

AUGUST 1964

TWO SHILLINGS

tape recorder



CONSTRUCTING A RECORD - PLAYBACK AMPLIFIER
BATTERY PORTABLE SURVEY — FIDELITY PLAYMASTER REVIEW

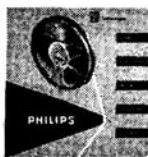


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tape recorder

INCORPORATING 'SOUND AND CINE'

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EDITORIAL

WHEN comparing mains recorders within a fixed price range one comes to the conclusion that good value is being given for money. Whatever criticisms of excessive hum or narrow frequency range are levelled at the less-expensive recorders, they are counteracted, in most cases, when the price of the pure hardware is taken into account. Even without labour costs it is a miraculous achievement when a mains tape recorder of reasonable performance can be bought for under £30.

In the past decade the pound has crept steadily down in value and in nearly all fields of commerce prices have risen without an increase in quality. But the tape recorder has grown closer to the pocket of the man-in-the-street as prices have fallen. Mass production is one reason for this price decline; the unselfish attitude of the average manufacturer is another, for he could frequently ask a higher price.

But try listening to a few battery recorders and it becomes immediately obvious that price is no criterion by which to judge quality. When a recorder costing little more than £25 outperforms another in the £40 region something is obviously very wrong.

With the mains recorder there are inevitably exaggerated figures in the maker's specification. Such exaggerations are sometimes stretched in the battery field, however, a little too far. Claims of "truly high-fidelity" can be compared with the washing-powder being "whiter than white", but a false frequency response indicates either that the manufacturer is incapable of measuring a specification (which is most unlikely) or that he is knowingly misleading potential customers. If the washing-powder manufacturer says his product contains GL 70 you can rest assured that he speaks the truth—whether or not what he says is relevant to washing.

Discovering that the recorder with wow and flutter figures "better than 0.15%" is fluctuating audibly, and then comparing it with the excellent transport system of a "1% peak-to-peak" machine which is almost half the price but sounds much better, indicates that the manufacturer or distributor is not aiming his literature at those who have learnt to read between the lines.

National characteristics become very evident in the battery recorders exported by many countries. While Japanese, British, German and Dutch professional and semi-professional equipment are almost indistinguishable in quality and value, the

SUBSCRIPTION RATES

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cheaper products from the same sources are far from comparable.

The really cheap Japanese portables, thousands of which are now sold at between £5 and £20, have for many consumers cast a slur on Japanese equipment in general. This is far from fair, yet there is *not one* British battery recorder within the medium £30 to £50 range with which the more expensive imported models can be compared. German and Dutch recorders fill in this mysterious gap with a wide selection of battery equipment.

In an attempt to assist in the difficult choice of a battery addition to the domestic recording set-up we publish this month a survey of portable recorders. All the models shown are currently in production and should, with the obvious possible exception of the *Nagra* range, be obtainable from any reputable dealer. Again, however, we face the problem of the unreliable specification, for which reason we give the dates of relevant reviews and trials published in the past.

It cannot be too strongly stressed that no specification, no review or recommendation should be treated as more than a guide. A comparative demonstration from a dealer can show up the practical *merits* of the various recorders he has in stock; but the *bad* features will not be discovered unless the prospective buyer tries the machine for himself. Look for the badly fitting hub, the loud *clicking* noise that occurs when it is held upside-down, the loose or inconveniently placed controls—and above all, the background hiss and motor interference.

Distortion, if present on playback through the inbuilt speaker, may be overlooked provided you have a good second machine, and if the tapes play well on another recorder. The dealer should be quite prepared to use one of his mains machines for a playback demonstration, if one is requested. If distortion is very apparent when tapes are played in this way you should seriously reconsider your purchase.

But whatever model is decided on, the usefulness and versatility of the better battery portables can add a great deal to the enjoyment of tape recording as a hobby. Thanks to the transistor, the tape recorder need no longer be significantly more cumbersome than a good camera, and practically *everyone* uses a camera.

COVER PICTURE

BBC outdoor recording staff often find themselves working in precarious positions. An EMI L2 battery portable is being used here to tape an interview some 25 storeys above ground level. (Readers may notice the Festival Hall in the background.)

The L2 was recently superseded by the transistorised RE321, listed in the survey of battery recorders on page 276.



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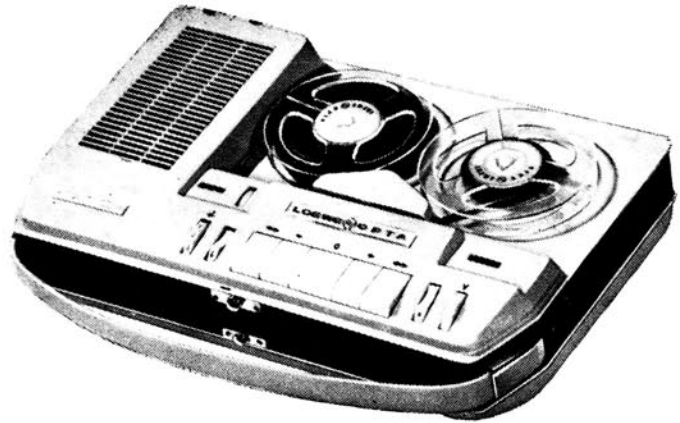
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world of tape

INSTANT HEARTBEAT

DESIGNED for industrial use, the transistorised *Teldicord* is an invaluable addition to the first-aid kit. After a serious accident, such as an electric shock, the heartbeat occasionally falls below the level which can be detected from a pulse. In such cases the unit, which weighs 13 oz., is connected to the patient's wrists or ankles, through which electrodes relay faint heart currents to be reproduced as audible whistles.



The heart-monitor can also be applied in hospitals, both in the operating theatre and to observe a resting patient's condition from a remote point.

Manufacturer : Teldix Luftfahrt—Ausrustungs G.M.B.H., 69 Heidelberg, Postfach 1730, W. Germany.

CELESTION SPEAKER DEMONSTRATION

NO admission tickets are required for the series of demonstrations, open to trade and public, at the Rembrandt Hotel, Thurloe Place, London, S.W.7, on the following dates : Friday, 28th August and 4th September, from 12 noon to 9 p.m. ; Saturday, 29th August and 5th September, 10 a.m. to 9 p.m. The demonstration is intended to be held in various towns throughout Britain, details of which are not yet available.

Studio Series 12in. speakers will be on show, models CX1512 and CX2012 of which became available in the third week of July.

Manufacturer : Rola Celestion Ltd., Ferry Works, Thames Ditton, Surrey.

MASS RECORDING SESSION

MORE than 12,000 reels of magnetic tape and 150 recorders have been donated to the *Boy Scouts of America* organisation by the 3M Company. Arrangements for the grant were concluded at the annual meeting of 1,500 adult Scout-leaders at Cleveland on May 22nd. The recorders, Wollensak mono and stereophonic models, were used at the Sixth National Scout Jamboree between the 17th and 23rd July in a "remarkable and massive new operation in electronic journalism".

The equipment served as the recording media for some 2,000 Scouts who prepared news tapes from the Jamboree for 3,000 commercial radio stations throughout the country.

Each day the scouts, representing broadcasting stations in their

NEXT MONTH

THE September issue of the *Tape Recorder* will be on sale Friday, August 28th. In this number John Berridge will describe a rival to *Telcan*, Roy Russell will help you entertain friends with a short tape play, and John Gaselee will discuss the ins and outs of tape recorder insurance. Peter Turner will relate a nostalgic incident in the Forest of Dean and David Kirk will subject another battery portable to a field trial.

home-district, taped observations on the activities of different groups.

The seven-inch reels of tape donated, each capable of three hours recording time, were used in the production of a single report for each scout region represented in the event. Other tapes were used to record the speeches of various personalities expected to attend the Jamboree. A number of musical events were also scheduled to provide material for recording.

Tape recorders were located throughout the 28-acre site with which representatives from 3M's Revere-Wollensak and Magnetic Tape divisions trained adults and scouts in the operation of equipment and supplied information on microphone and general recording technique under varying conditions of recording.

MICROKIT CONFUSION ENDS

ALL enquiries regarding the *Microkit* condenser microphone should now be addressed to: **Nusound Recording Co., 93 Mortimer Street, London, W.1. (Museum 1219.)**

TELCAN DEMONSTRATED TO TRADE

ELECTRICAL dealers in the Midlands were invited to attend a demonstration of a domestic video tape recorder recently. Prototype recorders were operated with 19 and 23in. receivers and the technical and commercial aspects of sales and distribution were discussed. Orders were placed for the production model which, despite the news release published in April, is still not available.

Manufacturer : Telcan Ltd. (Nottingham Electronic Valve Co.), Main Street, East Bridgford, Notts.

FAIRCHILD DOMESTIC VIDEO RECORDER

INTENDED to retail at less than £200, a television recorder was shown recently in New York. The Fairchild Corporation are the second of several manufacturers, including 3M, Sony, CBS and Ampex, to develop such equipment, which uses 11in. spools of $\frac{1}{2}$ in. tape.

Audio and video signals are multiplexed on to a single track running at 120 i/s. This track occupies half the width of the tape and is automatically transferred to the other half at the end of the reel. Stationary tape heads, less than 1 micron in width, and fifty silicon transistors combine to give a reasonably well defined picture although the accompanying sound is said to leave something to be desired. Head life is in the order of 1,500 hours and replacements would cost about £5 each.

TAPE RECORDER AND H.F.N. BINDERS

READERS who keep past copies of *Tape Recorder* and/or our sister magazine *Hi-Fi News* will find it very much more convenient to store them in binders specially made for the job. Twelve issues plus an index may be housed with ease and kept neatly on the bookshelf. Binders for Vols. 5 and 6 of *TR* and Vols. 7, 8 and 9 of *HFN* are available at 15s. each, including postage.



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10/18 Clifton Street, London E.C.2. Telephone: B1Shopsgate 6711
(Distributors for U.K.)



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LAST month we dealt with the principles of microphones; we investigated impedance, matching and output voltage. There are, however, additional factors that the amateur tape recordist should have in mind when purchasing or substituting a microphone. Two of these are *frequency response* and *directivity*, the latter sometimes called *pick-up pattern* or *polar diagram*.

Looking first at frequency response, we find that this is related to

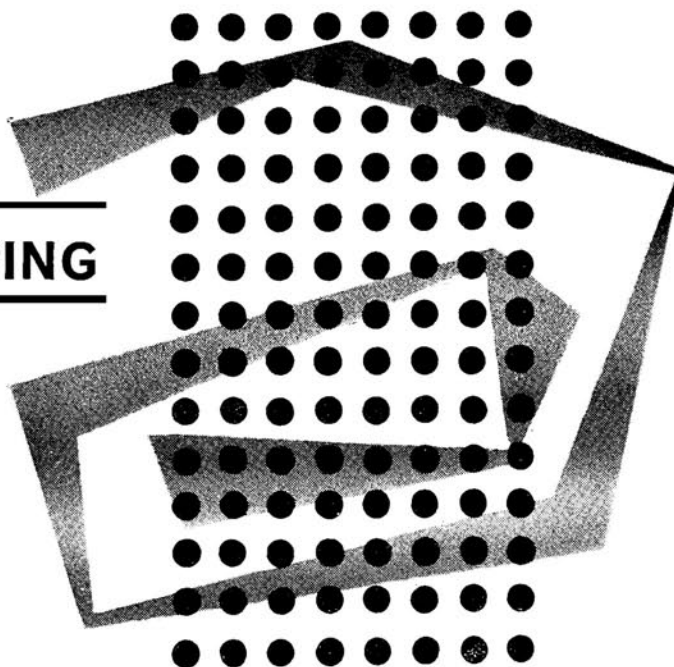
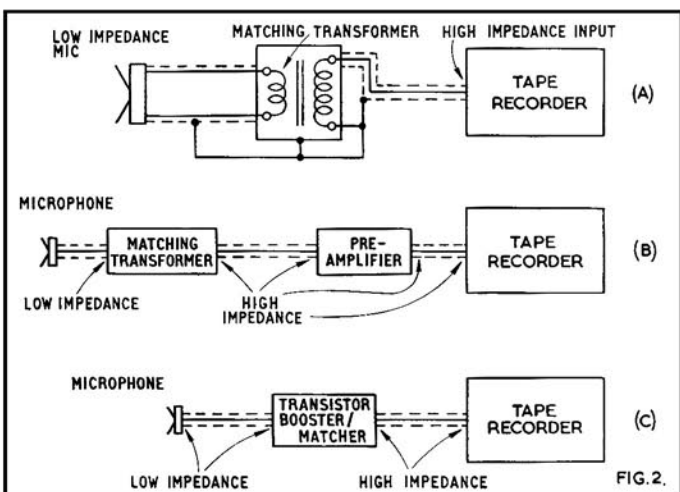
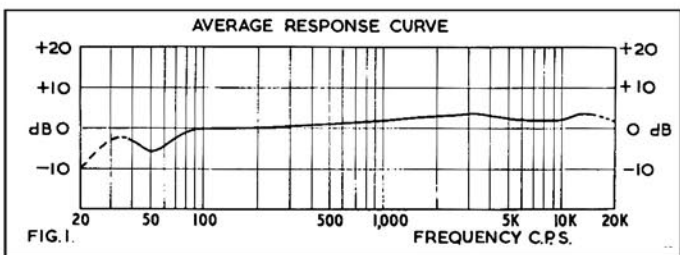
TOWARDS BETTER TAPING

the magnitude of signal output voltage generated by the microphone due to sound pressure of equal intensity over a range of eight or nine octaves, depending upon the type and quality of the microphone. That is, a response from about 32 c/s up to approximately 8 Kc/s to give the eighth octave or up to 16 Kc/s to give the ninth octave. Note here that the first octave of 16 to 32 c/s is rarely covered with the type of microphone in which we are interested. This octave is responsible for the fundamentals produced, for instance, by large organs, but it is not essential for the high quality reproduction of serious music.

The ninth octave (as we are considering them—the tenth when the first octave is taken into account) from about 8 Kc/s to 16 Kc/s, again, is only fully embraced by the most expensive of microphones. This octave contributes to the 'sparkle' of the reproduction, but above about 12 Kc/s the human auditory response tends to degenerate with age, so sounds above that frequency may not be too important—music-wise—to all. Indeed, a response from about 80 c/s up to about 10 Kc/s can provide sounds of very high musical value, as long as the response does not cut off sharply at the extremes of the spectrum.

The frequency response of a microphone may be expressed in figures or in terms of a curve. The *Acos Mic 39* dynamic microphone, for example, is said to have a response from 80 c/s to 10 Kc/s +3dB and approximately 10dB down at 50 c/s and 15 Kc/s.

For practical purposes, this means that the microphone can be considered as producing an output voltage which is essentially constant at all frequencies from 80 c/s to 10 Kc/s. The +3dB bit means that the output voltage over the range may vary up or down by a ratio of about 1.4 to 1 (the decibel giving the voltage ratio, as may be found from decibel tables—see also Part 4). Outside the 80 c/s to 10 Kc/s range there is a fall in output voltage, and at both 50 c/s and 15 Kc/s



PART FIVE MICROPHONE IMPEDANCE AND SENSITIVITY

BY GORDON J. KING

the voltage has dropped by a ratio of about 3.2 to 1 (e.g., 10dB voltage ratio).

This microphone, then, like many others of a similar kind, is capable of responding to most of the important musical frequencies and the tail-off either side of the range is gradual, meaning that the response even to the higher frequencies is not deleted completely.

Fig. 1 shows how the frequency response may be expressed in the form of a curve. Here the frequency (in logarithmic order) is plotted horizontally against the relative output (in decibels) vertically. The most linear part of the curve extends from about 80 c/s to 15 Kc/s, and, in fact, the microphone to which this curve relates (the Grampian DP4 dynamic), is said to have a frequency response from 50 c/s to 15 Kc/s. The curve shows, however, that the response is about 6dB (2-to-1 voltage ratio) down at 50 c/s. The curve also shows (by the broken lines) that the response gradually tails off at the extremes of the range. The relative "0dB" corresponds to the curve at about 100 c/s. At 300 c/s there occurs a slight rise of a decibel or so up to about 4 Kc/s when the response tends to fall a little. This, of course, is not serious, and the overall effect is often better pictured by the amateur diagrammatically, as shown, rather than by figures. The statistics issued by microphone manufacturers now often include response curves of this kind.

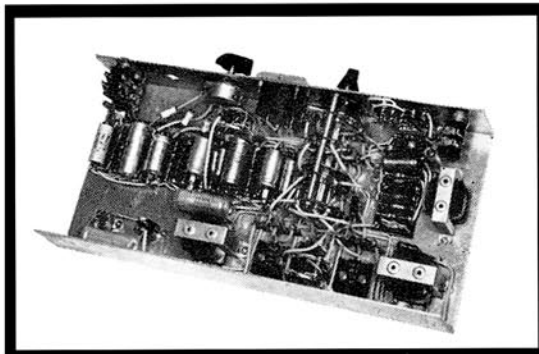
The response at fig. 1 could be correctly expressed as being substantially flat over the working frequency range. Perfect flatness of response comes only with costly, studio quality, microphones, but a few rises and falls have virtually no effect on amateur recordings. Excessive variation, of course, is to be avoided if good quality work is proposed.

Unfortunately, it usually follows that a microphone with a very good and flat response has low sensitivity, and can rarely be used direct with the popular type of recorder. The microphone signal needs first to be boosted by passing it through a small, flat-response pre-amplifier before being fed to the recorder microphone input socket, but then the output impedance of the amplifier should match the microphone channel input impedance, the microphone also having to be matched to the pre-amplifier input, of course.

Microphone boosters or pre-amplifiers are available commercially. The Reslo GE1, for instance, employs a transistor amplifier circuit and, apart from giving a boost to the microphone signal, it serves as a matching device so that low and medium impedance microphones may be coupled direct to a high impedance tape recorder input without the need for a matching transformer (see later).

