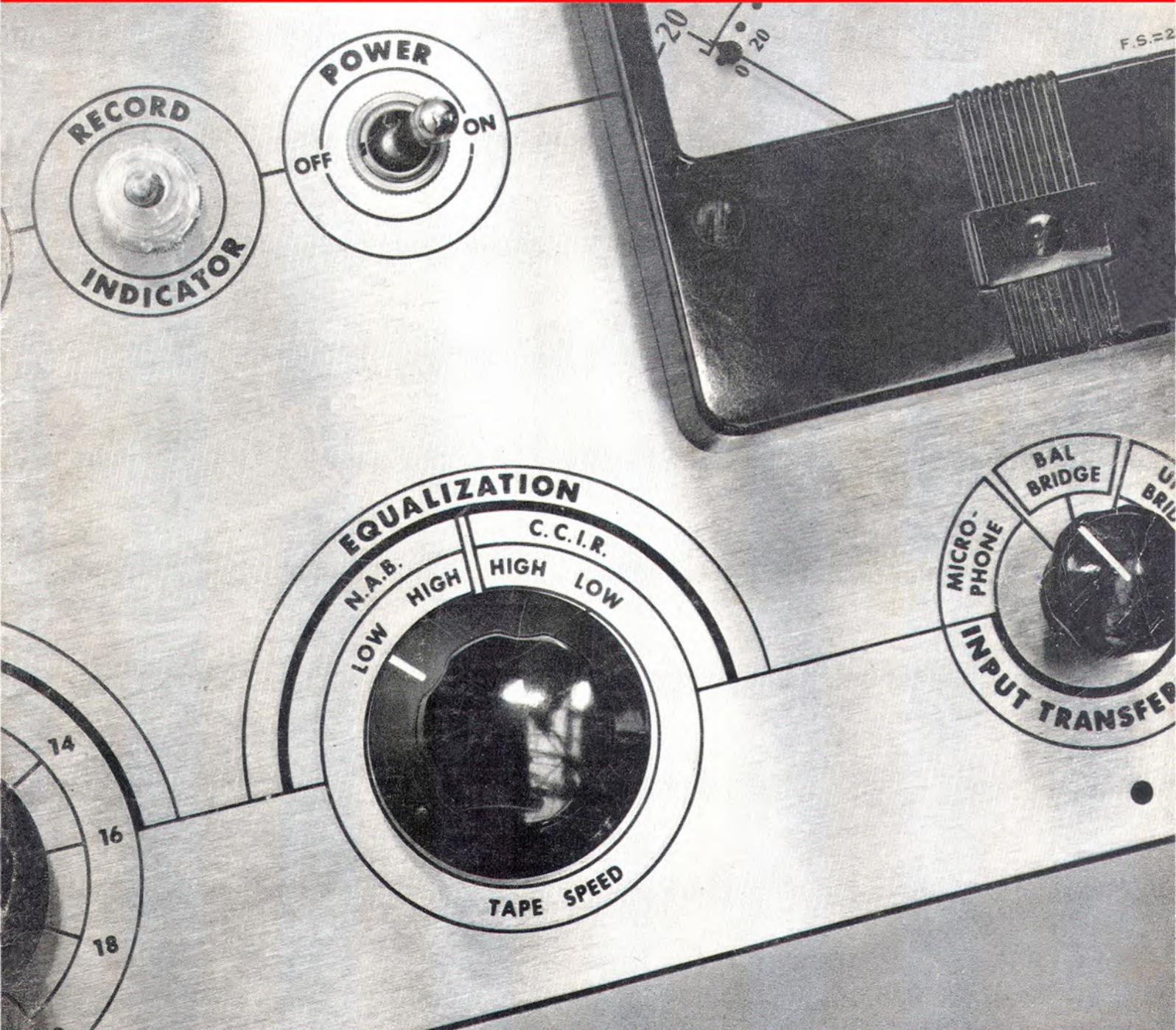


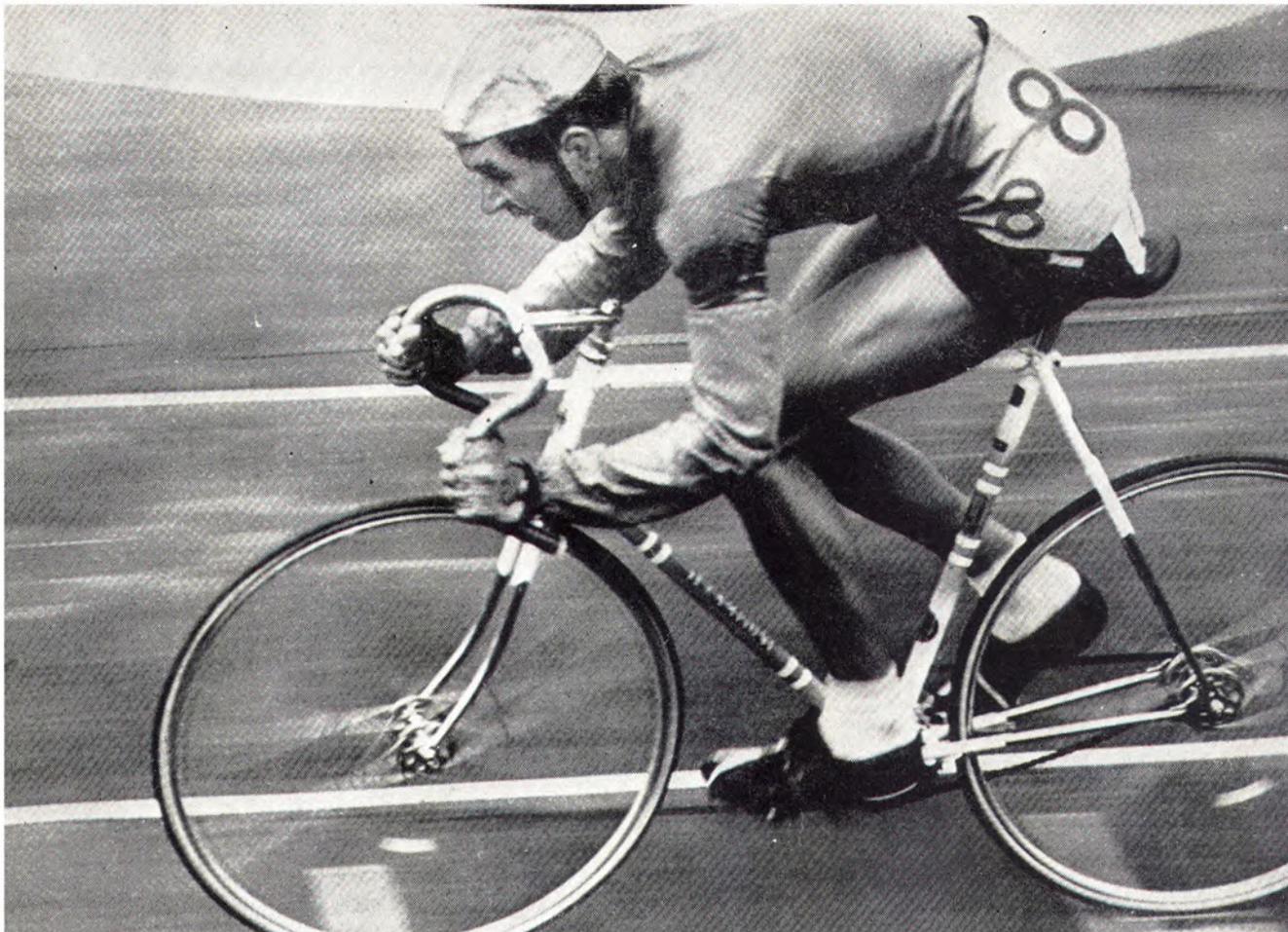
MAY 1966 TWO SHILLINGS

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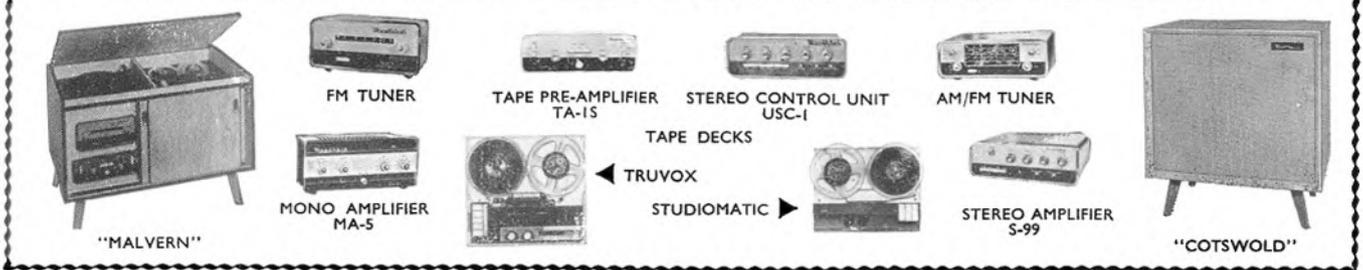
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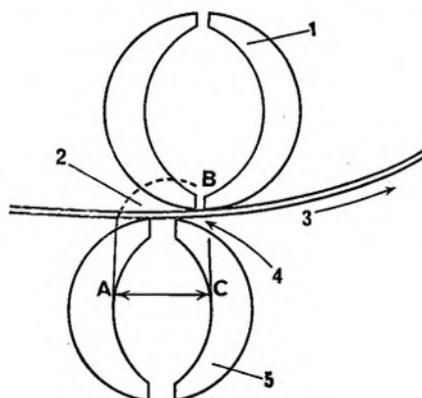


AKAI X4 **99 gns** A.C. Adapter £20
AKAI M8 **136 gns**
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Shown above Akai X4

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

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

It will be seen from the construction of the Akai Crossfield Head assembly that, as the signal head is arranged obliquely apart from the bias

head, across the tape, the amount of bias may be selected without regard to the functioning of the signal head. This means that the tape can be modulated over the entire frequency spectrum with maximum fidelity since the recorded signal is entirely unaffected by the bias field.

The maximum audio frequency that can be recorded on tape is usually around 790 c/s, at a tape speed of 1 centimetre per second, rising to about 2,000 c/s. at 1 inch per second. For Standard tape speeds: 9.5 cm/s. ($3\frac{3}{4}$ i.p.s.) —7,500 c/s. and for 19 cm/s. ($7\frac{1}{2}$ i.p.s.) —15,000 c/s.

The Akai Crossfield Head makes possible the recording of a signal frequency of up to 2,750 c/s. at a tape speed of 1 cm/sec. or 7,000 c/s. per inch. In other words, the Akai Crossfield Head—makes it possible to record 18,000 c/s. at a speed of $3\frac{3}{4}$ i.p.s. or 21,000 c/s. at $7\frac{1}{2}$ i.p.s. With the low speed of $1\frac{1}{2}$ i.p.s. (4.75 cm/sec.) now available on the M8 and X4 models, it is practicable to record up to 11,000 c/s.

