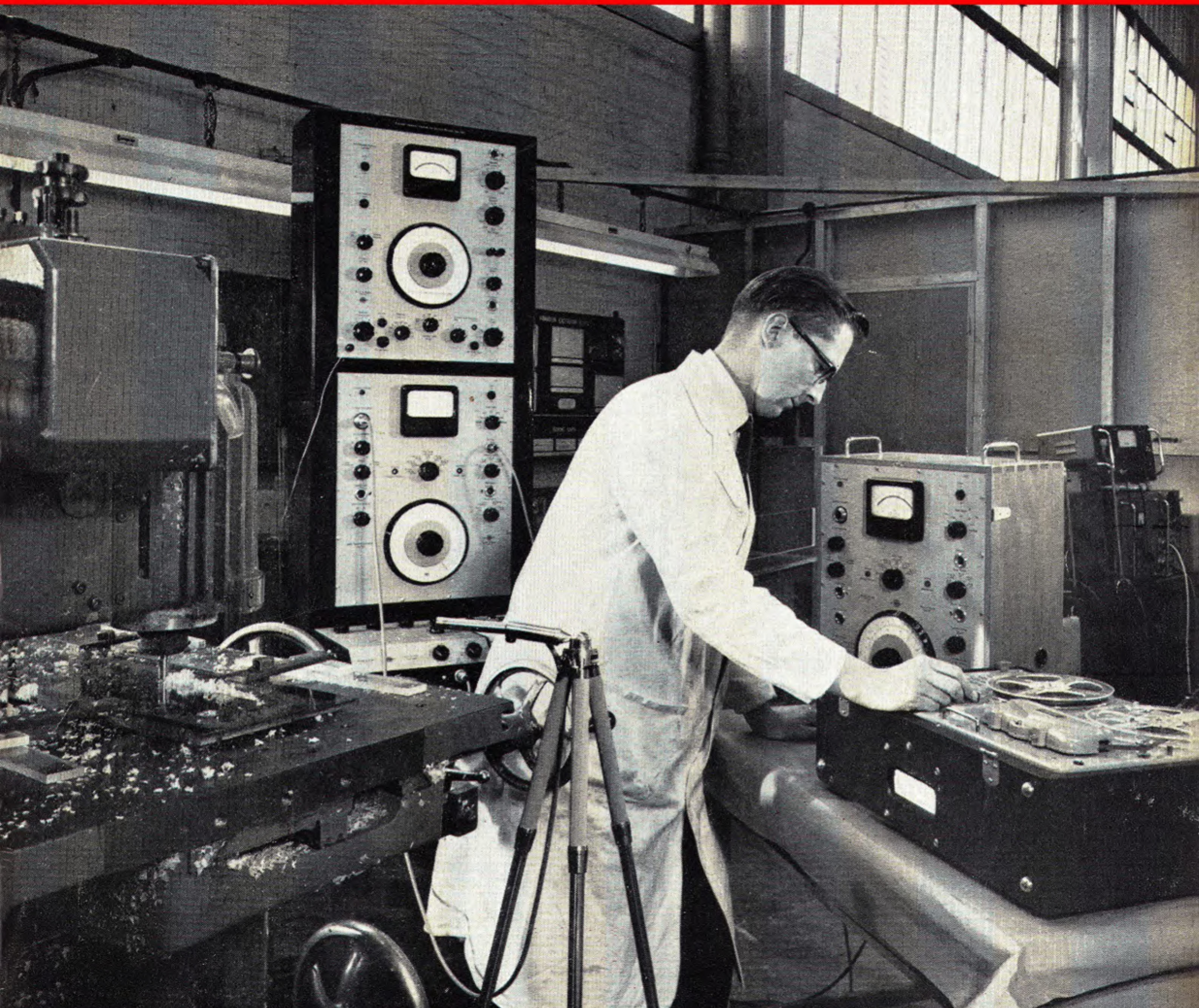
JUNE 1965 TWO SHILLINGS

tape recorder



■ B & O STEREOMASTER REVIEW ■ VARIABLE SPEED TAPE WINDING
THE FLYING LESSON ■ IDEAS ON INDEXING ■ OUR FEATHERED FRIENDS

I SAID YEAH YEAH YEAH ! YEAH YEAH YEAH WAOOOOH ! UM UM HE SAID
YEAH YEAH YEAH ! YEAH YEAH YEAH WAOOOOH ! UM UM UM WE SAID YEA
YEAH YEAH WAOWE SAID UM UM UM ! AN'A YEAH YEAH YEAH I SAID UME
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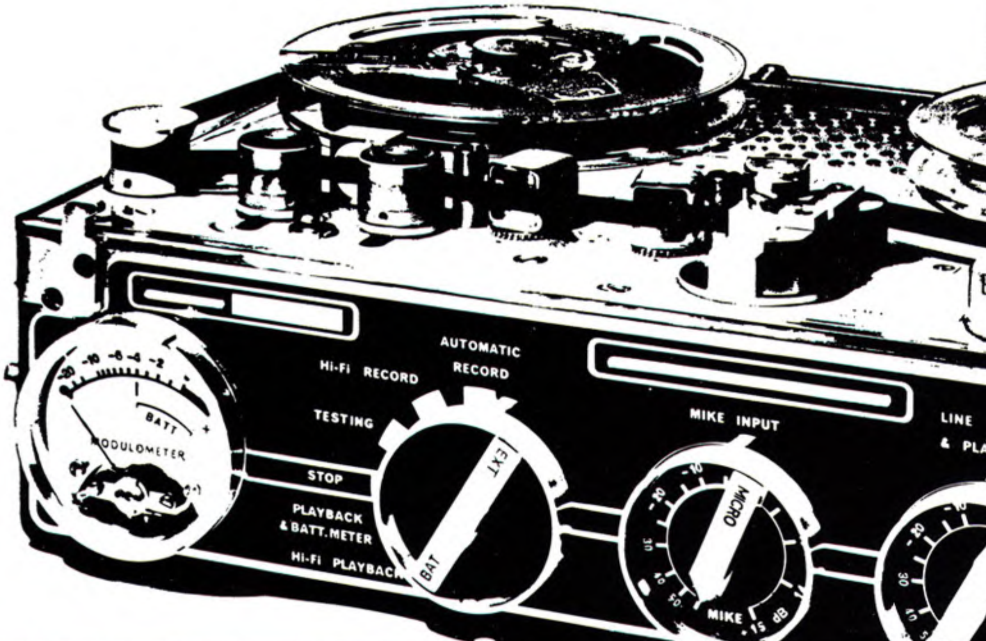

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editorial

DOES accuracy really matter? For the journalist, accuracy often extends to points that are never noticed by the reader. As a magazine we have, in common with most other specialised publications, an editorial policy governing the abbreviation of "inches per second"; the term "frequency response" is never applied to bandwidth figures without suitable qualifications regarding level (otherwise it is merely frequency *range*), while a proper distinction between "¼-track" and "four-track" is exercised where relevant.

Naturally, we do not expect our advertisers and their agents to conform with our techniques of abbreviation, but we would like to see a little more attention paid to factual detail in some cases. This should not be taken for one moment as a rebuke to those on whom we depend for our very existence. When a manufacturer pays good money to his agent and to a magazine for space to display his products, he shares with the window-dressing retailer the problem of using a small area of window or paper to its greatest advantage. Artistic layout plays an important part in catching a reader's eye, of course, but no reader is going to be impressed by inaccurate spelling of brand names (this has happened).

Technical errors, however, lay an advertiser open to the ridicule of knowledgeable readers (do not make the mistake of assuming that only a few readers know and care about the real meaning of such commonly misused words as *monaural*). Whether the advertising world or the manufacturers behind it are responsible we do not know, but certain aspects of tape recording terminology have been so frequently distorted that they run the risk of losing their original meaning completely.

"*Monaural*" is perhaps the best example of such language twisting. This word was born of a marriage between the Greek *monos* (meaning single) and Latin *auris* (ear). Ever seen a tape recorder with one ear?

Listening to sound monaurally involves the use of a single headphone, or deafness in one ear. Wherever audio is carried in a single channel (that is, when it comprises one electrical signal) it is, when reproduced, *monophonic* (mono) unless it is described as being heard through one ear only, in which case it is monaural. If present linguistic trends are not discouraged we will be unable to convey concisely the meaning of the sentence: "Listening to stereo reproduction monaurally is less enjoyable than hearing monophonic sound binaurally." We shall have to invent another pair of words!

Most of us are aware of the difference between a tape deck, tape unit and tape recorder. Yet we know of some trade guides and year books which totally confuse the three. In some cases a tape deck would be listed under the heading *Tape Units* as "excluding amplifier" while a unit would appear under *Decks* as "with amplifier". Why bother with terminology at all?

In view of the controversy aroused lately around the DIN connecting system, we are publishing this month a fairly detailed description by H. W. Hellyer. This is not claimed to be a complete breakdown of the coding which, if every manufacturer's 'adaptation' were included, would need an entire issue for complete coverage. We wonder if Mr. Hellyer, or anyone else for that matter, could have filled much more than a page with a similar account of the jack connecting system!

Finally, B. G. Essenhigh's letter, published on page 201, moves us to comment again on the subject of slap-happy servicing. His letter is typical of many received over the past years (not published for fear of libel suits). But it is the customer and not the retailer who decides whether or not inefficient salesmen and manufacturers are to survive. If every enthusiast who experienced trouble with a manufacturer or dealer boycotted that concern and 'spread the word', a severe decline in trade would occur in certain quarters. And if those of us who would not dream of buying a tape recorder, television receiver or amplifier without an accompanying circuit diagram—if we were in the majority...

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COVER PICTURE

The Production Engineering Research Association, to whom we are grateful for this month's cover, are constantly experimenting in factory machine and press shops to determine the connection between excessive noise and damage to health. An engineer at their Melton Mowbray laboratories is shown taping the noise of a high speed routing machine on to a *Vortexion* recorder.

SUBSCRIPTION RATES

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

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

world of tape

TAPE AT THE APAE EXHIBITION

CLARKE & Smith, Fi-Cord, EMI, Vortexion and Lustraphone were among the manufacturers exhibiting at the Kings Head, Harrow-on-the-Hill on 17th and 18th March. The *Association of Public Address Engineers* Exhibition was as specialised as it sounds, however, and what tape equipment did appear was far removed from the conventional domestic machine. Outside the improvised BBC closed-circuit television studio, the only recorders in evidence were those shown by Clarke & Smith and Pamphonic. In conjunction with the GPO, the APAE displayed an array of microphones, telephones and associated PA equipment from yesteryear.

FI-CORD AT NEW PREMISES

CHARLWOODS Road, East Grinstead, Sussex, is the new home of Fi-Cord International. Expansion into the photographic market was the cause of their move from Dover Street, W.1 ; as well as manufacturing tape recording and dictating equipment, Fi-Cord are now handling *Braun* and *Nizo* photographic products, and also the *Synchrodek*, *Synchroslide* and *Beyer* microphone range.

AN ADAPTED COMPRESSOR

SINCE the introduction of HF bias into magnetic recording by Von Braunmuhl and Weber, there has been little development towards improvement in signal-to-noise ratio of tape systems. What improvement has been obtained has mainly resulted from high coercivity tapes and refinements in operating conditions.

Most links in a recording chain, the microphone, amplifiers and loudspeaker, are capable of attaining signal-to-noise ratios of 70dB. Tape recorders in general, however, are limited to some 60dB.

A new electronic system, the *Noisex* modulator, recently demonstrated in Switzerland, claims to improve on these figures by at least 6dB.

Most noise in a tape recording is either background hiss, or odd harmonics and intermodulation products produced at high recording levels. The Noisex system is an adaptation of the old principle of volume compression and expansion, at one time a popular talking subject among audio enthusiasts and used by communications to improve long distance speech circuits.

The input signal is passed through the Noisex modulator where the volume is compressed linearly to a range of 40dB. This is done by an automatic circuit and following the setting of levels no further adjustment is required. On replay the signal is passed through an expander circuit whose output characteristic is a closely controlled inversion of the input characteristic.

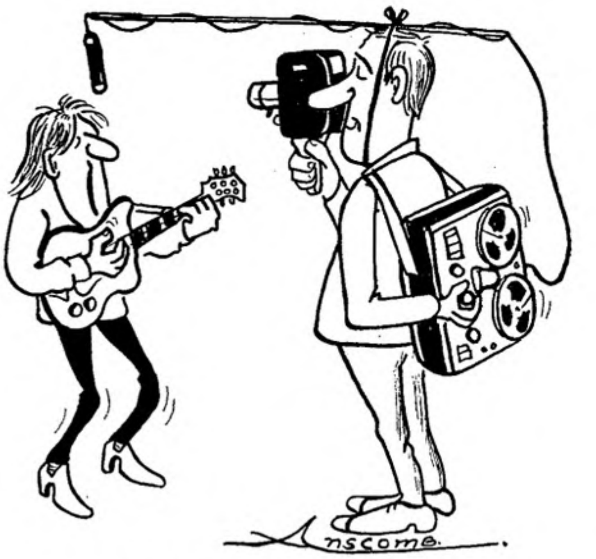
Compression of the signal to a range of 40dB enables the maximum recording level to be reduced from 200 milli-Maxwells to a maximum level of only 110 milli-Maxwells. This greatly reduces the harmonic distortions and noise added at high recording levels. At the same time the low levels are still recorded at a sufficiently high level to avoid background noise from the tape.

In any system of this type the time-constant of the gain control circuit is extremely important. Too long a time constant can result in very peculiar sounds, the effect depending on the type of signal concerned. In the Noisex system the time taken to adjust gain when the signal jumps from zero to 3dB below peak modulation level is less than one millisecond.

It is claimed that a signal-to-noise ratio of 76dB referred to full modulation can be obtained using the system. The unit was also demonstrated being used as a means of reducing the effective noise level on old gramophone recordings when used purely in the compressor mode.

The system has been introduced in a form suitable for use by professional engineers in conjunction with any standard studio recording system working on normal studio line systems. That is to say, input impedances of about 10K and output impedances of 600-ohms. The manufacturers say that such a unit could be made in a form suitable for the audio enthusiast to use at home for about £13.

The makers are *EMT KG* of Lahr, Western Germany, well known as producers of professional sound equipment.



MAN WITH THE MICROPHONE

OUR attention was drawn recently to a song by Sydney Carter on the subject of Copyright. It makes an amusing poem and we thought readers might find it of interest. 'Man with the Microphone' is reproduced by kind permission of *Essex Music Ltd.*

As I went out one morning I was singing a country song.
I met a man with a microphone, and oh! he did me wrong.
He led me to a shady nook, put on a reel of tape
And had my country ditty down before I could escape.

To Tin Pan Alley he took my song, and there he happened to meet
A publisher who cleaned it up and gave the time a beat,
And now it's on the Hit Parade and now they pay a fee
To that false young man with a microphone, and nobody thinks of me . . .

I'll sell my rock, I'll sell my roll, I'll buy a steel guitar,
I'll take a ticket to London Town, and in a coffee bar,
I'll sing until my name is known, and when I'm on TV
I'll tell the world of that false young man and what he did to me.

So all you pretty country girls who like to sport and play,
Be careful of your copyright! (That's all they want today)
And never trust a roving man, whoever he may be,
If his hand is on the microphone, and not upon your knee!

AKAI PRICES DOWN AGAIN

PULLIN Photographic appear to be the only importer adhering to the downward price trend one would expect from the speed and enthusiasm with which their rivals aligned their profit margins to the import surcharge, now slightly reduced. Akai equipment now retails at the following prices : Model 345—£229 19s. Model M8—£153 6s. Model X4—£137 11s. Model 44S—£112 7s.

ELIZABETHAN EXPORT TO USA

ORDERS totalling £100,000 have been won by *Elizabethan Tape Recorders Ltd.* of Romford, Essex, to produce tape equipment for the USA. The company is one of a small number of manufacturers showing initiative by modifying their products to suit overseas markets. The most recent order, worth £14,000, is latest in the line of contracts resulting from an extensive survey of American requirements.

NEXT MONTH

A full report on the Audio Fair will appear in our July issue, to be published on 14th June. Graham Balmain will reflect on the recent *Which?* survey of recording tape, while Robert Kendal describes an original way to win competitions with a recorder. There will also be an article describing the *Son et Lumiere* system installed by *Philips* at Southwark Cathedral.

THE ABC OF TAPE RECORDING

absolute beginners' corner

PART THREE—WHY BIAS?

BY DAVID KIRK

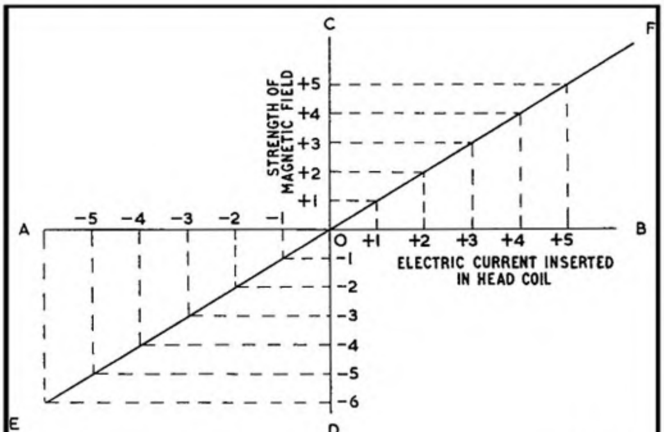


FIG.1.

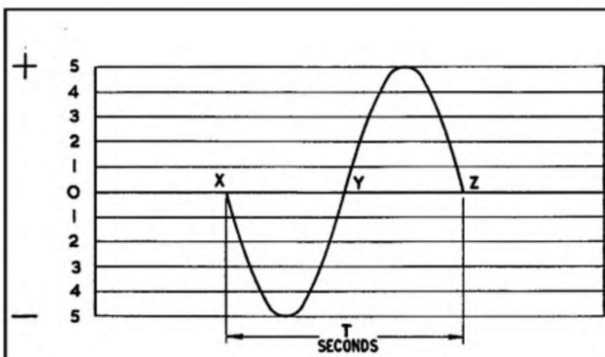


FIG.2.