We have seen that the sensitivity and the response of microphones
(continued on page 269)

A TRANSISTOR TAPE AMPLIFIER



PART ONE

THE RECORDING CIRCUIT

BY S. WELLDON

THE use of transistors in tape-recorders can produce results comparing favourably with thermionic valve equipment. Probably the biggest single advantage in using transistors in this type of equipment is the relative ease with which a high gain amplifier can be constructed without adhering to a precise circuit layout or using elaborate screening precautions to minimise unwanted feedback loops and hum pick-up. Freedom from microphony is another important advantage, particularly where space is limited and components are mounted close to the tape deck motors.

The record/playback amplifier described here was originally designed for use with a medium-impedance half-track R/P head having a low DC resistance, enabling a low-impedance current-operated input stage to be used. Typical heads are those on the standard *Brenell*, *Collaro* Transcriptor (now *Magnavox*) and *Truvox* decks. A fall-off in bass response is obtained with heads having a lower inductance-to-resistance ratio, but extra equalisation can be added to compensate for this and in practice the circuit will work satisfactorily with a wide variety of heads.

It is initially described here suitably modified for use with the BSR single-speed *Monardeck* TD2 tape deck, fitted with the standard 600mH half-track R/P head (gap width 0.0002in.), and a low-impedance erase head. The circuit may be thought to be rather elaborate for a simple deck of this type, but it is easy to build and the combination is capable of excellent performance. The simple addition of a speed-change equalising switch (to be described later) makes it suitable for both the new BSR TD10 and the *Magnavox Studio* three-speed decks, as well as those mentioned earlier.

The recording sensitivity is adequate for most signal sources, and simple networks allow for ready adjustment of equalising on both record and playback. The recording head is driven in the conventional manner via a high resistance, hence the performance of the amplifier is independent of head characteristics. The circuit also includes a 60Kc/s push-pull oscillator which will erase the most heavily recorded tape.

The amplifier is designed to operate from a 12V supply, the total power consumption being 3½W on record and 2½W on playback (at full output). A suitable power supply is also described.

The circuit of the complete amplifier is shown in fig. 1. Five transistors are used in the recording amplifier, the head being driven by an autotransformer T.1. Component values are given on the circuit, apart from the inductors and transformers which will be detailed in a table next month.

In the first stage a low-noise transistor (Tr.1) is biased at an emitter current of 450µA which, together with the use of high-stability resistors, results in a good signal-to-noise ratio. The first two stages (Tr.1, Tr.2) form a directly-coupled feedback pair, used as a linear amplifier on record and as an equalising amplifier on playback.

Treble-boost networks are placed between the third and fourth stages (Tr.3, Tr. 4), both of which have some uncoupled emitter resistance to provide local negative feedback.

On record the fourth and fifth stage (Tr.4, Tr.5) are directly coupled. On playback the fourth stage becomes the driver for the 1W audio output stage, Tr.5 then being switched out of circuit. Two matched

GET116 transistors (Tr.6, Tr.7) are used in the output stage, and these operate on record as the 60Kc/s erase and bias oscillator.

The overall response shown in fig. 2 (curve 'b') will normally be obtained with an HF bias current of 250-300µA. The response shown is within 3dB of the 1Kc/s level, from 60c/s to 7½Kc/s.

At this point it will be easier to examine the amplifier in greater detail by considering the recording and playback requirements and arrangements separately.

It is usual to drive the record head via a high resistance to provide a substantially constant current signal-source. This tends to reduce equalising problems and minimises variations in performance due to the spread of head characteristics, as well as allowing the tape to be magnetically 'loaded' equally well over the required frequency range.

The peak recording level is an arbitrary value, usually such that the amount of 3rd harmonic distortion introduced by the curvature of the tape transfer-characteristic is not more than 2 or 3%. The level at which this occurs varies with the HF bias current, as shown in fig. 3 (curve 'a'). The bias current also controls the tape sensitivity (fig. 3, curve 'b'), in addition to which tape drop-outs are reduced as the bias is increased. Since the optimum values of bias current for these various factors do not coincide, the selected recording conditions are the result of a compromise between high sensitivity and a reasonable recording level relatively free from drop-outs.

From the measured characteristics of the BSR head used with *Scotch* 150 tape, a bias current of 270µA and a peak recording current of 60µA were chosen, these conditions giving not more than 2% of 3rd harmonic distortion on a 400c/s sine-wave signal. (N.B. Early models of the *Monardeck* used a lower impedance head, requiring a bias current of about 800µA.)

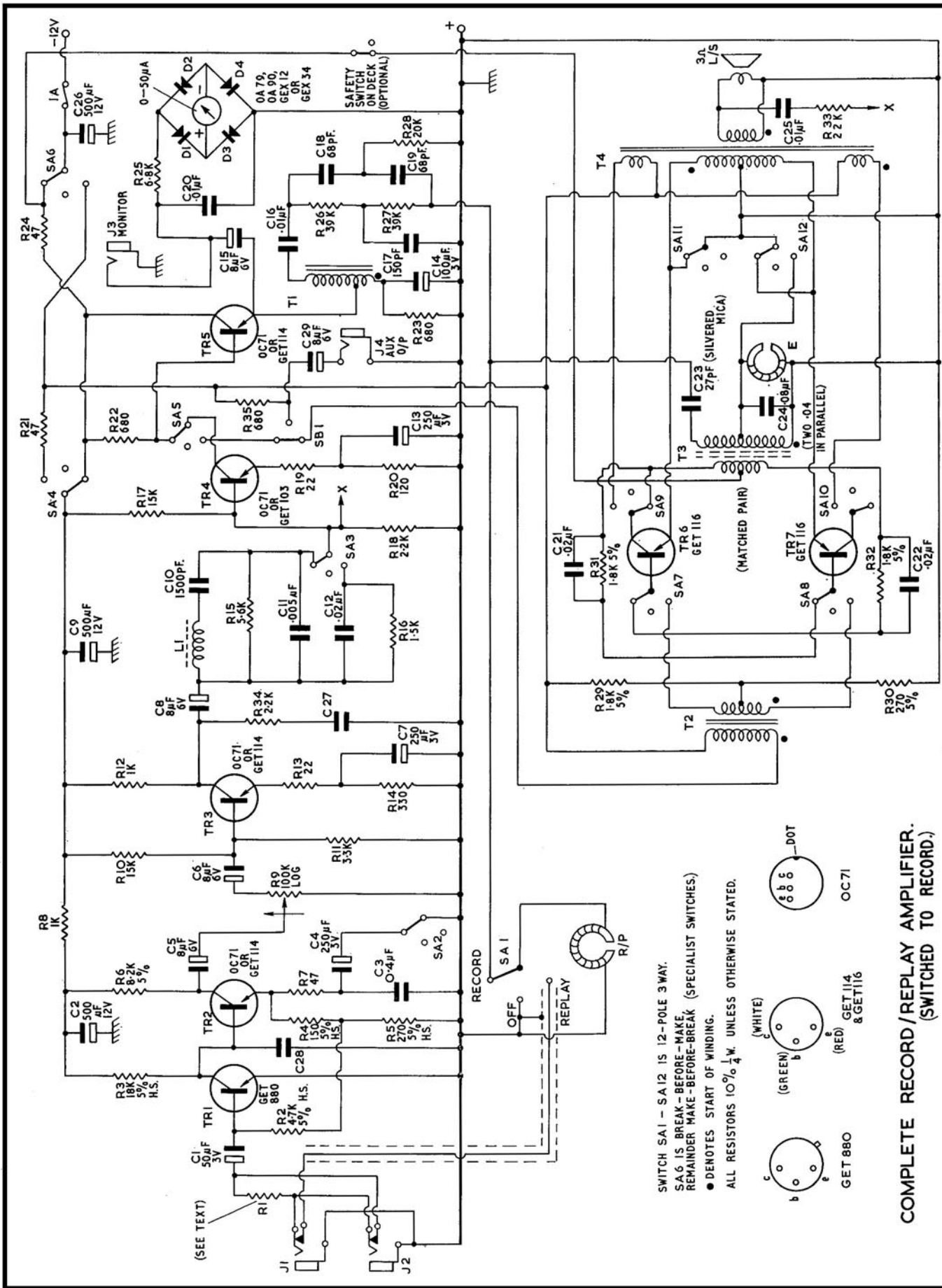
In order to maintain a high signal-to-noise ratio on the tape it is desirable to record at a level such that transients may exceed this arbitrary peak recording value. Therefore the amplifier should be capable of handling signals somewhat in excess of the normal peak, because any overloading of the amplifier results in severe clipping of the waveform, whereas the tape distortion tends to increase in proportion to the signal level.

Treble-boost is required to overcome both head and tape losses, which are dependent not only on the HF bias current, but also on the head structure, the magnetic tape, and the degree of contact between the oxide coating and the head. With so many variables it is an advantage to use a simple LC resonant circuit that can be readily adjusted to give the desired response.

For optimum low-noise performance the major part of this boost is applied on record. This again requires that the amplifier be capable of handling signals in excess of the normal peak recording level so as to avoid severe distortion on transients.

Referring to fig. 1, which shows the amplifier switched to record, the first stage has an input resistance of 250 ohms, a signal level of 20µV at 1Kc/s being required for 60µA of recording current. This is adequate sensitivity for most domestic low-impedance microphones which can therefore be coupled directly into the amplifier. Higher input levels are accommodated by attenuating networks. For example,

(continued on page 269)



COMPLETE RECORD/REPLAY AMPLIFIER.
 (SWITCHED TO RECORD.)

FIG.1.

Here's something
really **NEW** in
tape recording:

CARTRIDGE LOADING

—exclusive feature of the brilliant new
PHILIPS BATTERY POCKET TAPE RECORDER

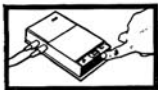
EL3300

Just check these revolutionary features:



The easiest tape system in the world—cartridge loading.

Forget about troublesome spools and tape threading—simply clip in the one-piece cartridge for instant use—get 30 minutes recording per side.



The simplest operation—controlled by one push-button.

Single control gives playback, record (with interlocking safety button), fast wind and fast re-wind. No drain on batteries except when recorder is actually operating.



The most versatile microphone—use it any one of three ways.

Sensitive, omni-directional "stick" type microphone can be held in hand, clipped in pocket or stood on plastic stand.



The most useful extra control—remote stop-start.

Remote control switch on microphone starts and stops recorder—detaches from microphone for separate use.



Battery operation for instant use—anywhere, any time.

Five small batteries last about 20 hours. Indicator needle shows recording modulation level and battery strength.



Real Leather carrying case—always ready for action.

Carrying case gives easy access to recorder controls. Tape is visible through special window. Case has space for accessory stowage.

The first really new tape recorder for years

25 gns COMPLETE

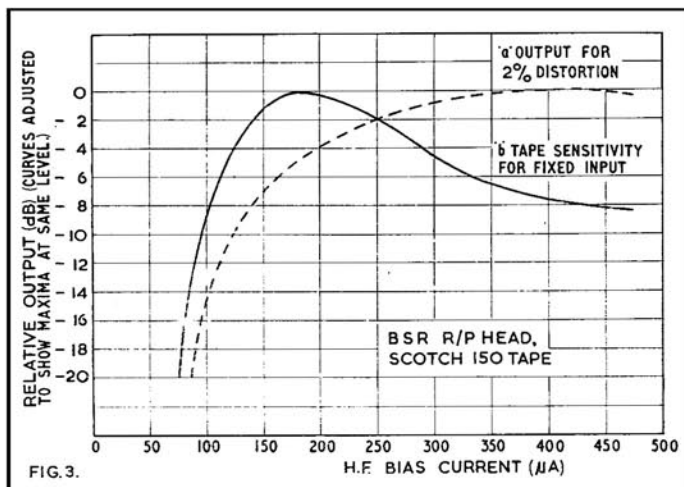
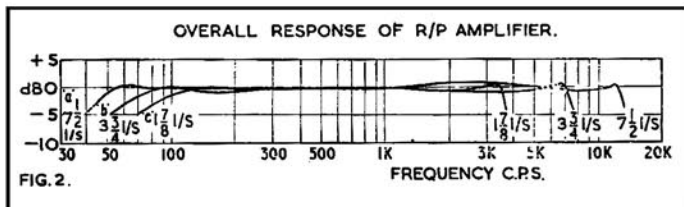


ANOTHER BRILLIANT DEVELOPMENT BY



PHILIPS — the friend of the family

(PTR0014B)



if R1 is 1 Meg., as may be necessary for loading a crystal pickup, an input of 80 mV will give the peak recording level. The signal applied to the base of the first transistor should not exceed 500μV (i.e. 2V into 1 Meg.) to avoid overloading the stage.

Treble-boost is provided by a series-tuned LC circuit between Tr.3 and Tr.4. The inductor L1 can be wound on any good-quality ferrite pot-core assembly that gives a high circuit Q together with good magnetic screening. The shunt resistor R.15 determines the amount of boost.

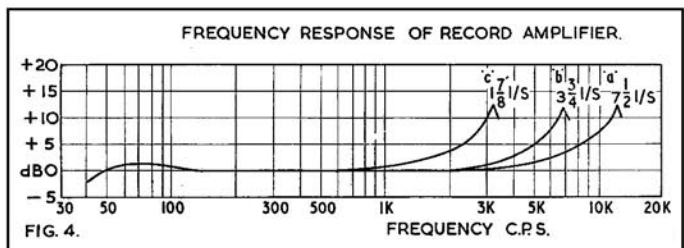
The fifth stage is an emitter-follower which provides excellent damping for the head transformer and makes the performance of the amplifier independent of the head characteristics and the monitoring and recording level indicator circuits.

The maximum signal available at the emitter of Tr. 5 is about 3.5V RMS. The transformer has a turns ratio of 1 : 8, hence the maximum output voltage is about 28V RMS. The head is connected to the transformer via a twin-T filter which provides the constant current source and also reduces the amount of HF bias circulating in the amplifier. The AF impedance of the filter is 80K, so that the maximum recording current available before clipping occurs is about 300μA. A signal voltage of 5V RMS across T.1 secondary corresponds to the 60μA level. The total harmonic distortion of the amplifier is typically less than 0.2% at this level, and less than 3% at maximum output.

The frequency response of the amplifier, measured at T.1 secondary, is shown in fig. 4 (b').

One problem arising in the design of a transistor tape-recorder is the provision of an efficient erase system. The erase power should be sufficient to saturate the tape so that over-modulated tapes may be adequately cleaned.

Generally, from 1 to 3W of erase power and 20 to 50mV of bias power are needed, depending on the heads, the oscillator frequency and the tape coercivity. For audio equipment the oscillator frequency



is usually between 30 and 100Kc/s, requiring a medium-power transistor with a cut-off frequency of about 1 Mc/s.

The oscillator shown in fig. 1 uses two matched GET 116 transistors (Tr.6 and Tr.7) in a class-B push-pull arrangement. The power delivered to the load is about 2W at 60 Kc/s and is substantially independent of both transistor current gain and ambient temperature variations.

The DC operating bias and positive feedback to the transistors are maintained by two identical RC networks R.31/C.21 and R.32/C.22. The tuned transformer T.3 is wound on a high-efficiency ferrite pot-core assembly, the turns ratio reflecting a load of 30 ohms to each collector. The circuit is tuned by C.24, the value of which is determined by the type of erase head used, the Q of the transformer and the loading of the HF bias circuit. The output terminals of the oscillator should not be short-circuited during operation since this would give rise to a very large collector current and damage the transistors. In practice it is advisable to include a fuse in the DC supply line as a protection against a shorted load.

Next month we shall continue this discussion on the oscillator circuit, consider the playback amplifier performance, and go on to constructional and testing aspects and power supply.

TOWARDS BETTER TAPING — CONTINUED

are very much related. Flatness of response costs more than sensitivity, and if both are wanted, then it is usually necessary to employ a microphone of low sensitivity and flat response and boost the signal prior to its application to the tape recorder input.

The crystal microphone is probably one of the most sensitive, though not necessarily of flat response. The ceramic microphone has a smaller sensitivity and, in some cases, a better response than the crystal. Dynamic (moving-coil) microphones usually have an even smaller output or sensitivity, and many of the more expensive versions boast an excellent response. The sensitivity of the variable-reluctance type is about the same as, or a little above, the sensitivity of the moving-coil. Ribbon or velocity microphones have a very small sensitivity though very good response characteristics. The condenser microphone has probably the smallest sensitivity of all, and in studio versions a head or pre-amplifier is required to step up the small signal voltage to a usable level, while at the same time dropping the impedance so that the signal may be carried through a conventional lead to the equipment; but this type of microphone can hardly be considered in isolation from its pre-amplifier. However, the condenser type has extremely good frequency characteristics and remarkable treble response. Indeed, it can be designed to respond to frequencies above hearing (supersonic).

We now come back again to impedance. In the high impedance family we have the crystal, ceramic and condenser microphones, while in the low impedance counterpart we have the variable reluctance (also available in high and medium impedance versions), the dynamic and the ribbon microphones.

Many amateur tape recordists have been very disappointed with the results on connecting a relatively costly microphone in place of the inexpensive one supplied with the recorder. In many cases examined by the author, poor quality and low output have been caused by the use of a microphone of too low a sensitivity and of incorrect impedance.

As we have seen, the better the frequency response of a microphone, the lower its sensitivity (generally speaking). This often means that by connecting such a microphone to a tape recorder which is designed essentially to take a signal from a high output crystal microphone sufficient pick-up is not possible even with the RECORD LEVEL control set to maximum. The trouble here is often aggravated by the new microphone being of medium or low impedance and the tape recorder input being of high impedance to suit the crystal microphone with which the recorder was supplied.

The solution to such a problem lies in the use of a low-to-high impedance matching transformer between the microphone and the recorder input with, where necessary, a pre-amplifier interposed in the circuit to boost the signal. Alternatively, a transistor booster/matcher (e.g., transistorized 'coupler') can be used between the microphone and the tape recorder input. The three conditions are illustrated at (a), (b) and (c) in fig. 2, and we shall return to this next month before going on to mixers and polar diagrams.