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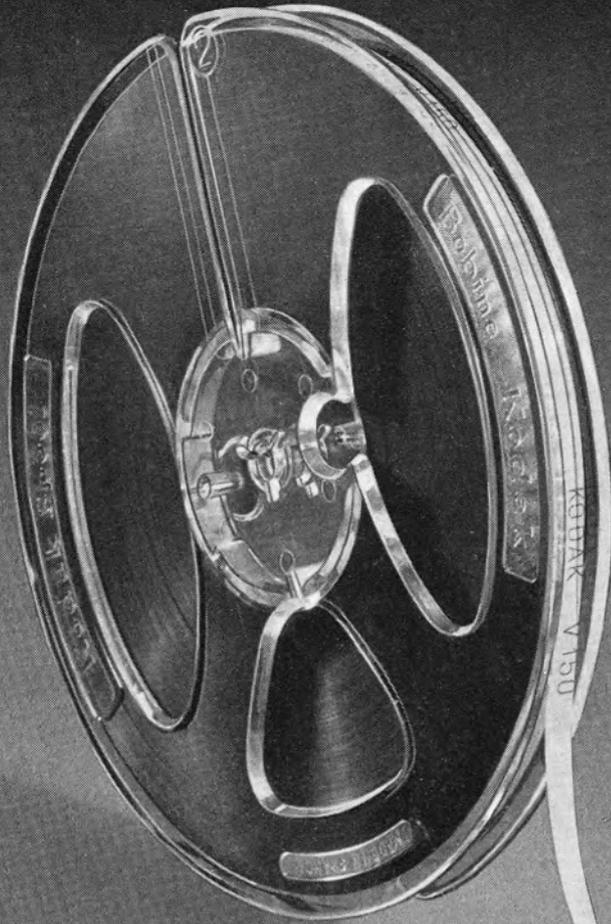
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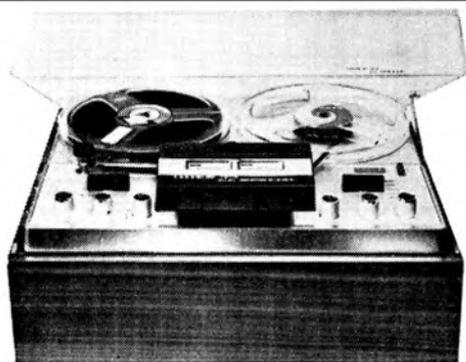
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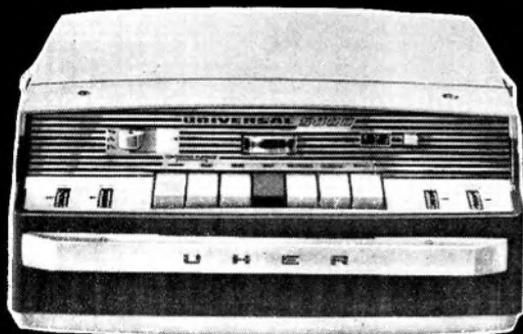
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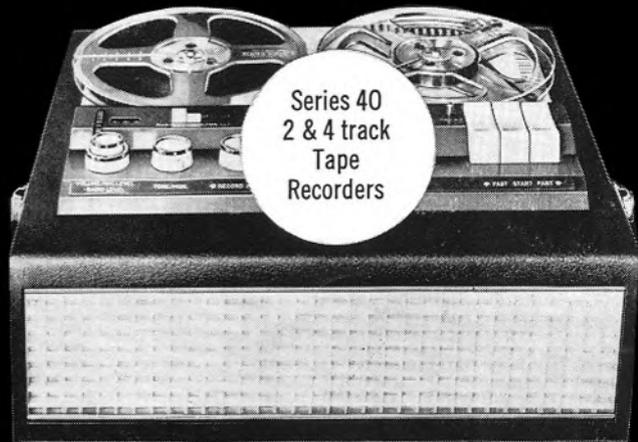
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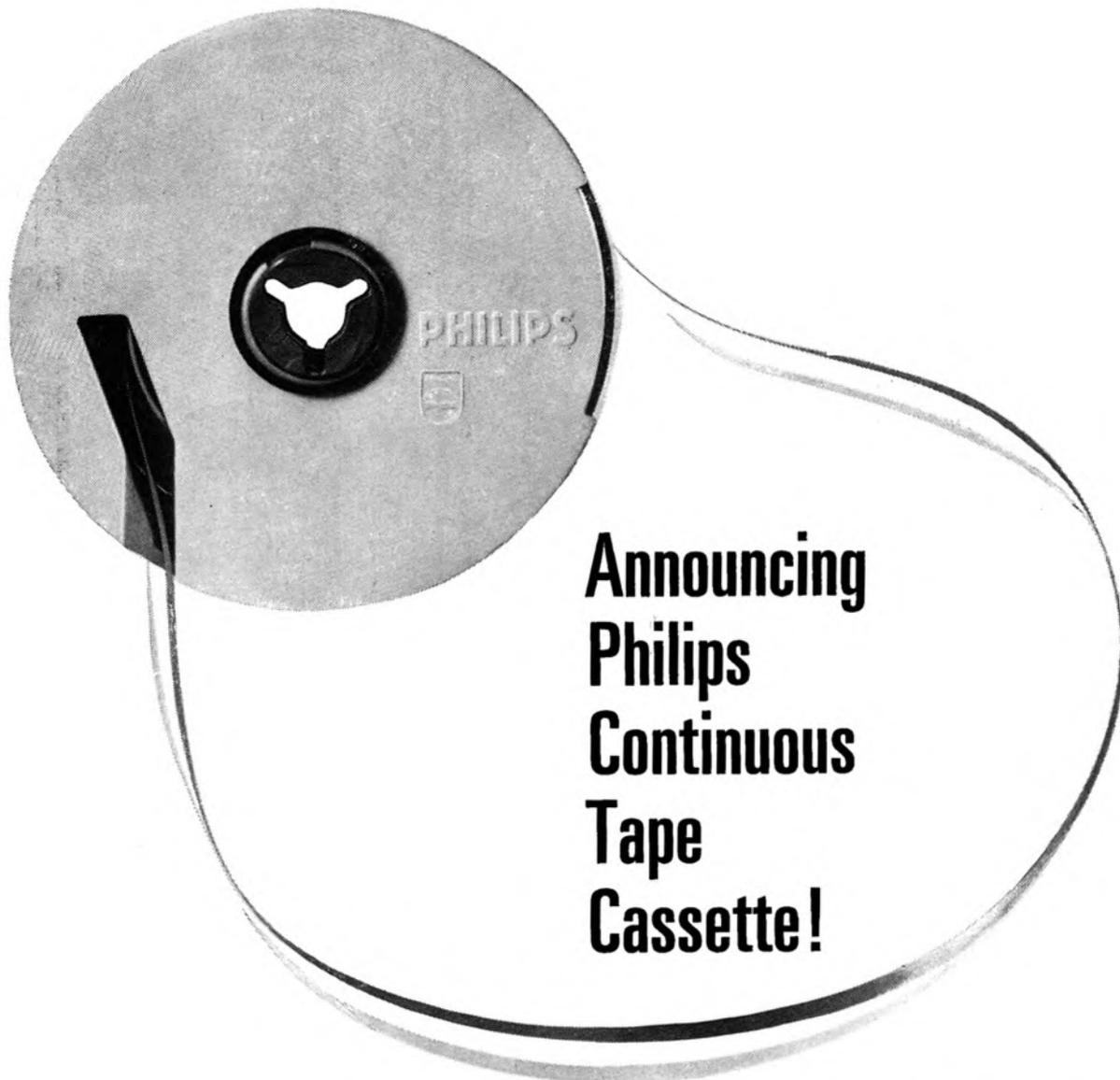


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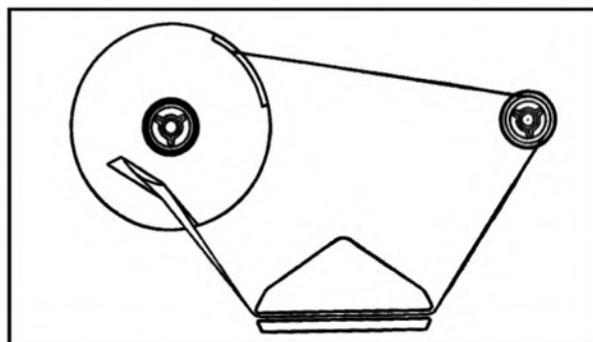
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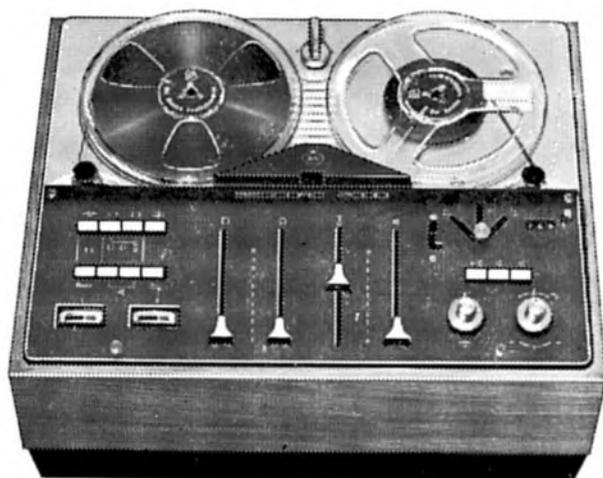
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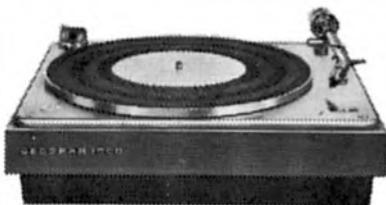


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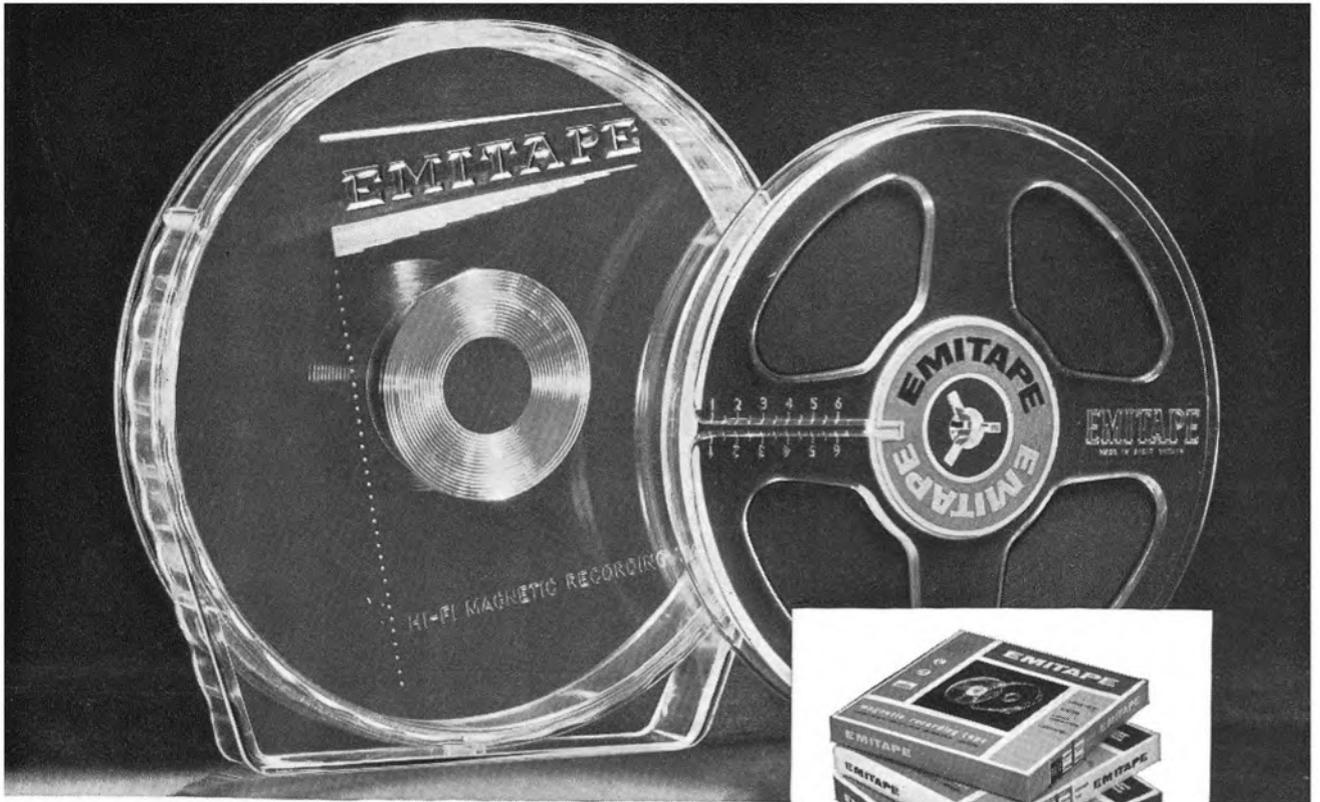
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editorial

THE 1966 AUDIO FAIR is upon us, providing, with the introduction of many new recorders, an opportunity to gauge the more obvious trends in styling and constructional technique.

Really fresh thinking is by no means a regular feature of Audio Fair exhibits, but this year the offerings include a new cassette system, a pocket recorder with cross-field bias, and a return to what one manufacturer has painfully described as the "Instrument Look". Take heart, fellows, ugliness is coming back into fashion!

The recurrence of names like *BSR*, *Elizabethan* and *Wyndor* suggests that the 'strictly domestic' manufacturers are now trying hard to produce high-quality equipment without breaking self-imposed barriers of price.

Professional recording machines have been shown at the Russell for several years now, but 1966 sees a sizeable increase in the number of exhibitors catering for studios and broadcasters. At least six (it depends where you draw the line in quality) different manufacturers will be displaying equipment designed purely for the professional.

Video tape recording seems to have suffered something of a drawback. The *Loewe-Opta* machine originally planned for display is now undergoing production delays, while *Sony*—who might well have shown their £300 machine—decided not to exhibit at all. We can console ourselves, however, with the thought of a second demonstration of the *Philips EL3400*.