LAST month's discussion of general electrical and magnetic theory closed with a mysterious reference to the *bias oscillator*. But before describing the effect of bias, let us consider what would happen if a recording were made without it.

The signal from the microphone is amplified until sufficiently powerful to induce a useable magnetic field across the pole tips of the recording head. By running a tape past the head, this alternating field becomes magnetically 'printed' in the tape's oxide coating. **Fig. 1** illustrates in graphical form just what happens within the head coil. For convenience, the two base lines (axes) are labelled **AB** and **CD.** The **O** point at the centre intersection of the two base lines represents zero. We begin by examining the section embodied within **COBF.** The line **OB** represents, as the label shows, an electric current in the coil of a recording head. The further one travels away from **O** towards **B,** the stronger the current becomes. Again for convenience, the current is graduated into five units. Turning our attention, now, to line **CO,** which rises vertically from **O,** we find similar graduations from one to five, representing the strength of the magnetic field produced in the head by a current on **OB.**

The purpose of **OF** and the broken lines intersecting along it is to show the all-important connection between the current inserted in the head and the strength of the resultant magnetic field.

An increase of electrical current from zero to two units can be read along **OB** and the associated increase in magnetic field strength seen by following the dotted vertical line from point 2 through **OF** and horizontally to **OC.** Further doubling the current, from two to four units, shows a similar doubling in strength of magnetic field.

Since, however, we are dealing with an *alternating* current (one continually reversing its direction of flow), the graph must make allowance for the reversal in magnetic polarity which accompanies this. When a current of, say, 5 units is inserted in a coiled conductor, the magnetism at one end of the coil would be either NORTH or SOUTH in polarity. When the current flow is reversed (as it would be if it were AC) it becomes a five-unit flow in the opposite direction. This is termed *minus* 5 (—5). As one would expect, the magnetic polarity is reversed accordingly, the pole which was originally NORTH now being SOUTH.

It is, however, impossible for the current flow to change direction instantaneously. Some time, however small a fraction of a second, must be incurred during the change of direction. Just as a motor vehicle cannot reverse from a high forward speed without slowing to a low forward speed, stopping and then accelerating backwards, so a current of, say, +4 units needs to decrease through 3, 2 and 1 to zero and then increase in the opposite direction until it reaches —4 units.

Pursuing the car analogy, imagine a car travelling from London to Dover at 30 miles per hour; we can say, if we so wish, that it is going at +30 miles per hour. If the car stops, we can still say it is 'moving' at 0 miles per hour. Following the same logic, if the driver turns his car round and travels back towards London at 30 mph it can be said that he is still travelling towards Dover but at a *negative* speed, namely *minus* 30 mph. I hope this analogy might make the positive and negative parts of **fig 1** look slightly less formidable.

Fig. 2 shows a single *waveform* of an alternating signal, such as that produced by the AC mains. Again, the vertical axis is graduated in units (which might be volts or amps), to conform with the graduations of **fig. 1.** The waveform **XYZ** illustrates a build-up of flow from zero(**X**) to minus five units and back to zero, then increasing similarly in an opposite direction to +5 units and back to zero. From **X** to **Z** is a complete *cycle*. The horizontal distance from **X** to **Z** is measured in *time*. The amount of time taken to complete a cycle depends on the

(*continued on page 199*)

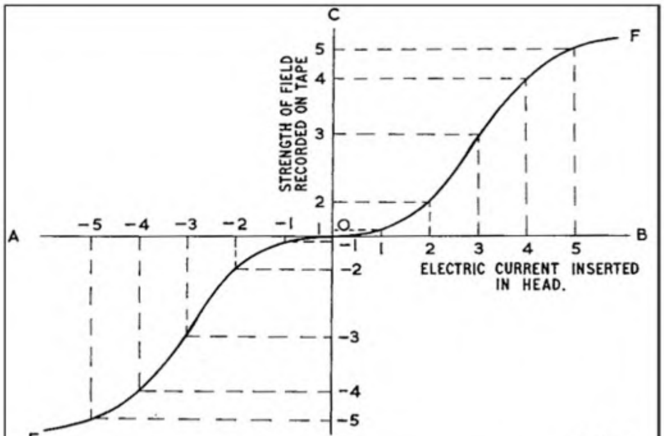


FIG. 3.

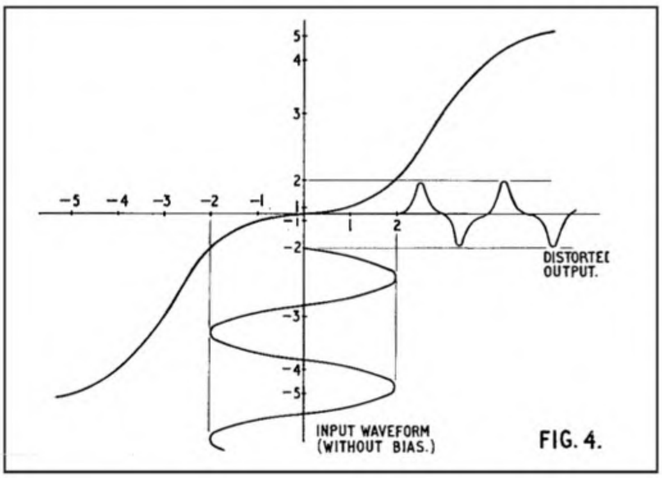


FIG. 4.

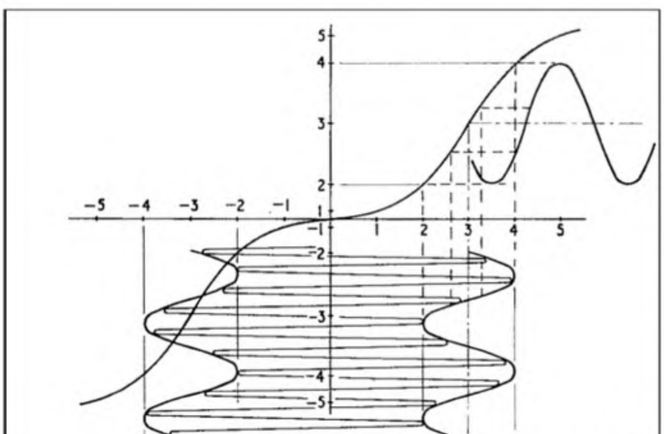


FIG. 5.

frequency of alternation. A 50 c/s signal would require $\frac{1}{50}$ (one fiftieth) of a second to complete one cycle. **T**, in **fig. 2** would therefore be $\frac{1}{50}$.

Since the magnetic field induced in a coil by an AC signal corresponds almost exactly to the electric current inserted, it will be seen that the waveform in **fig. 2** could also represent the change in magnetic polarity of each end of a coil in which the current **XYZ** was inserted. The vertical graduations in this case would represent magnetic field strength and the peak and trough would indicate, not positive and negative current flow, but the points of maximum strength of NORTH and SOUTH magnetic polarity.

The conversion of electric energy to magnetic energy in a coil is therefore a comparatively simple affair. Where does bias come into the picture? Bias is needed because the line **EF** in graph **fig. 3** is curved, unlike its straight equivalent in **fig. 1.** The complex twisting is caused by the introduction of *hysteresis* (don't be alarmed) into the recording process. This occurs in the iron oxide coated on the tape.

While the magnetic field across the recording head gap corresponds more or less exactly to the current inserted in the head coil, the tape does not 'remember' the magnetic signal in such an accurate fashion.

Examination of **fig. 3** shows that a rise of one electric unit, from zero to 1, on axis **AB** gives a very tiny rise in the magnetic field imprinted on the tape (the magnetic strength of which is shown on vertical axis **CD**). A further rise of 1 unit, to 2, results in a much larger increase in strength of the magnetic imprint. Rising yet again to 3 units of electricity boosts the taped imprint by a similarly great amount. While electric current has increased in a constant *linear* fashion, the recorded magnetism has increased in a non-linear far-from-constant way.

Supposing, therefore, we attempt to record a waveform similar to that shown in **fig. 2.** Our amplifier is not particularly powerful, however, and only provides two units of current.

Fig. 4 shows the input waveform of the two-unit current (without bias) and illustrates the resulting magnetic waveform recorded on the tape. The magnetic waveform is far from similar to the coil current: it is distorted. In practical terms, the sound reproduced by the recorder would not be a faithful copy of that recorded. The non-linear electromagnetic transference curve governs, of course, the 'shape' of the recorded waveform. Just as important, however, is the position of the input/output signal on that curve. Between units 0 and 2 it will be seen that the curve is very pronounced; but the segment between units 2 and 4 is almost straight. Should the recording amplifier, therefore, be replaced with a more powerful model capable of delivering up to 4 units? No—the output of such an amplifier would still be subject to distortion because the signal alternates through zero twice every cycle *whatever the amplitude*, and in quiet passages the whole waveform is in the non-linear regions.

To overcome distortion, then, the input and output waveforms must be kept clear of the strongly curved portions of the transference graph at its lower and upper ends.

Fig. 5 shows just how this can be done. The input waveform still comprises two current units, but the current now sits astride a high frequency alternating bias signal. The maximum volume level which can be recorded without leaving the straight portion of the transference curve is now represented by points 2 and 4. The purpose of a magic-eye or modulation meter found on almost every tape recorder is to show just when this optimum level has been reached. Amplifying the input signal more strongly will give more volume but will also cause distortion. Some readers may notice that only the positive side is shown in **fig. 5**; but this is a graphical convenience only, and one way of looking at the process is to imagine that the curved middle portion of the graph is simply chopped out.

It would be perfectly reasonable to ask, at this point, why we cannot hear the bias tone when a tape is replayed. Part of the answer is that, like the tape recorder, our ears have a limited frequency range. Whereas a young person might detect sounds in the 20 Kc/s region (an older person hearing up to some 10 Kc/s), recorder manufacturers push the bias frequency to a point well above human hearing in the 40 Kc/s to 60 Kc/s region, usually. Readers who keep bats might find their pets troubled when a recorder is being used (though I cannot speak from experience!), since evolution has given these creatures an extremely well-developed sense of hearing. Apart from this, there are various reasons why the bias signal cannot be recorded very efficiently, and a slight trace only is left on the tape—if any at all.

A few cheap battery recorders, along with early domestic machines, use DC bias. That is, rather than go to the expense of incorporating a high-frequency bias oscillator, the manufacturer introduces a DC supply to the record head in such a way that the recording signal sits astride it. A DC charged coil, however, takes on the characteristics of a permanent magnet, causing a considerable background hiss to be recorded, along with the signal inserted in the head.

For similar reasons of background noise, the erase head which cleans the tape of all previously recorded material is energised, when in operation, by the bias oscillator rather than a DC signal.

Part 4 of this series, next month, will look first at the erase process and then proceed to discuss the working of microphones and problems of connecting them to tape equipment.

OUR READERS WRITE . . .

. . . about tape head wear

From: Walter H. Scrivenar, 11 Mountside, Guildford, Surrey.

DEAR SIR, I was very interested in the *Reader's Problem* of your March issue concerning head wear, with particular reference to a *Revox* recorder. You may be interested in my own experience with a Revox 2-track machine which has been in use for over two years, and a *Grundig TK5* which was in service five-and-a-half years before a head replacement.

I keep a card record for each tape showing the date each track was played, recorded and re-recorded. From these cards I have determined the Grundig TK5 to have operated for 1,128 hours, by which time head replacement was no doubt overdue.

The Revox operated for 487 hours before requiring head repolishing and has now been in service a total of 988 hours. The heads now show definite signs of wear, which is, however, even wear, and there seems to be some loss of quality which indicates that a head replacement is now due.

It is also of interest to mention that the heads and parts in contact with the tape are cleaned once a month with *Klenzatape* fluid and that the machines are used in rooms heated with electric fires only.

The foregoing (*drastic shortening of many carefully compiled details being regretfully necessary for space reasons*, Ed.) indicates that with a Revox recorder, head repolishing is desirable after 500 hours use, replacement probably being necessary after 1,000 hours at 3¾ i/s. If a faster speed is used, I should think the periods would be proportionately shorter.

Yours faithfully

. . . about BBC Zeppelins

From: Peter Amesbury, 25 Sydney Road, Enfield, Middlesex.

DEAR SIR, Part Twenty of the BBC's television series on the 'Great War' shown on 26th February dealt with the Zeppelin raids on London in 1916. I am most anxious to contact anyone who has made a tape recording of the sound track of this episode. It is of interest to me personally and any help will be greatly appreciated.

Yours faithfully

. . . about sleep learning

From: D. R. Garner, Inductive Learning, 31 Buckland Crescent, Hampstead, London, N.W.3.

DEAR SIR, While Mr. Rubin has written a most interesting and informative article on sleep learning, or inductive learning as it is becoming widely known, it is a pity that he has given the impression that the technique can be used as a therapeutic panacea.

I believe that the use of inductive learning as an educative tool is so valuable that we should be most careful that the claims we make for it do not retard the progress of acceptance by educators. The cases quoted by Mr. Rubin, far from strengthening the case for this new educative tool, only load the gun of objection wielded by traditional educators. Though it is true that inductive learning is successful in treating certain negative personality traits, those suffering from such traits should take professional advice before sending for one of the many do-it-yourself postal kits available today. For such an undertaking correct diagnosis is essential, since symptoms such as unreasonable fears, nail biting, stuttering, etc., may well express more serious emotional disorders, or in some cases even organic disease. Any attempt to treat these symptoms in such a cavalier fashion with generalised positive suggestions can only result in the masking of important diagnostic symptoms or cause temporary relief with the return of the symptoms at a later date. The high proportion of failures will only discredit this fledgling science.

Having worked on this subject for a number of years, it has been my experience and that of others in this field, that for optimum results it is essential to make individualised induction tapes to prepare the pupil's subconscious for receiving data. Subtleties of psychological, emotional and educational backgrounds often so set apart two seemingly alike individuals that one can breeze through a course of inductive learning in days, while the other not only requires a short course of relaxation training, but periodical monitoring to benefit from study.

The point I wish to make and make strongly is that inductive learning is not a hit or miss proposition, it is a precise science yielding precise results in the hands of the specialist.

Yours faithfully

The author comments:

I am not advocating the 'do it yourself' psychotherapy carried out without adequate control in my article. But I would like to emphasise the beneficial and useful application of the tape recorder in certain conditions by treating emotional or personality disorders, in cases where *verbal conditioning* with the voice of the therapist (who can be a psychiatrist or psychologist) is actually prescribed for the patient. I deeply appreciate Mr. Garner's cautious views on the right and skilful application of therapeutic inductions, which shall be prepared in accordance with his case history.

In special clinics in the USA and Europe the patient of the 'sleep wards' receives the treatment technique of verbal conditioning with the application of tape recorders reproducing the recordings of therapists, while the patient is put to sleep by light sedation or electronic sleep-inducing instruments. In this type of treatment the patient receives the therapeutic suggestions or instructions repeatedly over and over again from his therapist as the necessary 'rapport' between him and his patient is already established.

Referring to Mr. Garner's views that I am "loading the gun of objections wielded by traditional educators" by quoting my cases, I suggest that we should not worry too much, as the "new educative tool" has already proved to be a very powerful instrument. **F.R.**

. . . about chasing wild geese

From: B. G. Essenhigh, Gable Cottage, Pembroke Road, Sevenoaks, Kent.

DEAR SIR, I think the only answer to poor or non-existent servicing of tape recorders must be to emigrate to some other country where there is a more enlightened attitude towards this matter. After my own venture into the tape recording world I am really at a loss to know what to do next.

Three years ago I bought a £62 recorder of a very well-known make from a firm of tape recorder specialists, also well-known and who made quite a song and dance about their after-sales-service. Apart from one minor fault which developed soon after purchase, the machine gave very good service for about eighteen months, when a series of faults appeared. From the outset I should mention that I was the sole user of this machine and endeavoured to exercise every care with it.

To the best of my recollection, the trouble consisted of a rather noisy rattle in the take-up mechanism which appeared after some fifteen minutes operation, faint cross-tracking, a 'fast rewind' that became progressively slower, and an auto-stop that did not always stop.

As I am no expert in the electrical field I took the machine back to the retailer with a list of the faults—it goes without saying that these troubles appeared almost immediately *after* the expiry of the guarantee period. I was told that the repairs would take from ten days to a fortnight, but after hearing nothing for three weeks I telephoned them only to be told the recorder was not yet ready. When six weeks and as many phone calls had elapsed I rang once again and was told the same story. After some angry remonstration I was coolly informed that "You can phone our service department yourself if you like". On doing so I was told that my recorder had been returned to the shop about three weeks previously with the repairs completed. Back to the shop where I first received an apology for a "mix-up in the paper work" and then a bill for £5 for the repairs, which comprised replacing the main drive belt and one output valve and adjusting and cleaning the deck mechanism, heads and guides.

At the first subsequent attempt to use the recorder, there was a

(*continued on page 203*)

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For use with most tape decks. Thermometer type recording indicators, press-button speed compensation and input selection. 3-position bias level and printed circuit construction.

TA-IM	Kit £19 18s. 0d.
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This is an acoustically-designed enclosure 26" x 23" x 14½" housing a 12" bass speaker with 2" speech coil, elliptical middle speaker, together with a pressure unit to cover the full frequency range of 30-20,000 c/s. Delivered complete with speakers, cross-over unit, level control, grille cloth, etc. Ralph West ("Hi-Fi News") says: "The reviewer was very impressed and places this design among the top few and unhesitatingly recommends it to the most critical music lover."

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SSU-1 SPEAKER

AG-9U

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Kit £8 12s. 6d. Assembled £13 12s. 6d.