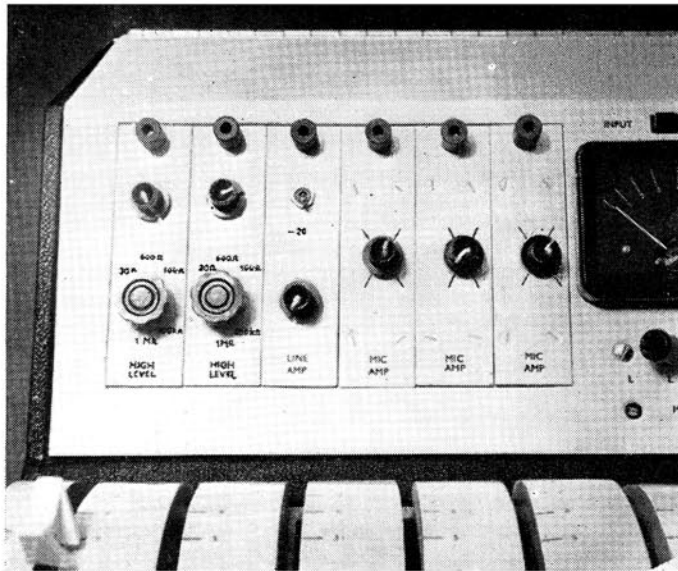


Fig. 1. The module amplifier rack.

BY now keen readers will have built the power supply and framework of the mixer, so this month's article makes a start on the electronics. The main path of the signal, from microphone input to tape recorder output, will be described, leaving the monitoring circuits and programme meters for next month. All the circuits are fully transistorised, and this enables full use to be made of small block circuits, and in particular the use of plug-in modules for matching the mixer to different sources. Three such modules will be described, although there is almost no limit to the number that can be conceived for other applications.

The modules are identical in overall dimensions, and differ externally only in the front panel. Fig. 1 shows the appearance of a nest of amplifiers; the dimensions are given in fig. 2. The units are made from one strip, 15/16in. wide, which is bolted to the 1 1/16in. front panel. The rear

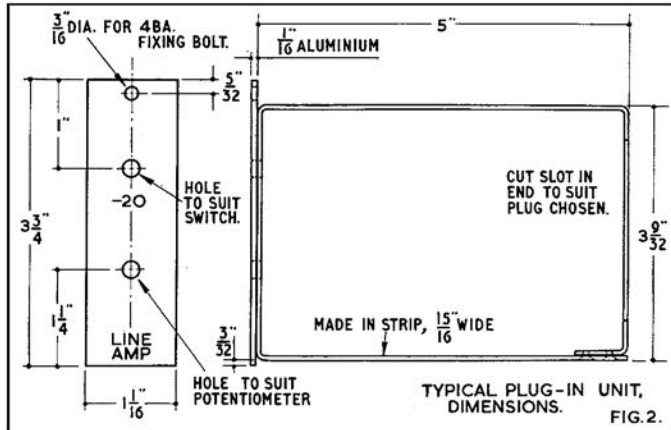
is cut to take the multiway plug chosen. Details are given for the line amplifier, and in this case the front panel can be held neatly to the chassis by the fixing nuts of the two controls. Units with one or no controls will use nuts and bolts for this purpose. Some care should be taken on the construction of the chassis, since the ease with which the units can be plugged in and out will depend on the accuracy.

The actual components are mounted on Paxolin board, which is held in position by bolting it to the bottom of four aluminium pillars which are in turn fastened to the chassis frame. A metal plate is then bolted to the top of the pillars to provide shielding between units, and to protect the components when the unit is removed from the mixer. The photograph, fig. 3, shows the completed unit with this metal top-plate removed.

The first circuit requirement was for an amplifier which would accept an input signal of zero level, or 775 mV, for use in matching to a programme line or standard sound distribution system. The input must be balanced and isolated from earth, which means a transformer has to be used. If the amplifier can be designed to accept a slightly smaller signal as well, it can be used for high-output microphones such as the capacitor variety which usually have a built-in pre-amplifier to match the capsule and to raise the very low output signal-level to something more manageable. Fig. 4 shows the feedback amplifier that was designed to accept a signal of +2 dB without distortion in the maximum gain position, and +22 dB in the normal or line position.

The input can be either 60 or 600 ohms, selected by a switch at the rear of the mixer, and is balanced to earth by the capacitance in the windings; the input sockets are arranged so that if an unbalanced line is used, one side is automatically earthed. The secondary of the transformer passes either direct to the base of the first transistor or

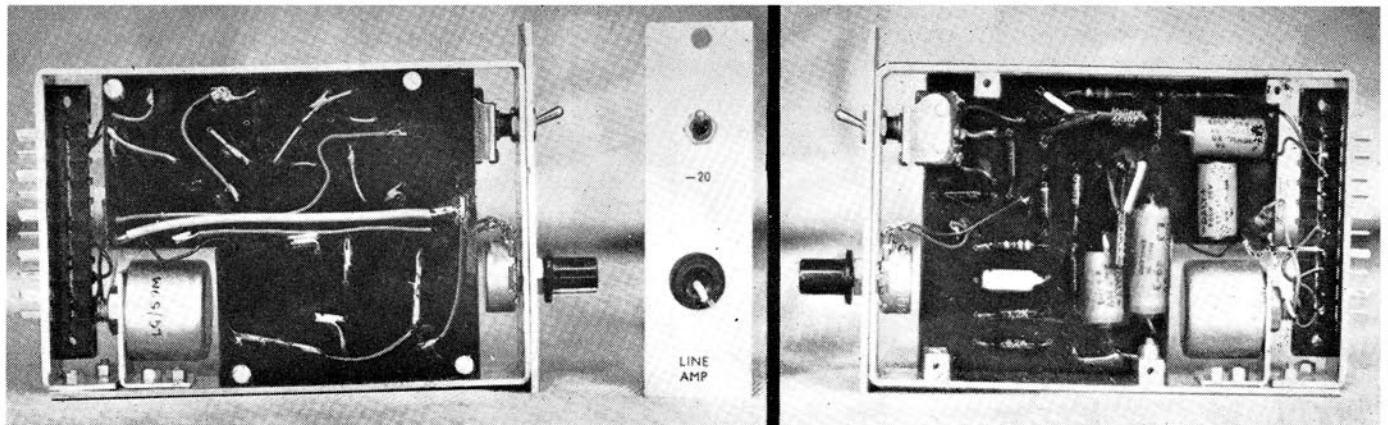
A STUDIO QUALITY MIXER



via a 10:1 attenuator, and is amplified in the first stage which has some local feedback from the uncoupled part of the emitter resistor. The first transistor should be of the low-noise type, such as the AC107 or GET106, for best results. Tr.2 forms another amplifying stage, again with some local feedback, and with a 'bootstrap' input arrangement to raise the overall gain of the amplifier before loop feedback is applied. The junction of R10 and 11 is a suitable point from which to stabilise the DC conditions, and C5 is added to decouple the chain.

The AC output is taken from the collector of the second transistor, and at the same time variable feedback is applied to the first stage by C2 and VR1, which raises the input impedance so that the transformer is correctly loaded by R1 and R2 only. VR1 appears as a front panel control, and is used to preset roughly the amount of gain required so that the quadrant faders, which are the main controls per channel, are

Fig. 3. (below). Three views of the completed input amplifier modules showing Paxolin mounting boards, and "poor man's printed circuit".



all approximately in the same position ; this makes for easier mixing.

The prototype circuit was constructed on Paxolin board, drilled to take the component wires which were then bent over to form the wiring on the other sides. This forms a neat reliable assembly—a 'poor man's printed circuit'. However, the design is very suitable for full printing, and fig. 5 shows the two sides of such a board. There are kits on the market for making printed circuits, and one of these would be suitable for this circuit and the others to be described.

The most important amplifier in the complete mixer is undoubtedly that for the microphone. This has to accept in one extreme a very low signal from a quiet passage in a recording, and provide an amplified signal without significantly increasing the noise level, and at other times it must be capable of accepting a large signal without overloading. The design of such a stage is difficult and is not to be undertaken without much time for experiment. The circuit shown in fig. 6 is one solution, which has been developed by the Designs Department of the BBC ; the author is indebted to the Corporation for their permission to publish the circuit and its details. At the time of writing it represents one of the best microphone amplifiers in production, and is fully described, together with the theoretical and practical considerations which lead to the final design, in the BBC *Engineering Monograph No. 46* (The Application of Transistors to Sound Broadcasting), which also includes several other interesting circuits ; this is a most useful publication for the audio engineer.

The noise figure for the amplifier is typically 3 dB, which means that the noise at the output terminals is 3 dB greater than, or about 1.4 times, the noise from the thermal movement of electrons (Johnson noise) in a resistor of the same value as the input impedance, followed by a noiseless amplifier of the same gain ; or put another way, this is an excellent amplifier ! This noise figure is better than most existing valve circuits. For a 600 ohm resistor the inherent noise is about

A STUDIO QUALITY MIXER

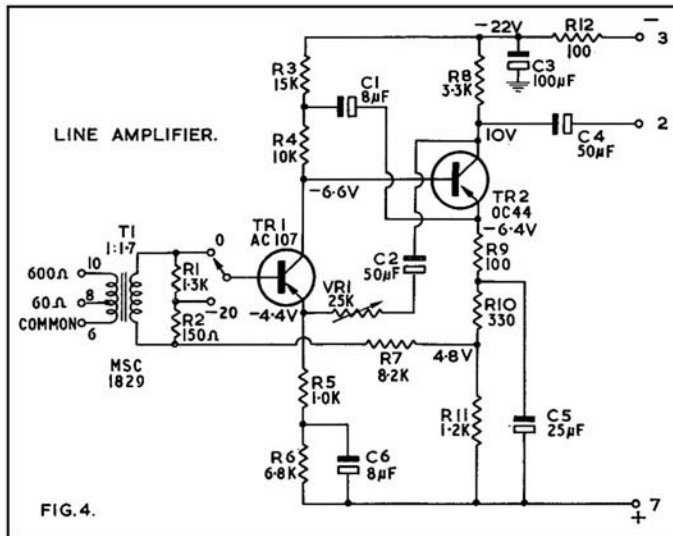
BY D. P. ROBINSON PART 3

THE INPUT AMPLIFIERS

0.5 mV, or -127 dB ; the amplifier makes this appear as -124 dB, which means that extremely small signals from microphones can be handled successfully.

At the other end of the scale, an input level of -25 dB can be accepted before the onset of serious distortion, and this represents a very loud noise for most microphones, almost at the threshold of pain. For louder situations a pad can be used on the input, or the line amplifier used, if by then the microphone output itself is still undistorted. Such a situation has not yet arisen with the prototype, but it is theoretically possible !

The amplifier input is transformer-fed to provide both a balanced input and also facilities for 600 or 60 ohm microphones, the two

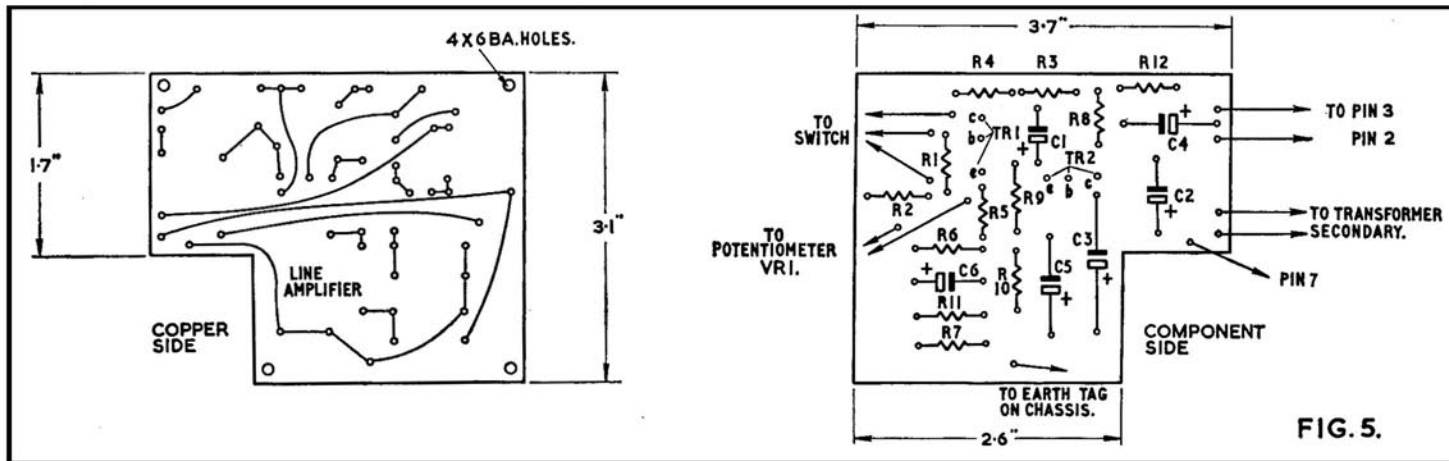


commonest types met in high quality work. Other types will require a different input transformer. Two transistors are used in a feedback amplifier with both DC and AC feedback for stability and to determine correctly the input impedance which is essential for low-noise operation. The first transistor is set at the optimum collector-emitter voltage, and collector current, and is DC-coupled into the next stage. The emitter of the second transistor is in a long chain of resistances which are used in the feedback circuits. R11 is in the DC path, and the AC feedback is both shunt (R1, C2) and series (C4). The transformer is included in the loop ; it is manufactured by Fortiphone Ltd., type No. MSC 1829, and is the same type as is used in the line amplifier described earlier.

The output from this stage passes to a variable 30 dB attenuator which is mounted on the front panel, and then to an output stage which has a controlled gain of some 17 dB with feedback from the uncoupled part of the emitter resistance. The output is taken from the collector and passes eventually to the channel fader in the rack at the front of the mixer.

The remaining plug-in module to be described at present is the high input impedance stage. The main use of this is to match to the output from valve equipment such as tape recorders and pre-amplifiers. It can also be used to match to crystal pickups if necessary, but this is not recommended since the input impedance is only 1.5 Meg., which means there will be a loss of 6 dB at about 60 c/s with the average cartridge. This may or may not be a disadvantage ; the author has recently been engaged in copying old 78 rpm records on to tape, and the low frequency cut-off was a help in removing the large amount of rumble and hum on the originals.

The circuit, shown in fig. 7, is conventional, and is basically a two-stage cascaded emitter-follower. Without extra feedback this gives an input impedance of just under a megohm at low frequencies ; the bootstrap arrangement with C3 raises this to 1.5 M, but only at low frequencies (continued overleaf)



STUDIO QUALITY MIXER—CONTINUED

frequencies where the capacitive effects in the transistor are not important. To maintain the impedance throughout the audio band collector feedback is used with R7 and C2. The front panel control is used to switch in a range of matching resistors so that if the source contains an output transformer of some sort (which must be correctly matched to obtain the correct frequency response) the right terminating resistance can be added simply. Most of the time this facility is not

Also in this diagram are the connections that must be made in order to provide full echo facilities in the mixer. A separate volume control, labelled 'echo mixture', is used to take a fraction of the output signal of each plug-in unit, after it has passed through the main channel gain control. This is passed to a mixing stage, identical with that used in the normal channel (to be described next month), where it is mixed with signals from all the other channels in any desired proportions. This output is then passed from the mixer to an external echo machine.

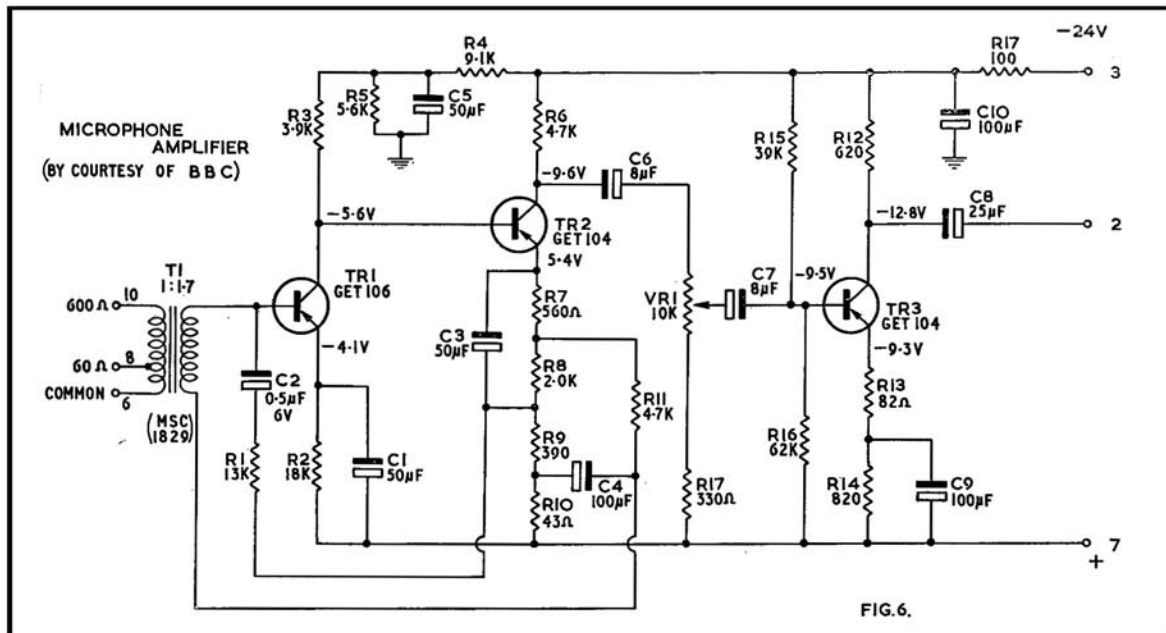


FIG. 6.

used, but it is worth including for that one most important time. The input is taken to a different pin from those used for the transformer stages, and does not pass through the phase-reversal switch, since it would then be possible to short out the input signal in one position of this switch. Fig. 8 shows this wiring in more detail; it is also shown in the block diagram which appeared in the first article in this series. Fig. 8 also shows the connections for the 'pan' control; the prototype has this feature on two channels. By this method a soloist or injection microphone can be positioned electrically to appear anywhere on the stage, or made to move around for special effects. VR1 is a double potentiometer, one half with the usual log-law, and the other antilog. These must be wired in reverse to achieve the correct characteristic, which is that moving the control from the central position should decrease the amplitude of the signal to one channel while leaving the other output substantially constant. This produces a very smooth and accurate positioning control.