Tape accessories achieve a new distinction this year, with one exhibitor specialising almost entirely in plugs and sockets. Donald Smith of *Tape Recorder Maintenance* assures us that he, for one, is not upset by the chaotic non-standardisation that exists in audio connectors!

It is no mere coincidence that our Audio Fair Preview on page 158 is illustrated by a large number of microphones. Despite our comparatively late copy date—just four weeks prior to the Fair—many of the publicity boys have apparently not yet awakened from their winter hibernation. Manufacturer's specifications were received in abundance, but photographs were few and far between. Apathy is rife enough among the two million (or is it three now?) tape recorder owners; let us not see it in the industry's press officers.

And while on microphones, the 'do-it-yourself' pastime has taken a new turn. A microphone for home construction is now being produced by *Philips*. The home-assembly of electronic equipment has long been a popular pastime of audio and radio enthusiasts. This new trend to mechanical assembly may well prove equally successful. Those of us brought up in a jungle of *Meccano* are looking forward to the first home-constructor's tape transport. Who knows what the gentlemen at *Daystrom* have up their sleeves!

Another newcomer to the audio scene makes its debut at the Russell within the coloured cover of the 1966 *Audio Annual*. Readers

in the habit of filing their copies of *Tape Recorder* in string binders will be aware that, since our yearly index has been incorporated in the last issue of each volume (rather than sold as an extra booklet) one of the thirteen strings in the binders has been doomed to redundancy. For an outlay of 5s., readers can now fill this thirteenth string with a souvenir edition of the two magazines—or, if you prefer it, this souvenir of the Audio Fair. Occasional readers of the magazine may also find interest in the review reprints which accompany the many feature articles in the *Annual*. No less than 25 items are reviewed, including the *Revox 736*, *Clarke & Smith TR634*, *Beocord Stereomaster 2000* and *Sony TC500*. Much of the equipment included will be found at the Fair, and readers may care to weigh the equipment against the review, where relevant.

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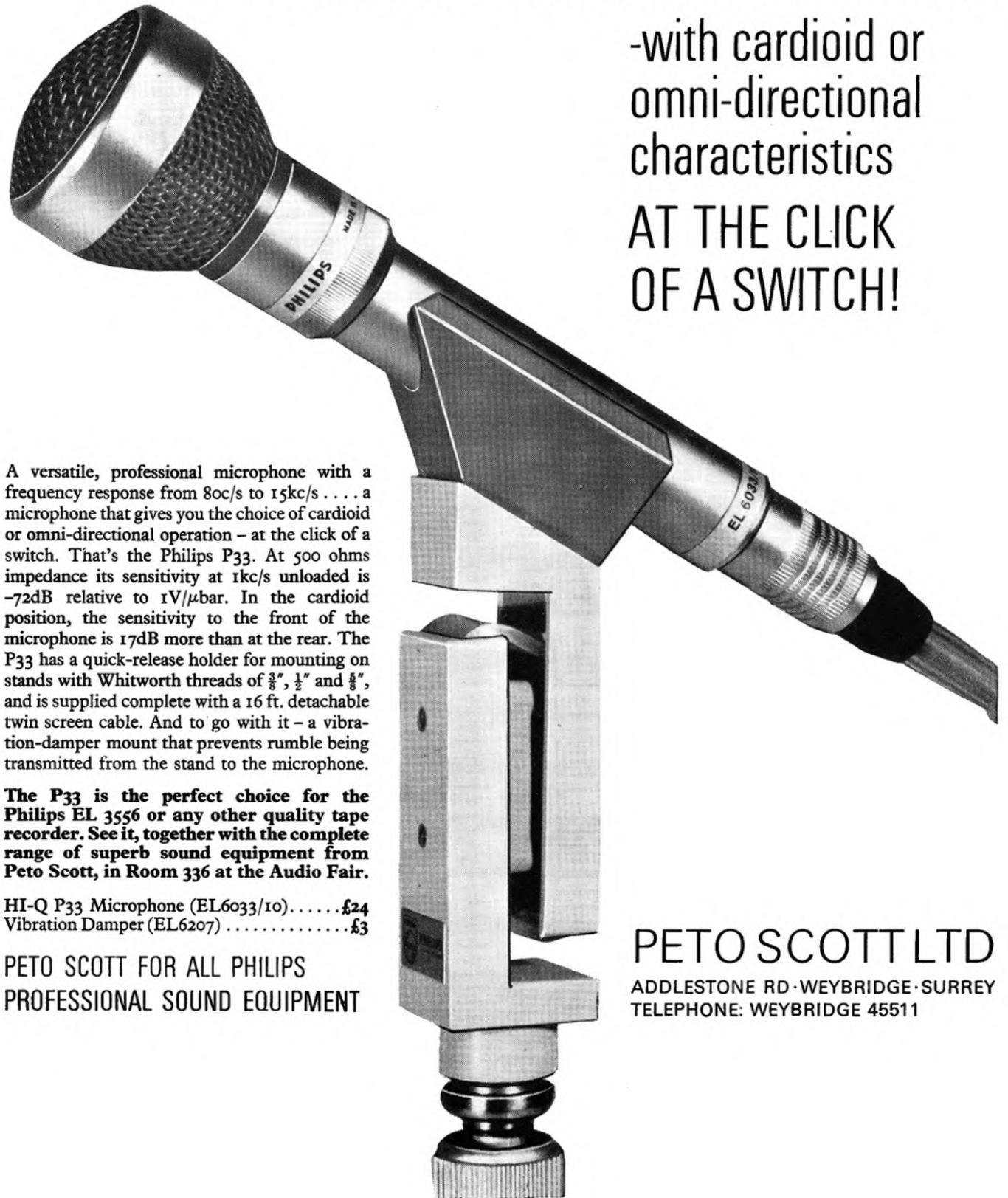
What facts would the great Holmes have deduced from this photograph? From the term 'Tape Speed' below the equalisation control he would imagine the view to be of a tape recorder, while the provision of NAB and CCIR characteristics suggest the origin of the machine to be the USA or Europe. English labelling and a VU-meter suggest the former, while switching for microphone, and balanced and unbalanced bridge inputs point to this being no homely amateur recorder. Who are the largest American manufacturers of professional tape equipment? Holmes is replacing his acoustic gramophone with an *Ampex*.

SUBSCRIPTION RATES

Annual subscription rates to *Tape Recorder* and its associated journal *Hi-Fi News* are 30s. and 38s. respectively, Overseas subscriptions are 32s. 6d. (USA \$4.50) for *Tape Recorder* and 38s. 6d. (USA \$5.40) for *Hi-Fi News*, 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.

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The P33 is the perfect choice for the Philips EL 3556 or any other quality tape recorder. See it, together with the complete range of superb sound equipment from Peto Scott, in Room 336 at the Audio Fair.

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world of tape

COPYRIGHT LICENSING FOR AMATEURS

RECENT announcements by the *Mechanical Copyright Protection Society Ltd.* suggest that the intricacies of copyright, as it affects the amateur, are now well on the road to clarification. An annual licence may now be purchased, giving domestic tape users the right to record from certain sources for home entertainment purposes.

For 10s. per annum, recordings may be made of all musical works under MCPS administration which have been previously recorded in this country for retail sale, or produced on publishers' library records. The licence covers private exhibition in domestic surroundings, for the benefit of other enthusiasts in amateur tape and cine clubs, and submission for judging in national and local amateur competitions.

For £2 10s. annually, recordings may be made and synchronised to film and slides "by any known means".

With an eye to the future, the company have arranged licences for domestic television tape recordists, these costing £5 per annum. Application for further information and licences should be made in writing to the *Mechanical Copyright Protection Society Ltd., Licensing Department, Elgar House, 380 Streatham High Road, London, S.W.16.*

TAPE RECORDS IN THE USA

FROM the USA comes news of developments in commercial tape records. Eight-track stereo tape machines designed for mounting in motor car dashboards are selling well, and *RCA Victor* recently announced the introduction of 175 tapes for use in these machines, more being added each month. Each cartridge is guaranteed for one year against manufacturing defects.

Forty-two $3\frac{1}{2}$ i/s tape records were added to the *Ampex* stereo tape catalogue during the latter part of 1965. The growth of $3\frac{1}{2}$ i/s tapes, which are new to the American market, brings the price of tape records into line with competitive LP discs. A double-play tape album sells for approximately £3 10s. which is slightly less than the equivalent material on stereo disc.

FURTHER FACTS ON PHONOPOST

IN view of the confusion in some quarters over certain restrictions in the *Phonopost* reduced-rate tape mailing service, further details have been obtained from the GPO. The only objects that may be sent under the *Phonopost* system are gramophone records, tapes, wires and other similar recording materials (whether or not bearing a sound recording), suitably protected "needles" for reproducing the (disc) recording, and a written notice relating to the method of playing the recording. Letters or photographs may not be enclosed.

Packets should not be sealed but fastened in such a manner that they may easily be examined. The sender is required to mark the packet PHONOPOST in capitals above the address of the addressee, also showing his own name and address on the outside of the packet. A green customs declaration must be attached. Not all countries accept *Phonopost* packets, neither despatch nor acceptance being obligatory under the international regulations of the Universal Postal Union. The names of countries which will accept the packets are given on pages 142-336 of the *Post Office Guide*. Amendments are being issued to post offices as information is received regarding changes from the countries concerned.

F.B.T.R.C. COPYING SERVICE

A COMPREHENSIVE list of successful entries to past British Amateur Tape Recording Contests has been produced by the *Federation of British Tape Recording Clubs* and is being circulated to Member Clubs and Associate Members. Copies are also available to non-member societies and individuals for 10s. 6d. The copying service is free to members who submit their own tape, while a charge of 5s. per hour of recording time is made to non-members to cover the cost of dubbing and packing. Unless otherwise requested, copies are made on $\frac{1}{2}$ -track equipment at $7\frac{1}{2}$ i/s. For an extra 21s. the *Federation* will supply a 7in. reel of Standard Play tape. Further details may be obtained from: *The Librarian, F.B.T.R.C., 33 Fairlawnes, Maldon Road, Wallington, Surrey.*



"He takes these plays very seriously."

AMPEX OPEN NEW FACTORY

EXPANSION at the Nivelles branch of *Ampex International* in Belgium has culminated in the opening of a new factory and office block providing 42,000 sq. ft. of floor space. High speed digital tape mechanisms and a range of food-sorting equipment are to be manufactured for Belgian industry and for export. Production of domestic audio and professional video tape recorders is envisaged, along with construction of a magnetic tape testing centre.

PHILIPS PATENT DROPOUT INDICATOR

ONE of the many steps involved in producing a gramophone record is a test for audible faults that might originate from a defective disc matrix or from dropout on the magnetic tape master. Until recently, the only reliable method of checking a tape or disc has been by the simple process of listening to it, though this was both time-consuming and technically unsatisfactory. An ingenious system patented by *Philips* now provides an efficient alternative to the human ear. The recording under analysis is played backwards and the combined audio and interference signals are fed to a filter. A characteristic of audio signals is their fairly steep leading edges and relatively slow trailing edges. With the record played backwards, this characteristic is reversed and the filter discriminates between interference (which is of an impulsive nature) and audio by 'recognising' the slow build-up of each audio signal. The signals passing the filter—mainly interference—are fed through a rectifier, resistive voltage divider and integrator and the two outputs applied to a differential amplifier. The output of this amplifier can be used to operate a relay, halting the tape transport whenever an interference signal is detected.