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HI-FI STEREO 6 WATT AMPLIFIER Model S-33. Attractively styled, completely self-contained. Printed circuit makes it easy to build. Only 0.3% distortion at 2½ W/chal. U/l output, ganged controls. Kit £13 7s. 6d. Assembled £18 18s. 0d.

HI-FI MONAURAL AMPLIFIER Model MA-5. An ideal general-purpose reasonably priced mono amplifier, 5 watts output at only 0.5% distortion, has inputs for Gram, Radio. Printed circuit board. Kit £10 19s. 6d. Assembled £15 10s. 0d.

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Single channel, ideal for stereo conversion.
Kit £11 18s. 0d. Assembled £15 18s. 0d.

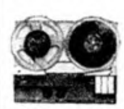
MAGNAVOX "STUDIOMATIC" DECK. Two tracks. "Wow" and "flutter" not greater than 0.15% at 7½" p.s. Long Term Speed Stability better than 0.5%. £14 19s. 6d.

SUGDEN MOTOR UNIT "CONNOISSEUR CRAFTSMAN". Heavy duty motor, operating at 33⅓ and 45 r.p.m. Very heavy 12" turntable. £17 2s. 11d. (incl. P.T.)

USC-1

TA-IS

TRUVOX D93



STUDIOMATIC

HI-FI STEREO 18-WATT AMPLIFIER Model S.99. Within its power rating, this is the finest stereo amplifier available, regardless of price. U/L push-pull output. Printed circuit. Kit £27 19s. 6d. Assembled £37 19s. 6d.

TRANSISTOR INTERCOM. Models and XI-IU XIR-IU. Ideal for office or home. Each Master operates up to five Remotes.
Master Kit £10 19s. 6d. Assembled £16 19s. 6d.
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STEREO CONTROL UNIT Model USC-1. A deluxe stereo control unit with variable filter, switched rumble filter, printed circuit boards and many other refinements. Operates direct from tape heads. Kit £19 10s. 0d. Assembled £26 10s. 0d.

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Kit £14 18s. 0d. (including P.T.)

SHORTWAVE TRANSISTOR PORTABLE Model RSW-1. Four wave-band seven transistor portable with telescopic and ferrite aerials, slow-motion tuning. Covers Medium, Trawler and 6-26 Mc/s in four switched bands. Uses printed circuit board and latest circuit technique. Superbly styled leather case. Kit £19 17s. 6d. (incl. P.T.)

TRUVOX D93/2 AND D93/4 TAPE DECKS. High quality mono-stereo Tape Decks.
D93/2 ½-track for highest fidelity. £36 15s. 0d.
D93/4 ¼-track for most economical use of tape. £36 15s. 0d.

GARRARD AUTO-RECORD PLAYER Model AT-6. A 4-speed stereo-mono unit with manual or fully automatic record selection; adjustable counter-balanced arm.
Fitted with Decca Deram ceramic cartridge £14 6s. 1d.
or Ronette 105 mono/stereo cartridge £13 12s. 1d. (incl. P.T.)

GOLDRING LENCO TRANSCRIPTION RECORD PLAYER Model GL-58. Fitted with the G.60 pick-up arm and Ronette 105 mono/stereo cartridge, it has infinitely variable speed adjustment between 33⅓ and 80 r.p.m. and four fixed speeds. 3½lb. turntable to reduce rumble, "wow" and "flutter". £20 1s. 3d.

S-99 AMPLIFIER

UMC-1 CONTROL UNIT

UXR-2 PORTABLE

GL-58 PLAYER

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.... HT6 distinct fault with the amplifier so it was back to the shop once again and another wait of nearly three weeks. In due course I was presented with another bill for 17s. 6d., but my protestations were brushed aside as this was in respect of something which was "not one of the natural faults", and it seemed a new part had been necessary. It could be said that this was my own fault for not having ensured that everything was in working order after the first set of repairs. However, at that time my own mains plug had been refitted to the machine and as this did not correspond with the fittings in the shop it would have meant waiting while this was changed ; I did not have the time to spare.

Six months later every single fault had reappeared and one other—a pronounced intermittent crackle in the amplifier, particularly noticeable at 1⅞ i/s. In view of my previous experience, I decided to go directly to the manufacturer and explained my dissatisfaction with the retailer's servicing. My recorder was accepted although I was told that they were not in the habit of making repairs for the general public. I will not go into the mix-up that occurred over the estimate, but when this finally arrived I was shocked to find that the work required would cost nearly £11. The parts requiring replacement were again the drive belt and this time the record head and pressure roller. I accepted this under protest and mentioned that the machine had received every care in my hands and in my opinion had not been used frequently enough to bring about excessive wear on the record head, not to mention that only six months previously it had been given a comparatively expensive overhaul.

This produced a monument of impertinent comment. A tape recorder, I was told as if I did not know, incorporated many fast-moving and wearable parts ; that although every care was taken in manufacture, periodic service attention was necessary. In conclusion I was reminded that a direct repair service was not offered to the public and that an owner should look to his retailer for service. This, even after telling them of the 'service' provided by my retailer!

Well, now I have given up. I have had enough of the retailer and the manufacturers apparently do not care very much. My recorder works well enough but they never did cure the crackle in the amplifying system ; the fast rewind *and* fast forward have now become slow and I think the rattle in the take-up system is trying to make itself heard once again.

One last brickbat to the retailer. I have a battery-powered portable of European make which has given excellent service but will now not work for a fairly obvious fault. The service agent for this make changed his address some time ago and I enquired of the above retailing expert where one could get the machine serviced. I was told that they had not the slightest idea and in any case did not service such machines themselves. They would be the last people I would ask to do the job in view of my past experiences, but the scant politeness and complete lack of interest certainly belies their current advertisements. My parting shot to the very young assistant was the oft-heard one that sales seem to engender helpfulness and concern but servicing an attitude of couldn't-care-less. His reply—"I quite agree"!

Yours faithfully

. . . about plugs and leads

From: Donald Smith, Tape Recorder Maintenance Ltd., 323 Kennington Road, London, S.E.11.

DEAR SIR, Whilst agreeing that the subject needs ventilating, I cannot agree with the general line of argument in your April Editorial, nor with one or two of the specific points you make. In catering for the enthusiast I am sure that "one plug, one connection" is desirable and certainly lends itself to rapid interchange and experiment. I think you will agree, however, that the makers of the more popular types must aim at a far wider market. This popular market requires connecting facilities in the simplest form and this is best provided by single lead interconnection ; as you point out, only multiple Continental plugs can provide this.

There appears to be a clear pattern of connections followed by the Continental manufacturer and only occasionally varied by their English distributors, and then for a good reason. Basically this standard (conforming, I believe, to a DIN specification) allows not only monophonic and stereophonic recording and replay but provides for re-recording between any two similar models ; all of this can be achieved by the use of one connecting lead only, which remains permanently in position. With this specification in mind you may agree that the exchange of information on this subject between importers is not necessary.

British manufacturers have been slower in adopting a common pattern, but the recent BREMA paper is leading the way ; the cheapness of the phono plug and socket where *only simple results* are required will be a barrier to the adoption of the more expensive multiple plug and socket. The Japanese are far from committed : one commonly sees a mixture of sockets including the 2½mm. jack which seems hardly strong enough to carry the weight of cable. *(We know at least one Japanese machine, available in Britain, which incorporates DIN, Phono, Octal and Jack sockets !*—**Ed.**)

If this problem is ever solved, it will be a solution based, as are most, on economic factors, and there seems little doubt that to achieve a given comprehensive result the jack plug system you advocate is the most expensive, the phono system comes next, with the far cheaper DIN pattern (for the layman, easier to use) the one with the greatest sales appeal.

Until this happy day comes, your own magazine could perform a signal service by printing a resume of the Deutsche Industrie Norm and British Radio & Electrical Manufacturers Association recommendations.

Yours faithfully

(An article describing general aspects of the DIN system is published on page 210 of this issue—**Ed.**)

. . . about classless postage

From : Charles L. Towers, Secretary, Worldwide Tapetalk, 35 The Gardens, West Harrow, Middlesex.

DEAR SIR, I was most interested to read your Editorial in the March 1965 issue and am naturally delighted to learn that the views of the Editor are now in direct contrast to columnist Rafe Seabrook, whose adverse opinions of tape talkers appeared in an issue of a few months ago.

I agree entirely that "exchanging tapes from continent to continent may be an excellent thing for the world of the future . . . but it can be hard hitting to the average recordist's pocket". We here at Worldwide Tapetalk are very conscious of the amount of money members have to spend on postage if their hobby is to be truly "worldwide", and owing to numerous complaints received in this respect, our organisation decided to inaugurate the Petition which was referred to in your Editorial.

However, in order to keep the record straight, it must be stated that this petition was never presented to the Postmaster General. Although the entire membership of Worldwide Tapetalk of two years ago had the opportunity of signing the Petition, the number who actually did so was disappointingly small and it would appear that apathy exists in the tapetalking world just as it does in most other facets of life. Under the circumstances it was felt that it would be a waste of time to present such a Petition.

Your question of why there should be such a difference between First and Second Class air postages when the cost of conveying the two classifications of packages (weight for weight) is identical, is a good point and I was interested to see their reply.

I also agree that very few people can really make use of 2nd Class Airmail when it comes to tape recordings, if they are to keep strictly within the existing regulations. A solution I would like to see is the disbandment of First and Second Class air rates for tape recordings and the introduction of one class with the postage somewhere between the two extremes now in operation.

Yours faithfully

. . . about the Philips approach

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

DEAR SIR, As requested in your April editorial columns we would like to comment on the subject of connecting leads. As manufacturers we feel very strongly that standards for inter-connecting plugs and sockets are necessary and that once these are agreed all manufacturers should try and copy with them as quickly as possible.

(continued on page 205)

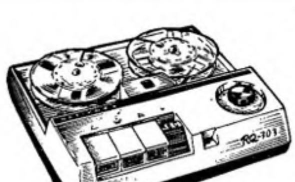
YOU SAID IT! (played it, sang it!) NATIONAL HAVE IT TAPED SUPERBLY!

Just say the word – and it starts! You stop, and the recording stops, too! The **National RQ-150** is the first completely automatic **Voice-operated** portable tape recorder in the world.

And this is only the beginning—the incomparably versatile RQ-150 also provides automatic slide and film synchronisation, automatic threading and remote control. If you really want to spread the word, there's a Public Address System that permits accurate monitoring through a built-in loudspeaker while recording. All this and *immaculate* reproduction—for precisely 44 gns!

SPECIFICATION

Power Source:	6 unit cells (U.2.), 9 V.
Output:	500mW (700mW max.)
Transistors:	9 Transistors, 1 Thermistor, 1 Diode.
Tape Speed:	$3\frac{3}{4}$ i.p.s., $1\frac{7}{8}$ i.p.s.
Frequency Response:	100-7,000 c/s at $3\frac{3}{4}$ i.p.s., 100-4,000 c/s at $1\frac{7}{8}$ i.p.s.
Recording Level Indicator:	VU meter.
Speaker:	$3\frac{1}{2}$" Permanent Dynamic Speaker.
Dimensions:	$3\frac{1}{4}$" x 9" x $12\frac{1}{4}$".
Weight:	5 lb. $14\frac{1}{2}$ oz.
Accessories:	Dynamic microphone with remote control switch; 5" recording tape (600 ft.); 5" empty reel; radio cord; leather case for accessories; hand belt; splicing tape; sensing tape; plug for slide sync.; magnetic earphone.



RQ-303

Also from NATIONAL:

RQ-303, Mains, 2 track, single speed, 15 gns.

RQ-115, Battery*, 2 track, 2 speed, 35 gns.

RQ-116, Battery*, 4 track, 2 speed, 39 gns.

RS-753, Mains, Full stereo, 4 track, 2 speed, 76 gns.

**With optional mains adaptor available*

RQ-115 & RQ-116

National

TAPE IT EASY—

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UME 5-7658-100

ideas ON INDEXING

BY MARTIN YORK

5 in. Scotch Type 150			Tape No: 13
900 ft.			Leader: Green
47 minutes			Track: 2
Philips	**Truvox**	**Title**	**Time**
000	000	Mozart (Own record) Overture - Marriage of Figaro LSO/ Colin Davis	07.00
038	045	Mendelssohn (Own record) Violin Con - in E minor Menuhin/LSO/Davis	31.00
000	000	Beethoven Symph - No. 6 (Pastoral) Berlin Phil/ Kempe	45.00

Tape	Leader	Track	Title	Length (Minutes)
1	Red	1	Junior's birthday 3/5/65	47
1	Red	2	Beethoven 5th Symph	47
1	Green	1	Sound Effects	47
1	Green	2	Percy Flange Quartet	47
2	Red	1	Light Popular Music	32
2	Red	2	Al Jolson	
2	Green	1	Superimposition Experiments	32
2	Green	2	Operatic Arias - Baritone	32

If you feed the cat on goldfish and change your *Rolls-Royce* whenever the ashtray is full, you will probably use a separate tape for each item and tell the butler to remember which is which. We lesser peasants, however, must squeeze several items on to one track and solve for ourselves the problem of locating each piece. I suspect that even your butler keeps some sort of index.

Any catalogue of recorded material must depend to a great extent on the purpose for which it is used. While the music-lover can often get away with a simple note on the outside of the box, this is of little value to the enthusiast who keeps a stock of five hundred sound effects, ninety "pop" tunes or Baby's clever sayings for the last six years. In the absence of contrary evidence, I must assume that most owners have something like the York Collection—a library of unbelievable complexity whose use is made possible only by an indexing system which really works.

My system does not claim perfection but it does all that is asked of it and seems to provide a suitable basis for modification to suit the requirements of most, if not all, other collections.

The foundation on which the index is built was shamelessly stolen from that used on (if you will pardon the expression) gramophone records. No disc enthusiast ever has difficulty, for each record is easily identified from its sleeve and as the collection grows, it is easy to keep a simple list on which each record is given a number. The detailed material on one side of a record is contained on the circular label and by dividing the side into bands, the locating of an individual item is simple. To allay your alarm, I am *not* going to suggest sticking circular paper labels on your cherished tape spools!

My index is in two parts—a numbered index of general titles, similar to that kept for a disc collection, and a detailed loose-leaf index, one page to a track, which corresponds to the label on the disc. The function of the bands is fulfilled by the digital counter reading. The spools themselves are identified by a number typed on a quarter-inch square of paper and secured to the spool by a half-inch square of transparent tape. Such squares are, of course, easily removable.

The general index is used to find which spool contains the required material and, perhaps more important, shows at a glance which tracks are available for recording new material, and their length.

A track containing material of a permanent nature is entered emphatically—red ink, block capitals or what you will—while material of merely passing interest is noted in pencil. It is surprising how often a lightly-written entry can be rubbed out without damaging the paper. A typical general index might look like **fig. 1.** Block letters show 'permanent' entries. The reasons for deciding 'temporary' or 'permanent' are irrelevant ; what matters is that the fact of such decision, a matter for the individual.

An itemised index offers more scope for personal choice of detail. I like to compare different makes of tape, so the maker's name is noted. Others may wish to leave spaces for comment on recording techniques, quality of performance and so on.

Astute readers will have noticed **(fig. 2)** how a change of material is recorded. It will be found in practice that certain tracks will suffer repeated "wipings" while others continue to bear their original material. Hence the reason for choosing a loose-leaf (or card-index) system, so that filled pages can be renewed without bother.

It will be seen that time plays a leading part in my index. This is a great factor in tape economy. A continuous performance, for example, lasting twenty-eight minutes, would leave a seven-minute 'tail' on a tape having a timed length of thirty-five minutes. True, one could record on it but access to the seven minutes could only be obtained by fast winding through the twenty-eight minutes. How much easier if the seven minutes were at the beginning of the track—but how risky, unless your timing is impeccable!

There are problems attendant upon this method of 'stacking'. The solution is to have a master tape upon which transient recordings are made (e.g., radio programmes) and from which the material can be transferred by the use of a second machine.

READERS' LETTERS CONTINUED

Only in this way can we get to a position where the connecting together of different types of apparatus is no longer a problem.

In accordance with Continental practice our Company uses the DIN type plug and sockets on tape recorders. The 5-pole 180° DIN socket, when specified, is fitted on AC mains radios and radiograms manufactured in this country, and this is in agreement with the recommendations of British Radio Electronic Manufacturers Association (BREMA), so that there should be no connecting problems involved. However, we would agree that where space is a problem such as on transistor radio receivers, then another form of socket connection has to be fitted and usually the miniature jack is employed.

In general we are confident that our tape recorder users are not confused by the actual plug or socket numbered connections since every endeavour is made in the accompanying operating instructions to give as much information as possible on this point. All Philips monophonic tape recorders are supplied with a connecting lead, type *EL.3768/03*, which has a 3-pole DIN plug with built-in attenuator at one end whilst the other end of the 2-core lead (Screening forms common connection) is left unterminated. The 3-pole 180° DIN plug also fits into an 180° 5-pole DIN socket. Connections can thus be made quite easily to other apparatus for recording or playback by the customer or dealer to meet individual requirements.

With regard to Philips stereophonic tape recorders we supply two connecting leads with the tape recorder. One is a 4-core screened type, *EL.3768/04*, terminating at each end with a 5-pole DIN plug which enables recording and playback via a stereophonic radio or radiogram fitted with a 5-pole DIN type "Diode" socket, whilst the other lead, type *EL.3948/07* has a 5-pole DIN plug at one end with unterminated coloured cores at the other for use with apparatus other than that using a DIN socket. The coloured cores and pin connections are described in the relevant operating instructions.

For neatness and convenience of connection, particularly for stereophonic recorders surely the 5-pole DIN type plug and socket arrangement is to be preferred.

It is as well to bear in mind that when considering the problem of plug and socket connections as applicable to tape recorders and other associated equipment that impedance and sensitivity problems are liable to be met due to local signal conditions and apparatus design.

Being a local problem, if the user is unable to make satisfactory connections then it is advisable for the dealer to marry the products together with the full technical backing of the manufacturer concerned.