This can be of any type commercially available, such as the metal plate, coiled spring or tape machine. If a quiet reverberant room is available this makes an excellent echo chamber. The output from the device is returned and fed into the main channel faders with the other sources. Echo is shown in mono only; for stereo the system is similar, but the second side of S11 (2p co) is used to switch the echo feed to two separate echo mixers in an identical manner as the main signal is switched.

A few key pieces of information were omitted from last month's description of the power supply: mains transformer is type MTA3, diodes for the main bridge are type XU612, and, most important, the OC 28 transistor must be mounted on at least 6 sq. in. of aluminium. All these components are obtainable from Henry's Radio. Part 4 will commence with details of the common mixer amplifier.

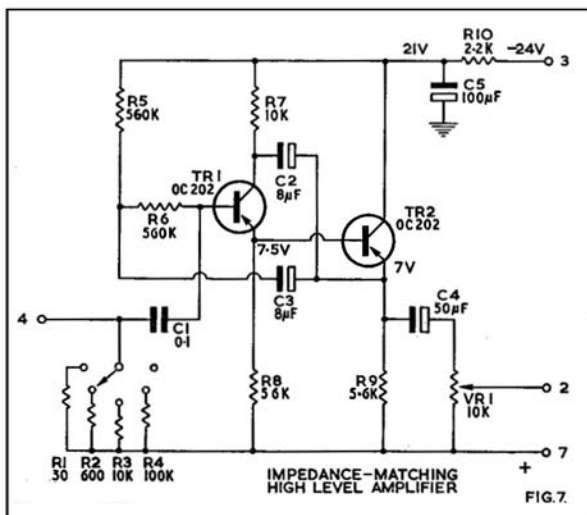


FIG. 7.

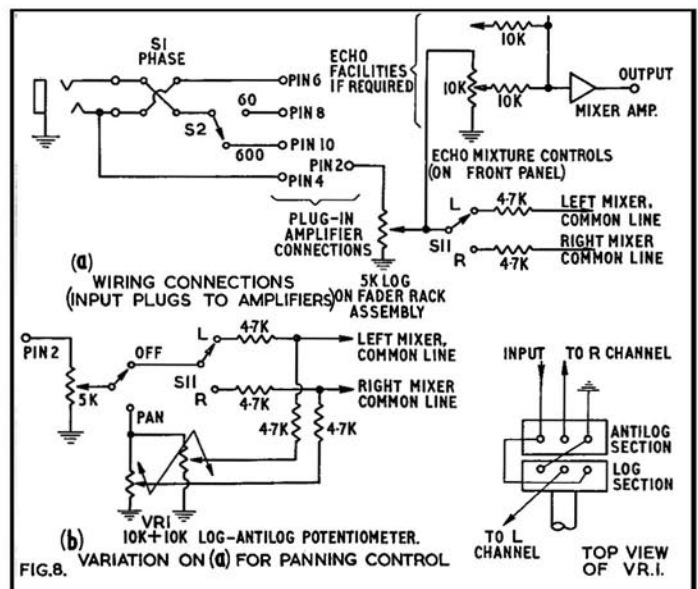


FIG. 8.

book reviews

MAGNETIC TAPE RECORDING. By H. G. M. Spratt, 382 pages, 203 illustrations. Price 63s. Published by *Temple Press Books Ltd.*, 42 Russell Square, London, W.C.1.

THIS second edition of what is now a standard book on tape recording will gladden the hearts of those whose first (like mine) is falling to pieces, and give many new readers, I hope, a clear, detailed, readable and commonsense insight into what a magnetic recording system contains, how it is put together and how it works.

After a short historical survey, the twelve main chapters cover: Principles of Magnetism, Sound Reproduction and Electro-Acoustics (short, this, and strictly relevant to the subject), Principles of Magnetic Recording, Tape Manufacture, Tape Testing, Tape Recording Machines, Recording and Reproducing Machines for Music and Speech, Testing of Machines, Applications of Magnetic Recording, Present Trends and New Developments and Recording Standardisation.

Parts of BS1568:1960, "Magnetic Tape Sound Recording and Reproduction", dealing with frequency characteristics and the dimensions of tapes and spools, are reproduced in one Appendix. Two others contain notes on "Abnormal Climatic Effects" and "The Basic Electrical Design of the Reproducing Head" respectively. Practical recording is not covered—it's not that kind of book. Nor will readers find any collected hints on keeping tape recorders in good condition, although the "Testing of Machines" chapter may open their eyes a bit; and the one on "Tape Testing", come to that.

What they will find is a comprehensive up-to-date and factual account of almost all functional aspects of magnetic recording, tape, heads, machines and applications, with the emphasis on audio techniques but with much interesting fringe stuff on new recording methods, TV recording, data storage, etc.

MUCH NEW MATERIAL

A lot of new material has been added in this edition, and some of the old rewritten and expanded, all with great attendance to detail and care to preserve the flow of the text and the logical arrangement.

In particular, the section on ferrites, heads, new recording methods, AC biasing, and the many references to transistor techniques, will interest those who like to keep abreast of developments in audio work. Severe critics of the tape manufacturers will perhaps think again when they meet statements like "... no controversy associated with magnetic recording is more baseless than the prejudice against the spliced reel"; or—"... the additional production cost of fitting them (leaders) is quite out of proportion... Their inclusion is a bane which no manufacturer will suffer gladly"; or when they read about the choice of materials and complicated production process necessary for a high-quality magnetic tape.

There are the odd mistakes, of course. For instance (pages 49 and 128) the lowest tape base thickness in common use is 0.0005 in. not 0.0007 in., and the coating thickness may have to be considerably less (on triple-play tape) than the 0.0003in. quoted as a minimum. Orientation of particles in the coating (page 143) should cause less than ½dB directional difference in sensitivity, not 2dB, and it is as necessary for the manufacturer to bulk-erase unoriented tape as oriented (page 150) before packing. Again, on my pet subject of level meters (page 232), no recordist would tolerate a recording channel in which the recording gain has to be set so that "the pointer just kicks perceptibly on loud passages".

But these are trivial things which most tape enthusiasts will recognise on sight and ignore because the text as a whole is so good. All the relatively small amount of mathematics is paraphrased, so that one can understand and enjoy the text fully without it, although in fact it's no more advanced than what one did in sixth forms (or *does*, if you're in one). A new clearer type-face on good paper makes for less tiring reading than in the first edition, and the layout, diagrams and photographs are excellent and to the point. The index is perhaps not as full as one might like for reference use, but it's an easy book to get to know and almost anything you can think of on the subject can be found quickly enough. I can unreservedly recommend 'Spratt' as the best buy of its kind available at the moment. G.C.B.

TAPE RECORDING AND HI-FI. By R. Douglas Brown, 159 pages, 8 line illustrations, 32 half-tones. Price 5s. Published by *Arco Publications*, 9 Grape Street, London, W.C.2. **TAPE RECORDING AND HI-FI.** By Frederick Oughton, 128 pages, 14 line illustrations, 23 half-tones. Price 5s. Published by *Collins Nutshell Books*, 144 Cathedral Street, Glasgow, C.4.

TWO books, written by different authors and produced by separate publishers, with identical titles. Good enough reason for a combined review!

Douglas Brown's book is far from new. First published as an Arco 'Handybook' in 1961, it was re-introduced recently as a paper-back. It is larger and thicker than Frederick Oughton's equivalent, of the same price, which was first published a couple of months ago.

Mr. Oughton's version begins poorly with a blatant misuse of 'Print-through', in the context of poor erasure of previous recordings. A rather jerky style of writing in these first few pages quickly gives way to descriptions of imaginative recording techniques. The chapter on "Candid and Tapespondence" is well written and contains much useful information.

The book is unpretentiously levelled at the complete tyro—so much, however, that a half-track recording is diagrammatically illustrated by three equidistant parallel lines. This is, perhaps, oversimplifying the relevant and interesting point of erase-scanning being wider than recorded tracks.

A possible source of confusion, frequently found in books of this nature, shows itself in a tape-length-playing-time chart. This is calculated for double-track playing times, although no such reference is given to that effect.

Pages 51 onwards concern themselves with hi-fi, though elementary information on the cleaning and servicing of recorders is given in the last chapter. The book closes with a postscript on copyright which is, in fact, out of date according to Mr. Brown's work published three years previously. Consequently much of the information given is misleading.

A prospective sound enthusiast reading Brown's 'Handybook' is thrown deep into a mono-stereo-cost debate in the first chapter. The author, perhaps unfairly, sides strongly with the "good-mono-rather-than-indifferent-stereo" sect, possibly at the expense of frightening his readers to the pursuance of another hobby.

Nevertheless, a much more factual and intelligent style is presented by the paper-back. Illustrations are clear though not drawn as if intended for moronic readers. Considerable emphasis is placed on the suitability of the tape recorder as a creative instrument, rather than an off-shoot of the hi-fi world, with interesting suggestions for do-it-yourself *musique concrète*. Mr. Oughton's book seems of doubtful value at any price. Mr. Brown's version gets my 5s.

D.K.

RADIO AND ELECTRONIC HOBBIES. By F. C. Judd, 159 pages, 8 line illustrations, 19 half-tones. Price £1 1s. Published by *Museum Press Ltd.*, 26 Old Brompton Road, London, S.W.7.

ALTHOUGH covering a very wide range of topics, this book should prove extremely interesting to the home-experimenter and constructor. Hi-fi, amateur radio and remote control of models, to name just three completely different subjects, are dealt with fully in a simple, practical way. Several fascinating circuits are shown, including a very simple oscilloscope and several audio signal generators. The latter form part of a comprehensive chapter on electronic music and *musique concrète*.

Twelve pages of text and line illustrations are given to un-diluted tape-recording, covering basic principles of tape-transport, tracking and microphone anatomy. Frequency correction is quite well covered, although the function of bias is only sparsely described.

The reader's enthusiasm is whetted by a short section on *Chromasonics*, a system of converting sound into vision. Considering this is a field in which Mr. Judd has made several original developments, much too little space is given.

Not ideally suited to the prospective recordist searching for information on his hobby, but highly recommended as a mine of information for the experimenter wishing to leave audio at a tangent.

D.K.



TA-IS

TAPE AMPLIFIER UNITS

Models TA-IM and TA-IS
The monophonic version (TA-IM) can be modified to the stereo version (TA-IS) by modification kit (TA-IC). Special features include the provision of a bias level control, easy-to-read thermometer-type recording level indicators; large printed circuit boards. Both models have identical presentation. TA-IM £19.18.0 kit TA-IS £25.10.0 kit TA-IC £6.15.0 kit TA-IM £28.18.0 Assembled TA-IS £35.18.0 Assembled



TRUVOX D93 TAPE DECKS

Standard. High-quality stereo tape decks. D93/2 4-track for highest fidelity £36.15.0 With TA-IM £52.18.0 With TA-IS £58.10.0

D93/4, 4-track, for most economical use of tape. £36.15.0. With TA-IS £58.10.0

TO ALL MUSIC LOVERS AND HI-FI ENTHUSIASTS

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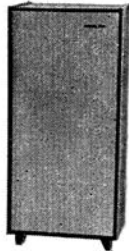


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For your convenience, this model is available in two units sold separately: Tuning Unit (FMT-4U—£2.15.0 including P.T.) with 10.7 Mc/s I.F. output, and Amplifier Unit (FMA-4U—£13.3.0). Built-in power supply; 7 valves. Total £15.18.0 kit



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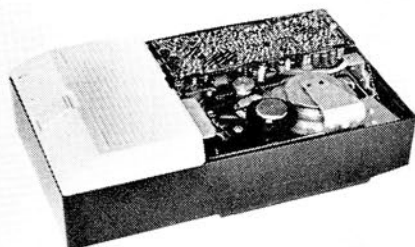
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A rear view of the 'works' showing printed circuitry and sizable capstan.



OF BATTERY PORTABLES

field trials

PHILIPS recently took a step into the unknown with the announcement of a battery portable recorder using cartridges in place of spools. Previous attempts to popularise the cartridge in this country have always failed, though this may have been due to poor promotion.

All relevant accessories are included in the cost price—a leather carrying-case, cartridge, microphone with battery on/off switch, and recording lead.

The recorder's minute size is camouflaged, to some extent, by the carrying-case, which also provides storage space for a few accessories. 'Pocket-size' is almost the word, although a raincoat pocket bulges visibly on the machine's intrusion.

Having purchased the batteries, five 1.5V leakproof cells giving some twenty hours playing time, they were inserted into the appropriate compartment, access to which is gained through a spring-loaded clip. Diagrammatic outlines of the cells, imprinted on leather battery cradles, ensure—in a foolproof manner—the correct combination of polarities.

My first attempts at serious recording took place in an empty railway carriage somewhere between Croydon and London Bridge. Microphone and remote on/off switch were extracted from the case and inserted into two DIN sockets. Plastic clips, thoughtfully included by the manufacturer, held the two leads together, preventing the awkward tangle that so often occurs at inconvenient moments.

A description of the surrounding scenery, spoken less than two inches from the microphone, was then begun. Background sounds were so loud that I could hardly hear myself speak, and would have been grateful for the provision of a headphone monitor-while-recording facility which, contrary to a remark by a Philips representative at the EL3300's press-demonstration, would not have required extensive and expensive modification to the case and layout. Only a small number of the two DIN socket pins are used on this machine and the 'modification' would be in the form of two wires taken from some convenient point in the recording amplifier to the pre-amp output socket.

As it happened, recording balance proved almost perfect on replay later in the evening. Over-sibilance was non-existent even though some of the recording had been made speaking directly at, and not across, the microphone diaphragm. Distortion, hiss and electrical

motor interference were entirely absent, hidden perhaps by the sound of the train.

Holding a microphone outside a carriage window is no way to record railway sounds, but the EL3300 reproduced wheel-clatter in this way without any noticeable wind effects whatsoever. Considering the speed of the train this was a very good performance.

The full range of notes taped from a piano showed up two faults in the reproducing system. Not surprisingly, considering the small size (2½in.) of the speaker, bass reproduction was lacking. Middle-range sounds, however, gave rise to considerable distortion caused by vibration of the plastic cabinet. In an attempt to eliminate this, everything from claspings the machine tightly between the hands to extracting various sections of the casing was tried, without much success. Wow and flutter were almost inaudible on playback of that most telling instrument, but when the machine was supported from the shoulders, rather than on a table, speed fluctuation became noticeable. Lurching railway trains could not prove damaging to speech, however.

Light music reproduced quite well through the internal speaker, although the cabinet vibration still proved slightly annoying; but on connection to an external amplifier and speaker, the results proved magnificent for such a slow speed, narrow track and low price. The piano recordings, played back in this fashion, also showed an impressive rise in quality. In this case bass reproduction was emphasised considerably more than the middle and high frequencies; this was corrected by moderate use of a tone control. With the absence of box vibration it was possible to discern just how clear the recordings were.

Sufficient voltage was obtainable from the pre-amp output to load fully the high-level input of a mains recorder, and I have no hesitation in recommending the EL3300 as an inexpensive 'second machine' for the dubbing of speech and light music.

Background hiss, although this is virtually a '¼-track' recorder, is, in common with motor noise, only very slightly louder than on the Philips EL3586. With the latter recorder (my own) on hand during

NUMBER TWO PHILIPS EL3300 BY DAVID KIRK

the Field Trial I spent long periods trying vainly to distinguish between the comparative qualities of the two machines. Unfortunately (from my point of view—but obviously not from the manufacturer's) I could find nothing to suggest any great difference in quality. Which brings me to the inevitable conclusion.

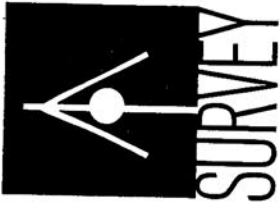
The EL3300 has one great advantage over the EL3586: it is little heavier than an average-sized camera—sufficiently light to forget that one is carrying it. After an unforgettable nightmare tour of Glasgow carrying 10lb. of EL3586 (made all the worse by the fact it was never used) there seems only one major reason for not selling it to buy an EL3300, the difference in quality being, as I said, hardly discernible. This reason lies in the latter machine's use of cartridges. I do not have a great collection of cartridges, whereas my stocks of tape (mainly un-used 'cheap' brands) have to be seen to be believed. A Philips cartridge retails at 19s. 6d. and gives sixty minutes playing time.

Perhaps the right line of approach to the cassette-spool problem is that put forward recently by a friend. He already owned a *Stella* version of the EL3586 but has decided to buy an EL3300, not to

(continued on page 286)

MANUFACTURER'S SPECIFICATION :

Speed : 1½ i/s ; **Wow and Flutter :** 1% peak-to-peak ; **Frequency Response :** 120 c/s to 6 Kc/s ±3dB ; **Playing Time :** One hour on cartridge-loading 3/20in. triple-play, ¼-track. **Microphone :** Moving-coil, fitted with clothing clasp, detachable table stand and remote on/off switch. **Dimensions :** Cabinet—7¾ x 4½ x 2½in. Carrying-case—8¾ x 6½ x 2½in. **Weight :** 4lb. including batteries. **Battery Complement :** Five 1.5V cells. **Signal-to-Noise :** 40dB. **Inputs :** Microphone : 0.3mV at 2K ; high level : 200mV at 2K with EL3768/03 connecting lead. **Output :** 0.5V at 20K from pre-amp. 250mW to 2½in. speaker. **Price :** £26 5s. **Manufacturer :** Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.2.



"WE recently checked a recorder," reads the *Nagra 3* Test Report, "which was accidentally dropped into the Amazon and suffered very little from its ducking." Considering the weight of the machine, over 20lb., it is surprising it was ever retrieved from the river-bed, though a charmed-life may well be included in the price—£317.

But are you in fact looking for a waterproof recorder? Probably this aspect of a specification will not hold a very wide interest—in which case you can expect to pay just a little less for its absence.



PHILIPS
EL3586

Similarly, if the machine is required for serious recording of tapes to be replayed elsewhere, look for the model with a monitor-only replay and a top quality recording system. This will generally indicate that a greater proportion of the cost price has been devoted to achieving something which is not already possible with your mains recorder.