TELEVISION ADVERTISING FOR EL3301

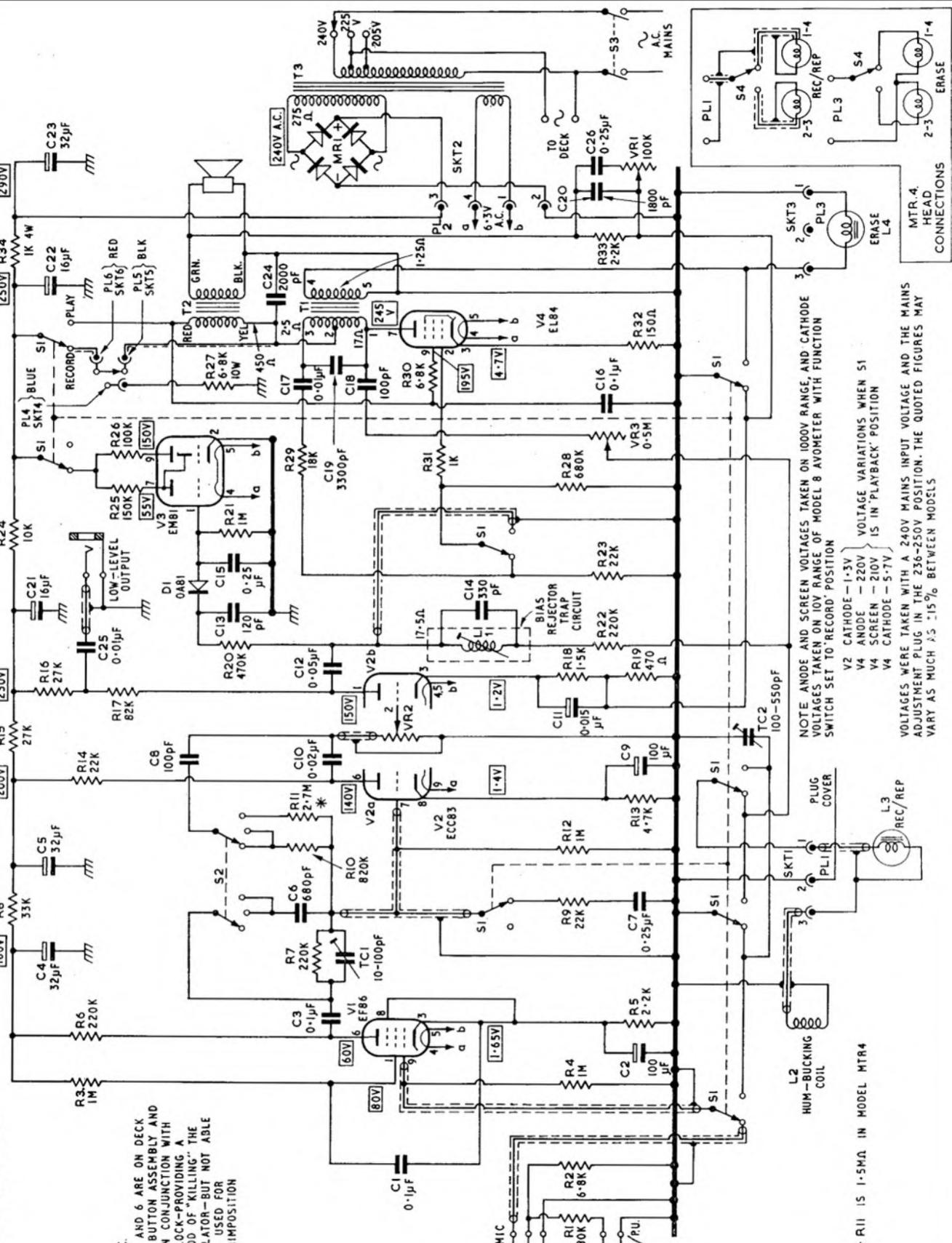
RARELY does a tape recorder sell sufficiently well to warrant television advertising which, at some £1,000 per minute, quickly eats into profits. The *Philips EL3301* has proved so successful, however, that the manufacturers are confident of a sizeable potential market. To bring their battery portable cassette recorder to the attention of the millions of commercial television viewers who do not read *Tape Recorder*, *Philips* promoted the machine in a series of 30-second advertisements. Between February 14th and March 27th an average of 13 advertisements appeared on each of the three main ITV viewing areas in London, the Midlands and the North.

NEXT MONTH

TO BE PUBLISHED on Saturday, 14th May, the June issue of *Tape Recorder* will have a blue cover and will include an outline of the Czech tape recording scene by Otto Musil. H. W. Hellyer describes a recent tour to an imaginary continental factory—*A Visit to Grozound*. This will be accompanied by an article in Michael Gordon's *Battery Powered Tape Recorders* series entitled *Overcoming Interference*.

MARCONIPHONE MTR1/MTR4
CIRCUIT DIAGRAM

NOTE.
PL4,5 AND 6 ARE ON DECK
PUSH BUTTON ASSEMBLY AND
ACT IN CONJUNCTION WITH
INTERLOCK—PROVIDING A
METHOD OF "KILLING" THE
OSCILLATOR—BUT NOT ABLE
TO BE USED FOR
SUPERIMPOSITION



NOTE: ANODE AND SCREEN VOLTAGES TAKEN ON 100V RANGE, AND CATHODE VOLTAGES TAKEN ON 10V RANGE OF MODEL B AVOMETER WITH FUNCTION SWITCH SET TO 'RECORD' POSITION

V2 CATHODE - 1.3V
V4 ANODE - 220V
V4 SCREEN - 210V
V4 CATHODE - 5.7V

VOLTAGE VARIATIONS WHEN S1 IS IN 'PLAYBACK' POSITION
VOLTAGES WERE TAKEN WITH A 240V MAINS INPUT VOLTAGE AND THE MAINS ADJUSTMENT PLUG IN THE 236-250V POSITION. THE QUOTED FIGURES MAY VARY AS MUCH AS 15% BETWEEN MODELS

* R11 IS 1.5MΩ IN MODEL MTR4

MTR-4 HEAD CONNECTIONS



TAPE RECORDER

SERVICE

NUMBER FIFTY-THREE

MARCONIPHONE MTR1 AND MTR4

BY H. W. HELLYER

THERE are two prime difficulties in the preparation of these articles: first, we are strictly limited in the circuits we may publish because some manufacturers, as stated before, take a dim view of our knowing more than the plain operating information. Though many of us whose business it is to repair the machines can obtain service data from some makers, we are forbidden to pass it on. Again, some makers will not even give information to the accredited repairman, be he radio dealer or service group agent, unless he is also an agent for that particular brand of goods. Which makes it a bit hard for the chap in the street who has had a bad deal from the only local agent, has his letters of appeal brushed off by the manufacturer, and cannot get anyone else to handle his repair job.

This brings me to my second point: that many of the circuits in my files are almost literally the result of hasty scribbles on the backs of envelopes—either because no data had ever been published, or could not be made available. We may eventually get around to pressing our tame draughtsman into making something intelligible out of them, and publishing circuits in *Tape Recorder* style (such as the accompanying diagram).

The MTR1/4 circuit is itself something of a model. When it appeared in 1961, with half or $\frac{1}{4}$ -track operation and three speeds (using the *Collaro Studio* deck), in a neat carrying case, and at a fairly competitive price, it justifiably attracted much popular attention. True, the response fell off rather sharply at top and bottom, and even the 7in. forward-facing speaker could not get the bass some users desired; and there was no provision for an extension loudspeaker. But this was a small detraction, easily overcome. Moreover, the low-level output, at an impedance of 220K, giving about 0.5V, was sufficient to load a separate playback amplifier and obtain an extended response. At the upper end, there was again a noticeable falling off, partly due to the heads used on this earlier type of Studio deck, and the $7\frac{1}{2}$ i/s speed was intended for serious work. We have come a long way since then.

Which brings me, deviously, to my next point. A number of readers have asked for advice on fitting $\frac{1}{4}$ -track heads to their $\frac{1}{2}$ -track machines, and are sometimes deterred by the thought of extensive circuit alterations, particularly in the equalisation network. As can be seen from this circuit, the transposition from half to $\frac{1}{4}$ -track heads required only the changing of one resistor in this network. But, what is more often overlooked when this question is asked—and answered—is the difference between the modern head and the older version. Almost invariably, newer types have a higher inductance, which requires a lower signal current and sometimes a higher source resistance from which this feed is obtained. Of course, the simple answer is to insert

a series resistor, which both attenuates the signal level and increases the virtual source resistance. But like most simple answers, it has its drawbacks, and there is a very decided limit to the amount of resistance that can be added to some circuits. Modern heads are very good at the top end of the frequency range, and one's amplifier may not be suitable for this difference in the response curve, so a balance has to be struck between the recording resistance for correct conditions, the new setting of bias, and the modified equalisation circuit. Everything really depends upon the equipment in use, and quite often a fair amount of experimentation is needed to achieve satisfactory results.

These notes may seem to have little to do with the MTR1/4, but are necessary at this point, if only to save future correspondence. Summing up the points—the modern head has a higher inductance and a greater treble efficiency. Therefore it needs less recording current, delivers less signal (though not usually less than the amplifier can compensate for) and needs less bias. Recording current can be reduced by the insertion of a series resistor—between 100 and 200K is usual, depending on the head inductance. The higher the inductance, the higher the added resistor.

The bias should always be adjusted for a balance between treble in playback (of a test recording made as bias is adjusted) and distortion. As the bias feed is generally via a capacitor (and this is, in many cases, including the accompanying diagram, a trimmer capacitor) a certain amount of adjustment can be made without any circuit alterations. But, in general, a reduction of the overall value of the bias capacitor will be needed, and a new trimmer may have to be fitted. (Reactance is inversely proportional to capacitance, so a reduction in capacitance increases the reactance, which decreases the bias value.) In the example given, the 100-550pF trimmer TC2 could be substituted by a standard 30pF trimmer with about another 30pF across it—again, this value being determined by experiment. Less may be required.

To set the bias, make a recording with a good amount of treble in it—a bit of Mantovani, with bags of singing strings, if you like—and begin with the trimmer at minimum value, i.e., screwed out. Replay the test passages, each time increasing trimmer value slightly, noting the position of the trimmer screw or other convenient mark. At a certain stage, there will come a point where the treble response starts to fall away again, having risen to its peak. The distortion, which should have been apparent as we started and should have gradually improved, will continue to improve beyond this peak.

Precise setting depends on the tape you intend to use, and some other factors, but should lie between these two points, of maximum

(continued on page 170)

YOU CAN RECORD FROM RANGOON TO REYKJAVIK



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—WITH THE NEW **EMI L4** ALL THE WAY!



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Full details on request to:—

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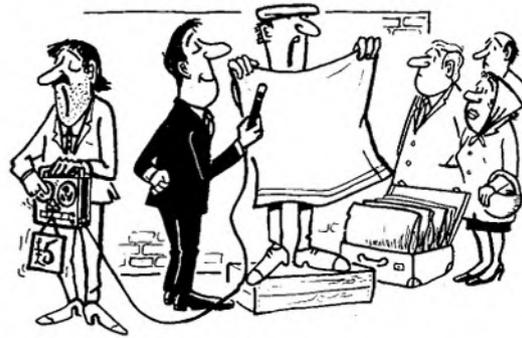
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The colourful characters of Petticoat Lane will add humour to your recordings. Useful bargains are also to be found.

LONDON ON A THREE-INCH REEL

Some suggestions by Anscomb for enthusiasts 'in town' for the Audio Fair



Big Ben sounds o'er London's traffic. Take care London's traffic does not sound o'er thee.

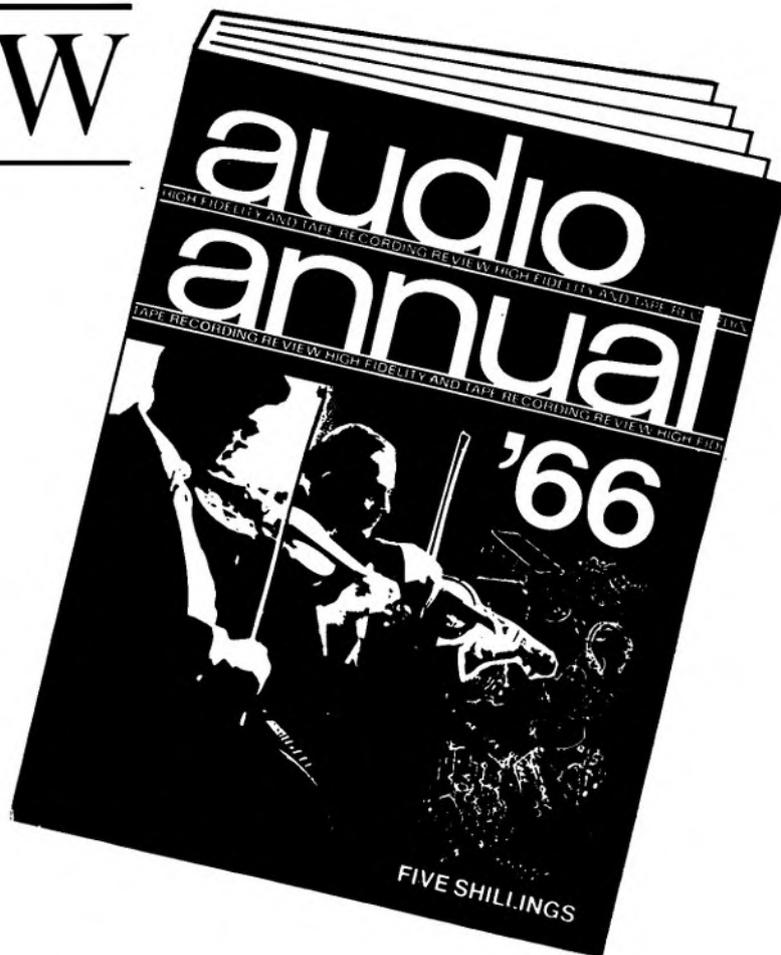
Automatic gain control allows the unskilled to assist when circumstances require.