Yours faithfully

variable speed tape winding

TAPE editing, an art which can be undertaken at very little cost, can provide a very fascinating pastime for the owner of a tape recorder. There are, however, two limiting factors imposed by some domestic and semi-professional machines which make tape editing more difficult. The first is an inability of the machine to reproduce during the fast wind of the tape and the second is that no means of varying the speed of the fast wind is usually available, although it is a common feature of expensive professional machines. A combination of the above facilities provides a means for accurate cueing of the tape in editing and saves much time and effort when long lengths of tape are involved.

It is, of course, perfectly possible to overcome these difficulties, even with the simplest domestic machines, by trial and error, but to achieve accurate editing, especially when involved with single notes in music, a high degree of skill is required and the editing of a large tape could be quite a formidable task.

The purpose of the present article is to describe a modification to a *Ferrograph 422U* recorder so that its spooling speed can be continuously varied from full speed forward to full speed reverse. This has a definite advantage over the simpler manual free-wheeling facility sometimes found in semi-professional recorders. In the latter case the tape can be moved backwards and forwards by hand to obtain an accurate cue for editing, whereas use of the continuous control will, in addition, enable the whole programme to be scanned and any part quickly located for editing in the usual way.

The principle of the modification can be applied to many domestic and semi-professional machines which have separate motors to drive the reels. The original circuit, together with the modified circuit, which was suggested by Messrs. Ferrograph, is shown in **fig. 1.**

In the original circuit, switch Sw1 enables mains potential to be applied either to the wind-on motor (switch at A) or the wind-back motor (switch at B). The other two positions are used for recording and playback and in these functions the motors are protected from mains voltage by the resistor R_2 (1.2K). This is so arranged that more power, and therefore a larger torque, is applied to the wind-on motor and less to the wind-back motor, which is necessary to prevent spillage of the tape during its transport from one reel to the other.

In the modified circuit, the two fast-wind positions of switch Sw1 have been joined together and the power taken from a 2.5K potentiometer, R_1. In its simplest form the circuit can be illustrated by the 'bridge' shown in **fig. 2,** where R_b and R_o represent the resistances of the wind-back and wind-on motors respectively and R_1 the resistance of the control potentiometer, which for the purpose of this discussion is divided into the two halves x and y. When the ratio $R_b/R_o = X/Y$ the circuit is said to be balanced and no current will flow through the centre tap T. At this point current can only flow through the motors in series, along the path A B C, and since the torques of the two motors will be equal and opposite and at a low value, determined by the combined resistance of the motors, the speed of the tape will be zero.

As the resistance x is increased, current will begin to flow through R_b and energise the wind-back motor and the current flowing will increase until it reaches a maximum when $x = R_1$. At this point mains voltage will be applied to the wind-back motor and its speed will be maximum. Similarly, as y is increased the current through R_o, the wind-on motor, will also increase and full speed will be obtained when $y = R_1$. This is shown in **fig. 3.** In this diagram the actual shape of the curves will depend on the efficiency of the induction motors and on the load applied to each, that is the relative amounts of tape on the reels. The negative part of **fig. 3** shows the speed of either motor when it is being driven in the reverse direction by the pull from the other motor.

At the point where the curves intersect (X in **fig. 3**) the reels will be stationary and, if the loads on the two motors are the same, their torques will be equal and opposite and X will represent the balance point of the circuit. It can also be seen from **fig. 3** that as the speed of one motor is decreased from maximum, the speed of the other is increased. This, in practice, means that the torque of the supply reel will increase as the speed of the take-up reel is suddenly reduced, which is a convenient arrangement to prevent tape spillage.

So far little has been said about the actual motors used to drive the reels. These are generally of the single-phase induction type where there is no electrical connection between the stator (fixed coil) and the

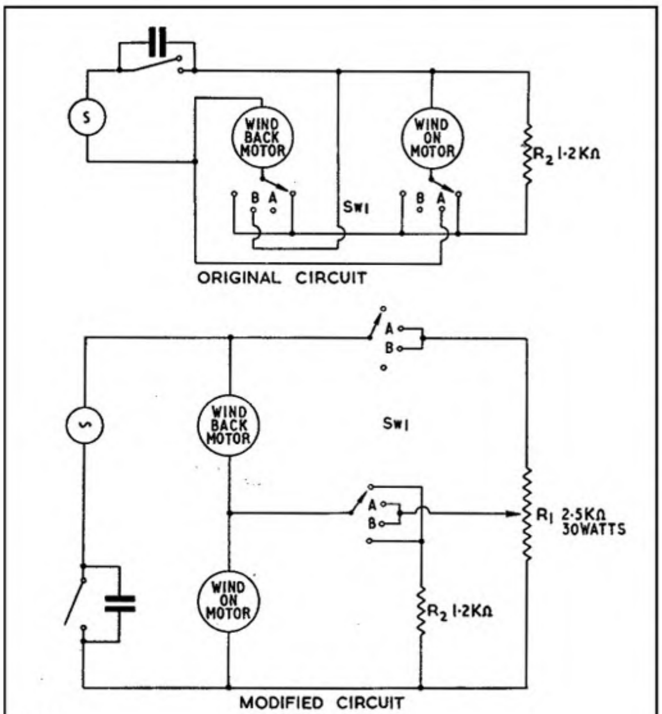


FIG. I.

AN INEXPENSIVE AID TO EDITING

BY G. T. ROGERS

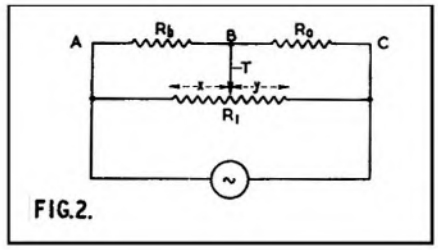


FIG.2.

Bridge circuit illustrating theoretical arrangement of motors and control potentiometer

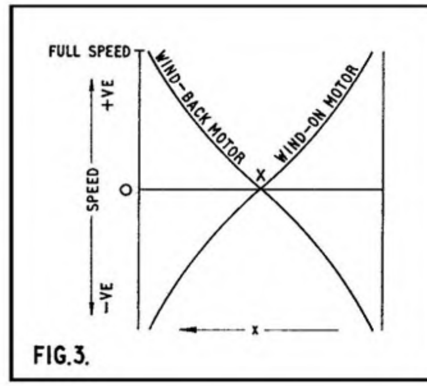


FIG.3.

Variation of motor torque over supply voltage range

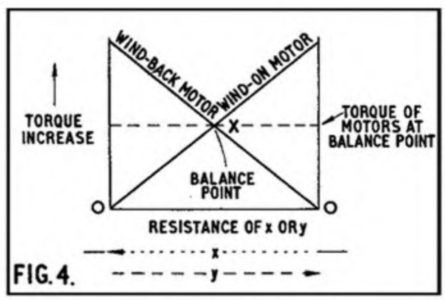


FIG. 4.

Relative torque between motors

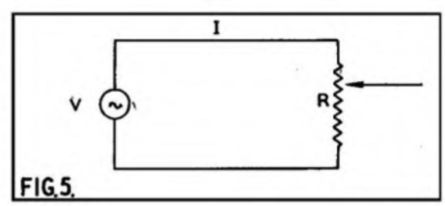


FIG.5.

Circuit for calculation of potentiometer power rating

rotor (moving coil). The energy is transferred entirely magnetically by means of the EMF induced in the rotor conductor by the alternating field set up by the stator winding. This principle of operation enables the motor to be simple, robust and efficient, but as any attempt is made to reduce the speed, by reducing the supply voltage, the efficiency falls.

In the induction motor the speed of the rotor is always less than the synchronous speed, the difference being the speed at which the rotor 'slips' in the field ; it is known as the slip. Clearly, as the slip increases the speed of the rotor decreases. Without going into the theory of the induction motor, it can be stated that as the supply voltage falls the torque at a given slip is reduced. In the modified motor circuit (**fig. 1**) it is therefore the *relative* torque between the two reels that determines the speed and direction of the fast wind. This is shown in **fig. 4,** and again the point of intersection X will represent, in practice, the balance point of the circuit.

Consider the potentiometer in the circuit illustrated in **fig. 5.** All the energy in **R** will be converted into heat as a result of 'free' electron collisions with the atoms while the current flows. The power consumed by R is the rate at which the latter uses up energy supplied to it and is given by the following formula : Power$=I \times V$ watts (and by Ohm's law)$=I^2 \times R=V^2/R$. Therefore the power consumed by the potentiometer in the motor circuit will be : Power$=V^2/R=\frac{250 \times 250}{2500}=25$ watts. To allow a suitable safety factor a potentiometer with a power rating of at least 30W was used.

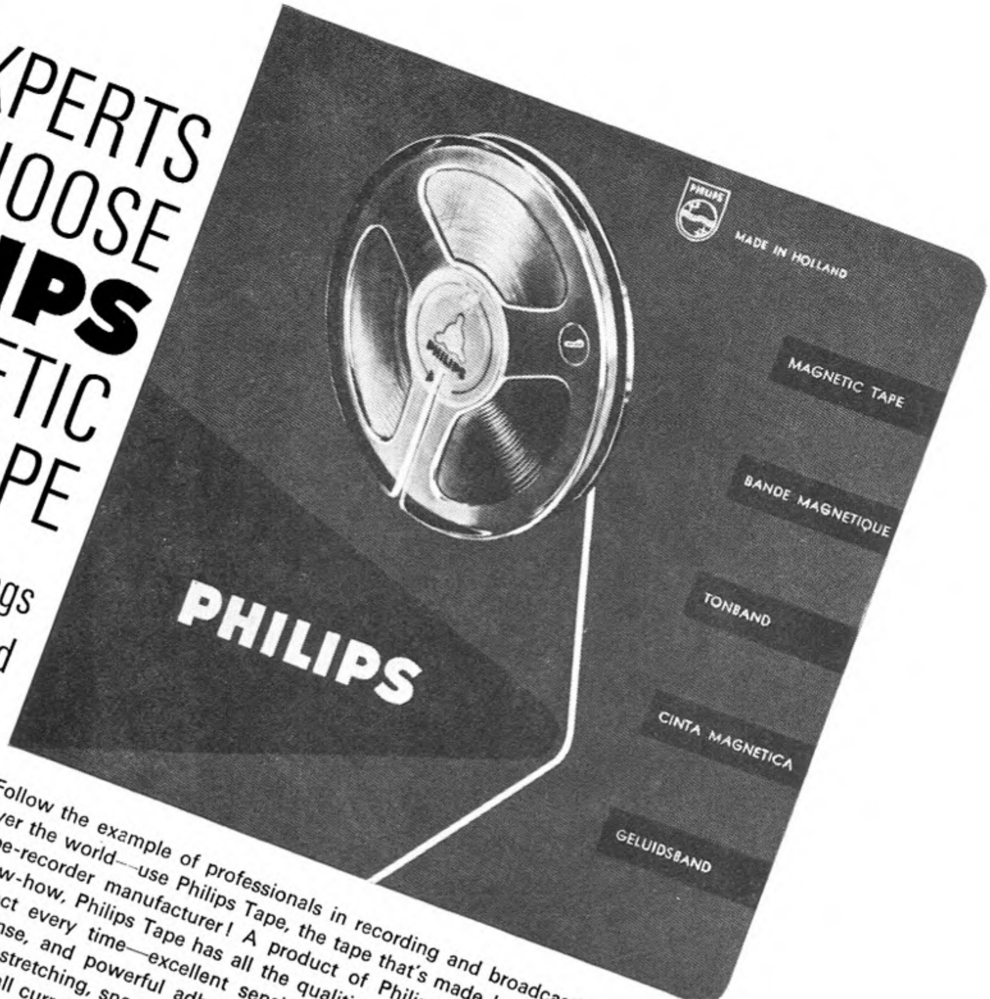
For those wishing to apply this modification to other tape recorders, the following general points will have to be considered. Machines with a single motor to drive both the capstan and the reels generally rely on some mechanical means, such as a pulley and friction wheel, in order to engage and reverse the fast wind, and the modification described in this article will not be possible. Some machines have two motors, one for the capstan and the other for the fast wind. Again this latter function is generally effected by physical engagement of the motor, or a friction wheel, with the appropriate spool carrier, and modification, if possible, would be limited to separate controls for each direction of fast wind. Induction motors are not reliable when running at below synchronous speeds, and this could be a problem when one motor is used to run the reels.

It is, of course, essential that the machine reproduces while the fast-wind is operating, although if this is not so it can usually be rectified by minor modification to the main function switch on the recorder.

Because of the heat dissipated and the restricted space inside nearly all non-professional recorders, it will be found convenient to mount the potentiometer on a separate ventilated control panel. The most useful position for this is on the right-hand side of the recorder, level with the deck. The power supply (mains voltage) can then be fed by a short length of three-core cable from an auxiliary socket at the rear of the recorder to a similar socket on the control panel.

EXPERTS CHOOSE PHILIPS MAGNETIC TAPE

—for perfect recordings of every sound



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

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

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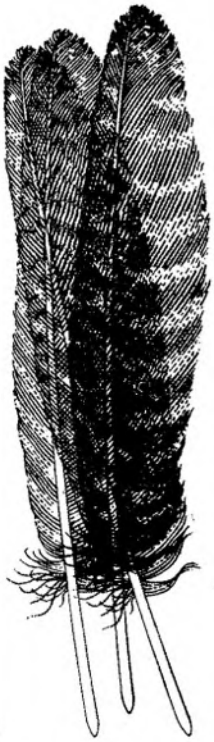


OUR FEATHERED FRIENDS ON TAPE

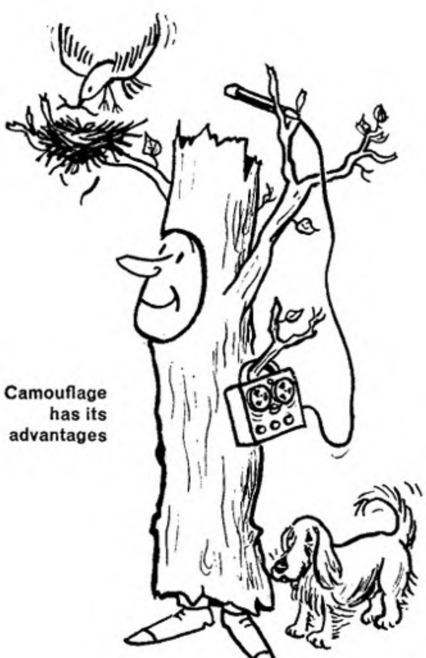
BY ANSCOMB

an illustrated guide to bird recording

Eagles present a problem of their own

Protect your equipment from the damp

Avoid the hedgegrove lark



Camouflage has its advantages

Pigeons are not hard to find

LIVING WITH D.I.N.

The European approach to audio connectors
by H. W. Hellyer

MENTION 'standardisation' to the dyed-in-the-wool enthusiast and he is likely to shudder with horror. Any attempt to impose regulations is regarded as an encroachment on personal liberty.

Standardisation of the plugs and sockets used for interconnections of audio (and radio) equipment can lead to *greater* freedom. Quite contrary to the sense of restriction that the term implies, the knowledge that such-and-such a pin will be the chassis connection, that the right-hand channel will be inevitably right and that the microphone plug that fits machine A will insert equally well in B enables the user to forget some of his problems and concentrate on the important part of his work—be it experiment or repair.

This vital fact was recognised some time ago by the principals of those enterprising specialists, *Tape Recorder Maintenance Ltd.*, who now supply inter-connecting leads in many forms, that will couple anything to anything. Kits of leads with the many alternative couplings are a boon to the service workshop. With the input and output types joined by phono-lead connectors, 100 combinations are possible.

Tentative steps toward standardisation had been made for years by various manufacturers. But without a concerted effort, the growing chaos up to the start of this decade threatened to get out of hand. On the Continent, with the much greater amount of electrical equipment, the problem was being tackled by the German Standards organisation. This body, the D.N.A. (Deutscher Normenausschuss), recommended the D.I.N. plug and socket as the most versatile type of connector. In 1960, the Audio Manufacturers Group (AMG) of BREMA joined the trend toward uniformity and issued a joint recommendation "... for Connections between Tape Recorders and Radio Receivers". These recommendations were largely in accordance with the German standards of DIN 45511 and DIN 41524.

The DIN plug is a three or five-pin connector with a metal skirt that completely screens the pins and provides a keyway for insertion in the socket. The fitting is non-reversible. A popular form of this plug is illustrated in **fig. 1.** This is the type manufactured by Richard Hirschmann of Germany, and distributed in this country by *Neoflex Ltd.*, London, N.W.2. A plastic body with flexible neck slides over the metal skirt previously mentioned. As the latter is in two halves, with one bearing a cable clamp and the keyway while the other has the pressed-out tongue over which the cut-out in the plastic body fits, assembly is a simple matter of holding the parts together and sliding into place. No screws, no springs, no odd parts to be lost.

As was stated above, the two DIN plugs to the DNA specification are the three and 5-pin types. In fact, there are several types, ranging from a 2-pin to a 6-pin, and these receive wide use in the business equipment field. *Grundig*, for example, have their own versions, with strengthened cable clamp and outer spring protection. The basic pin

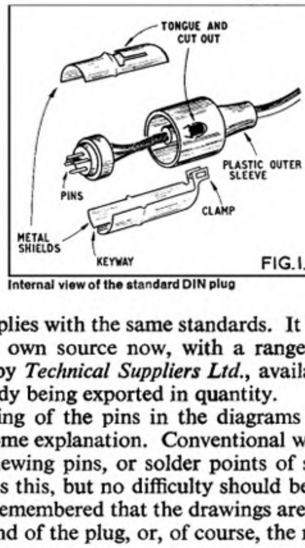


FIG. 1.