Should the portable be required for entertainment where mains power supplies are not available, such equipment is also listed below. The *Stuzzi Disc-Corder*, despite its poorly chosen name, would compete very favourably with the most carefully-chosen of such combinations obtainable at £62.

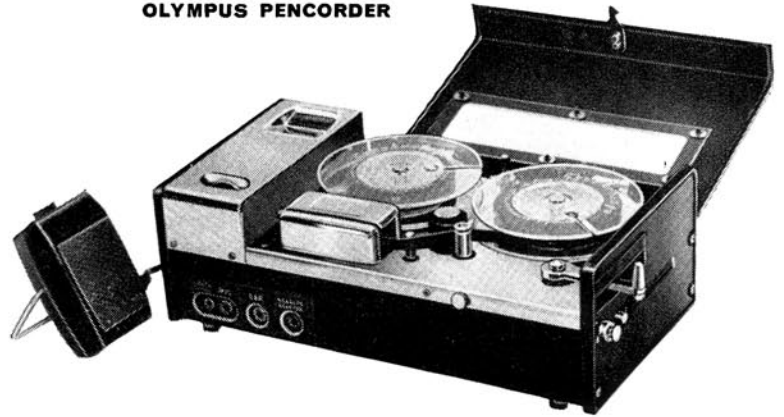
The *Uher 4000* range offers all 'mod. cons.', with the exception of the Light, Home and Third, for little over £100. Its performance, as illustrated in a fairly recent review, equals that of some even higher priced mains machines. Outdoor stereophonic recording facilities must surely be unique to this model.

Telefunken brought hi-fi replay quality to the battery field, as any visitor to their Audio Fair demonstrations will confirm. No such pretensions are made, however, by the *Philips EL3586* and its *Stella* and *Cossor* equivalents. Their straightforward facilities for good quality recording and quite reasonable monitoring are difficult to equal at £26 5s. It is not possible to include all battery-operated recording equipment in this survey, due, among other things, to the indefinable margin between recorder and dictaphone. The latter term is often applied to a poor quality tape recorder but, as in the case of the *Fi-Cord 101*, some dictaphones are so good that they become known as tape recorders.

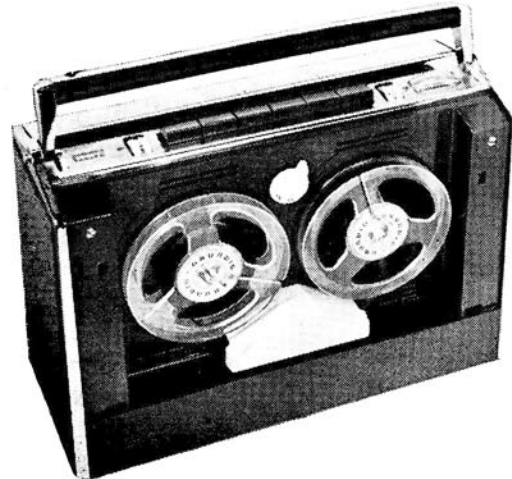
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COSSOR CR 1621. TAPE SPEED: $1\frac{7}{8}$ i/s. SPOOL CAPACITY: 4 $\frac{1}{2}$ in. BATTERY COMPLEMENT: Six 1.5V cells. BATTERY LIFE: 40 hours. FREQUENCY RESPONSE: 80 c/s to 8 Kc/s ± 3 dB. SIGNAL-TO-NOISE: 40dB. OUTPUT POWER: 500mW. LOUDSPEAKER: 4in. LEVEL INDICATOR Meter. WOW AND FLUTTER: 1% peak-to-peak. DIMENSIONS: 12 $\frac{1}{2}$ x 9 x 4 $\frac{1}{2}$ in. WEIGHT: 8lb. with batteries. MISCELLANEOUS: Fast Wind and Rewind. Tone Control. ACCESSORIES: Mains convertor. Remote

OLYMPUS PENCORDER

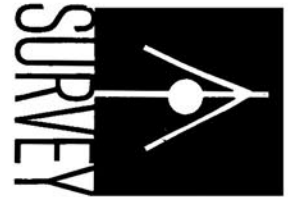


TELEFUNKEN
M300



GRUNDIG
TK6

**TRANCORDER
TR100**

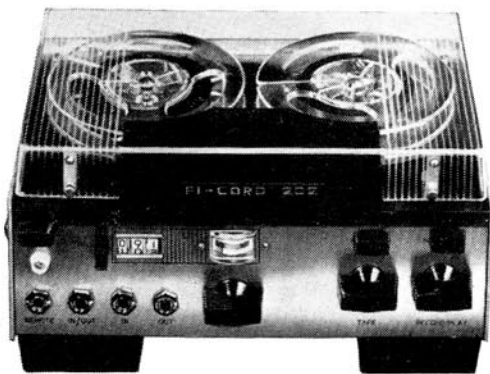


on/off switch. Shoulder-case. PRICE (including moving-coil microphone, tape and recording lead): £27 6s.

Manufacturer: Cossor Radio and Television Co. Ltd., 233 Tottenham Court Road, London, W.1.

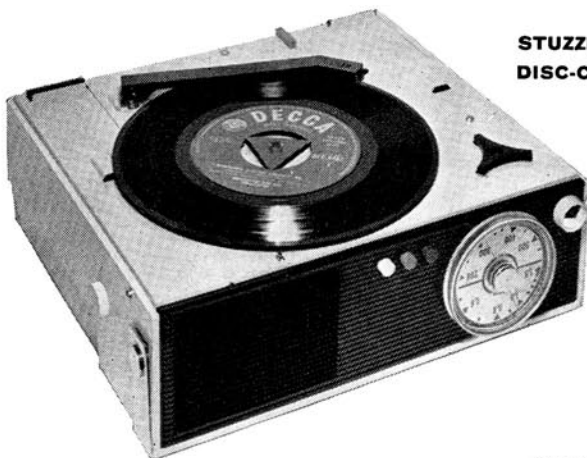
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DANSETTE CADET. TAPE SPEEDS: $3\frac{3}{8}$ and $1\frac{7}{8}$ i/s. SPOOL CAPACITY: 4½ in. BATTERY COMPLEMENT: Six 1.5V cells. LEVEL INDICATOR: Valve. WOW AND FLUTTER: 0.2%. DIMENSIONS: 11½ x 5½ x 12 in. WEIGHT: 10 lb. MISCELLANEOUS: Fast wind and rewind. Tone Control. Incon-



**FI-CORD 202
(LEFT)**

**Q-CORD 203
(RIGHT)**



**STUZZI
DISC-CORDER**

porating Garrard Battery Tape Deck. ACCESSORIES: Microphone, recording lead and tape—supplied. PRICE: £27 6s.

Manufacturer: Dansette Products Ltd., 112-116 Old Street, London, E.C.1.

● Field Trial: June 1964.

* * *

EMI RE 321. TAPE SPEED: $7\frac{1}{2}$ i/s. SPOOL CAPACITY: 5 in. BATTERY COMPLEMENT: Eight 1.5V cells. FREQUENCY RESPONSE: 60 c/s to 10 Kc/s to CCIR recording characteristic. SIGNAL-TO-NOISE: 44dB unweighted. OUTPUT: Phones/Line, max +8dBm. LEVEL INDICATOR: Meter. WOW AND FLUTTER: 0.25% RMS. DIMENSIONS: 14½ x 8 x 16½ in. WEIGHT: 17½ lb. MISCELLANEOUS: Full-track recording and playback (70mW through monitor speaker). PRICE £124.

Manufacturer: EMI Electronics Ltd., Hayes, Middlesex.

● Review: November 1961.

* * *

FI-CORD 101. TAPE SPEED: $1\frac{3}{8}$ i/s. SPOOL CAPACITY: 3 in. BATTERY COMPLEMENT: Two Mallory ZM9. BATTERY LIFE: 20 hours. DIMENSIONS: 6½ x 3½ x 1½ in. WEIGHT: 1lb. 11oz. MISCELLANEOUS: Automatic Volume Control. Fast forward and rewind. ACCESSORIES: Stethoscope Earphones, Electronic Foot Switch, Transcribing Amplifier, Case, etc. PRICE £55 13s.

Manufacturers: Fi-Cord International, 40a Dover Street, London, W.1.

**OPTACORD
414**

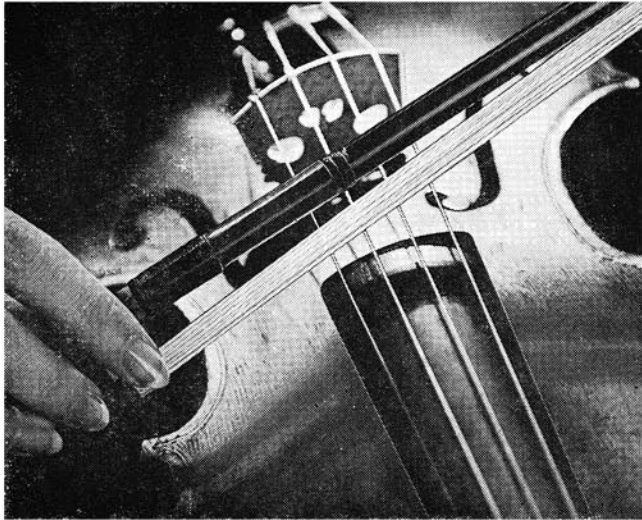


FI-CORD 202. TAPE SPEEDS: $7\frac{1}{2}$ and $3\frac{3}{8}$ i/s. SPOOL CAPACITY: 4½ in. BATTERY COMPLEMENT: Mercury Cells. BATTERY LIFE: Motors—20 hours at $7\frac{1}{2}$ and 30 hours at $3\frac{3}{8}$ i/s. Electronic—60 hours. FREQUENCY RESPONSE: 50 c/s to 12 Kc/s ±3dB. LEVEL INDICATOR: Meter. WOW AND FLUTTER: 0.3% RMS. DIMENSIONS: 9 x 6½ x 4½ in. WEIGHT: 6½ lb. with batteries. MISCELLANEOUS: Fast wind and rewind. Remote control socket. ACCESSORIES: Carrying case, mains unit, rechargeable batteries. PRICE (with tape and batteries): £69 6s.

Manufacturer: As above.

(continued on page 279)

IN A WORLD OF SOUND



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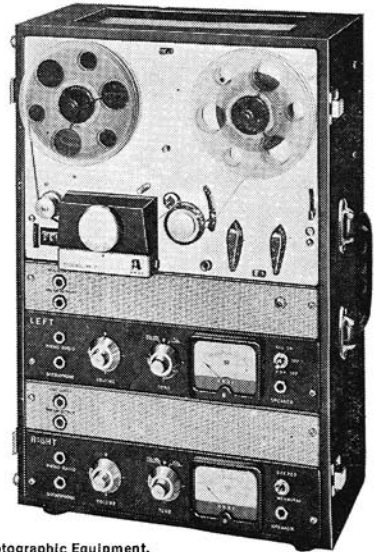
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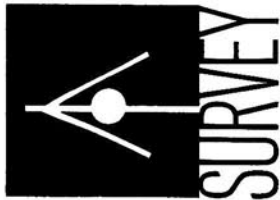
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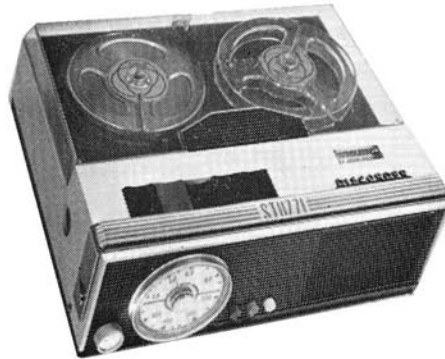
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Top : Nagra III B. Below (centre) : Stuzzi Disc-Corder. Bottom Left : Uher 4000. Bottom Right : EMI RE321.



SURVEY OF BATTERY PORTABLES — CONTINUED

GRUNDIG TK6. TAPE SPEED: $3\frac{3}{4}$ and $1\frac{7}{8}$ i/s. SPOOL CAPACITY: 4½ in. BATTERY COMPLEMENT: Six 1.5V cells and mains. BATTERY LIFE: 20 hours. FREQUENCY RANGE: 50c/s to 13Kc/s. LEVEL INDICATOR: Meter. WOW AND FLUTTER: $\pm 0.2\%$. DIMENSIONS: $12\frac{1}{4} \times 9\frac{1}{2} \times 5\frac{1}{4}$ in. WEIGHT: 13½ lb.

Price: £68 5s.

Manufacturer: Grundig (Great Britain) Ltd., Newlands Park, Sydenham, London, S.E.26.

● Review: May 1964.

* * *

HITACHI TRQ399. TAPE SPEEDS: $3\frac{3}{4}$ and $1\frac{7}{8}$ i/s. SPOOL CAPACITY: 3 in. BATTERY COMPLEMENT: Four 1.5V cells. BATTERY LIFE: 15 hours. FREQUENCY RANGE: 150 c/s to 7 Kc/s. OUTPUT POWER: 500mW. LOUDSPEAKER SIZE: 4 x 2½ in. elliptical. DIMENSIONS: $8\frac{3}{8} \times 3\frac{3}{8} \times 6\frac{1}{2}$ in. WEIGHT: 4½ lb. LEVEL INDICATOR: Meter. MISCELLANEOUS: Supplied with leather case, tape, moving-coil microphone, earpiece, splicing tape, recording leads and polishing cloth. ACCESSORIES: AC Adapter, price 6 gns. PRICE: £36 5s.

Distributor: Lee Products (G.B.) Ltd., 10-18 Clifton Street, London, E.C.2.

* * *

LOEWA-OPTA 414. TAPE SPEED: $3\frac{3}{4}$ i/s. SPOOL CAPACITY 9 4½ in. POWER SUPPLY: AC 40 to 60c/s, 110 to 220V. 6V car battery. Five 1.5V cells. BATTERY LIFE: 20 hours. FREQUENCY RANGE: 50 c/s to 10 Kc/s. SIGNAL-TO-NOISE: 45dB. OUTPUT POWER: 1W. LOUDSPEAKER: 3 x 6 in. elliptical. LEVEL INDICATOR: Meter. WOW AND FLUTTER: 0.13% RMS. DIMENSIONS: $15\frac{1}{2} \times 9\frac{1}{4} \times 4\frac{1}{2}$ in. WEIGHT: 9lb. MISCELLANEOUS: Fast wind and rewind. Accessories. Choice of microphones. PRICE: £49 7s.

Distributor: Highgate Acoustics, 71-73 Portland Street, London, W.1.

● Review: June 1963.

* * *

NAGRA 111B. TAPE SPEEDS: 15, $7\frac{1}{2}$ and $3\frac{3}{4}$ i/s. SPOOL CAPACITY: 7 in. BATTERY COMPLEMENT: Twelve 1.5V cells. BATTERY LIFE: 20 hours. (70 hours with alkaline accumulators). FREQUENCY Response: 40 c/s to 18 Kc/s ± 1.5 dB. SIGNAL-TO-NOISE: 51dB at 15 i/s. LEVEL INDICATOR: Meter. WOW AND FLUTTER: 0.08 RMS. DIMENSIONS: $8\frac{3}{4} \times 12\frac{1}{2} \times 4\frac{1}{2}$ in. WEIGHT: 20lb. 12oz. including batteries. MISCELLANEOUS: Optional automatic volume control, separate record, replay and erase heads, servo-operated direct-drive motor. Remote control. Stroboscopic speed indicator. Three-channel

mixing. ACCESSORIES: Various. PRICE: £317 including duty. Distributor: Livingstone Laboratories Ltd., 31 Camden Road, London, N.W.1.

● Review: September 1963.

NAGRA 111P. Details as for 111B, but an additional head for film lip-synchronisation. PRICE: £361 including duty.

Distributor: As above.

* * *

OLYMPUS PENCORDER F. TAPE SPEEDS: $3\frac{3}{4}$ and $1\frac{7}{8}$ i/s. SPOOL CAPACITY: 3½ in. BATTERY COMPLEMENT: Six 1.5V cells. BATTERY LIFE: 12 hours. FREQUENCY RANGE: 200 c/s to 5 Kc/s. SIGNAL-TO-NOISE: 35dB. OUTPUT POWER: 200mW. LOUDSPEAKER: 4 in. elliptical. LEVEL INDICATOR: Meter. DIMENSIONS: $5\frac{1}{2} \times 9\frac{3}{8} \times 3\frac{1}{2}$ in. MISCELLANEOUS: Remote on/off switch on microphone. Fast wind and rewind. ACCESSORIES: Leather case (£3 3s.) PRICE (including microphone, earphone, tape and recording lead): £35 14s.

Distributor: Pullin Optical Co. Ltd., Ellis House, Aintree Road, Perivale, Greenford, Middlesex.

* * *

PHILIPS EL3300: TAPE SPEED: $1\frac{7}{8}$ i/s. BATTERY COMPLEMENT: Five 1.5V cells. BATTERY LIFE: 20 hours. FREQUENCY RESPONSE: 120 c/s to 6 Kc/s ± 3 dB. SIGNAL-TO-NOISE: 40dB. OUTPUT POWER: 250mW. LOUDSPEAKER: 2½ in. LEVEL INDICATOR: Meter. WOW AND FLUTTER: 1% peak-to-peak. DIMENSIONS: $7\frac{1}{8} \times 4\frac{1}{2} \times 2\frac{1}{2}$ in. MISCELLANEOUS: Cartridges of 3/20 in. triple-play tape in place of spools. ACCESSORIES: Mains unit, headphones. PRICE: (including moving-coil microphone, cartridge, and remote on/off switch): £26 5s.

Manufacturer: Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.1.

● Field Trial on page 275.

PHILIPS EL3586. TAPE SPEED: $1\frac{7}{8}$ i/s. SPOOL CAPACITY: 4½ in. BATTERY COMPLEMENT: Six 1.5V cells. BATTERY LIFE: 40 hours. FREQUENCY RESPONSE: 80 c/s to 8 Kc/s ± 3 dB. SIGNAL-TO-NOISE: 1% peak-to-peak. DIMENSIONS: $11\frac{1}{8} \times 7\frac{1}{8} \times 3\frac{3}{8}$ in. WEIGHT: 8lb. with batteries. MISCELLANEOUS: Fast wind and rewind. Tone control. ACCESSORIES: Mains convertor, remote on/off switch, shoulder case. PRICE: £25 6s.