Demonstrations at the Audio Fair sometimes take an unexpected turn.



NEW



1966 audio annual

This new publication is concerned with high fidelity sound reproduction and tape recording and is produced by Britain's leading magazines in the audio field — "HI-FI NEWS" and "TAPE RECORDER".

Main features include ■ What matters in amplifiers ■ Comparing and measuring tape recorder performance ■ Judging audio quality ■ Creative taping as a hobby ■ An approach to tape recorder servicing ■ Whither stereo? ■ Tape prospects and problems ■ The hi-fi revolution

Plus a selection of the more important equipment reviews that appeared in "HI-FI NEWS" and "TAPE RECORDER" during 1965.

OUT NOW 5/- GET YOUR COPY NOW

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OUR READERS WRITE . . .

. . . about the Phonopost

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

DEAR SIR, I note with extreme satisfaction that at long last the GPO have thought fit to introduce the Phonopost service. The thousands of tapetalkers in this country will benefit by this and I know they will join me in thanking you for your past efforts to get this much needed service 'cracking'. Perhaps it could also be placed on record that during Worldwide Tapetalk's campaign a few years ago, quite a number of our members wrote to their MP's urging them to do something to get a cheaper rate for airmail tapes. It would appear that our joint efforts paid off!

I would like to take this opportunity of clarifying your Editorial remarks to the effect that "The new rates are only fractionally higher than second-class tariffs and, bearing in mind that packages may be sealed . . .". A letter from the Harrow postmaster received today states: "The make-up should be such that the contents are protected but also easily accessible. It would not be permissible to enclose in such a way that the wrappings have to be broken to gain access. A clasped flap would be acceptable but if metal fasteners are used they must be blunt and well pressed down to obviate risk of injury to the hands of the Post Office staff."

An article in the next issue of our publication *Sound Advice* will be giving the full implications of this new Phonopost service, together with a complete list of countries involved and the postal charges.

Yours faithfully,

(Further details of the Phonopost service have been received from the GPO and are given on page 149—Ed.)

. . . about a helpful manufacturer

From: Donald Hannam, 6 Hevers Corner, Horley, Surrey.

DEAR SIR, Being a regular reader of your magazine *Tape Recorder*, I often read of complaints regarding tape recorders and their manufacturers. I do agree with many aspects of these complaints and feel that they are fully justified. I have been very fortunate in purchasing a WyndSOR recorder. Although this may not be a professional item, I feel that they deserve a few words in print on the wonderful service and good faith they show in their products. I have had teething troubles, but on asking for WyndSOR's help, have been furnished with

new components and wiring diagrams free of charge; any help I have needed they have gladly given.

In this day and age of the indifferent manufacturer, firms such as WyndSOR warrant all the publicity and praise they can get. Theirs may not be the most expensive equipment, but they have really satisfied customers. Well done WyndSOR.
Yours faithfully,

. . . about the Countess tape recorder

From: D. May, 12 Leverton Court, Melton Road, West Bridgeford, Nottingham.

DEAR SIR, I should be grateful if any reader could supply me with the name and address of a firm offering servicing and spares for the Countess tape recorder. This is the machine with stacked, concentric spools which was advertised and reviewed in the October 1961 issue and which was retailed by *Radio Clearance Ltd.*
Yours faithfully,

. . . about a condensed letter

From: Colin Braddock, The Tape Recorder Centre, 266 Waterloo Road, Blackpool, Lancs.

DEAR SIR, Well, as expected, it has started: my phone has rung many times admonishing me for "my views on single-motor machines, etc., and transistors". I would earnestly ask you to point out that the letter published in your March issue . . . about *Victorian concepts*, being a shortened version of my original contribution, reversed its meaning at one point in your subbing. The sentence beginning "I would add . . ." and ending ". . . coals on the fire." was not meant to represent my own opinion, which it did as published, but was quoted as the opinion of many people in the audio world. I have, indeed, great admiration for many single-motor decks and also many transistorised units. The intended theme of my letter was one of agreement with Mr. Bolt upon his impressions that U.K. manufacturers generally were Victorian in thought, while pointing out the differences between his opinion of what the hi-fi man wants in a tape recorder and the opinions of my acquaintances.
Yours faithfully,

(Mr. Braddock is quite right. In condensing his rather lengthy letter we altered the meaning of one sentence by removing the preceding one. We apologise for the misunderstanding and for any inconvenience which may have resulted. We would also take this opportunity of reminding readers that 'short and sweet' is the ideal rule-of-thumb when submitting technical queries and letters for publication—Ed.)

book reviews

BUILDING AND USING SOUND MIXERS. By R. E. Steele. 152 pages. 124 line and 8 tone illustrations. Price 30s. Published by *The Focal Press*, 31 Fitzroy Square, London, W.1.

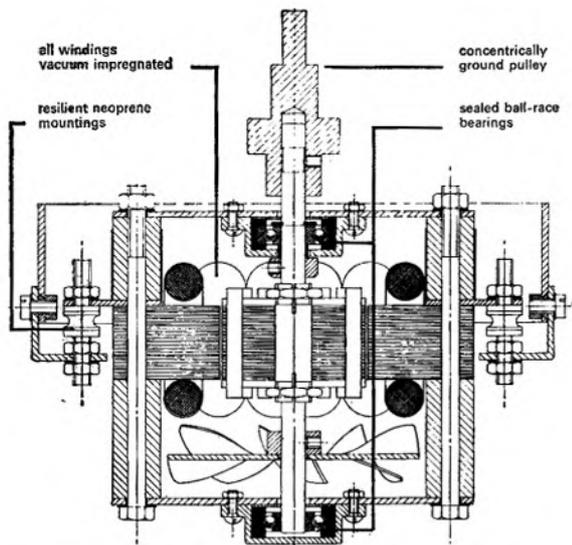
THE book is divided into seven chapters, with five appendices and an eight-page glossary of technical terms. The first three chapters describe mixers in broad outline; the various types available, simple and more involved, passive and active, etc. There follows a chapter on power supplies for valved equipment, a short chapter on integrating the mixer into an existing arrangement, and then a long chapter on a few circuits for building, with Mr. Steele's own valved design taking pride of place. The final chapter describes various ways of using a mixer.

The first impression on reading the book is that it is a little disjointed, with various subjects (such as the use of transformers and balanced lines, for example) being briefly touched upon in more than one chapter instead of being described and finished at one time. It is about then that the reader becomes aware of inconsistencies and errors in the text. For example, it is only rarely necessary to match the output of the mixer to the input impedance of the main amplifier, and not always as stated in the text. In most cases it is better to have

a low mixer output impedance feeding into a higher impedance at the other end to reduce noise and pick-up in the cable. The exceptions are with a transformer input to the main amplifier (very rare for amateurs) which must be correctly matched for correct frequency response, and where the feedback in the main amplifier is dependent on source impedance, which is most unlikely.

In the book there are only four transistor circuits, one for a VU meter (shown with an incorrect meter sensitivity) and three for pre-amplifiers (one of these is stated as having an input impedance of 1M when in fact it cannot be higher than 350K). The remainder of the circuits are valved; this is not really adequate in these days when transistors are offering overwhelming advantages of cost, low noise, no hum, small size and greater reliability than valves. The circuits given include equalisation for pickups, radio and tape signals direct from the tape head—the latter given only for 3½ i/s, although there is no mention of this in the text.

The review copy had many printing errors which I feel should have been corrected at the proof stage; but more disturbing were the fundamental errors. The last appendix in the book is a glossary of technical terms, potentially most useful to the amateur or beginner; however, the definitions leave room for confusion. For example, a picofarad is not one millionth of a farad—this error is perpetuated in the previous appendix, which also calls a microfarad 10⁻³F. A few quotes from this glossary illustrate the tone of the book: "Bridge—a circuit commonly used for measuring out of balance components by



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Every Ferrograph tape recorder is fitted with three independent motors each designed for its specific task and built by Ferrograph to give enduring reliability over a long, long period of time. The Capstan Motor is synchronous, mounted on resilient neoprene pillars for lowest mechanical noise and is fitted with ball-race bearings to ensure a maintenance-free life and assist speed accuracy. Its design minimises hum fields. This motor is just one reason why Ferrograph tape recorders are incomparable. Other reasons include:

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THE INCOMPARABLE TAPE RECORDER

BOOK REVIEWS CONTINUED

use of a sensitive meter"; "Reverberation—more or less gradual dying away of a sound in a room"; and "Rumble cut—filter network designed to cut off sharply very low frequencies approximately equal to the r.p.m. of the turntable of a record player". I find it difficult to confuse 33½ r.p.m. (about ½ c/s) with the normal rumble cut at 30-40 c/s.

There is a very strong need for a book covering the subjects attempted in this book, with the rapid growth in the number of domestic tape recorders and tape clubs, and it is a pity that I cannot recommend it in any way. There can never be an excuse for incorrect information, and unfortunately the book is full of such information. To take but one further example of this, it is stated in Chapter 3, when discussing simple resistor-capacitor filters, that the rate of cut is dependent on the size of capacitor used; in figs. 44 and 45 the effect of varying this is shown as a 30 times change in turn-over frequency for a 2:1 change in capacity, and both producing a slope of some 2dB per octave. (The change in frequency is in the case above exactly 2:1, and all simple R-C networks produce slopes of 6dB/octave.) This is simply not good enough, particularly in a book which is aimed at "the man who prefers to design and build his own sound recording and reproducing equipment". The book is aimed as well at the beginner—and here it is most essential to give correct information; the example above is unfortunately representative of the whole book.

Finally, a note on the presentation of the book. For an outlay of 30s. I would expect to find a considerably better standard than the cardboard covers, and hand-drawn untidy circuit diagrams—many of whose figure numbers do not agree with the text. However, even with immaculate circuit diagrams, it would be impossible to recommend this book, least of all to the newcomer for whom it is designed. The book was lent to an amateur (without comment from the reviewer) who builds a little of his own equipment, belongs to the local tape club, and is an enthusiastic but non-technical user of tape recorders. Since it is difficult to review a book from exactly the viewpoint of those for whom it is intended, it is useful to report that, while the technical faults were not all seen (adding point to the earlier remarks), the other comments were broadly endorsed. D.P.R.

COMEDY SCRIPTS FOR TAPE RECORDING. By Peter Cagney. 27 pages, 24 line and wash illustrations. Price 3s. 6d. Published by *Minnesota Mining and Manufacturing Ltd.* in co-operation with *Queen Anne Press Ltd.*, York House, Queen Square, London, W.C.1.

SCRIPTS for light-hearted tape sketches have long been available across the Atlantic, though even there, to my knowledge, they have never been marketed other than individually. *Comedy Scripts for Tape Recording* is thus, perhaps, unique. No mighty epics are included, the book comprising eleven skits, the longest of which would run for about ten minutes. Mr. Cagney is, we are informed, a professional scriptwriter, and he certainly exhibits no lack of imagination in the subjects he covers. The customary formula of creating two or more characters is not followed rigidly, two of the sketches—*The Weather Man* and *Piano-Interruption Routine*—being for a single performer accompanied, in the latter case, by sound-effects.

In reading the book, I attempted to assess the 'creativity' one could put into the production of each sketch, rather than comment on the humour itself. In this respect, *Piano Interruption Routine* seemed outstanding, since an ambitious producer could employ mixing, superimposing and editing to achieve a very polished effect. The ability to tinker with a piano 'by ear' is enjoyed by many tape enthusiasts and, in this case, the poorer the accompanying performance, and the less well-tuned the piano, the better the resultant sketch. Those skilled in the ivory art might imitate that painfully beautiful piano-playing that accompanied some of the old Goon Shows.

In a short introduction, Mr. Cagney suggests possible applications of the playlets and then continues to suggest ways and means of creating sound-effects. The list of effects is culminated with the advice that readers can purchase suitable 'mood music' on 10 and 12in. 'seventy-eights'. Considering the very wide selection of sound-effects and mood music now produced for the tape enthusiast on microgroove discs and commercial tape records, there seems little reason for tolerating the extra background hiss.