Internal view of the standard DIN plug

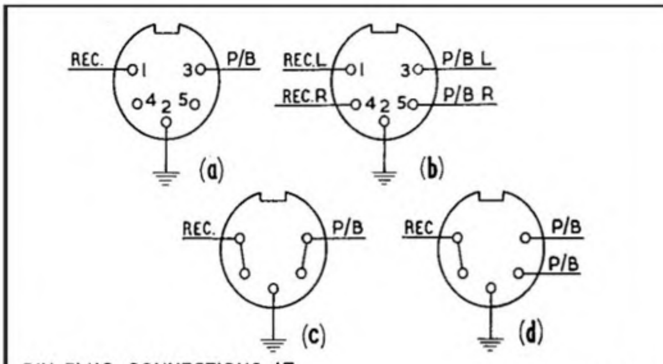
formation complies with the same standards. It is good to report that Britain has its own source now, with a range of plug, socket and coupler made by *Technical Suppliers Ltd.*, available through retailers only, and already being exported in quantity.

The numbering of the pins in the diagrams that accompany this article needs some explanation. Conventional way of numbering pins is clockwise, viewing pins, or solder points of socket. The German method reverses this, but no difficulty should be encountered so long as it is always remembered that the drawings are of the pins as viewed from the free end of the plug, or, of course, the rear of the socket, the solder points.

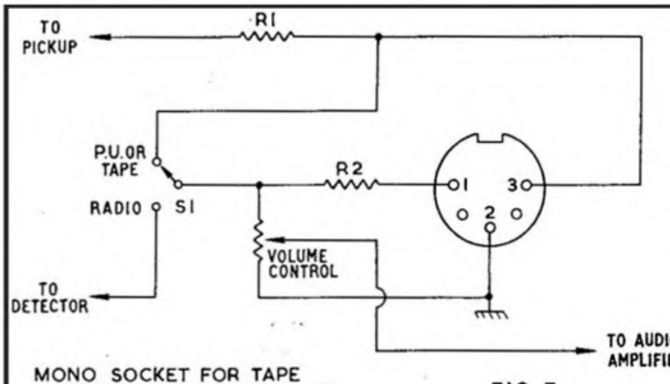
Reference to **fig. 2** will also show that the centre or lower pin, Pin 2, is always earthed. Pin 1 is the Record connection, whether in 3- or 5-pin version, and Pin 3 the Playback connection. But matters go further than this, and the recommendations are actually for 'Connections between Tape Recorders and Radio Receivers'. This means that where a 'Tape' outlet socket is fitted, the connections of **fig. 2** will apply, but need not necessarily be the same at the tape recorder end, where things are left more to the manufacturer's discretion.

For example, the accepted method of stereo outlet and input is as in **fig. 2(b)**. The chassis connection is again commoned at Pin 2, the Record pins are 1 and 4 for Left and Right channels respectively, and the Playback connections are from Pins 3 and 5. But one notable exception is the plug of the Philips EL3787 transistor preamplifier, whose connections are as follows : Pin 1, R.H. channel input recorder signal ; Pin 2, earth ; Pin 3, L.H. channel Diode output from tape recorder ; Pin 4, earth, connected only when plug is inserted ; Pin 5, 22V line (negative) from Recorder. Again, the Radio socket, while connected as in **fig. 2(d)**, with Pins 1 and 4 linked, and 3 and 5 separate, has the latter two combined by a switch operated by the Playback button, as this is not a stereo machine.

A good example of the versatility of the DIN connector is gained from the Grundig TK40 input and output panel, where seven connec-



DIN PLUG CONNECTIONS AT RADIO OR AMPLIFIER INPUT. FIG.2.



MONO SOCKET FOR TAPE INPUT/OUTPUT AT RADIOGRAM. FIG. 3.

tors are used, all 5-pin. A wide variety of facilities is catered for, including ciné attachment, telephone adapter and remote control. Consequently, the pin sequences are not as given in the diagrams of **fig. 2**, even Pin 2 being 'above earth' in the case of the telephone socket. Reference to the diagram should always be made when tracing out the tape recorder connections. **Fig. 2** refers to the plugs and sockets at the radio or amplifier to which the recorder is connected.

The reason for this dissertation is to underline a few important strictures made in the AMG paper which set out the CNA recommendations. These are : in addition to making possible recording and playing back via record player, radiogram or amplifier, to play a mono tape through both amplifiers of a stereo system, to play a stereo tape monophonically through the single channel of a mono amplifier, to leave the tape recorder in circuit while the radio operates normally, and to balance volume and tone by controls on the radio.

This means that provision has to be made at the receiver end for acceptance of the tape recorder signal, and **fig. 3** shows the recommended circuitry for mono recording from a mono amplifier (or radio). For the benefit of numerous readers who have wished to improve on the method of tacking a couple of wires to the external loudspeaker sockets, this, and the following circuits may give a little guidance. A permanent connection on the family radio, with plug and socket rather than loose wires and matchsticks, is always more impressive to the scientifically-minded nephew on his annual visit.

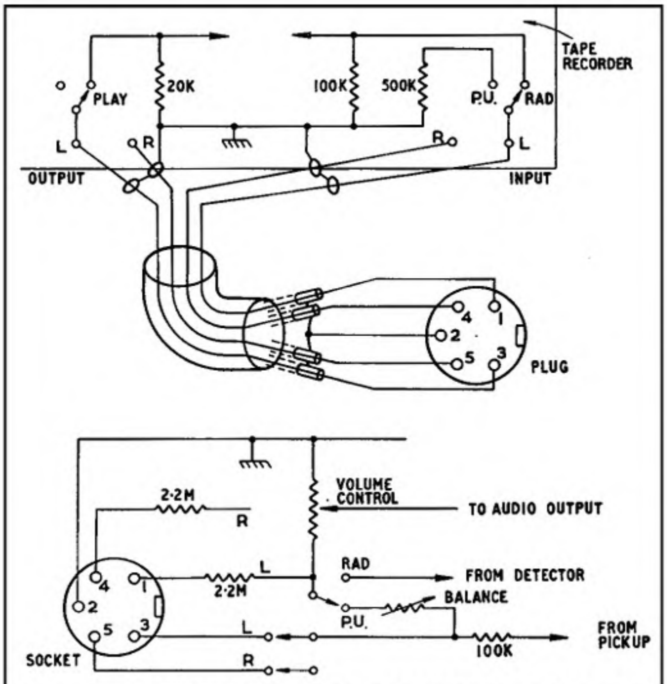
In **fig. 3**, it can be seen that the input lead to the tape recorder goes to Pin 1 and the output from the tape recorder (this is the high-level or Monitor output) is applied to the radio via Pin 3. Pin 2, as before, is the earth connection. General practice is to use two separate screened leads, with the screened connection (the outer braiding) of each joined at Pin 2. The two resistors have special functions, and the switch is used to select either radio or gram and tape combined. Therefore R1, which should be about 100K, serves to prevent the self-capacitance of a crystal pickup from damping the tape recorder output, the two sources being in parallel across the volume control of the radio receiver when P.U. or Tape is selected for playing back. The alternative problem, of the tape recorder output damping the pickup, requires a 'Tape Play' switch in the tape recorder. This is only a simple break in the connection to Pin 3, so that the recording of discs is accomplished when the radio switch S1 is in the upper position, and on many machines is automatically done when the user switches from *Play* to *Record*. Alternatively, this can be done at the radiogram end, as in the stereo examples below.

The other resistor in **fig. 3**, a 2.2 Meg component, is quite important, both in its function and its physical position. Its purpose is to prevent the tape recorder input circuit from shunting the detector circuit of the radio. Its positioning, at the tape recorder input plug rather than in the more convenient place shown, in the internal wiring of the radiogram, is to reduce HF losses by maintaining as high a sensitivity input of the tape recorder as can be obtained.

This question of HF loss is also considered in the AMG paper. The self-capacitance of each playback lead in a connection arrangement such as shown in **fig. 2(d)** must not exceed 150 pF. Usual self-capacitance of screened connecting cable is about 30 pF per foot. This allows up to 5ft. of connecting lead, but does not allow for the HF losses when recording, which are more severe, especially when recording from disc. The best way of reducing losses is to keep the cable as short as possible, and to use cable of as small a self-capacitance as possible. 20 pF per foot is a good figure to aim at, but this cable will, of course, be rather more expensive.

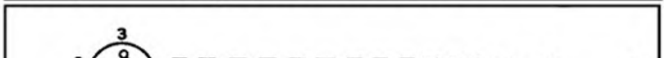
It is the problem of cable capacitance that complicates the stereo switching as shown in **fig. 4**. Should the arrangement of tape recorder and radiogram be required to operate as a mono playback through a stereo amplifier, with channels in parallel, and then the connector plug

(continued on page 212)



STEREO CONNECTIONS, TAPE RECORDER-RADIOGRAM.
(only one channel drawn in full.)

FIG. 4.



PHILIPS LEADS.

FIG. 5.

be left in, when the radiogram is to be used once more for stereo disc playback, the capacitance of the leads from the recorder to Pins 3 and 5 of the input plug will be shunted between the stereo channels. This could lead to crosstalk, and demonstrates why it is necessary to keep connecting cables short and of low self-capacitance.

Fig. 4 shows a recommended circuit from tape recorder to radiogram, with suggested values of components and switching to allow the greatest versatility. Modifications to this would be to insert the 2.2 Meg resistors as described in the plug connection to the tape recorder, and to fit the links between Pins 1 and 4 for mono recording (on the plug to the radio in **fig. 2(c)** and **(d)** to the tape recorder input socket). If the radio is a mono type, it is easier to fit the link at the receiver socket. Then, if a stereo receiver is to be used later, a twin-cored lead will have to be fitted. Provided the 2.2 Meg resistors are fitted at the tape recorder plug end, a cheaper cable could be used, and a 4-core type for stereo work will be quite satisfactory provided it is not too long.

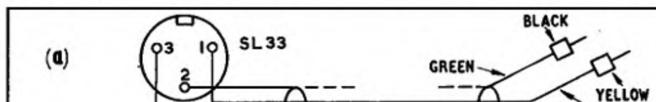
To come to specific cases, some details of Philips interconnecting leads follow (the writer pleads exoneration; editorial instructions were to incorporate the details in this article rather than in the servicing piece).

Fig. 5 shows five separate connecting leads, with their relevant part numbers. **(a)** is for recording and playing back via radio, the three loose pins being supplied to fit the receivers not adapted for tape links. Note the 2.2 Meg resistor. Input sensitivity of recorders it matches should be 350mV, and output from them 1V across 1K. In this case, as in **(b)**, the colour coding of the loose ends is always Red, Record; White, Playback; and Black, screen. The second connector, **(b)**, is a later version, with a 1.5 Meg series resistor in the recording lead. As well as being supplied with all mono recorders, it is suitable for connection to the *EL3787/00* preamplifier.

Stereo versions of these are given at **(c)** and **(d)**, and are useful for copying purposes, for Duoplay and Multiplay. Note, particularly, the arrangement of resistors in **(c)**.

A general-purpose lead is shown at **(d)** with no resistors and colour-coded ends, and with the screens of the four cables commoned. Finally, a 2-pin plus centre-connector plug and lead is illustrated, to suit earlier machines, and for connecting to many Philips radios of older vintage. These extensions all cost 12s. 6d. and are available from a Philips dealer, but not directly from the manufacturer.

To complete the picture, a few Grundig leads are shown in **fig. 6.** The 6ft. long SL33 **(a)** is used with many machines, from the TK5 to



GRUNDIG CONNECTORS.

FIG. 6.

the TK55 and suits all inputs, high and low impedance outputs, etc. Note that the colour coding for both the plugs and the cable is given. This is to avoid confusion with **(b)**, the SL33/S which is used for the TK60 and which has a different colour-coding. **(c)** and **(d)** are connecting leads for the Cub, the latter being a lead adapter to match the non-standard 5-pin socket to a standard DIN. **(e)** is worth noting, being the microphone extension lead suitable for many machines—the catch being the connection of MIC casing to screening. Finally, **(f)** is the multi-purpose 4-way plus screen supplied with the TK60.

field trials of battery portables

BY DAVID KIRK

NO. 9 TELEFUNKEN M.300

MANUFACTURER'S SPECIFICATION. Tape Speed: 3¾ i/s. **Spool Capacity:** 5in. **Battery complement:** Five 1.5V high power cells. **Frequency range:** 40 c/s to 14 Kc/s. **Signal-to-noise:** 50dB. **Output power:** 1W. **Loudspeaker:** 4 x 2¾in. elliptical. **Level Indicator:** VU-meter. **Wow and flutter:** ±2%. **Dimensions:** 10½ x 10¾ x 3in **Weight:** 7lb. **Accessories:** Mains unit with rechargeable battery. Microphone with built-in modulation level meter and control. **Price:** £61 19s. 6d.* **Distributor: Welmec Corporation, Lonsdale Chambers, 27 Chancery Lane, London, W.C.2.**

EVERYTHING went wrong! Basic speed was some 20% slow, new batteries were registering as near-flat. Playback volume was low and increasing gain reduced the speed even further. After giving fifteen minutes of power, the battery voltage fell below the level required for efficient erasure, and the struggling bias oscillator let through considerable distortion during recording.

Then I read the instruction book. This informed me that 'high-power' batteries must be used. They were duly purchased for some 10s. and on insertion gave the results closer to those one tends to expect from £62 recorders.

The recorder is cleverly designed, being of attractive appearance, and really easy to use. Every function can be operated—not with one hand, but with a single finger. Mechanical controls are situated piano-key style where they may be depressed by the firm touch of a fore-finger or thumb, depending on whether the user is left or right-handed. The four tabs govern, from left to right, FAST REWIND, RECORD, PLAY and FAST FORWARD. They are cancelled by a STOP bar running the full length of the 'keyboard'. The RECORD tab locks into place to enable recording level to be set without running the tape. Before recording can commence, the RECORD tab must be pressed either before or with PLAY.

The recording level indicator, a VU-meter, is angled upwards and can be seen easily when used by a standing operator. Modulation level is governed by a feather-light rotary control built in to the handle. When holding the machine in the right hand, the thumb rests comfortably on a short plastic segment of the handle which is, in fact, the pause control.

Campaigners for the *DIN* connecting system may raise their 'everything-through-one-socket' eyebrows on learning that the M.300 has no less than *five* DIN sockets of various types. The instruction book, however, gives a detailed account of the connections and no complaint can be made of the machine's versatility. It may be connected to an external loudspeaker or amplifier for replay, the monitor speaker being operative or cut out as required ; a mains unit or battery charger (rechargeable cells are available as accessories) may be connected ; earphone monitoring is possible during recording (an important point) and replay.

No tape recorder, be it mains or battery powered, is really complete without an external amplifier and speaker. As seems often the case with tape recorders incorporated in plastic cabinets, the internal speaker produced a dull, gritty sound, caused by vibration of the lid and grill. Nevertheless, the speaker is good enough for monitoring purposes.

Visitors to the 1964 Audio Fair may have heard the M.300 demonstrated through a Telefunken radio which was used as an external amplifier-speaker. Despite the limitations of the comparatively small speaker within the radio, the quality of reproduction could hardly have been bettered by similarly-priced mains machines at 3¾i/s. The model under trial behaved equally well, producing a clean and well balanced sound. To obtain recordings of a reasonably high standard, however, it was necessary to control modulation with extreme care. A little too low and amplifier hiss and motor interference encroached on quieter passages, while just a little too high a setting caused the usual distortion. There was little margin between under and over-recording when radio, pickup or microphone was supplying the signal. Motor interference on the FM band proved slightly troublesome, depending on the position of the M.300 in relation to the tuner (*Armstrong 224*). This is apparently not peculiar to my own equipment.

Battery consumption was found to be rather high and I would advise any owner of the M.300 to purchase rechargeable cells. The dual-purpose meter indicated the high power cells to be below optimum voltage after little more than four hours of intermittant use.

Used after this four-hour period, the machine functioned deceitfully well on a short test run but tape speed slowed gradually in the course of a longer recording. The M.300 is, therefore, very expensive to run on non-rechargeable batteries, requiring a new set of 10s. batteries every four hours.

High battery drainage may have accounted for the exceptionally powerful drive, which, in conjunction with a contra-rotating double flywheel mechanism, allowed the recorder to be swung and twisted without speed instability.

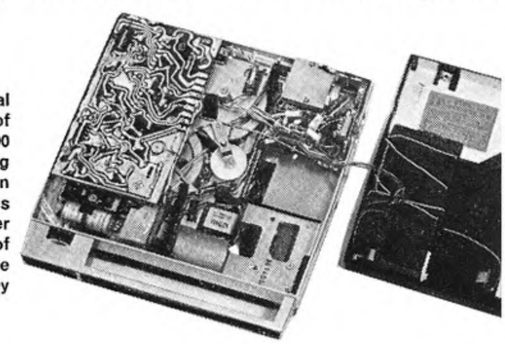
Tight-fitting spool hubs allowed the machine to function horizontally, vertically and upside down.

Sockets for the connection of a shoulder strap are incorporated at each end of the handle, though the thin casing (just 3in. from base to lid) and remarkably light weight (7lb.) make this accessory by no means essential.

Entry to the battery compartment is a simple matter. Placing the recorder upside-down reveals a plastic plate with indented finger grip. The plate is removed by a combined forward and upward movement. The internal mechanism is also easily accessible, entailing the removal of four screws from the cabinet base.

The microphone supplied with the M.300 was a moving-coil stick type with detachable stand. This gave excellent results on speech and

Internal view of the M.300 showing the twin flywheels on either side of white pulley



live music and was not unduly sensitive to cable rattle.

Fast wind and rewind were faster than generally found on battery machines, despite some sluggishness when beginning a wind on to an almost full spool.

My closing comments on the M.300 reflect a divided opinion. The machine gives excellent wow-free and wide frequency range reproduction when used with high power batteries, despite a very little electrical motor interference which never seems completely absent from speech recordings. Battery consumption, however, is far too high for the domestic user, the recorder costing some 2s. per hour to run. The accessory rechargeable cells presumably overcome this problem, in which case the M.300 represents reasonable value for money.