Manufacturer: As above.

* * *

Q-CORD R.119K. TAPE SPEED: $3\frac{3}{4}$ i/s. SPOOL CAPACITY: 4½ in. BATTERY COMPLEMENT: Four 1.5V cells. FREQUENCY RANGE: 60 c/s to 10 Kc/s. LEVEL INDICATOR: DM70 valve. WOW AND FLUTTER: 0.50%. DIMENSIONS: $9\frac{1}{4} \times 4 \times 9\frac{1}{2}$ ins. WEIGHT: 6lb. including batteries.

(continued on page 281)

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Telefunken 85 ...	8 15 0	6 10 8	83
Grundig TK 41 ...	8 0 0	5 17 11	75
Brenell 5/2 (Meter) ...	7 15 6	5 16 7	74
Brenell 5/2 ...	7 5 0	5 8 8	69
Truvox 92 ...	7 5 0	5 8 8	69
Reps R10 Mk. 2 ...	6 4 0	4 12 11	59
Telefunken 95 ...	6 4 0	4 12 11	59
Grundig TK 18 ...	4 2 0	3 1 5	39
Grundig TK 14 ...	3 13 6	2 15 2	35
Wyndor Trident ...	3 10 0	2 11 11	33
Ferguson 3206 ...	2 16 6	2 0 10	26

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MAINS 4-TRACK			
Grundig TK 40 ...	8 19 0	6 3 4	79
Reps R10 Mk. 2 ...	7 5 0	5 8 8	69
Truvox R94 ...	7 5 0	5 8 8	69
Philips EL3549 ...	6 12 0	4 17 6	62
Grundig TK 23 ...	4 15 0	3 10 10	45
Philips EL3541/H ...	4 12 0	3 5 10	42
Elizabethan LZ29 ...	4 0 0	2 19 10	38
Philips EL3541 ...	3 15 8	2 16 9	36
Fidelity Major de luxe ...	3 13 6	2 15 2	35
Ferguson 3204 ...	3 10 0	2 11 11	33
Philips "Star Maker" ...	2 16 9	2 2 7	27

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Uher 4000S ...	9 16 0	7 6 5	93
Ficord 202 ...	7 0 0	5 3 10	66
Grundig TK6 ...	6 17 0	2 5 4	65
Butoba MT 5 ...	6 4 0	4 12 11	59
Telefunken 300 ...	6 4 0	4 12 11	59
Stuzzi Magnette ...	6 4 0	4 12 11	59
Optacord 414 Bat/Mns ...	4 19 0	3 14 0	47
Philips EL3586 ...	2 12 6	1 19 5	25

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MISCELLANEOUS: Fast rewind. PRICE: £34 13s.

Distributor: C. Braddock Ltd., The Tape Recorder Centre (Blackpool) Ltd., 266 Waterloo Road, Blackpool, Lancs.

● Review: November 1963.

* * *

Q-CORD 203. Details as above. DIMENSIONS: 10 x 4 x 10in. PRICE: £35 14s.

* * *

SHARP TRC-1004. TAPE SPEED: $1\frac{7}{8}$ i/s. SPOOL CAPACITY: Non-standard, approximately 3in. diameter. BATTERY COMPLEMENT: Four 1.5V cells. BATTERY LIFE: Four hours. FREQUENCY RESPONSE: 200 c/s to 3 Kc/s ± 3 dB. LOUDSPEAKER: 3 x $2\frac{1}{2}$ in. elliptical. DIMENSIONS: $3\frac{3}{4}$ x $5\frac{1}{2}$ x $2\frac{3}{4}$ in. INDICATOR: Meter. MISCELLANEOUS: Supplied with detachable playback amplifier and speaker. ACCESSORIES: Earpiece, moving-coil microphone, splicing tape, recording leads and standard-spool holder—included in price. AC Adapter available. PRICE: £37 16s.

Distributor: Wholesale Supplies (Swinton) Ltd., 16-18 Worsley Road, Swinton, Manchester.

* * *

STELLA ST471. Stella equivalent of Cossor CR1621 but dissimilar colour schemes. PRICE: £27 6s.

Manufacturer: Stella Radio and Television Co. Ltd., Astra House, 121-3 Shaftesbury Avenue, London, W.C.2.

* * *

STUZZI DISC-CORDER. TAPE SPEED: $1\frac{7}{8}$ i/s. SPOOL CAPACITY: 4 $\frac{1}{4}$ in. FREQUENCY RANGE: 60 c/s to 8 Kc/s. SIGNAL-TO-NOISE: 40dB. OUTPUT POWER: 400mW. LOUDSPEAKER: 4in. LEVEL INDICATOR: Meter. DIMENSIONS: 10 x 9 x $3\frac{1}{4}$ in. WEIGHT: 7lb. excluding batteries. MISCELLANEOUS: Also plays 45 rpm discs and incorporates 190 to 580 metre radio. Internal recording facilities. ACCESSORIES: Shoulder case, microphone, mains unit/extension speaker. PRICE: £61 19s. 6d. Distributor: Recording Devices Ltd., 44 Southern Row, Kensington, London, W.10.

TELEFUNKEN M300. TAPE SPEED: $3\frac{3}{4}$ i/s. SPOOL CAPACITY: 5in. BATTERY COMPLEMENT: Five 1.5V cells. FREQUENCY RANGE: 40 c/s to 14 Kc/s. SIGNAL-TO-NOISE: 50dB. OUTPUT POWER: 1W. LOUDSPEAKER: 4 x $2\frac{3}{4}$ in. elliptical. LEVEL INDICATOR: Meter. WOW AND FLUTTER: $\pm 2\%$. DIMENSIONS: $10\frac{3}{4}$ x $10\frac{1}{2}$ x 3in. WEIGHT: 7lb. MISCELLANEOUS: Fast wind and rewind. ACCESSORIES: Mains unit and rechargeable battery. Microphone with built-in modulation level meter and control. Carrying case. PRICE: £61 19s. 6d.

Distributor: Welmex Corporation, Lonsdale Chambers, 27 Chancery Lane, London, W.C.2

* * *

TRANSCORDER TR - 100. TAPE SPEEDS: $3\frac{3}{4}$ and $1\frac{7}{8}$ i/s. SPOOL CAPACITY: 3 $\frac{1}{2}$ in. BATTERY COMPLEMENT: Six 1.5V cells. FREQUENCY RANGE: 150 c/s to 7 Kc/s. LEVEL INDICATOR: Meter. WOW AND FLUTTER: 0.3% DIMENSIONS: $7\frac{3}{4}$ x $3\frac{3}{4}$ in. WEIGHT: 4lb. PRICE: £51 9s.

Distributor: Fonadek (Branson) Ltd., Vivian Road, Harborne, Birmingham 17.

* * *

UHER 4000 REPORT-S. TAPE SPEEDS: $7\frac{1}{2}$, $3\frac{3}{4}$, $1\frac{7}{8}$, $\frac{1}{8}$ i/s. SPOOL CAPACITY: 5in. BATTERY COMPLEMENT: Five 1.5V cells. BATTERY LIFE: 12 hours. FREQUENCY RESPONSE: 40 c/s to 20 Kc/s ± 3 dB. SIGNAL-TO-NOISE: 55dB. LEVEL INDICATOR: Meter (Optional Illumination). WOW AND FLUTTER: $\pm 0.15\%$. DIMENSIONS: $10\frac{1}{2}$ x $8\frac{1}{2}$ x $3\frac{3}{4}$ in. WEIGHT: 9lb. MISCELLANEOUS: $\frac{1}{2}$ -track mono. PRICE: £97 13s.

Distributor: Bosch Ltd., 205 Great Portland Street, London, W.1.

● Review: September 1962.

UHER 4002. Twin track stereo version of 4000S. Details as above. PRICE: £115 10s.

UHER 4004. Quarter-track version of 4002. Details as above. PRICE: £115 10s.

● Review: May 1963.

OUR READERS WRITE . . .

. . . about the 570

From: B. R. J. Plumtree, 20 Newburgh Road, Acton, London, W.3.

DEAR SIR, H.C.'s problems with the *Reflectograph* 570 and its variable-speed deck arise because: (1) Playing tape, there is no back torque on this model—the left hand motor is fed *not* with reduced voltage AC but with rectified DC and relies on eddy-current-breaking when tape in motion to give smooth back-tension over a wide range of speed (three to eight i/s). There is no tension in stationary tape, as the DC gives rise to no turning moment in either direction.

(2) The power resistor will be found at the rear of the deck, between the spools, just under the motor plate, and is usually green-vitreous in colour.

(3) Tape tension also depends on the sliding drag of the running tape between the three heads and their pressure pads. Some later models have stainless pins instead of the green felt pads (a method widely praised in the newer model for good 'wrap round' heads). However, neither type gives any help with stationary tape and in the indeterminate pause setting which H.C. mentions, creepage is easier with pins than pads.

(4) There is no slipping clutch (see answer page 169) on any specimen through my hands in four years of servicing Models 400, 500, 570 or 102—only a brake shoe which is lifted by the quite slight movement of tape controls. Very precise adjustment of the brake rods and pinch-wheel cam, etc., is needed to give the pause facility, as the original makers, Messrs. Rudman Darlington, intended only the provision of fast motor run-up until the right-hand level should be fully engaged to right—see manual.

(5) Speed variation from full to empty spool, also wow and flutter, are difficult to cure on these machines without brackets and stays to prevent shuddering of motor and cone assembly.

(6) If H.C. has any other queries I would be glad to assist.

Yours faithfully,

. . . about a Reader's Problem

From: Repts (Tape Recorders) Ltd., 118 Park Road North, South Acton, London, W.3.

DEAR SIR, We were interested to read a letter in your April issue from a Colchester reader who has harmonic trouble with his R.10 tape recorder. As manufacturers of this machine, and in a spirit of helpfulness, we have the following comments to make:

Slight out-of-balance voltage readings on both anodes of the bias oscillator do not necessarily indicate harmonic content in the wave-form. The frequency of oscillation is 65 Kc/s, so as two triodes are used (ECC82) the distortion would be basically second, which is cancelled by push-pull operation. Now if both sections of the ECC82 were incorrectly balanced by, for example, different self-capacity across each half of the oscillator coil, 65+130 Kc/s would appear in the bias and erase wave-form. This, in practice, means a residual DC component is recorded on the tape, which generally takes the form of rumble more noticeable at the higher speeds. Therefore, the harmonic content of the oscillator will not cause this additional spurious tone.

We would venture to suggest that the 9 Kc/s tone was recorded at full modulation level instead of at -20dB below, and due to the rising record characteristics, this signal will overload the recording channel and the fourth or fifth harmonic would beat with 65 Kc/s to produce this audible tone. This effect is common with all magnetic recording systems, more so at the slower speeds. As the energy content of most sounds is very low at 9 Kc/s as compared with 1 Kc/s this effect is generally of no consequence.

Yours faithfully,

Editor's Note Again and again we are gratified by the prompt response of readers to their fellows in distress. The letter from Mr. Plumtree in quick reply to H.C. demonstrates this, while the one from Repts Ltd. shows that not all manufacturers lock themselves in ivory towers.



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tape reviews

THE D minor 'double' concerto by Bach has probably been heard more often as a double harpsicord concerto in the key of C minor. This is Bach's own transcription from the older version for violin and oboe. It is the older version that we have here and, in my view, it is the more attractive of the two.

All the concertos on this tape are by 'pre-classical' composers, and the soloists are rather less in the limelight than in concertos by later composers such as Mozart, or later still, Beethoven and Brahms. So anyone buying this tape expecting to hear Menuhin or Goossens play long cadenzas with lush romanticism will be disappointed. Style, elegance, beauty-of-line and phrase are the key-notes here, with much interchange between soloists and the small orchestra.

In the Bach concerto I felt that Menuhin subjects himself to the playing of Goossens, particularly in the slow movement where the soloists are prominent. I wished for more assertion from the violin during the beautiful counterpoint between the two instruments. However, this is a small point, for it is splendid playing of fine music.

The Vivaldi concerto is music of a lighter, more delicate character. It requires great sensitiveness and feeling for style to make the most

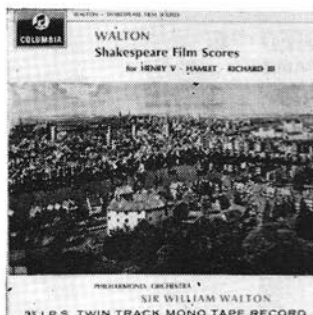


BACH, VIVALDI, HANDEL CONCERTOS. Concerto in D minor (J. S. Bach), Menuhin—violin, Goossens—oboe. Concerto in B minor Op. 3 No. 10 (Vivaldi), Menuhin, Masters, Goren and Humphreys—violins, Simpson—cello obligato. Oboe Concertos No. 1 in B flat major, No. 3 in G minor (Handel), Goossens—oboe. Bath Festival Chamber Orchestra. HMV TA-ALP 1949, 3½ i/s mono twin-track, 35s.

of it. This I felt was lacking in this performance. The notes were all there within their phrases and the tempos well judged, but those extra tiny points of accent were somehow missing.

The Handel oboe concertos are made of good, basic stuff, and Goossens with the Bath Festival Chamber Orchestra cruises through them easily, dropping points of piquancy on the way. The orchestra has a lot to say here, and in places rather drowns the oboe.

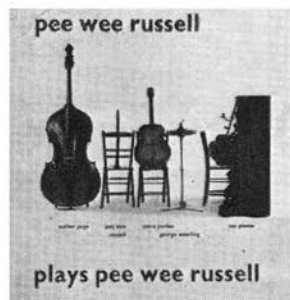
The recording quality is free from serious defects, though the string tone sounds rather lifeless on wide-range equipment. A harpsicord is sometimes dimly heard, but its presence is not acknowledged in the list of performers on the box, though the cello obligato player is.—G.G.



SHAKESPEARE FILM SCORES, Sir William Walton. Music from Richard III, Hamlet and Henry V. Philharmonia Orchestra conducted by composer. Columbia TA-33CX 1883, 3½ i/s mono twin-track, 35s.

EVEN though this music is written as film scores, it makes pleasant listening without the tableaux to go with it. It is all very easy on the ear; noble marches, majestic fanfares, tender love songs and stirring charge and battle music are arranged in the form of two orchestral suites, the result being a well balanced programme.

Sir William Walton and the Philharmonia Orchestra give an appropriately theatrical and technically polished account of the music. The recording quality is clean, but the frequency range is restricted. The 'thinness' of the recorded sound is very noticeable when played through wide-range equipment, though less so when played through the tape recorder's internal speaker.—G.G.



PEE WEE RUSSELL. Eight pieces played by Pee Wee Russell (clarinet), Nat Pierce (piano), Steve Jordan (guitar), Walter Page (bass), George Wettling (drums), World Record Club TT 308, 3½ i/s mono twin-track, 29s.

THE croaking, cracked, thin-toned clarinet of Pee Wee Russell is a product of Chicago-Dixieland jazz, but whereas many of his old associates from the thirties have been unable to escape the narrowing confines of this style, Pee Wee has long since shown his ability to play with mainstream and even modern groups.

He now appears with this tape among those few jazz musicians who have made a successful recording backed only by a rhythm section, which in itself is a mark of an outstanding instrumentalist. Of course, the backing is provided by four very good jazzmen in the persons of George Wettling (drums), Nat Pierce (piano), Walter Page (bass), and Steve Jordan (guitar).

The best items are *Exactly Like You*, and two numbers credited to Pee Wee: *Muskogee Blues*, and *Pee Wee's Song*. But why, oh why, did we have to have *Somewhere Over The Rainbow*? It doesn't even rate as good background music, let alone jazz.

Nat Pierce gives very good support throughout and his solos are excellent, especially on *Pee Wee's Song*, which is reminiscent of Teddy Wilson.—T.F.



HIGHLIGHTS FROM TOSCA, Puccini. Maria Callas (soprano), Giuseppe Di Stefano (tenor), Tito Gobbi (baritone), Angelo Mercuriali (tenor), Dario Caselli (bass), Melchiorre Luise (baritone). Orchestra and Chorus of La Scala Opera House, Milan, conducted by Victor De Sabata. Columbia TA-33CX 1893, 3½ i/s mono twin-track, 35s.

THE story of Tosca is a tale of love, jealousy, betrayal, abuse of power, physical torture, murder and suicide told to a background of the Napoleonic wars, so it is not surprising that a selection of highlights from it should be at a high level of emotional intensity. Maria Callas's range of expression is renowned, and the selections on this tape record demonstrate them to the full, from tenderness and passion in the love duets to violent hate in her dispatching of Scarpia. Stefano's voice I find rather less convincing in the part of Cavaradossi, Tosca's lover, but Tito Gobbi is splendid as the villain Scarpia.

The quality of the recorded sound is very good, and the voices are well balanced with the orchestra. In all, this is a warmly recommended issue, it should give pleasure to many.—G.G.



How flat is Flat ?

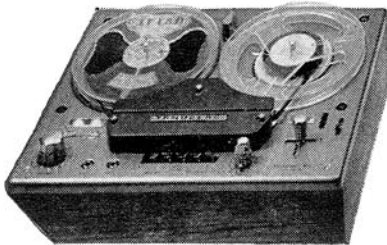
So often do we read in tape recorder specifications "Frequency Response Flat 40 to 16,000 cycles", a statement completely valueless unless qualified by the upper and lower limits of deviation, in decibels, throughout the frequency range.

While the "Replay Amplifier" specification is worthy of note, it is the overall "Record/Play" response which is most important, for record and replay heads, and their associated circuits, are all involved. In a Stereo Machine, careful attention should also be paid to ensure that both channels meet the specification and are matched. Only in tape recorders designed up to a specification rather than down to a price may a manufacturer safely refer to a FLAT response curve.

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In conclusion we quote from a review in AMATEUR CINE WORLD, JULY 18/1963:—

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THE Model 262 has much in common with the 101, mechanically, and with the 103, electrically. Rather more austere in appearance, and with a different control knob layout, the 262 retains the familiar Sony features: the capstan and pinch wheel 'out in the open', and the overlapping spools.