This book is well worth purchasing at 3s. 6d., both as a source of recording material itself and also as an example of the versatility of the sound play for the budding David Haines's of this world. D.K.K.

INTRODUCTION

This short play returns to the elementary voice-positions of drama-on-tape.

The judge should be positioned near the microphone; the prisoner is slightly more distant; and the juror is between.

Any empty-room acoustic will suggest a courtroom interior.

It is easy, but very interesting, to balance the voices according to the gain-control, setting. However, advanced amateurs can take the exercise a stage further.

The prisoner, being in the distance, is obviously in the inferior dramatic position; the judge, being nearer to us, is dramatically superior. These two key positions can be slowly *reversed* during the scene—thus assisting the prisoner's growing ascendancy over the judge. The two actors merely exchange studio-positions during their dialogue—progressively changing over from a suitable point in the script (indicated here by square brackets).

The entire play (like many others) can easily be performed by one person if he steps to-and-fro between selected voice-positions. The 'interruptions' are made convincing by snipping short the recorded lines and splicing them to the next speech.

Further explanation of the theory of aural perspective is included in *The Dramatope Guide* (Focal Press, 7s. 6d.).

PRISONER: Oh, gorbliney!

JUDGE: But he was a most persuasive speaker. Every prisoner has his own little hobby-horse. He turned all the jury into vegetarians.

PRISONER: (*thoughtfully*) I suppose I could talk about stamp-collecting . . . (*change-over*)

JUDGE: Stamp-collecting? Is that your hobby?

PRISONER: Yes, my Lord. That's why I stole the mail-bags.

JUDGE: (*sternly*) Don't be flippant! Since you have nothing serious to say, I shall now proceed with the sentence. (*intoning*) Prisoner at the bar, I hereby sentence you to—

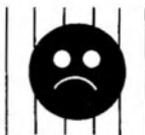
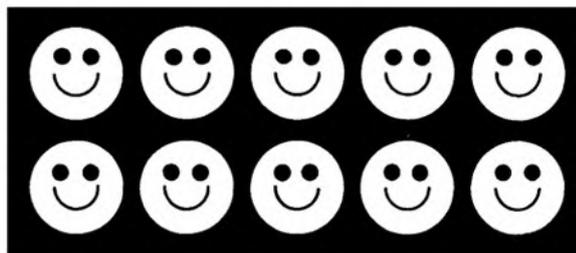
PRISONER: (*interrupting*) I hope you'll take into account the fact that I had an unhappy childhood.

JUDGE: (*starting again*) Prisoner at the bar, I hereby sen—

PRISONER: (*interrupting*) I'm not a man to indulge in self-pity. But I've had a hard life—one continuous struggle!

JUDGE: Kindly refrain from interrupting. You've made me lose the thread. (*starting again*) Prisoner at the bar, I hereby—

PRISONER: (*interrupting*) At school, for instance, my headmaster knew nothing, absolutely nothing, of child psychology. I was expelled without compunction. He never enquired



A FAIR TRIAL

A TAPE SKETCH BY DAVID HAINES

ANNOUNCER: We present a short play entitled *A Fair Trial* . . .

JUDGE: Members of the jury, do you find the prisoner guilty or not guilty?

FOREMAN: Guilty, my Lord.

JUDGE: Prisoner at the bar, you have been found guilty. Have you anything to say before I pass sentence upon you?

PRISONER: No, my Lord.

JUDGE: Nothing at all?

PRISONER: Not a single word.

JUDGE: Surely there must be *something* you'd like to say?

PRISONER: I'm sorry, my Lord. My mind is a complete blank.

JUDGE: This is most unusual. Most prisoners like to make a speech before they go down. Perhaps you're feeling nervous?

PRISONER: I'm just no good at making speeches.

JUDGE: We had a chap last week who spoke for nearly three hours. Think of that!

PRISONER: Did he make you change your mind?

JUDGE: Dear me, no—a judge cannot allow the prisoner to influence the sentence. (*with relish*) I gave him 14 years.

into the motives that led me to pick his pocket.

JUDGE: Prisoner at the bar, I—

PRISONER: (*interrupting*) The same impulse, in later life, led me to steal those mail-bags. Basically, I'm insecure. I need love.

JUDGE: I hereby sentence you to a term of—

PRISONER: (*interrupting*) And I hope you'll take my matrimonial situation into account. My wife's husband went off with another woman.

JUDGE: Prisoner at the bar I hereby sentence you to preventive detention for a period of—

PRISONER: (*interrupting*) I'm not really a criminal, my Lord. I'm just an ordinary human being—the same as yourself. Lend me your wig and I'll prove it.

JUDGE: (*angrily*) If you interrupt me again, I'll dismiss the case! (*starting again*) Prisoner at the bar, I hereby sentence you to—

PRISONER: (*interrupting*) All I ask, my Lord, is a fair trial.

JUDGE: (*promptly*) That settles it—go home you pest! Clear the court.

WHO'S FOR THE FAIR?

CAREFUL analysis of the figures—if there are any—would probably reveal that the British Museum attracts a large proportion of its annual visitors during the summer months. The popularity of that historians' haven can be expected to fall off as the nights grow longer—rising to a sudden peak in mid-December when exhausted sight-seers take refuge from the London Lights.

A similar peak, of rather smaller proportions, occurs during the first weekend after Easter—building up slowly on the Thursday and collapsing abruptly at 8 p.m. on Sunday. The museum staff have their own theories as to the cause of this phenomenon—which is all the more intriguing for being synchronised with the phases of the moon. Our own opinion, however, is that some connection exists between these peaking figures and an annual gathering at a large hotel which borders, like the British Museum, on the rectangular greenery of Russell Square. Disciples of the Audio Cult are believed to be extremely susceptible to aching feet—this physical limitation being offset by extraordinarily durable ears. In consequence, the modern seats which adorn the museum hallways provide a logical—almost magnetic—attraction for those tape recording enthusiasts, manufacturers, music-lovers, technicians and salesmen who subscribe to the religion that is the *International Audio Festival and Fair*.

To understand still further the unique qualities of the British Museum, it is necessary to study the Things-That-Go-On in the Hotel Russell.

The 1966 Audio Fair opens to the public at 4 p.m. on Thursday, 14th April, closing at 9 p.m. and re-opening from 11 a.m. to 9 p.m. on Friday and Saturday. On Sunday 17th, the Fair closes one hour earlier—at 8 p.m. Entry is by Privilege Ticket only, these being obtainable from audio dealers in most parts of the country. Readers who find themselves stranded without tickets might consider an expedition to dealers in nearby Tottenham Court Road, where the precious pink cardboard should still abound in some quantity. The tickets admit up to two persons and may be used once only.

The format of previous years is being adopted, with the ground floor devoted to static exhibition booths while the four floors above are used by manufacturers for display and demonstration of their products. In addition, the fifth floor is being used this year, enabling exhibitors to expand their space allocations to include—in several cases—Trade Offices. Readers referring to the List of Exhibitors accompanying this article should note that the first digit of the demonstration room or lounge number denotes the floor on which that room is situated; Room 315, for example, would be found on the third floor.

We commence our tour of tape-equipment exhibitors on the second floor of the Hotel Russell, and at the beginning of the alphabet.

Akai are expanding in two directions from their hitherto restricted interest in expensive semi-professional stereo recorders by introducing a professional console machine and a miniature battery portable. The *PT.5011 Studio Console* is to be produced in several forms, offering a choice of tape speeds, tracks and channels. The *X-355* was introduced several months ago as a successor to the *345 Automatic Stereo* (automation, here, being in the mechanism and not of the gain control) and costs £250 19s. A cheaper non-automatic version of this recorder is



S.G. Brown Dynamic headset

being shown—the *X-300*. Both recorders employ transistors throughout and feature cross-field bias. The *X-PK1* has the distinction of being the first mono battery portable to employ the cross-field technique (the first cross-field stereo model being the *X4*, introduced at the Russell last year). Described as a pocket recorder, the *X-PK1* has two speeds and takes 3½ in. spools. An unusual feature is the internal loudspeaker which doubles as a microphone. The Akai range now includes a single-channel mains recorder—the *910*—using the basic Akai deck and featuring capstan-sleeve speed change. Half and ¼-track versions of this recorder are available, conventional bias and a pressure-pad-free mechanism being incorporated.

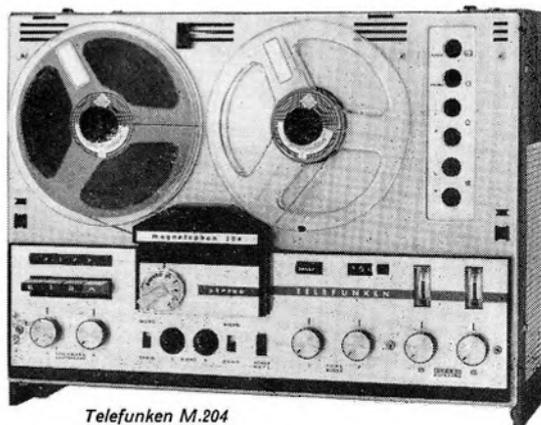
Ampex, who dropped from last year's Audio Fair at the eleventh hour, compensate for past introversion by taking part in two exhibitions simultaneously. The *2000* and *800* Series are expected to be shown at the Russell and also at the United States Trade Center (four stops on the Underground). The latter exhibition is described at the end of this article.

Audio & Design has at least one important thing to recommend it—contributor Graham Balmain as a director! The company have interests in various aspects of audio and are hoping to display a professional tape transport fitted with four-channel heads and using ½ in. tape.

BASF adhere to the 'free-sample recorded lecture' first shown in 1964 and developed from their language laboratory display of 1963.



STC demonstration recording in preparation



Telefunken M.204 stereo

An improved version of the BASF tape storage box will be shown. *Brenell* need no introduction. Their four-speed tape deck has gained something of a reputation as a younger brother of Grandad Wearite. It is a sturdy mechanism, nevertheless, and can form the basis of a low-price stereo tape unit if combined with the *Hi-Fi Tape Link*. Deck prices start at £38, while the recording amplifier costs £46. There is no pampering to prettiness (apart from that tape head cover!); the incorporation of jack microphone sockets and twin PPMs suggest that functionality over-rides appearance.

S. G. Brown concern themselves mainly with industrial communications. The aircraft controller, pilot and radio operator are as interested in long-term comfort as they are in audio quality. Headphones produced by this company for the hi-fi market embody much of the experience *S. G. Brown* have in designing comfort. The *Dynamic 3C 1100* is one of the newer models to be shown, while the *Lorgnette 11C 201/1* provides an addition to the growing species of 'handphones'. A version of the latter model is available with built-in volume control, designated the *11C 200/1*.

One feels that Henry Ford would have been proud to know *BSR*. The tape and disc mechanisms, tape decks and gramophone pickups produced by this Staffordshire company have brought pleasure to a vast portion of the 'medium-fi' market. Whatever the perfectionists say about record-changers, the *BSR TD10* tape deck has all the essen-

(continued overleaf)



Left: Shure 533
Sper-O-Dyne



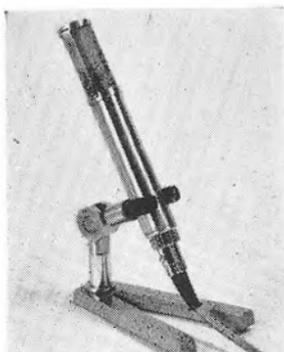
Lustraphone LH/58
hand microphone



Wyndsor Vanguard
with loudspeaker in lid



Shure SM50
Omnidirectional
microphone



Lustraphone VR/75
with built-in pre-
amplifier



Shure 581
SF Unidyne A

tials of a reliable transport—simplicity and solidity—without the meticulous machining that makes the *Studers* of this world so expensive. The result is a machine well up to domestic standards which will roll on for years. Regular visitors will note that this is the first occasion that BSR have taken part in the Audio Fair.

Butoba must have made many mouths water in their 1965 display of the *MT225* battery portable, which featured a battery-exhausting array of solenoids, three motors and a lamp! This machine was first shown in 1964 (when it was more-or-less 'under the counter') but has only just become available. It is surprising to note that, at £93 9s., this is the first battery portable ever to sell here in the £70 to £100 price bracket. Equally surprising is the fact that there are only two British-made battery recorders on the market—the *Fi-Cord 202A* and *EMI LA*. The *MB* range of microphones will be displayed alongside the *Butoba*.