* Going to press we learn that the M.300 has been reduced in price to £51 9s.

THE factors involved in the equalisation of a separate playback amplifier are not always fully understood by the newcomer to the art. This aspect of tape recording is very important, especially when it is proposed to add a second isolated channel to a single channel machine for monitoring or stereo applications. One may be excused for failing to delve too deeply into the technicalities of equalising, as they apply to a commercially designed machine which is featured essentially for operation as distinct from experimentation. However, there are now many enthusiasts in favour of experimentation!

Last month we saw how the spare section of a ½-track head can be used for playing back a recorded track while the 'active' section of the head is actually making a recording. A head amplifier for this purpose was described, as also was its equalisation.

If it were possible to record a tape with pure signal so that the magnetism imparted to the oxide was equal in strength at all frequencies from the lowest bass to the highest treble, the EMF (voltage) induced into the winding of the playback head would rise in strength at the steady rate of 6dB-per-octave from the lowest frequency up to a frequency where the signal rise would cease and subsequently fall rapidly. The frequency at this point is called the 'turnover frequency', and a curve illustrating the effects described is given in **fig. 1.** It will be seen that the turnover frequency is based on the 3dB point.

In practice the magnetic induction on a tape is not constant towards the higher audio frequencies because the small bar magnets which are effectively implanted upon the oxide are so short that they tend automatically to demagnetise themselves. This is because the field associated with one pole tends to cancel out the field associated with the other, owing to the very short distance between the poles. To some extent this effect is countered by the application of treble boost during record. This causes the strength of the signal currents in the record head to rise towards the treble end of the audio spectrum and likewise the magnetic field across the head gap. The tape is thus subjected to a rising treble magnetic field, which tends to combat treble demagnetisation.

Nevertheless, even with treble boost the output from the head on playback still falls sadly beyond the turnover frequency, as shown in **fig. 1.** Apart from the treble being 'demagnetised' from the tape, this is caused by other factors. One is associated with the losses in the head which increase progressively towards the top end of the audio spectrum. Another is related to the gap in the playback head.

Clearly, for a head to 'define' the very short magnets of high audio frequencies (assuming that they have been recorded on the tape), the gap must be no wider than half the length of such a magnet for optimum results. Thus, there comes a frequency whose corresponding magnet approaches the width of the gap. When this happens the output from the playback head starts to fall and the output is zero when a magnet is so short that it fails to produce a change of magnetic flux across the gap because its whole length just fills the gap.

All this, of course, is basic theory which we probably already know about, but it is just as well to refresh our minds on this theory as it has so much to do with the quality of reproduction via a second or monitor head.

The 6dB/octave rise in output from the playback head means that the signal EMF in the head winding doubles in strength as the frequency is doubled—up to the turnover frequency. This is a normal physical law which is brought about by the electromagnetic principle of the playback head/recorded tape combination. The head with the small magnets recorded on the tape passing the gap can be considered as a dynamo. That is, the output is proportional to the *rate of change* of magnetic flux across the winding. Clearly, the rate of change of magnetic flux doubles for each octave, thus the output voltage doubles likewise.

Now, to combat this rising output up to the turnover frequency we need a head amplifier with a response falling with increase in frequency at the rate of 6dB/octave. Such a response is shown in **fig. 2.** Thus, if a head with an output shown in **fig. 1** is connected to the front of an amplifier with a response shown in **fig. 2,** the output from the amplifier will be similar to that shown in **fig. 3.** Here we see that the two slopes cancel each other out to give an output which is flat up to the turnover frequency.

Unfortunately, beyond the turnover frequency the output starts to fall fairly rapidly owing to the fall-off of the output voltage from the head itself. There is, of course, a way that this can be overcome, which is by causing the response of the amplifier to flatten out (or even rise) beyond the turnover frequency. This, then, gives an output which is flat over a substantial portion of the audio spectrum, as shown in **fig. 4.** To secure this, the amplifier may have a response similar to that shown in **fig. 5.**

This equalisation is often applied either in the playback head first amplifier stage or as the result of the coupling from the playback head to the head amplifier (or both).

Now to recapitulate. If we apply the playback head EMF direct to the input of an amplifier (which responds to voltage, as distinct from current) with a flat response, then the output from the amplifier would match the characteristic shown in **fig. 1.** There would be a significant bass loss and a peak in treble at the turnover frequency. This happens when a playback head is connected to an unequalised input of a hi-fi amplifier, for instance.

If the amplifier has equalisation to satisfy the 6dB/octave effect, then the loss in bass is countered but the treble tends to drop badly beyond the turnover frequency. This is overcome by flattening or even lifting the response of the amplifier beyond the turnover frequency. Treble lift is often given in the playback channel to keep the output at as high a level as possible at the top end of the

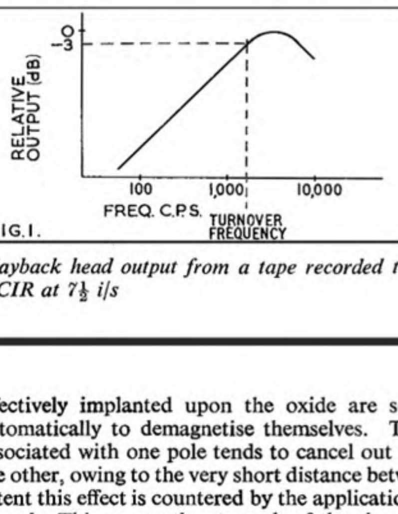


FIG. 1.

Playback head output from a tape recorded to CCIR at 7½ i/s

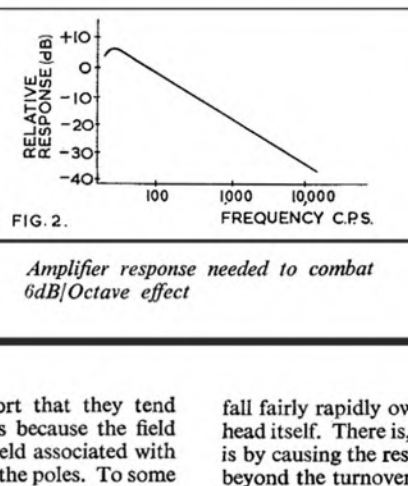


FIG. 2.

Amplifier response needed to combat 6dB/Octave effect

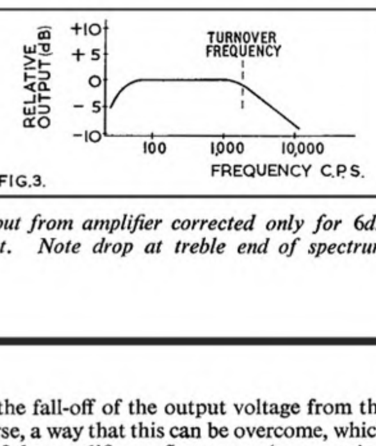


FIG. 3.

Output from amplifier corrected only for 6dB effect. Note drop at treble end of spectrum

spectrum thus helping to compensate for the various losses.

In a valve head amplifier the necessary equalisation is often performed by frequency-selective negative feedback. That is, the feedback is at a minimum at the bass end of the spectrum and gradually rises towards the turnover frequency. The effect is then that the overall gain of the amplifier stage decreases with increase in frequency. The feedback components are so arranged that the relative response of the amplifier falls at the rate of 6dB/octave (**fig. 2**) and then flattens out at the turnover frequency (**fig. 5**).

A representative circuit of this kind is shown in **fig. 6.** Here a triode valve is used and this may pick up signal either direct from the playback head or from the output of a pentode amplifier which itself is connected to the head.

The triode stage is straightforward as an amplifier, but in addition feedback is applied from the anode circuit to the grid circuit via the 180pF capacitor and one of the resistors selected by switch S1. Should there be no capacitor in the feedback loop, the feedback would be constant at all audio frequencies and the amount of feedback would be governed by the value of the resistor in the loop circuit. The smaller the value, the greater the negative feedback and the smaller the gain of the amplifier stage.

However, the capacitor modifies the feedback since its reactance decreases with increase in signal frequency. Reactance is the effective 'resistance' that a capacitor (or inductor) exhibits to AC and signal currents. At low frequencies the reactance is high, meaning that the effective 'resistance' in the feedback loop is high, as also is then the gain of the amplifier. As the signal frequency increases, so the reactance of the capacitor falls. The result is that the effective feedback is increased and the gain of the amplifier decreased.

The resistor in series with the capacitor fixes the minimum gain of the amplifier. For instance, at frequencies where the reactance of the capacitor is virtually a short-circuit, the resistor takes over and prevents the gain from dropping to a very low level. At low frequencies where the reactance of the capacitor is very high, anyway, the series resistor has very little effect.

By arranging suitable values for the capacitor (C) and the resistor (R), equalisation to match any tape speed is possible. It is not necessary to alter both C and R. In practice one of the other is switched. In the circuit of **fig. 6** it is the R element which is switched.

Equalisation is often given in terms of a ***time-constant*** equal to C times R (given simply as CR). This time-constant is in microseconds and is related to the turnover frequency in accordance with the following expression:

turnover frequency = 160/CR,

where the turnover frequency is in Kc/s and CR in μS (microseconds). At 7½ i/s, for instance, the old CCIR standard is 100 μS, giving a turnover frequency of 1.6 Kc/s. At 3¾ i/s, a time-constant of 200 μS is sometimes used. This corresponds to a turnover frequency of 0.8 Kc/s

TOWARDS BETTER TAPING

PART 15 BY GORDON J. KING

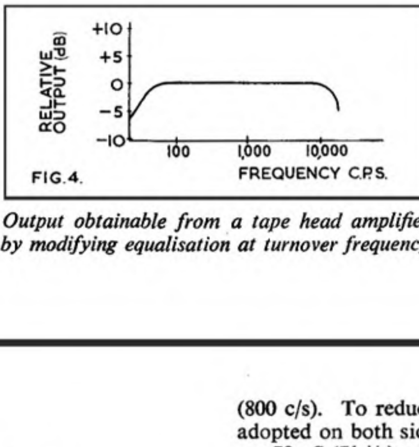


FIG.4.

Output obtainable from a tape head amplifier by modifying equalisation at turnover frequency

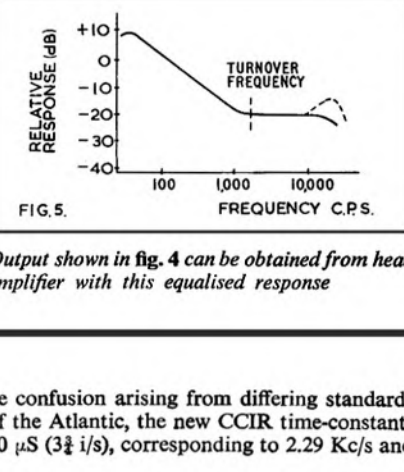


FIG.5.

Output shown in **fig. 4** *can be obtained from head amplifier with this equalised response*

playback equalisation

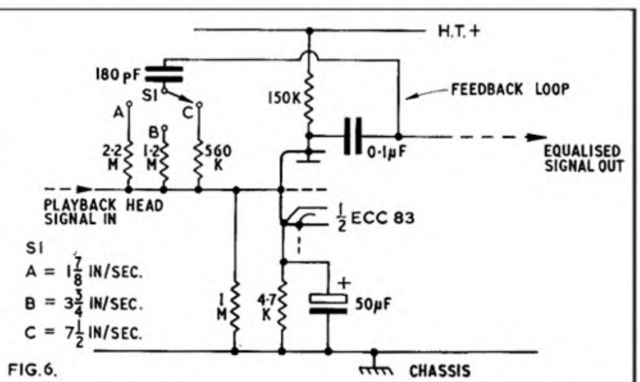


FIG.6.

(800 c/s). To reduce the confusion arising from differing standards adopted on both sides of the Atlantic, the new CCIR time-constants are 70 μS (7½ i/s) and 140 μS (3¾ i/s), corresponding to 2.29 Kc/s and 1.15 Kc/s respectively.

Note that the time-constant in the circuit of **fig. 6** is derived by multiplying the selected feedback resistor in *megohms* by the series capacitor in *pF*. The time-constant is then given in μS. For example, at 1⅞ i/s the time-constant is 2.2 times 180. This works out to a little under 400 μS, corresponding to a turnover frequency of 0.4 Kc/s or 400 c/s.

It will be appreciated, of course, that the turnover frequency is higher the greater the speed of the tape. To take extremes, at 15 i/s the turnover frequency is 4.5 Kc/s (tape recorded to new CCIR or DIN characteristic, 35 μS), as compared with 800 c/s at 3¾ i/s (old CCIR, 200 μS).

In this article, then, we have exposed some of the secrets of playback equalisation and we have seen why very poor quality of reproduction is likely to be obtained on a second or monitor channel simply by feeding the output of the head direct to the input of a 'straight' amplifier.

Next month we shall continue with our investigations of playback equalisation and see how easily it can be achieved in a transistor tape head amplifier.

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Grundig TK46 ...	11	7	0	8	8	4	107
Tandberg 74B ...	9	16	0	7	6	5	93
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MAINS 2-TRACK							
Brenell 5 Type "M"...	9	5	0	6	18	7	88
Ferrograph 5 A/N ...	8	19	0	6	13	10	85
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
Tandberg 92	7	5	0	5	8	8	69
Reps R10 Mk. 2 ...	6	4	0	4	12	11	59
Tandberg 823 ...	5	14	0	4	5	0	54
Telefunken M55 ...	4	10	6	3	7	9	43
Grundig TK18L ...	4	7	0	3	4	6	41
Grundig TK14L ...	4	0	0	2	18	1	37
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NUMBER 42

PHILIPS — THE STEREO MODELS

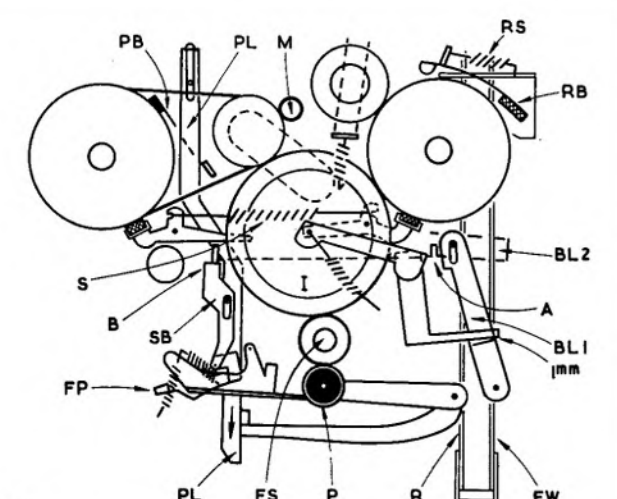

FIG. I.

IT is the fate of the contributor to a monthly magazine to be perpetually out of date. By the time the Editor has put away his blue pencil and the printers have finished their mysterious activities and the presses begin to roll, a company as sedulous as *Philips* will have brought out one or two new models.

Fortunately, these articles are concerned not so much with the freshly unwrapped as with those which, having spent a while in the loving care of proud owners, may now be in need of some attention. Some of these machines have arrived in the author's workshop with quite minor troubles, giving him the opportunity to get to know them better than sales demonstrations and equipment reviews allow.

The ironical factor here is that these small troubles could often have been solved by the owner. But as the stereo tape recorder is necessarily more complicated, people are reluctant to tackle minor repairs and adjustments. A few words on the principal features of the popular Philips stereo models may not therefore come amiss.

'Stereo', in this context, can be taken to include machines with stereo playback, as well as the complete machine incorporating stereo recording facilities.

Typical of these tape recorders is the **EL3548,** which is a $\frac{1}{4}$-track, two speed ($3\frac{3}{4}$ and $1\frac{7}{8}$ i/s), hybrid mains-operated machine. The valves used are an ECL82, triode pentode, employed as driver and output stage, and an EM87 magic-eye modulation indicator. The best of both worlds is thus obtained: a four-transistor amplifier for low noise, good response and moderate gain, sufficient to drive an external amplifier or provide headphone monitoring, with a valve output stage which is by no means overtaxed, giving $2\frac{1}{2}$W of audio power. The simple experiment of taking this output to a separate loudspeaker, correctly enclosed, in place of the in-built 6 x 4 in. unit, which is really only suitable for monitoring, will immediately show what good results can be obtained.

A very simple transistorised oscillator is used, built around an OC79, with a small sub-panel to which the track selector plus parallel-play switch is coupled by a rocker mechanism. The switch itself is the usual, vertically mounted, slide-action type. Two screws secure the selector switch, and a further two secure the sub-panel, allowing easy access to both the print and the component side. The two skeleton presets used for bias adjustment are easily accessible from the top.

Before adjusting these for correct bias current, it is necessary to ensure that the bias filter is properly set. This is a coil mounted on the sub-panel bearing the ECL82, and adjacent to the pre-set used for modulation level indicator calibration. This coil, tuned by a 1,000 pF. capacitor, forms a trap circuit between the output of the recording amplifier and the record play head windings; but in addition to preventing bias voltages from upsetting the amplifier it has the effect of buffering the oscillator from the amplifier, reducing the shunting effect of the amplifier output impedance on the bias circuit. With the machine switched to tracks $\frac{1}{4}$, and all three manual controls at minimum, this trap coil must be tuned for maximum reading across the 100-ohm resistor in the return lead of the upper coil winding.

There is no need to search for connecting points in making this and other similar measurements, for both of the 100-ohm resistor junction points with the track windings—in effect, test points—are brought out to pins on the monitor socket, tracks $\frac{1}{4}$ to pin 4 and tracks 2/3 to pin 5. An AC millivoltmeter is needed for this kind of reading, otherwise the amount of deflection is too small to be of any use.

If this coil is sealed and shows no sign of having been altered from its factory setting, it may be wise to leave it alone, unless bias readings are below par.