In fact, these features make for a versatile machine, for this compact (15 x 7 x 11 in.) tape recorder takes 7 in. spools, is two speed (7½, 3¾ i/s), has a digital tape position indicator and a magic-eye modulation level indicator. The amplifier is valve-operated, with a 12AT7 two-stage amplifier, 6BM8 triode amplifier plus pentode output, the latter doubling as oscillator during recording, a 6DA5 modulation level indicator and 6X4 rectifier. The consumption is 70W, and inputs are either 100, 110, 117 or 220V, 50 or 60 c/s.

To dismantle, first remove the volume control, tone control, function selector and tape speed selector knobs. These are secured with set screws. The FAST FORWARD control knob pulls off, and the PAUSE control knob likewise. The head cover is a push-fit. The top panel is secured by three Phillips headed screws. After taking all the top gear off, turn the machine over, remove the two securing screws on the sides of the handle, take out the two screws for the rubber feet on the loudspeaker side, and a single screw at the base centre, when the cabinet can be lifted away.

Most of the servicing detail has been dealt with in the previous article, but the following notes may be regarded as complementary, and are also applicable to other machines in this range.

First, lubrication. In general, a thin oil is quite suitable for the faster rotating parts, such as the motor spindles of tape recorders; sewing machine oil is best to avoid the drag that heavier oils can cause when the motor is cold. Oiling should only be necessary after about 1,000 hours running, and one or two drops at the vital points are sufficient. If the base of the motor is inspected, a small hole will be found near the spindle, where the oil-can nozzle can be inserted. The fan may have to be removed to obtain access to the top hole, and the bottom hole needs extra care, the motor being turned by hand until the oil has run into the bearing, to avoid its being thrown off and possibly getting on rubber drive surfaces—a distinct possibility on these machines, where several rubber-tyred wheels are employed.

Dynamo oil, or heavy-medium viscosity oil, is more suitable for the pinch and idler wheel bearings, and the spool carrier spindles. On these machines, the drive capstan has a felt ring beneath the top portion over which the tape runs; this should be oiled and allowed to run-in before tape is loaded, and with the pinch wheel temporarily held off. A felt ring is also to be found beneath the retaining screw of the pinch wheel. Great care must be taken to avoid the oil seeping to the rubber roller. Even greater care is needed when oiling idler wheels. The rubber tyres are fairly wide, and the central boss is held by the upper washer and circlip. It may be easier in some cases to remove this last item, withdraw the idler wheel, wipe the spindle clean and merely lubricate with an oily rag before refitting the wheel. Spool spindles also have an upper retaining screw and oil can be injected at the top of the spindle quite easily. These points need oiling a little more frequently than motor bearings—every 500 hours of running time is a good general rule.

Next general point, before pressing on, is the wiring colour code that is adopted by the Sony designers. My personal reaction to colour coding of cables is: don't trust it unless you are quite certain of your details. Production bods have a habit of making modifications in the light of exigencies. Different makers use different codes: there is no

common rule, not even for the products of one factory. Nevertheless, I quote below the wiring colour code as used on the 262 and other machines in this range, with the proviso that this be used as a *guide* rather than an infallible *rule*:

White: A.C. wiring, or the secondary of the output transformer. *Blue*: heater wiring. *Green*: cathode circuits. *Yellow*: grid circuits. *Orange*: screen grid circuits. *Red*: anode circuits. *Brown*: HT wiring. *Black*: chassis or earth.

The Sony 272 has a different action again, and the general mechanical layout is shown in fig. 1. Key selection of the various functions is used, and the speed change is push-button operated. There is a transistorised input stage, a diode pentode valve (6AV6) used for signal level indicator rectifier plus AF amplifier, and a separate 6AR5 pentode used as output and oscillator valve.

Dismantling is a simple operation, much as outlined above, except for the way the top panel is removed. This has to be lifted from the rear then slid forward to clear the keys and edge-type controls. The main cabinet lifts straight upwards after the top, side and feet-securing screws, and the handle retainers, have been removed.

TAPE RECORDER



SERVICE

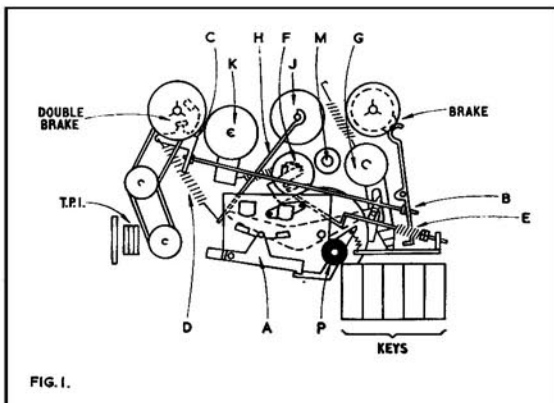
NO. 32 — THE SONY RANGE

CONTINUED BY H. W. HELLYER

Pivoted, spring-loaded latch-plates beneath the keys (fig. 1) engage levers and rods to perform the functions. The pinch roller P is mounted on an arm with counter-spring, and selection of PLAY allows this arm to travel inwards, releasing the lock of arm A, which has a spring at its left hand end. Inward movement actuates the pressure pad engagement system. In fig. 1, this is not shown in detail. It consists of a raised tongue and hinged pad plates, and is characteristic of Sony machines. Space permitting, greater detail will be shown in the next article, which will cover the 464 and later machines. The special advantage of this system is that a wide clearance is gained for tape loading, head cleaning, etc. This is a point that might well be considered by designers of some other machines. From the servicing aspect, apart from checking the palette plate action, beneath the keys, and ensuring that spring tensions are adequate for a clean return to neutral in all cases, there is little to bother us. The throw of the lever which the PLAY key operates is perhaps the most important test. Check that, with the machine disconnected from its power supply, actuation gives an inward pressure such as to allow a pull on the tape at the right of the head system to turn the flywheel smoothly. Note that a release of pressure pad tension, by holding off the head plates with the point of a pencil, should not make any significant difference to the pulling force required.

Reference to fig. 1 shows that the brakes are coupled by a rod running across the deck, and locknuttred for exact length (and thus, engaging action). The important thing is to set the right-hand brake first by engaging STOP and setting the block for correct pressure. If

(continued overleaf)



Mechanical layout of Sony 272

FIG. 1.

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TAPE RECORDER SERVICE CONTINUED

there is no alternative, release the transverse rod at point B. It will be noted that the push-rod actuates a double brake, based on the pivoted bracket C. First setting is the locknut of the push-rod, and second the tension of spring D. The double brake is provided for clean action both on forward movement, to prevent spillage but also correct any tape 'pull' when pausing or inching, and also to ensure a clean stop action after fast rewind. The brake should clear the drum by about a millimetre if the STOP key is pressed lightly.

Flywheel drive is rather complicated. When the FORWARD key is depressed, the coupling rod E causes the coupled brackets to swivel, engaging the drive wheel F with one step on the motor pulley and simultaneously with the flywheel. At the same time, the idler G is drawn to the smaller step on the pulley and engages the clutch drum of the right-hand spool carrier. Points to check are the stop plate fitted at the return end of the latter bracket, the spring tension, the guide pieces beside the idler spindle, the felt pads and the bottom washers of the right-hand turntable.

Similarly, the speed change depends on the setting of this common bracket, and the play of the lower part on the spring support should be checked.

Rewind action is dual idler drive. When the appropriate key is pressed, the large pivoted lever shown dotted in fig. 1 draws the rod H forwards, causing the idler J to engage with the motor pulley and the other idler K. This, in turn, engages the left-hand spool and drives it. A return spring is fitted for neutralising, and the bracket is loosely pivoted. FAST FORWARD drive is direct. The only points to look for are distortion of the coupling rod, lack of return spring tension, and the usual faults, such as binding circlips, distorted angle brackets, etc. The retaining screws of the pivot points should be noted, as looseness here can cause all manner of strange faults.

Two other things to note are the leaf switches used both for muting between functions and for equalising, and the setting of the modulation level indicator. The first point is straightforward, depending on the mechanical setting of the switch mounting and blades; the second point requires a valve voltmeter (VVM) and signal generator to be done properly. Although many readers will not have those instruments readily accessible, a short description of the method may give a guide to empirical adjustments.

First, switch to RECORD. Connect the valve voltmeter to the white lead, tag 4 of the strip approximately central below chassis. (Near the hum-bucking coil.) There is a mica trimmer nearby. This should be adjusted for minimum reading.

Next, connect the VVM to tag 3, the red lead, and adjust the 200K preset resistor near the oscillator transformer for a 30V, RMS reading. This sets the bias. From there we can check the recording level by connecting the VVM via a 0.1 mF paper capacitor to the top of the variable slider on the printed panel. With the volume control fully advanced, feed in a 1 Kc/s signal, adjusting the volume control to obtain a 3.8V reading on the VVM when a 0.77 mV input at 1 Kc/s is applied to the microphone input. The slider potentiometer on the printed circuit board can then be adjusted for correct indication on the 6RE13 magic eye, which is when the beam just closes.

PHILIPS FIELD TRIAL CONTINUED

replace, but to go along with the Stella. He suggested that the two machines had different things to offer, the EL3300 being a really portable machine, and the Stella a good general-purpose recorder, independent of mains supply.

Summarising, then, it is clear from the styling and publicity leaflets of the EL3300, that it is aimed as much at the general market as the domestic tape enthusiast. With sufficient advertising in the right quarters, beetle haircuts and transistor radios might well give way to the craze of carrying (and perhaps even using) battery tape recorders—which might not be a bad thing for the recording world in the long run.

The EL3300 makes a superb job of recording, taking into account its slow speed. Any serious user would do well to leave his 'remote-control' switch at home—or even sell that accessory if he wishes to preserve the recorder's good wow performance (it does not disengage the pinch wheel); but the light weight and considerate design make a valuable contribution to the evolution of tape recording. I forecast attempts at imitation by other firms within the next couple of years.

NEW PRODUCTS NEW PRODUCTS NEW PRODUCTS

SABA TK230-S

THE latest recorder from Saba is the $\frac{1}{4}$ -track stereo TK230-S. It is equipped with two speeds, $7\frac{1}{2}$ and $3\frac{3}{4}$ i/s, claimed wow and flutter figures for which are $\pm 0.15\%$ and $\pm 0.25\%$ respectively. Full playback facilities are included, with two $6 \times 3\frac{3}{4}$ in. elliptical speakers located within the cabinet. Extension speakers may be connected when required.



Transistorised input stages allow mixing of microphone (0.1mV. at 200 ohms), radio (10mV. at 100K) and pickup (200mV. at 1 Meg.). The remaining circuitry is valve.

Remote control, using a pedal switch, time switch or slide synchroniser, is optional. A variety of accessories are available, including a connecting lead for inter-track transcription, mono and stereo microphones, microphone stands and extension cables. The Saba *Regie-mixer* retails at 18 gns. and uses sliding controls. Output power is 10W with frequency ranges of 40c/s to 20Kc/s at $7\frac{1}{2}$ i/s and 40 c/s to 15Kc/s at $3\frac{3}{4}$ i/s.

To prevent excessive tape wear and friction, spinning tape guides and a tape cleaner are incorporated, the latter functioning during rewind. Maximum spool size is 7in. and the cabinet dimensions are $16\frac{1}{2} \times 14\frac{1}{2} \times 7\frac{1}{2}$ in. The retail price is £99 15s.

Distributor : Saba Electronics Ltd., Eden Grove, Holloway, London, N.7.

LAFAYETTE REDUCED PRICE OFFER

A SCHEME was introduced recently by *Leda Tapes* to provide clubs and associations with *Lafayette* tape at reduced prices. Minimum orders should be not less than £10, but should the tape prove unwanted within three months of its purchase, up to £10 worth will be taken back by *Leda* in exchange for its original value. More information is available from : *Leda Tapes*, 12 Montague Road, Leytonstone, London, E.11.

SCOTCH MAGNETIC TAPE VIEWER

BASED on the same principle as *Indicord*, a magnetic tape viewer has just been announced by 3M. It takes the form of a small disc, the overall size of which is approximately $1\frac{3}{4}$ in. diameter x $\frac{3}{8}$ in. deep. On one side is a glass window of $1\frac{1}{2}$ in. diameter through which the pattern is viewed. A dispersion of oxide lays in a film on the thin metal

base of the disc and, when placed over a recorded tape, coagulates to form a picture of the recorded signal.

The device, known as *Magnetic Viewer 600*, is at present available only to the industry ; but for readers interested in seeing a similar effect, the distributor of *Indicord* is : H. P. Freedman, 13 Talbot Road, Twickenham, Middlesex.

3M TRIPLE-PLAY

SCOTCH triple-play has just been announced by 3M. Said to be the least expensive of its kind on the market, it retails at £1 4s. 9d. for 600ft., on 3in. reels, and £1 18s. 6d. for 900ft., on 4in. reels.

A black oxide coating, making this brand easily distinguishable from most other tapes, is described as a direct development from instrumentation and computer-tape coatings. Manufacturer : 3M Co. Ltd., 3M House, Wigmore Street, London, W.1.

MSS TRIPLE-PLAY

YET another brand of triple-play tape claimed to be the least expensive available is that introduced recently by MSS. Retail prices of the polyester-based tape are as follows : 600ft. on 3in. spool—£1 1s. 6d.; 900ft. on 4in. spool—£1 7s.; 1800ft. on 5in. spool—£2 11s.; 2400ft. on $5\frac{3}{4}$ in. spool—£3 3s.; 3600ft. on 7in. spool—£4 19s.

Manufacturer : MSS Recording Co. Ltd., Poyle Trading Estate, Colnbrook, Slough, Bucks.

SPOOL ROTATION COUNTERS

SERIES 433 tape recorder rotation counters are fully listed in a folder now available from *English Numbering Machines*. Physical dimensions, direction of drive, colour and number of figures are included in the specifications.

Manufacturer : English Numbering Machines Ltd., Queensway, Enfield, Middlesex.



DANSETTE
EMPRESS



USING the *BSR TD10* three-speed tape deck, the *Danette Empress* is a $\frac{1}{4}$ -track recorder to retail at about £34. Facilities for straight-through amplification and mixing of microphone and radio inputs are included. The *Empress* has storage space for two 7in. spools and will play for a maximum of six hours with lid closed. A variety of two-tone cabinet colour schemes is available.

Manufacturer : Danette Products Ltd., 112-116 Old Street, London, E.C.1.

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*Telefunken M97—7½, 3½, 1½ i.p.s.	99 15 0
*Tandberg Series 7, 2 or 4 track. 7½, 3½, 1½ i.p.s.	97 13 0
Philips EL 3534—7½, 3½, 1½, ¾ i.p.s.	96 12 0
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*Ferrograph 424 U, ¼T playback—7½, 3½ i.p.s.	115 10 0
*Tandberg Series 6, 2 or 4 track—7½, 3½, 1½ i.p.s.	115 10 0
Sony 464 one replay amplifier—7½, 3½ i.p.s.	67 4 0

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Philips EL.3541—3½ i.p.s. only	37 16 0
Philips EL.3541/H—3½ i.p.s. only	44 2 0
Elizabethan LZ.29 (illustrated)—7½, 3½, 1½ i.p.s.	39 18 0
Elizabethan Popular 400—3½ i.p.s. only	26 5 0
Cossor 1604—3½, 1½ i.p.s.	40 19 0

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*Vortexion WVA standard system—7½, 3½ i.p.s.	93 13 0
*Ferrograph 5A/N (modernised)—7½, 3½ i.p.s.	89 5 0
*Telefunken 85 "The Classic"—7½, 3½ i.p.s.	87 3 0
*Telefunken 95—7½, 3½, 1½ i.p.s.	61 19 0
Elizabethan Popular 200—3½ i.p.s. only	24 3 0

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Manufacturer's Specification : Domestic $\frac{1}{4}$ -track recorder. **Tape Speeds :** $1\frac{1}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ i/s. **Frequency Range :** 60 c/s to 15 Kc/s at $7\frac{1}{2}$ i/s. **Spool Capacity :** 7in. **Amplifier Power :** 5W. **Signal-to-noise :** 50dB. **Wow and Flutter :** 0.15% at $7\frac{1}{2}$, 0.25% at $3\frac{3}{4}$ and 0.35% at $1\frac{1}{8}$ i/s. **Stereo Output Sensitivity :** 2mV at 1 Kc/s. **Price :** £36 15s. **Manufacturer :** Fidelity Radio Ltd., 11-13 Blechynden Street, London, W.11.

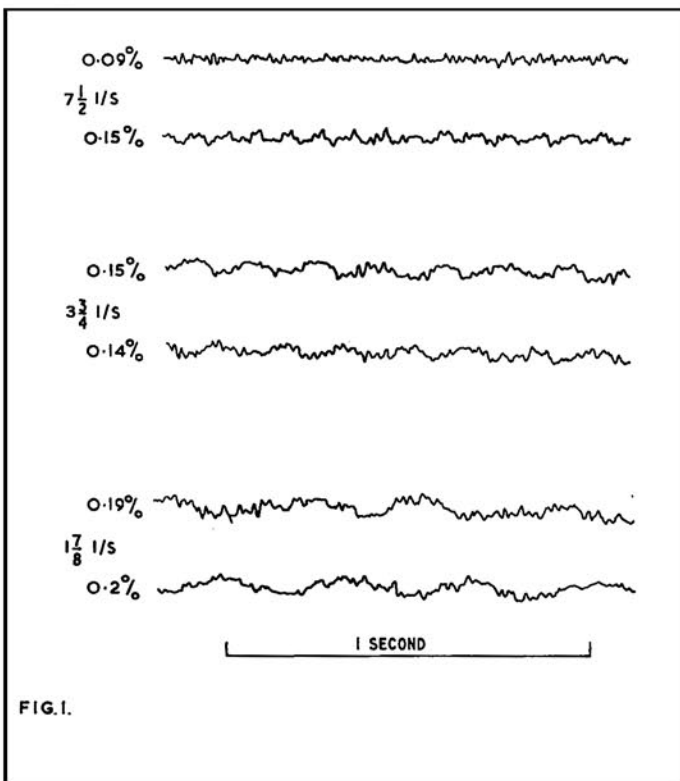


FIG. 1.