EMI cater almost entirely for the professional, forgetting their work in the magnetic tape and commercial tape record fields; but the *L4* is likely to attract many outdoor recording enthusiasts. Visitors are recommended to listen to the background noise—there isn't any. Slightly larger than the *L4* is the *BTR 4* studio console recorder, illustrated on right. Solenoid controls, continuously variable fast-wind and a pressure-pad-free tape transport are taken for granted on equipment of this standard—but more and more of the lower-priced designs are coming to incorporate them.

Ferroglyph are introducing a recorder based on their *Series 6* featuring A-B monitoring and a compensated input for magnetic gramophone pickups. The PPM modulation indicator functions on both record and replay, while a spot-erase facility permits accurate removal of unwanted passages. The recorder has full mono record and replay facilities, with 3W power amplifier and monitor loud-speaker.

The products of *Fi-Cord*, *Beyer* and *Braun* will be displayed at adjacent booths and demonstrated together in Room 147. The *Fi-Cord 202A* is quite well-known, being similar to the original *202* but having no automatic gain control. Nothing new is expected, though the *Braun TG60* might be shown. This machine was introduced last year, but the model destined for display was delayed in the customs—or so the story goes. The stereo recorder sells for about £200, has a solenoid-controlled mechanism operating at $7\frac{1}{2}$ and $3\frac{3}{4}$ i/s, and utilises *Papst* hysteresis synchronous motors for the capstan and (rather unusual) also for left and right-hand spool drives.

Grampian have produced some unusual accessories in the past—their parabolic reflector, reverberation unit and windshields being the first to come to mind—but this year they concentrate on mixers. A compact battery-powered mixer is being introduced for the amateur enthusiast, while a more elaborate low-noise mixer caters for the needs of the semi-professional—meaning, perhaps, the wealthier amateur!

Hammond have shown that a capacitor microphone is not necessarily an expensive microphone. The *M.100* was evolved from the *Microkit* but, unlike that device, is supplied fully assembled. Up to 200ft. of connecting cable may be employed between the microphone and tape recorder, using a mains power unit included in the price. Mono and stereo versions are available, with respective prices of £30 9s. and £51 9s. A battery model is currently being developed.

Water being what it is, there will be no liquid backdrop to the *Kodak* synchronised tape-slide display, though the impressive performance put on by the company at the recent Ideal Home Exhibition—using a 40ft. screen of cascading H_2O —would be hard to emulate in a hotel bedroom. The same programme will be shown, however, on a conventional screen, depicting the four seasons of the year.

Loewe Opta have cancelled plans to display the *Optacord 600* video tape recorder, following the news that production had been postponed. The machine is expected on the British market towards the end of this year, however, selling at about £900. No new audio recorders are expected, though the *416* and *408* mains/battery portables will be shown.

Lustraphone are this year emphasising an aspect of electronics that has hitherto escaped the microphone field: miniaturisation. Both the size and the cost of ribbon microphones are expected to come down as a result of the *VR70/1* ribbon insert which weighs just $\frac{3}{8}$ oz. and has dimensions of $1\frac{1}{4} \times \frac{3}{4} \times \frac{1}{4}$ in. The *VR/75* ribbon microphone is designed for hand or table-stand use and features an internal transistor pre-

amplifier, bass-cut switch and an ON/OFF switch for remote operation of external equipment. Moulded handles incorporating finger indentations for greater comfort and stability have been widely used in the photographic industry. They now extend to the audio market with the introduction of the *LH/59*, a small hand microphone with PVC holder and press-talk switch.

Mallory have no demonstration room, but will be displaying on a ground-floor booth their new range of Alkaline batteries, claimed to give a steady voltage over an exceptionally long period. The batteries are being produced in five standard sizes and will be shown alongside some of the equipment for which they are specified. Miniature mercury batteries will share a space on the stand.

Metrosound are encroaching more and more into the tape recording field with the introduction of two further accessories. The *Metro-Splicer* is suitable for cutting recording tape and 8 mm. cine film and comes complete with cutting blades and film scraping tools. A plastic cleaning brush with nylon bristles boosts a range of accessories already including the ingenious *Metro-Strobe* tape speed indicator.

Revox-Studer undertook, last year, a demonstration which none of the other tape recorder exhibitors seem willing to imitate. Taking advantage of the instant monitoring facility afforded by independent record and replay heads, they fed a musical signal through four *736* recorders and compared the quality of the original with the fourth copy. No details have been released of this year's mode of demonstration, but, if it follows the last, the *736* should win quite a few converts. Studer professional recorders are widely used professionally (the BBC have more than 80) and vary from the £1,393 *C.37* stereo to the new transistor *A.62*, price £566 in full-track mono and £712 in $\frac{3}{4}$ -track stereo forms. Speeds are 15 and $7\frac{1}{2}$ i/s.

In the midst of gimmicks and eye-catching displays it is pleasing to report that at least one tape manufacturer is introducing a new brand. *Scotch* are aiming their *Dynarange* at users of semi-professional machines having moderately high bias level. A "low-noise" oxide formulation is claimed to give between three and five decibels improvement in signal-to-noise ratio, compared with conventional tape. Reduced dropout and head wear are also claimed. A book of tape sketches by Peter Cagney will be among a range of publications on show—*Comedy Scripts for Tape Recording* (see review on page 152).

Sennheiser exhibit for the first time under the distributive wing of *Audio Engineering*. Microphones for professional and domestic use will be demonstrated, alongside some of the "smallest magnetic microphones in the world." The latter are designed for deaf-aids but will be, at the very least, of some academic interest to tape enthusiasts. 'Academic' would seem the most suitable description, also, for the interest visitors may show in the studio quality capacitor microphones, including a 'gun' microphone and measuring unit. The latter, intended for industrial use, employs RF transistors to attain a flat frequency response from one tenth of a cycle to 20 Kc/s.

Shure transistor stereo preamplifiers will be shown alongside two new microphones. The preamplifiers are designed for use with tape playback heads and magnetic pickup cartridges. The new microphones comprise a medium-price omni-directional unit—*Model 533*—and the rather more expensive cardioid *581 SF Unidyne A*. The *SM* series of studio microphones, including the omni-directional *SM50*, will also be exhibited.

STC microphones of widely varying prices vie against each other in a practical comparison of the *4113* ribbon cardioid (11 gns.), *4105* moving-coil cardioid (£22 10s.), *4038* figure-of-eight ribbon (£50) and *4126* cardioid capacitor (£100). A recent recording made by *CTS Studios* in Kensington compares the microphones on the efforts of a quartet comprising two violins, viola and cello.

Not all visitors to the Audio Fair take with them plans for heavy financial outlay at an early date, and we predict that the display of tape recorder plugs, sockets and spare parts will attract an unusually large number of visitors to the *Tape Recorder Maintenance* demonstration room. Many thousand of combinations can be made from the 38 interconnecting leads handled by the company, though no prizes are being offered, to our knowledge, for the exact figure.

Telefunken have produced an interesting variation on the tape-deck theme by placing the input/output connection panel to the immediate right of the take-up spool. In so doing, they have made the control panel of the *M.204* positively huge, with more than sufficient space to house the seven rotary controls, seven push buttons, three switches, two meters and two sockets that adorn the attractive stereo machine. The right-hand panel houses six sockets, making a total of eight DIN connections on one machine. So much for the continental 'all through

'one hole' theory! At £113 9s. this recorder looks like being one of the highlights of the Fair. If it has to vie for visitor-interest, however, its main competitor may well be in the same demonstration room, for the *M.401* battery portable will be the first recorder to be marketed in Britain using the *DC System International* cassette. Whether we like it or not, this type of recorder may be representative of the machine of the future. The *401* sells for £48 6s. and operates at 2 i/s.

Truvox repeat their 'Is it Live?' demonstration of the *Series 100* tape unit this year and will display, in addition, the *Series 40*. Input facilities for low-output microphones makes this an exceptionally versatile recorder for £46 4s.

A three-channel mixer incorporating a peak programme meter is

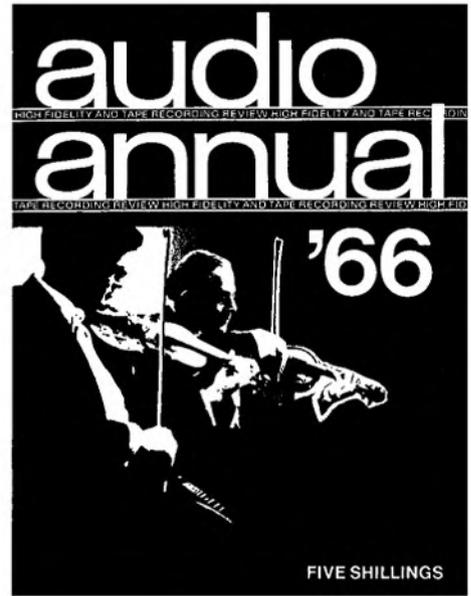
Booth 55 will be occupied, nominally, by our sister magazine *Hi-Fi News*, and copies of that magazine will be available for purchase, alongside *Tape Recorder*, the new *Audio Annual*—which will be published on April 14th—and those copies of the 1966 *Audio Diary* that Santa Claus overlooked last December. We look forward to meeting contributors and exhibitors in Room 155.

Three outside displays are being held by tape-equipment manufacturers. *Mastertape* invite Audio Fair visitors to 'Relax in comfort' in their exhibition at the Morton Hotel. The display, covering all aspects of the company's interests throughout the world, will be open for the entire period of the Audio Fair, as will the *Heathkit* display, to be held by *Daystrom* at the Grand Hotel. No tickets are required.

TRADE NAME	BOOTH	DEM. ROOM/ LOUNGE
Agfa-Gevaert	21	—
Akai	16	213
AKG	63	302
Allan, Richard	—	215, 216
Amateur Tape Recording	35	—
Ampex	—	449, 450
Arena	10	317
Armstrong	45	538
Audio & Design	65	220
Audio & Record Review	—	344
BASF	64	304
Beyer	31	—
BKSTS	—	346
Braun	32	122
Brenell	37	149
Brown	52	312
BSR	72	321
Butoba	59	242
Celestion	23	349
Connoisseur	48	347
Decca	73	236
Decca Kelly	—	235
Design Furniture	—	114, 109
Dual	12	322
Elcom	51	111
Electrical Trader	5	—
Elizabethan	41	120
EMI	39	247
Euphonics	18	—
Fane	8	214
Ferranti	13	112
Ferrograph	34	542
Fi-Cord	30	147
Fisher	14	320
Garrard	57	342
GKD	47	212
Goldring	38	248
Goodmans	24	434, 433
Gramophone	—	152
Grampian	15	334
Hammond	33	—
Hi-Fi News	55	155
High Fidelity	—	154
Jordan-Watts	22	—
KEF	—	442, 443
Kodak	19	115
Leak	69	534
Loewe Opta	11	318
Lowther	—	404, 439
Lustraphone	25	145

TRADE NAME	BOOTH	DEM. ROOM/ LOUNGE
Mallory	29	—
Metrosound	4	—
Micro	43	221
Mullard	—	211
Ortofon	3	217
Peto-Scott	—	335, 336
Philips	60	337, 339
Pioneer	42	313
Pye	9	447
Quad	70	504
Radford	74	448
Record Housing	49	117
Records & Recording	50	—
Rectavox	58	113
Revox	62	315
Richard Allan	—	215, 216
Rogers	67	402
Saba	56	311
Scotch	40	234
Sennheiser	53	121
Shure	66	237, 239

TRADE NAME	BOOTH	DEM. ROOM/ LOUNGE
SME	28	—
Sonotone	1	218
STC	—	249
Tandberg	17	222
Tannoy	54	547, 544
Tape Recorder	55	155
Tape Recorder	—	—
Maintenance	71	314
Tape Recording	—	153
Telefunken	68	202
Thorens	2	—
Truvox	36	548
Vortexion	27	348
Wharfedale	44	502, 563
Whiteley	46	204
Williman	—	244
Willmex	—	246
Wireless World	5	—
Worden	—	549
Wyndsor	61	118



being shown by *Vortexion*, attached to a £60 price label. Once again, the Wearite-based range of semi-professional recorders will be displayed, these models incorporating the three-speed deck introduced last year.

Wyndsor, although they have not exhibited at the Russell in recent years, are by no means new to its reverberant corridors. The *Vanguard* forms the centre-piece of their display, being a three-head, 1/4-track recorder designed around the *Magnavox Studiomatic* tape deck.

And that is it, at least so far as we can gather one month prior to the Fair. Needless to say, we shall be at the Russell ourselves, having, this year, a first-floor lounge in addition to a ground-floor booth.