The bias current can be measured at pins 4 and 5, for tracks $\frac{1}{4}$ and 2/3 respectively, with common return lead pin 2, of the same socket as before. This current develops between 60 and 110 mv across a 100-ohm resistor from these pins to chassis. Low bias will cause distortion at full modulation. A decrease in bias within these limits will, however, improve the treble response, and a compromise value must be found in practice. Increasing bias reduces the treble response.

If the full facilities af this machine are to be used, it will be necessary to balance the bias settings of both channels. The two resistors should be individually adjusted, then a recording made on each track. These two recordings, when played back should give outputs within 6 dB difference, if input levels were equal.

These conditions also depend on the adjustment of recording sensitivity and playback sensitivity, which is possible by further pre-set resistors on the main printed board. Space limitations prevent a full discussion of the electrical adjustments on machines of this type, but details can be given to correspondents who may require them.

More important, in a general article, is the mechanical adjustment and lubrication information, which is more likely to be needed. In fact, one correspondent has written irately from Canada, taking us to task for 'skimpy' treatment of such vital factors as lubrication.

I hope therefore, I shall, be forgiven for re-stating that the most vital piece of information I can offer about lubrication is: 'Don't overdo it!' Nevertheless, the lubricating points of the EL3548 are shown in **fig. 1,** as well as the principal mechanical adjusting sections.

But first, a brief mention of the mechanics of this machine, quite different from any of those previously described. The motor has a fairly deep pulley, **M** with two grooves at the top. Speed selection is obtained by movement of the main drive belt into the appropriate groove, and is effected by a quadrant selector with a toothed edge and a shaped protrusion on its boss which carries the belt into position. The belt and the flywheel are not themselves shown in **fig. 1,** to prevent confusion, but the flywheel spindle is illustrated at **FS.** The pinch wheel **P** engages the central spindle; the outer circle is used to drive intermediate wheel **I,** which has a wide rubber tyre. This in turn engages the clutch disc of the right-hand turntable assembly.

This type of clutch drive is made possible by the device of back tensioning by a friction pad **FP** which holds the tape against the left-hand guide, and also by the drag on the left-hand spool imposed by the rev. counter belt. Hence, correct clutch action depends also on these

(continued overleaf)

small points and is not self-regulating as on some previous models. A sticking rev. counter mechanism or excessive inward tension of the spring-loaded bracket to which **FP** is attached can cause wow.

The pause action is very definite and rapid, giving an excellent editing facility. When the pause button is pressed, it locks into place (and is released by moving it forward slightly), and moves the lever **PL** in the direction shown by the arrow. A small projection at the lower end moves the swivel arm attached to the pressure roller (**P**) bracket and holds the roller off the flywheel spindle. At the same time, a small brake, **PB**, engages the left-hand turntable. Again, make sure this action is positive if tape transport appears to drag or snatch.

The main brakes are linked by a 'hold-on' type spring, **S**, and are actuated in two different ways, so that effective braking on Record/Play and not on either Fast Wind or Rewind, or faulty braking on any one function, is possible and should lead one to investigate the individual action, whereas a general braking fault indicates only that the brake pads or main coupling spring and lever could be faulty. When RECORD, or PLAY are selected, the lever **BL1**, linked to the pressure roller arm causes **BL2** to pivot, pulling it forward, bringing the brake pads away from the turntables. The complete assembly is not shown in **fig. 1**, again to avoid confusion, but the pivot point is roughly half-way along **BL2** and the inner end of the brake levers rest against another bracket with two protruding tongues, and a spring at the left-hand end of **BL2** tends to pull it forward, i.e., tends to keep the brakes engaged. Weakening of this spring can cause erratic braking.

When the brakes are released. there should be 1mm clearance between pad and turntable. Fine adjustment can be made by bending the **BL2** lever, in which there is a cut-out **A** for this purpose. But note that after this adjustment, the left-hand pressure pad should again be checked, as the movement of slide bracket **SB** depends on its contact with the end of the brake arm, **BL2**, at **B**. The two springs shown at the lower part of this assembly are important factors in the action.

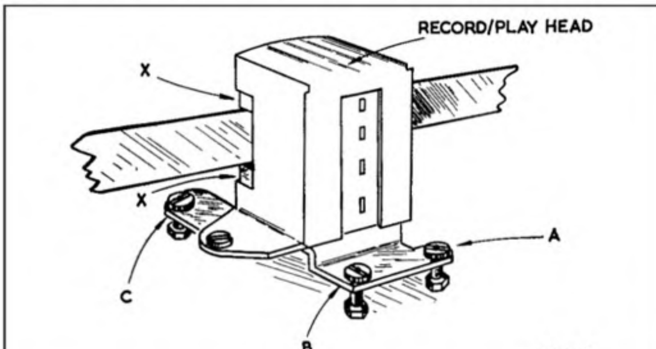

FIG.2.

The brake lever **BL2** is acted upon in a different way during fast forward and rewind, when small lugs on the two long levers **R** and **FW** engage **BL2**. In addition, a tape tensioning device is provided for rewind, to avoid spillage. The lever **R** allows the brake **RB** to engage with a pressure of 6 to 8 grams, which can be adjusted by inserting the free end of spring **RS** in one of the three holes provided in the fixed bracket.

The playback action, as described, also depends on the action and position of **BL1**, and it should be noted that the intermediate wheel **I** is mounted on a pivoted arm which is coupled to another, in turn acted upon by the step in **BL1**. When the play button is pressed, there should be at least 1mm. clearance at this point, as indicated. The clutch itself consists of a disc with felt pad and a lower coiled spring with a collar and a smaller felt ring. It is important that the felts should be free from grease, and that the spring should have the correct compression. No doubt, as these machines get older, it may be necessary to dismantle the clutch assembly and retension the spring slightly.

Fast forward and rewind action should be evident from **fig. 1.** The left-hand turntable is belt-driven from a pulley which engages the motor pulley, and the right-hand spool is driven by another intermediate wheel which engages the motor pulley—hence the deep pulley that is needed. The pulley itself is secured by two screws and should

(continued on page 228)

THE FLYING LESSON

BY DAVID HAINES

TO FLY an aeroplane in a sitting-room might seem inconceivable. But it can be done on tape.

This month's play provides a framework for simple aeroplane effects, and can be performed by two people (the man doubling briefly for the mechanic).

TECHNICAL NOTES

Perspective

Pupil and instructor at close-mike voice-positions. Mechanic slightly distant.

In flight, voices should be 'lifted' slightly (in speaking against engine-noise); characters turn off-mike for any shouting.

Acoustics

Record in 'dead' acoustic (i.e., blanketed room) for both air and ground location.

Sound-effects

Advanced amateurs: build on separate tape and mix in. Newcomers: work 'spot' with mechanical ingredients.

Use comic intonation in certain effects. *Entering plane:* knock large cardboard boxes. *Propeller-swing:* football rattle. *Engine:* electronic tones or any domestic appliance plus rotary egg-whisk.

Make engine-background less than reality, to allow for audible dialogue. Avoid excessive bass.

Climbing plane: steadily raise pitch of basic engine-effect. (Use tone and gain controls, or mechanical methods—e.g., impeding vacuum cleaner suction.) *Top of 'loop'* (when plane turns over) is indicated by brief silent pause. Adjoin to dive and levelling-out effect.

Construct final effect separately and splice into dialogue.

ANNOUNCER: We present a short play entitled *The Flying Lesson.* (*Scene : small private airfield*) (*Fade in general atmosphere—distant voices, rooks in distant trees, etc.—hold briefly and fade down slightly*)

MISS MURDOCH: (*scornfully*) Is *this* the aircraft?

INSTRUCTOR: (*meekly*) All my pupils graduate to this machine for their first semi-solo.

MISS MURDOCH: (*sarcastic*) Which cockpit do I sit in? Or doesn't it matter?

INSTRUCTOR: I sit in the *front* cockpit and you sit in the *back* cockpit. The controls are in the back, you see.

MISS MURDOCH: Thanks for telling me. Let's get aboard. (*They clamber aboard and settle*)

INSTRUCTOR: (*fussily*) Always remember, Miss Murdoch, that there's no need for panic. I shall be right in front of you—as a source of moral support.

MISS MURDOCH: (*briskly*) Stop talking and fasten your safety-belt.

INSTRUCTOR: Yes, Miss Murdoch.

MISS MURDOCH: And pull your goggles down.

INSTRUCTOR: Yes, Miss Murdoch.

MISS MURDOCH: (*after a pause*) You'll have to get out and swing the propeller.

INSTRUCTOR: (*protesting*) But I've strapped myself in.

MISS MURDOCH: How typical of men—completely inefficient! (*raising her voice*) Hey, you!

MECHANIC: (*from distance*) Can I help you, miss?

MISS MURDOCH: Come and swing this damned propeller.

MECHANIC: (*approaching*) Very good, Miss. (*near*) I'm ready . . .

MISS MURDOCH: (*calling the drill*) Brakes on ; switches off ; petrol on ; throttle closed.

MECHANIC: (*repeating*) Brakes on ; switches off ; petrol on ; throttle closed. (*pause*) Throttle set—contact!

MISS MURDOCH: (*repeating*) Throttle set—contact! (*Propeller swung ; engine bursts into life, increasing in crescendo as plane takes off*) (*cut airfield background*)

INSTRUCTOR: (*frantic*) We're going to hit the hedge! We're going to hit the hedge!

MISS MURDOCH: (*calmly*) I have no intention, none in the least, of hitting the hedge.

INSTRUCTOR: (*yelling*) Lift your nose! Lift your nose—the nose of the aircraft, you idiot! (*after a pause, in relief*) Phew—that *was* a nasty moment! Thank God we're airborne.

MISS MURDOCH: (*coldly*) Did you refer to me as an idiot?

INSTRUCTOR: (*impatiently*) Concentrate on the lesson, you silly fool! Watch the doo-dah!

MISS MURDOCH: I beg your pardon?

INSTRUCTOR: (*fumbling for the word*) The doo-dah—the whatsis-name! The thingummy-tight!

MISS MURDOCH: (*with disdain*) Are you referring to the air-speed indicator?

INSTRUCTOR: That's right—the air-speed indicator.

MISS MURDOCH: I am already watching it.

INSTRUCTOR: Then open the er-rer . . . the er-rer . . .

MISS MURDOCH: The throttle?

INSTRUCTOR: That's right—the throttle. Open it a teeny-weeny bit more. But don't forget to watch the other thing —the er-rer . . . the er-rer . . .

MISS MURDOCH: The altimeter.

INSTRUCTOR: That's right—the altimeter. Pull back the er-rer . . . the er-rer . . . and level off at 2,000 feet. (*after a few moments, in alarm*) Miss Murdoch, what are you doing? Miss Murdoch!

MISS MURDOCH: (*grimly*) I'm increasing the power. I'm pulling back the stick. I'm going to loop-the-loop.

INSTRUCTOR: Miss Murdoch, you are not experienced enough to loop-the-loop. I order you to fly straight and level.

MISS MURDOCH: I'll teach you to call me an idiot—you little pip-squeak! (*plane climbing at speed*) Up we go . . . up . . . up . . . (*plane describing loop*) and *over*! (*plane pulling from dive*) There—I've done it! I've looped-the-loop. And I hope I scared you stiff.

INSTRUCTOR: (*sternly*) Miss Murdoch, I am not going to gloss

(*continued on page 227*)

ANOTHER SCOOP

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BRIEF SPECIFICATION

4-track 3-speed Stereophonic Tape Recorder. Plays and records on 4 tracks Mono or Stereo.

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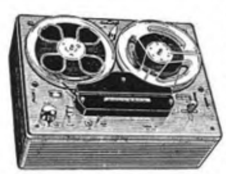

Model 823 2 track (teak case) **54 gns.**

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equipment reviews

BANG & OLUFSEN STEREOMASTER

MANUFACTURER'S SPECIFICATION: Transistorised ¼-track stereo tape recorder. **Spool Capacity:** 7in. **Tape Speeds:** 7½, 3¾ and 1⅞ i/s. **Inputs:** Microphone: 50-200 ohms, 50µV balanced; Gram: 33K at 2mV; Radio: 45K at 2mV. **Outputs:** Line: 0.0775V at 47K; Speaker: 8W per channel at 4 ohms. **Bias Frequency:** 100 Kc/s. **Frequency Response:** 40 c/s-16 Kc/s at 7½ i/s, 40 c/s-12 Kc/s at 3¾ i/s, 50 c/s-8 Kc/s, ±2dB. **Signal-to-noise ratio:** 50dB. **Channel Separation:** 45dB. **Wow and flutter:** 0.075% RMS at 7½ i/s, 0.11% at 3¾ i/s, 0.18% at 1⅞ i/s. Automatic Stop. **Weight:** 35lb. **Dimensions:** 17½ x 14 x 7½in. Price: £117 12s. **Distributor: Debenhams Electrical & Radio Distribution Ltd., Eastbrook Road, Eastern Avenue, Gloucester.**

THIRTY-SIX full-page illustrations in the well-produced instruction book are devoted to description of the many facilities offered by the *Beocord 2000*. This is a case where the instruction book really *must* be used, as an effort has been made to use universal symbols to label each control. Some of the symbols, including microphone, radio, gramophone, wind and rewind, are well known and present little difficulty in interpretation, but others, like two parallel lines with arrows at right angles, staggered or in line, to indicate 'echo' or 'track to track transfer', are a bit foxing until you have read the book and actually used the controls. Afterwards, as a reminder of the function of each button or control, they are perhaps better than printed labelling as the eye can take in a diagrammatic symbol more quickly.

The slide type mixer controls are excellent in use if the various inputs have first been adjusted so that peak recording level corresponds to nearly full setting of the slider. This means that external attenuation must be used on some inputs, for example, the radio input has a sensitivity of 2mV and has been designed to be fed from the standard DIN diode socket of Continental recorders where the diode output at the receiver volume control is attenuated to about this level. In this country, radio tuners can deliver an output of several volts with resultant violent overload of the radio amplifier in the recorder before the signal ever gets to the mixer control.

EASILY MET

The fluttergrams of **fig. 1** show that the specification figures are easily met with RMS readings of 0.05%, 0.07% and 0.1% at 7½, 3¾ and 1⅞ i/s. I have provided three traces at each speed to show the extreme consistency of the readings and the flutter content. There is no discernible cumulative build-up of record and play speed imperfections, and no trace at all of cyclical speed changes due to any rotating part of the tape transport mechanism. The slight flutters shown are probably due as much to the elasticity and friction of the tape as to the tape drive.

With the Papst synchronous motor drive it goes without saying that the absolute tape speeds depend only on the mains frequency and the accuracy of the speed change mechanism. A strobe tape was used to check the speed at 7½ i/s and a *Philips* tape-driven strobe checked the ratio of the three speeds. They were all rock steady, so that the tapes speeds are exact within the limits of the mains frequency.

Seventy, 140 and 280 µS test-tapes were played at 7½, 3¾ and 1⅞ i/s respectively and the level of each tone measured at the line outputs. Top and bottom tracks were identical and the responses are shown in **fig. 2.** It will be seen that the playback equalisation is to the desired DIN and CCIR standard characteristics to very fine limits and that the extreme low note response is maintained to the lowest frequencies on the test-tapes at all three speeds.

System noise with no tape running was 33dB below test-tape level and consisted mainly of very low frequency transistor noise which could only be seen on an oscilloscope and could barely be heard on the widest range speaker with the gain at normal listening level. Weighted to match the ear's response at low levels, the noise was 48dB below test-tape level.

The overall record play responses shown in **fig. 3** were taken with two different types of tape. The dotted curves are for a high coercivity Continental tape and the solid curves for a typically British tape with slightly 'softer' magnetic characteristics. Both tapes meet the specification responses at the two higher speeds, with a slight curtailment to 6 Kc/s, instead of the specified 8 Kc/s, at 1⅞ i/s.

NEGLIGIBLE DISTORTION

Peak recording level, at 12dB above test-tape level, was obtained with the record level meters just indicating overload, i.e., the meter pointers just entering the red sector of the scale. At this level, waveform distortion was negligible, and the recorded level could be increased by a further 1dB with the Continental tape and a further 3dB with the British tape. This does not indicate any superiority of one tape over the other ; a slight increase of bias would probably make the response and overload point of the Continental tape similar to the other.

The peak recording level was erased and the unweighted signal/noise ratio found to be 45dB. The weighted signal noise ratio was 55dB.

The gliding tone record-play tests showed some head contour effects at 7½ i/s, where the head dimensions were comparable to the recorded wavelength, which had been missed at the spot frequencies on the test tapes. There was also a slight fall in extreme low note response during recording.

SENSITIVE TO HUM

Listening tests on a wide-range external speaker seemed to indicate an abnormal sensitivity to mains hum on various signal sources. Tests proved that a bass rise of 6-8dB occurred at 50 c/s with the tone control set to the mid position with the white spot at 12 o'clock and that a

(continued on page 223)

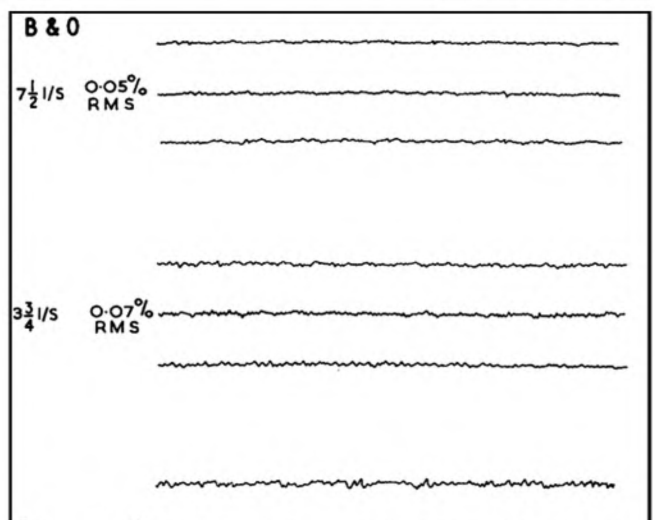

FIG.1.

