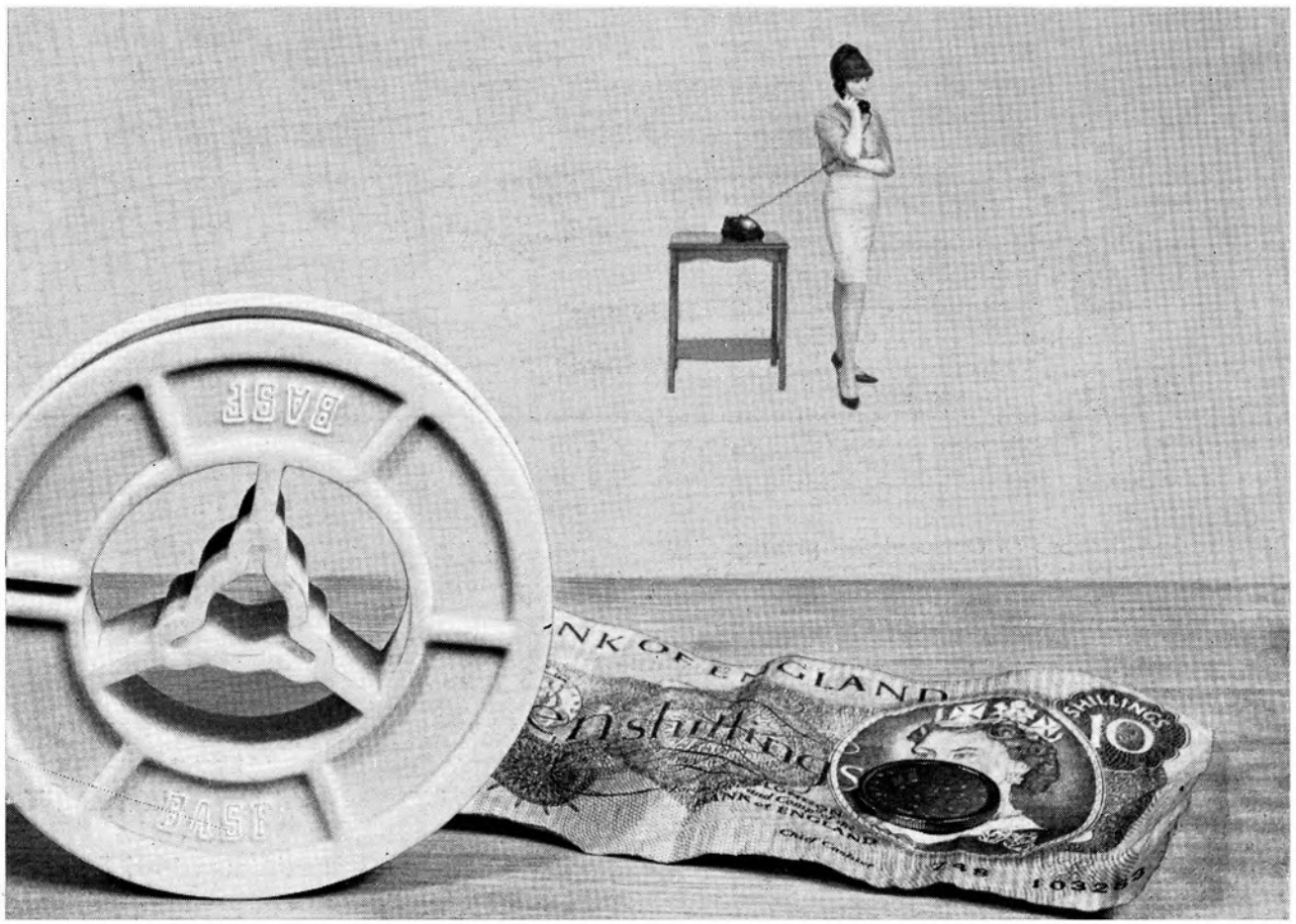
Model Hi-Fi 3 **22 gns.**

In handsome teak cabinets specially designed for use with Tandberg Tape Recorders and Radios. Can justly claim to be High Fidelity reproducers.
Dimensions:
22″ x $10\frac{3}{8}$″ x $9\frac{7}{8}$″ deep.
$14\frac{3}{8}$″ x $10\frac{3}{4}$″ x $5\frac{7}{8}$″ deep.

Tandberg

For further information and specifications please write to: Dept. TR

Elstone Electronics Limited, Edward Street, Templar Street, Leeds 2. Telephone: Leeds 3-5111 (7 lines)



How to lower the rising cost of overseas friendship

A 7½ minute phone call to the U.S.A. costs you £6 (cheap rate).

A similar message by BASF letter tape costs 5/6—plus postage.

There are two ways to talk for 7½ minutes to a friend or relative in America.

A phone call costs £6, bare minimum. And it's completely spontaneous. With the inevitable pregnant pauses. The sinking feeling of not knowing what to say —until the phone goes down.

A BASF Letter Tape costs 5/6—plus postage. You can plan in advance what you want to say—and say it clearly. And it can be used over and over again. Always with the finest quality reproduction to be heard anywhere.

To your friends and relatives overseas the sound of your voice is valuable. It doesn't have to be expensive.

Length: 150 ft. Up to 15 minutes playing time.

Price: 5/6.

BASF 1865 1965

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