THIS new recorder in the £36 price bracket offers 'the lot'—three speeds, 7in. reels, meter record-level indicator, superimpose, stereo head outlet, separate bass and treble tone controls, radio-mic mixing, tape timing indicator, nicely styled cabinet of adequate size to prevent 'boxiness'. Plenty of storage space at rear compartment for mic., stand, mains and radio lead and any other accessories which belong to the recorder.

A separate output stage with independent gain control allows loudspeaker monitoring while recording, and this gain control becomes the treble tone control on playback. The bass tone control carries the mains 'on-off' switch. Rocker type push button switches select the track and control the superimpose facility. All tone and gain controls are of the edge-operated type and, although these are uncalibrated,

there is no difficulty in deciding which way to turn them for a given effect; movement to the right always *increases* the effect.

Phone type sockets are provided on the control panel for radio-gram input, microphone input, extension loudspeaker input and stereo head output.

It was found essential to have a good earth connected to the green mains lead to reduce hum and hand capacity effects at the controls. The printed amplifier circuit is not screened in any way, and without an earth a very audible hum comes up each time the hand approaches a gain control. Even with an efficient earth, the polarity of the mains connection is important and should be selected for minimum hum. This must be done with the joystick tape motion control pushed

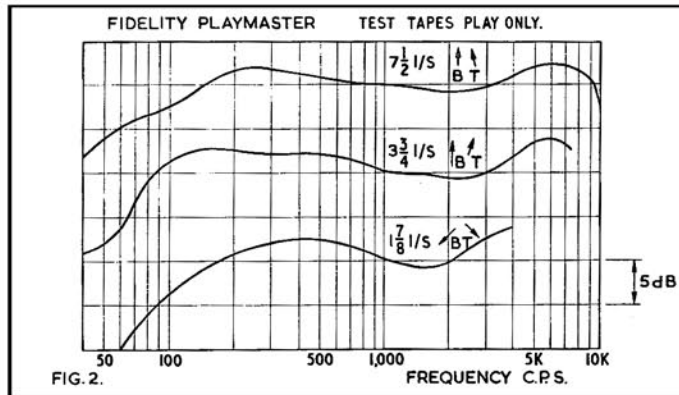


FIG. 2.

forward, as the amplifier circuit is muted in the OFF position. Apart from this minor criticism the performance of the machine is excellent and the objective tests detailed below bear out my listening tests.

The fluttergrams of fig. 1 show that the RMS wow and flutter are well within the specification with very low level 50 c/s flutter from the 3,000 rpm motor, and wow at capstan rotation frequency at 12, 6 and 3 c/s respectively at the three tape speeds of $7\frac{1}{2}$, $3\frac{3}{4}$ and $1\frac{1}{8}$ i/s.

The capstan wow was just audible on a continuous pure tone, but could not be detected on speech or most types of light music. At $7\frac{1}{2}$ i/s serious music of the most demanding type could be handled without any trace of speed imperfections.

Test tapes of 100, 200 and 400 μ s time-constant were played and the output voltage measured across the internal speaker terminals (no amplifier output is provided) to give the responses of fig. 2. In each case the tone controls were set to give the most level response from the test tape. The tone control settings selected are indicated by arrows on each curve. It will be seen that at the two higher speeds the controls are in the midway position, and at the lowest speed the bass control is at minimum and the treble control at maximum.

Hum was only 25dB below test tape level with the recorder properly earthed and the mains polarity in the most favourable position.

Fig. 3 shows the overall record-replay responses. It will be seen
(continued overleaf)

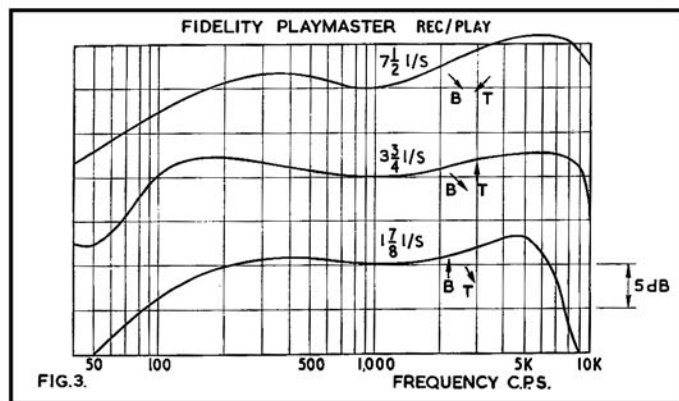
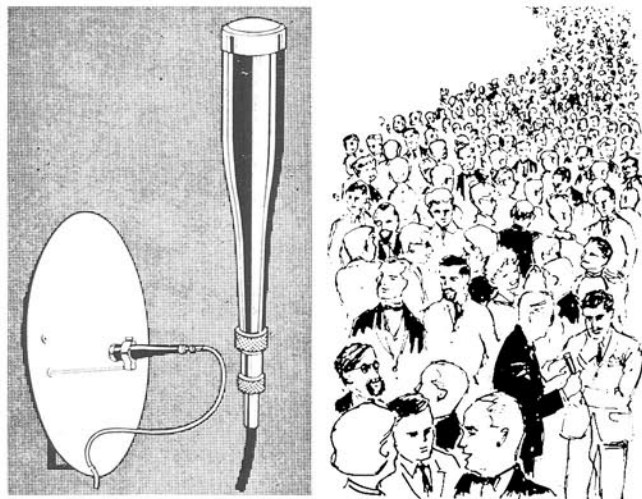


FIG. 3.

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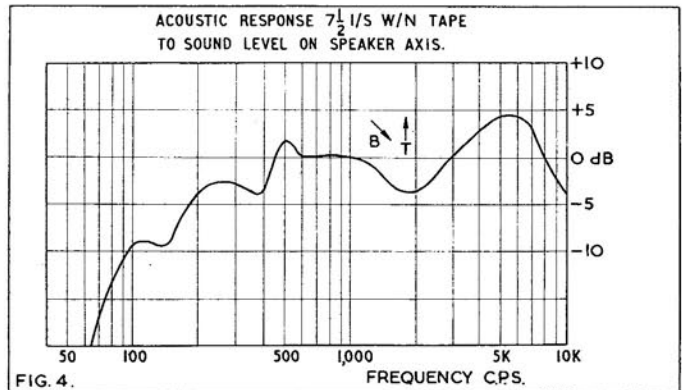
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EQUIPMENT REVIEWED — CONTINUED

that generally the bass control has to be advanced and the treble control turned back compared to the test tape responses, indicating that the new CCIR recommendations of 70 and 140 μ S have been adopted for the recording characteristic for $7\frac{1}{2}$ i/s and $3\frac{3}{4}$ i/s, and that the $1\frac{3}{4}$ i/s response is about 300 μ S.

Test tape level was recorded at about quarter-scale meter reading, and peak recording level, at 12 dB above test tape level, was recorded without distortion with the meter needle at the centre of the red sector of the meter scale. Waveform distortion commenced with the meter needle just off the scale. Recorded programme tests showed that the

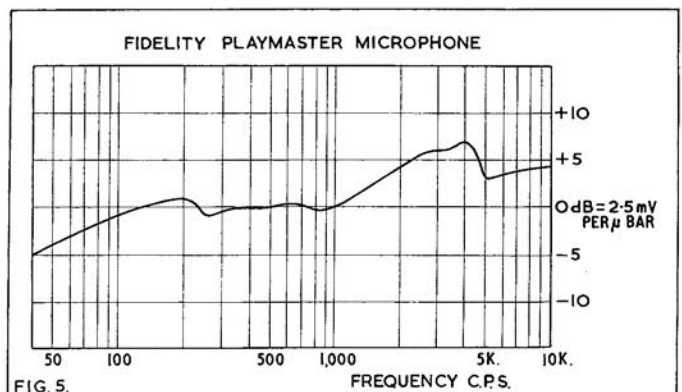


dynamics of the meter were satisfactory and that recordings made with the meter kicking into the red very occasionally used the dynamic range of the tape and recorder to the full.

Although the signal-hum ratio was slightly low at 37 dB, the signal-noise ratio, measured through a weighting network to approximate to the ear's response at low levels, was very satisfactory at 47 dB. This shows that bias and erase waveform is good and that first stage noise is low.

The overall acoustic response, including that of the speaker and the effect of the cabinet, was measured by playing a $7\frac{1}{2}$ i/s white noise test tape with the tone controls in the position shown in fig. 4. Response is within limits of plus or minus 5 dB over the range 200 c/s-10 Kc/s with bass response reasonably maintained down to the speaker resonance at 100 c/s.

The microphone response was also measured in a white noise sound field to give the response shown in fig. 5. This is excellent for a cheap microphone and is an ideal choice for this particular recorder. Recorded voice quality is clean and crisp at all speeds and the 8ft. lead length



allows one to get well out of range of the very slight mechanical motor noise of the recorder.

A square foot of foil-coated paper under the plastic control panel and around the printed circuit would almost certainly eliminate most of the hum trouble mentioned above. It would be a worthwhile refinement as the rest of the design is excellent.

The size and weight of this machine is considerably more than that of the average medium priced recorder, but it pays off handsomely in appearance, tone quality and the very useful extra storage space provided. 7in. reels can be left in position with the lid closed, but despite this it is well balanced for carrying.—A. Tutchings.

READERS' PROBLEMS

Readers encountering trouble with their tape equipment are invited to write to the editorial office for advice, marking their envelopes "Readers' Problems—Tape". Replies will be sent by post and items of general interest may also be published in this column at a later date. This service does not, however, include requests for information about manufacturers' products when this is obviously obtainable from the makers themselves. Queries must be reasonably short and to the point, limited to one subject whenever possible. In no circumstances should such letters be confused with references to matters requiring attention from other departments at this address. We cannot undertake to answer readers' queries by telephone.

BALANCED CABLES

Dear Sir, Would you please inform me if there is any advantage in employing balanced-line over unbalanced-line when using low-impedance microphones.

Yours faithfully, S.C.L., Birmingham 34

The advantage of using balanced-line on inter-connections is that very much longer lines may be used before hum and noise become troublesome. There is a subsidiary advantage for certain kinds of work, that with the correct twin-core screened cable, the floating winding can be reversed, and there is not so much possibility of inadvertent setting-up of hum loops.

The disadvantage is extra cost. The practical point to be watched is an absolute preservation of balance. In practice, a poor joint on a balanced connection, resulting in imbalance, can be much more troublesome than the hum or noise pick-up with a much simpler two-connection input.

PRONOUNCED FLUTTER

Dear Sir, I have a very pronounced flutter on my WyndSOR Trident that occurs at $3\frac{3}{4}$ i/s when there is about $\frac{1}{2}$ in. thickness of tape left on the feed spool. Easing this spool round by finger at this point seems to correct the fault. Could you put your finger on the fault by offering a cure in a more practical way!

Yours faithfully, C.A.P., Stevenage

You may have noticed from previous issues that the problem of smooth running of the Studio deck has exercised several correspondents. Your case seems rather different in that the flutter occurs when the feed spool is nearly empty. From this I would say that you may have a worn left-hand guide. These can be turned to present a fresh surface to the tape, and this is worth trying. But consider: the crux of the problem is the relative angle between tape and guide. If you run the tape over an auxiliary guide, temporarily, at a wider (less acute) angle, and the fault reduces, you may find it worthwhile to fit a guide at a point an inch or two to the left of the present one. But first check that the pinch pressure is adequate between roller and spindle, and that the pressure pads are not to blame.

HEAD DE-MAGNETISATION

Dear Sir, As a novice in tape recording I would appreciate information on the reason for de-magnetising heads on a recorder. How often, in terms of operating hours, should this procedure be carried out? Does it apply to the recording head only, or should the erase head be treated in the same way?

Yours faithfully, T.S., Draycott

The materials of which the record/playback and erase heads are made must be of high permeability. That is, they are easily magnetised, and just as easily de-magnetised. But although circuits are devised that cut magnetisation to a minimum, the residual magnetism has a gradual cumulative effect on all metal parts, even the most perfect material must have some remanence. Fortunately the process of 'flooding' the

(continued overleaf)

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READERS' PROBLEMS—CONTINUED

material with a strong alternating field is sufficient to return it to its random nature. The de-magnetiser does just this.

It is advisable to carry out the operation fairly frequently on some decks, whereas others rarely need it. Much depends on other factors, such as the circuitry in use, the depth of modulation, external fields, etc. A basis of no more than 100 hours is a useful figure with many decks.

The erase head should certainly be treated, as should other metal parts, including guide posts, tape pins, feelers, and capstan spindle. Take care not to apply a de-magnetising field for too long a period, or heating of the windings by induced magnetism, and hence current, can occur.

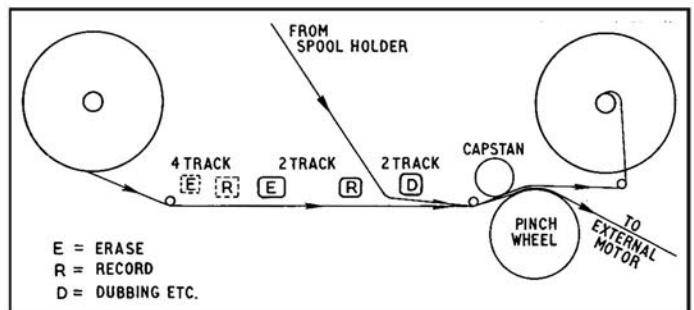
MODIFYING THE STUDIO DECK

Dear Sir, A short time ago I purchased a Magnavox Tape Deck and Martin Pre-amplifier kit. Having completed the pre-amp, and being delighted to find that it worked, I am writing to ask your advice on modifying the deck.

The first change I wish to make is to insert a switch between the oscillator coil and erase head, thus making superimposition possible. I would like to know what type of switch to use, and whether the length of wire matters. Secondly comes the problem of mixing. The makers of the pre-amp say this is easy; one merely plugs in both microphone and 'direct' lead together. I have not yet been able to try this but after reading about mixing units and their like I feel that there must be more to it than Martin suggest. (I may say that I am not thinking of completing all the alterations about which I am enquiring all at one sitting, so to speak).

Thirdly, I am very keen to have facilities for some of the effects which are made possible by magnetic tape. I have in mind a second recording head, which can be fitted easily on to the Magnavox deck. I am hoping that, with suitable switching arrangements, I can use the second head for monitoring, providing echo, and possibly dubbing.

Yours faithfully, M.H., Amersham



Superimposition: it is necessary to provide an alternative load for the oscillator when disconnecting the erase head. A 1.5 K resistor would be suitable, with a single-pole, double-throw switch to select either the erase head or the shunt resistor.

Mixing of one microphone and one radio or pick-up input is possible with no further modification. The microphone input is amplified by an additional stage, in normal practice, but a balance is obtained by attenuation of the radio input by a potential divider network. If further simultaneous inputs are required, an external mixer would be necessary. This could be a 'passive' type, with matching and isolating resistive branches, or an 'active' type, with transistorised pre-amplifier and balanced gain controls. Unless a varied series of inputs is anticipated, it is better to use the existing facilities.

The use of a second head for monitoring will need a pre-amplifier circuit. Quite a simple device can be built for headphone monitoring. See Mr. Bartlett Still's previous articles on mixers for guidance. For echo and dubbing work, it is advisable to incorporate a separate amplifier circuit, to separate the channels and avoid complicated switching.

Although the capstan is powerful enough to propel two tapes, this is not the best method for obtaining a quality recording. Combining two- and four-track heads on the single deck is quite feasible, but the switching must also allow for the different impedance and recording currents of the heads—and this factor is the reason for different amplifier specifications.

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All advertisements for the September issue must arrive not later than August 5th.

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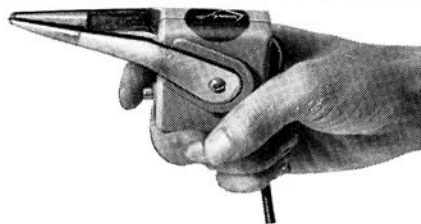
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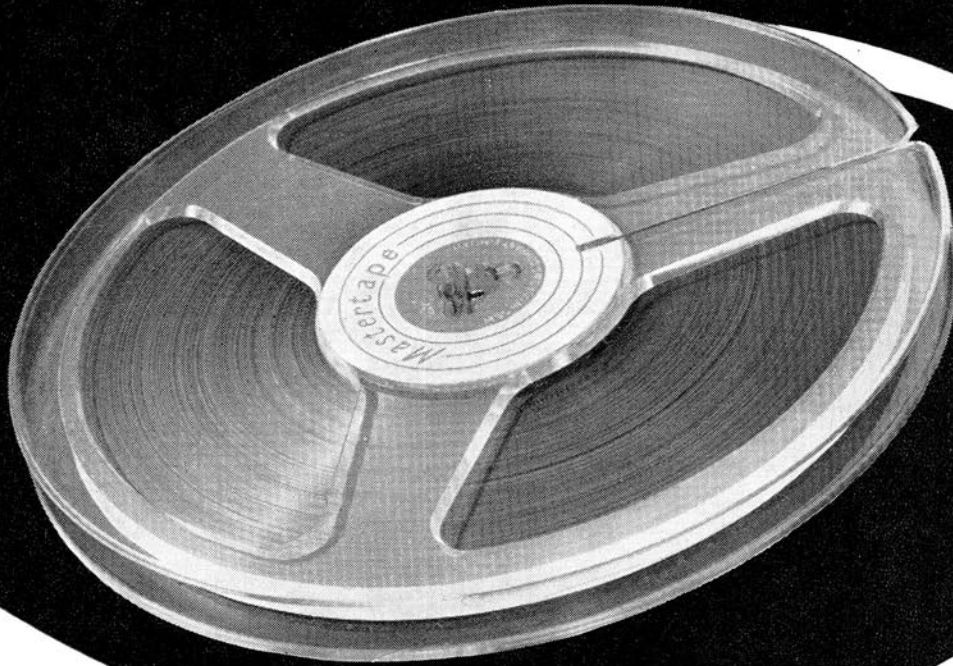
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