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60-10,000 c/s ± 3db. sig/noise 38db. below test level weight 5lb. 50db. below peak.

3¾ I.P.S. NARTB standard, wide tone control, 4¼″ spools, over 2 hours recording time, 2-track. Heads by Bogen, AC bias and erase. Straight through amplifier.

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P.V.C. RECORDING TAPE
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Adastra Electronics Ltd 167 Finchley Rd. London NW3 level bass response was obtained with the bass tone control nearly fully anticlockwise. From this level response position a bass cut of 4dB and a bass rise of 18dB was obtained at the extreme settings of the control. The treble control was level at the centre position with 12dB boost and cut at the clockwise and anticlockwise positions.

COMMENT

A very smooth performer indeed! Like other top class recorders with A-B monitoring facilities, it proved very difficult to judge whether one was listening to the programme directly or via the tape. Mains hum was conspicuous by its absence; I have remarked on this effect before on completely transistorised equipment; we seem to have become conditioned to a slight unobtrusive mains hum, but really miss it when it isn't there any more. I think this is the reason why the above mentioned slight mains hum from various signal sources was

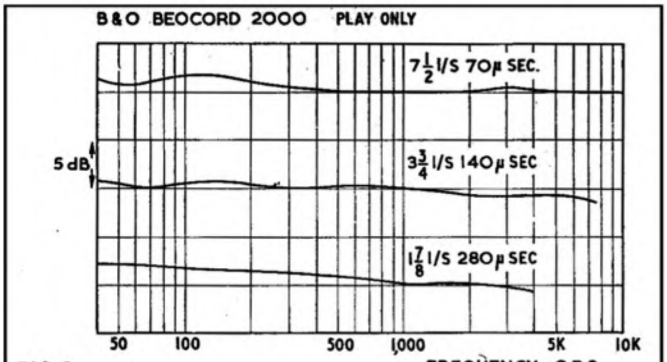

FIG. 2.

so obvious, apart altogether from the tone control bass rise. The tape hiss also seemed to be lower than usual, as some always seems to 'ride in' on recorded mains hum, but there are many other reasons why the hiss should be low: the push-pull oscillator has a very low second harmonic or DC component content, the bias and erase frequency is high at 100 Kc/s and the record head gap (10 microns) is relatively wide so that many more reversals of bias flux occur as an

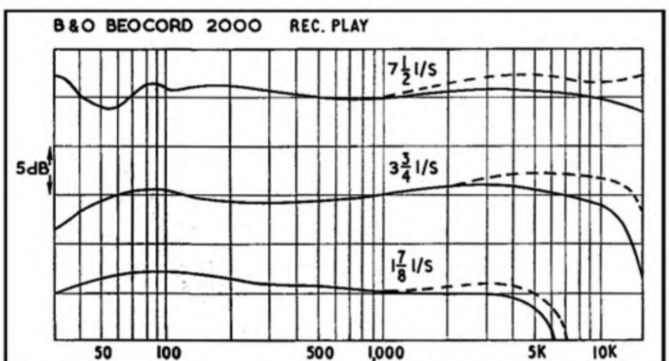

FIG.3.

oxide particle crosses the gap. All these details add up to a noticeable improvement, although any one of them would probably not be noticed by itself.

This is definitely a recorder for the expert, and could well form the nucleus of a high fidelity installation. With 8W per channel and properly equalised plug-in preamplifiers for dynamic or crystal stereo pickups, a start could be made by adding an FM tuner and wide range speaker. A turntable, pickup and second speaker could be fitted later to give full stereo record and play facilities. Mono or stereo microphones could be added as required, and *some* day, who knows, the BBC may give us stereo broadcasts, so that at last the full capabilities of this recorder may be realised.—A. Tutchings.

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7"	1800'	23/-	15/6
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3"	400'	6/-	5/-
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7"	2400'	39/-	23/-
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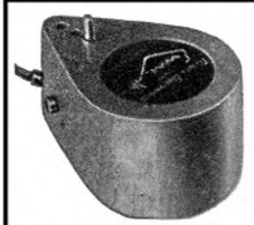

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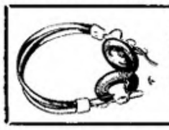

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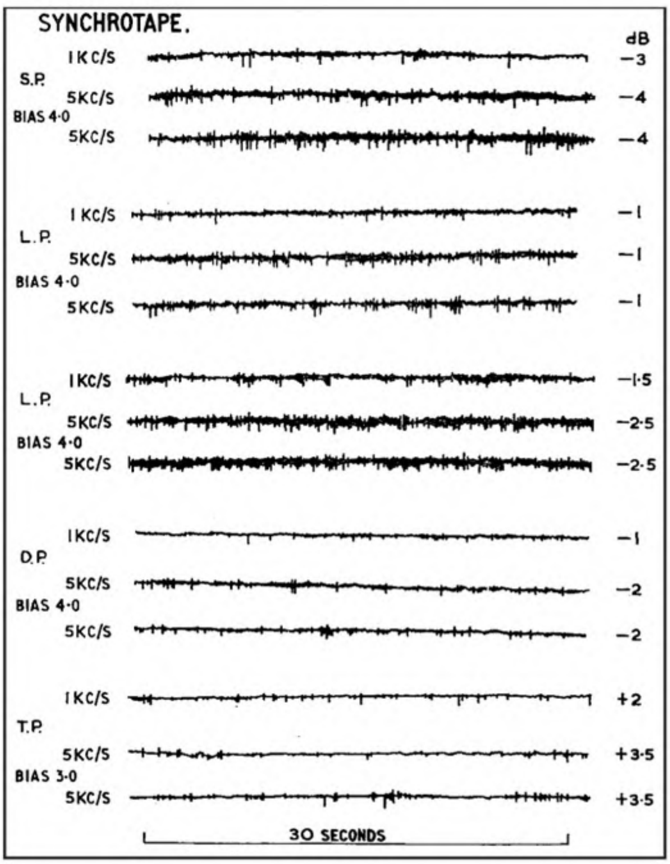
The tests were performed at a tape speed of $3\frac{3}{4}$ i/s on $\frac{1}{2}$-track heads at fixed frequencies of 1 Kc/s and 5 Kc/s. The test equipment allowed accurate monitoring of the bias and signal input to the record head and the output of the playback head. Thirty-second test tones were recorded near the beginning of each reel at 1 Kc/s and 5 Kc/s and a further 5 Kc/s recording was made near the centre of the reel. The playback signals were recorded on a high speed pen recorder to give the drop-out charts shown in the illustration. At the same time the playback levels were measured and compared to a reference tape which



had been carefully selected to have an average sensitivity and frequency response. The dB figures at the end of each drop-out chart trace refer to the playback level as compared to the reference tape. Thus —2dB means that for a standard input level and optimum bias for the sample being tested, the sample tape is 2dB lower in output than the output of the reference tape. The bias required for maximum sensitivity at 1 Kc/s is also shown for each tape. The reference tape bias was 4. Finally, an overload test was made on each tape at 500 c/s and the onset of waveform distortion noted at levels expressed in dBs above my standard test-tape level. Most normal tapes will accept a level 12dB above test-tape level without visible waveform distortion.

Referring to the diagram, we see that the SP tape is down 3dB in sensitivity and a further 1dB at 5 Kc/s. Bias is standard. Occasional

(*continued on page 227*)

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Two samples of LP tape were submitted on different size reels. No. 1 showed no drop-outs exceeding 3dB at 1 Kc/s and only very occasional ones of 6dB or more at 5 Kc/s. No. 2 was slightly worse at 1 Kc/s, and considerably worse at 5 Kc/s. Bias was standard on both samples. No. 1 was only 1dB down in sensitivity at both frequencies. No. 2 was 1.5dB down in sensitivity at 1 Kc/s and a further 1dB down at the high frequency.

The DP tape was considerably better in drop-out performance at both frequencies and the tones sounded audibly cleaner due to absence of continuous amplitude modulation. Sensitivity was 1dB lower than the reference tape and a further 1dB down at high frequencies. Bias was standard.

The Triple Play tape was surprising in showing a *higher* sensitivity than average, being +2dB at 1 Kc/s and a further 1.5dB up at 5 Kc/s. Optimum bias was 25% lower than standard. It was noticed that increasing the bias to 4 only dropped the sensitivity; the frequency response remained the same, showing the 1.5dB rise at 5 Kc/s despite the over-biasing. Drop-outs were low at both test frequencies.

Overload tests showed that the SP tape would only accept +10dB on test-tape level before waveform distortion became evident. This was because of its inherent lower sensitivity. All LP and DP tape recorded +12dB without difficulty, and the TP showed a little distortion at +12dB which disappeared at +10dB; this was to be expected due to the thinner oxide layer.

COMMENT

These tapes are all satisfactory as regards frequency response, and only the Standard Play sample is sufficiently down in sensitivity to be noticeable. The PVC based tapes, SP and LP show fairly severe continuous amplitude modulation and drop-outs, but whether this is due to the base or the oxide is difficult to decide from these tests. The polyester based tapes are excellent in every way, the Triple Play in particular being very impressive. **A. Tutchings.**

over this episode. Do you realise what you have done?

MISS MURDOCH: I have successfully looped-the-loop—and you ought to congratulate me.

INSTRUCTOR: I shall do no such thing. (*indignantly*) The flap of my top pocket happened to be unfastened. You looped-the-loop—and my fountain-pen dropped out. It's gone—lost without trace!

MISS MURDOCH: Why don't you get out and look for it?

INSTRUCTOR: (*insensed*) Don't be so stupid! It's a field of corn down there—I could *never* hope to find it. (*firmly*) Miss Murdoch, you will have to buy me a new fountain-pen.

MISS MURDOCH: How much did it cost?

INSTRUCTOR: Seven-and-sixpence.

MISS MURDOCH: (*with contempt*) How typical of men—all this fuss over seven-and-sixpence!

INSTRUCTOR: It had a very good nib. But it's the principle that matters—not the cost. You must buy me a new fountain-pen.

MISS MURDOCH: These flying lessons are expensive enough already—and I *refuse* to buy you a new fountain-pen. The loss of the pen was *entirely* your own fault. No man calls *me* an idiot.

INSTRUCTOR: (*suddenly*) Mind the top of that tree! Look out, you silly . . .

(*Engine cuts off; plane crashes into tree-top—with much rending of material; rooks scatter, squawking. Silent pause*)

INSTRUCTOR: (*triumphantly*) *And* you must buy me a new aeroplane.

be positioned so that the groove in the flywheel is midway between the two motor pulley grooves, to give equidistant belt throw for speed changing. The flywheel is allowed a vertical play of 2mm., and a locknutted screw in the deckplate limits this.

As for the lubricating points, **fig. 1** shows them all, but any more lines and arrows would almost certainly cause confusion so, briefly, these are the important points for a light graphite oil: motor bearings, and bearings of turntables, intermediate wheels, flywheel bearing, and pivot points of levers. A light grease, preferably with slight graphite content, should be applied to sliding points of levers, such as at the lower end of **R** and **FW,** the groove in **BL1** where it couples with **BL2,** the speed change quadrant boss, and the belt throw gear bolt, the slide of **SB,** and at the top end of **PL.** Beware of oil or grease near any of the driving surfaces, wheel tyres, belts, turntable edges, felts, etc. Remember that movement can cause creepage of lubricating oil or grease, and be very sparing in application. This restriction also refers to the button levers, which are very lightly sprung, and can be impeded by a stickiness caused by grease between two sliding surfaces.

It was intended, at the outset of this article, to give a few details of other Philips stereo models, in particular those with a completely different mechanical system, but again space has beaten us and this must be left for another month. Our carping reader from Canada, who complains that not nearly enough coverage is given to this firm who produce a large proportion of the tape recorders marketed in this country, should have some of his complaints satisfied, at least; whilst our apologies are offered to frustrated owners of less 'popular' machines—

It would not be fitting to close this article without mention of the azimuth adjustment. Although this has been covered previously, and, indeed, repeated for the benefit of enquiring readers, it seems that some folk are still doubtful about the correct head setting of $\frac{1}{4}$-track machines. The record play head is illustrated in **fig. 2,** shown from a rear angle to ease description. The three adjusting nuts are **A, B,** and **C.** These are slotted for screwdriver engagement.

First, set the head so that the tape runs cleanly between the guides and between the two 'jaws' of the tape head cover **X-X.** This is best done by unhooking the spring at the left-hand end of the roller bracket to release inward pressure, holding the tape taut between the guides, then pushing the roller bracket forward by hand. As the tape moves inwards toward the head, its exact position in relation to the jaws can be seen, and slight adjustment of the three nuts can be made for correct height. After this, it is only necessary to adjust **A** for maximum playback output using, preferably, a full-width modulated tape, not a $\frac{1}{4}$-track recording.

If a full-width modulated tape is not available, a little more patience is needed for head alignment. Do not be tempted to align with a $\frac{1}{4}$-track tape recorded on another machine. Discrepancies do exist, in the best-regulated circles. Use a clean tape, record the top track, noting the input level of the signal, then record a parallel signal on the other track (tracks 1 and 3). Replay and note any difference. If track 1 is weaker, raise the head very slightly and try again. When the modulation is equally potent on each track, or within reasonable limits, revert to track 1 and replay, adjusting nut **A** for maximum output. Recheck 1 and 3 for any attenuation, and readjust if necessary.

Next, invert the spools and record track 2 at a level of input that approaches overload. 'Sandwich' this recorded band between those previously recorded on tracks 1 and 4. Re-invert and replay 1 and 4 separately, listening for attenuation or crosstalk. This will give you the clue whether the head is now too low (when crosstalk will interfere with track 3).

When the record /play head is adjusted for the best possible azimuth setting, any further adjustment causing attenuation of any track, proceed to the erase head adjustment. Set the level visually for the top edge of the tape to be level with the upper edge of the gap, or 1mm. below it at most. Erase the first two tracks and note that erasure is complete. If not, adjust and recheck.

These are 'non-instrument' methods of azimuth alignment, and require patient work. With the correct instruments, the procedure is a matter of a minute or two added to normal service, and is regular workshop practice. The benefit of correct alignment, like the benefit of regular de-gaussing, fully justifies the small amount of trouble involved.

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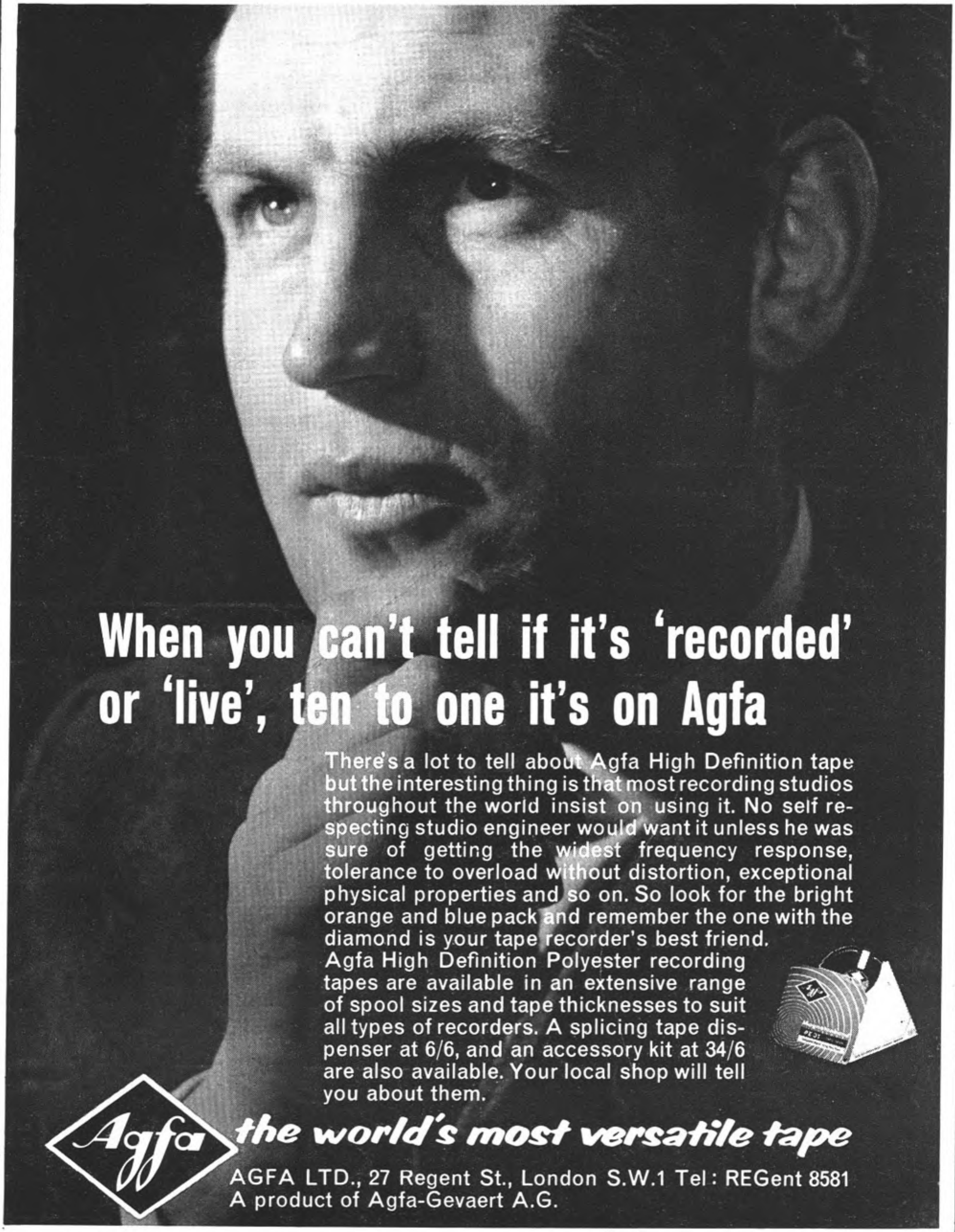
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