The United States Trade Center at 57 St. James Street, London, W.1 is holding an exhibition of American audio equipment between 14th and 22nd of April. The first two days will be restricted to members of the trade, but open to enthusiasts on the Saturday and from Monday to Friday of the following week. Like the Audio Fair, entry is by complimentary ticket, these being obtainable from the Director at the Centre (HYDe Park 5921) or from certain audio dealers. Exhibitors will include *Electro-Voice*, *Sherwood*, *Ampex*, *Fisher*, *Koss*, *Scott* and *Shure*.

Newcomers to the Hotel Russell are advised to travel by Underground on the Piccadilly Line, disembarking at Russell Square.



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MAGNETIC SOUND RECORDING

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FOR THE
NON-TECHNICAL

Part one

THE NATURE OF SOUND

By C. N. G. Matthews

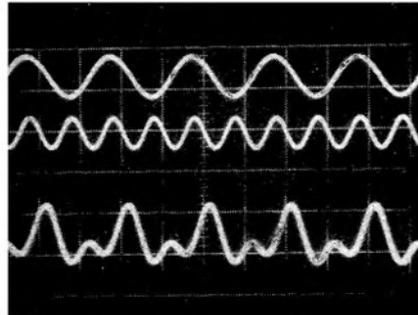


Fig. 1 (top):
Fundamental and
second harmonic

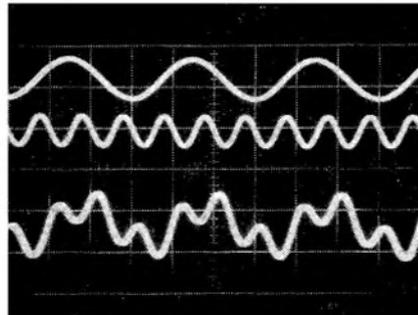


Fig. 2 (bottom):
Fundamental and
third harmonic

BEFORE we even begin to consider the problems of sound recording and reproduction we must know something of the nature of sound itself. Tapes, amplifiers, microphones and the like are merely tools; sound is the raw material whose properties and quality must be appreciated before it can be properly used.

Sound is the sensation caused when the drum of a normal ear is made to vibrate at any rate from something under twenty up to about twenty thousand times per second. One complete vibration is called a cycle and the number of cycles per second is called the frequency.

The vibrations are usually produced by waves of pressure travelling through the air. These we call sound waves. Sound waves are conducted by solids and liquids too, but for ordinary tape recording purposes we are concerned only with the airborne variety.

One way in which the conduction of sound through solids affects us all is that no man knows the sound of his own voice unless he has recorded it and played it back. When we speak, the vibrations travel through the bones of our skull to our ears. Although the frequency does not change, this conduction through bone causes the quality of our voices to appear different to us than to other people. In fact, Robert Burns might well have written:

*'Wud some power the giftie gie us,
to hear oorsels as ithers hear us.'*

Sound has three main qualities: pitch, tone and loudness. Let us examine them in turn.

Basically, the pitch of a note is governed by its frequency. High frequencies produce high notes and low frequencies produce low notes. Because the aural quality of a sound depends very much on the circumstances under which it is heard, though, there are times when pitch and frequency can vary independently. However, this need not concern us overmuch at present.

The actual range of frequencies that will produce audible sounds depends very much upon the individual ear. Young people can usually hear a greater range of frequencies than the middle-aged, while some animals, notably dogs and bats, can hear much higher notes than the average human.

A note containing only one frequency would be a very dull and unexciting sound; but we generally encounter 'pure' notes only when they are electronically generated for special purposes.

All normal sounds have a characteristic quality or tone-colour, which usually enables us to deduce the source. For instance, middle-C on a piano, middle-C on a violin and middle-C sung by a soprano are all of the same frequency, yet sound completely different. This is because the sound, in addition to its main or fundamental frequency, contains higher frequencies called harmonics, or more correctly in audio work, overtones. It is the differing proportions of these overtones that give notes of the same fundamental frequencies distinctive tones, though the manner in which a sound starts and finishes—the wave envelope—also plays an important part in tone quality.

True harmonics are direct multiples of the fundamental frequency and are indicated by the number of times it will divide into them. For instance, the first harmonic is the fundamental itself, the second harmonic is twice the fundamental, the third harmonic is three times, and so on. In musical sounds the overtones, though they correspond approximately to the harmonics, are not always direct multiples of the fundamental.

The presence of overtones gives sound engineers a problem which is not always appreciated. Figs. 1 and 2 are photographs of sound frequency alternating voltages taken on an oscilloscope. The two lower traces of fig. 1 are a pure sine wave and its second harmonic. Above these is the waveform produced when the two are combined. In fig. 2 a fundamental and its third harmonic have been treated in the same way. We can see not only the complicated nature of a note containing just two frequencies, but that if a harmonic is changed in any way the composite waveform will be changed too.

Since for faithful reproduction all the overtones of a note must be present in correct proportion, even low notes will not be properly produced unless the equipment handling them responds properly to the higher audio frequencies as well as the fundamentals of the low.

To make a sound more powerful without changing its tone-colour

(continued overleaf)

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played at a whisper through under-
pillow speaker

SLEEP-O-MATIC UNIT

including two speed tape recorder complete with microphone, time-switch and under-pillow speaker £27/10/- plus 6/- post (Batteries 5/-). Two models available, one for mains only and one for batteries which can be supplied with a mains power pack at 50/- extra. Both will take our special radio tuner at 42/-.
Publications: "Sleep Learning, Its Theory, Application and Technique" and "Mental Power Through Sleep Suggestion". Full details on request.

RAPID RECORDING SERVICE

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Lee Electronics

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SPECIAL OFFERS

GRUNDIG MA1.2 transistor tape head amplifiers can also be used to boost output of magnetic pick-ups or microphones. Listed 4½ gns., offered at 57/6 p/paid.

GEVAERT new boxed tape. 5½" spools, 600ft. with stop and leader tapes 9/- or 6 for 50/-.

SOUNDCRAFT 7" spools, new and boxed, 1200ft. 17/6 each p/paid. 400 Edgware Rd., Paddington 5521

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MAGNETIC SOUND RECORDING CONTINUED

we must increase the amplitude of the waveform without changing its fundamental frequency or the frequencies and proportions of the overtones. Since straightforward valve or transistor circuits sometimes amplify different frequencies unequally, or available signals are tonally unbalanced for various technical reasons, high fidelity equipment usually includes compensating circuits.

The final property of sound is loudness, which we measure in phons. This is rather a difficult unit to understand because it is a comparison. Our problem is that we cannot measure loudness in terms of sound pressure or power because notes of the same physical strength but different frequencies do not produce the same sensation of loudness. Consequently we have to select a standard frequency which we can use as a yardstick.

Up to a few years ago the frequency at which most sound equipment was tested was 400 cycles per second (c/s), but today we use a 1,000 c/s note. Its power level is measured in decibels (dB), another difficult unit which was originated because of the peculiar nature of the human ear. (See 1966 *Audio Diary* for a more detailed account of the decibel's various uses.) If we wish to make a sound twice as loud (an increase of approximately 10dB) we have to more than double its power: we have to multiply it by ten. To make it four times as loud we must multiply the power by 100, and to make it 64 times as loud we would need to increase its power a million times, and so on. This is shown in the table, which gives the power ratios to produce ten decibel increases from zero up to 140.

The first column of this table is the level in decibels of a 1,000 c/s pure note, starting when it is barely audible in special test conditions, and going up to the point where it is so loud that the sensation it produces verges on physical pain. These two limits are called the threshold of hearing and the threshold of pain respectively. The second column shows the power ratios corresponding to the decibel scale, and beside this is a third column showing the equivalent changes in audibility or loudness in phons.

Numerically, the third column is the same as the first, but whereas

SOUND POWER RATIOS

1000 c/s Note in dB	Power Ratio	Loudness in phons
0	1	0 (A)
10	10	10
20	10 ²	20
30	10 ³	30
40	10 ⁴	40
50	10 ⁵	50
60	10 ⁶	60
70	10 ⁷	70
80	10 ⁸	80
90	10 ⁹	90
100	10 ¹⁰	100
110	10 ¹¹	110
120	10 ¹²	120
130	10 ¹³	130
140	10 ¹⁴	140 (B)

(A) is the threshold of hearing.
(B) is the threshold of pain.

the phon is a measurement of subjective loudness irrespective of what kind of sound we are considering, the decibel gives the loudness of the 1,000 c/s comparison note only.

Any sound that is audibly as loud as a 1,000 c/s note measured in decibels above an agreed standard level used as a threshold reference (pressure of .0002 dynes per square centimetre) has this loudness in phons. For example, if a jet plane passing overhead gives the same sensation of loudness as a 1,000 c/s pure note at a level of 130dB, we say that the plane is producing 130 phons of noise. This kind of sound pressure has to be heard to be believed. So does the language of the people beneath it!

Levels of this sort were never heard from the early acoustic gramophone, of course, but we shall start with a brief look at this device in next month's article, which will deal with the basics of sound recording,

BBATTERY portables helped to bridge the fearful gap between painter and public during the John Moores Exhibition at Liverpool's Walker Art Gallery a while ago. Visitors could hire a machine and stroll around wearing headphones through which a taped commentary explained the offerings—and, I'm told, certain offerings really required some explanation. This was announced as the first use of this facility at a temporary exhibition in England.

One wit wrote to the morning newspaper suggesting a natural development: hiring the machine plus microphone and blank tape, to record one's opinions of the artists. For certain limited applications, such as an audible Visitors' Book has great possibilities; meanwhile, judging by some vitriolic views on modern art which enlivened the local letter columns for weeks, a small fortune may await the producer who markets an asbestos recording-tape. Anyway, it all helped, I suppose, to advertise tape's potential.

Which reminds me . . . some advertisements amuse me. Here's a neat machine making unsupervised but obviously superb recordings, amid gyrating youngsters full of the joys of Spring, tra-la, while trumpets tootle, bongoes rattle, guitars chime richly and revellers shriek with glee.

I've seen these parties. Someone knocks the machine from the table; it lands with a grand metallic crash and a tinkle of valves.

PERSONAL BIAS MOBIUS MADNESS

BY JOHN ASHCROFT

The spools turn on, spilling tape that's hooked and snapped by jiving ankles; great hairy feet stamp and tramp obliviously across the deck, and stiletto heels, in the throes of some teenage tribal initiation dance, merrily perforate the smouldering wreckage.

And here's a laddy darting forward nimbly, featherlight machine swinging alongside, offering his mike to a snarling car to catch a passing comment from Jim Clarke. Makes you positively envious . . . until you try the idea yourself.

The recorder's weight unbalances you, a foot skids, and you plunge face-down in the dirt. The swinging machine produces a siren of wow. Blasts from the car buffet the last shreds of fidelity from the tape; amid whuffing gobbles of wind-noise comes the viciously overmodulated engine-snarl like six dozen potato sacks being ripped in half with your head inside each one. And while the redoubtable Jim dwindles into a gnat-whining dark dot exemplifying the Doppler effect, you're left sprawling with a mouthful of hot cinders, a lungful of fumes, a suddenly denuded scalp, and unique souvenirs in the form of a flat mike and a squashed hand both stamped indelibly with the tread and trademark of a tyre.

Or your weeping widow submits part of the tape under the title *Impressionist Recollection of Heinkel Crash, 1944*, wins first prize in the Technical Experiment Class, and is given a holiday tour for two with the lodger.

Speaking of wives, Ebenezer's audio-widow and family were last seen heading for the Pennines; I popped in and found him running a tape at $\frac{1}{8}$ i/s on an obviously home-built machine. The tape seemed to be a long loop, following a guide system that defied description and made my eyes water as I squinted at it.

"Same customer," he said. "He lost interest in recording TV."

"No wonder," I said nastily, remembering last month's unexpurgated epic.

"Tcha! Could have been fixed. Anyway, now he wants unbroken background commercials and music for his supermarket's PA system—using the minimum tape."

I was boggling at the track-selector button, and counting the settings. "This is impossible," I protested. "Eight tracks on standard $\frac{1}{4}$ in. tape?"

"Eight?" His moustache bristled at me indignantly. "You miss the point. The tape will turn over, won't it? That gives sixteen tracks for eight heads."

Helplessly I stared at the crawling tape. Then I blinked and looked again. Either I was in dire need of Ebenezer's normal services (he's an optician, tape being his hobby) or this tape was actually dull on both sides.

"Ha!" he cried. "Glad you spotted that. Rather proud of it. Standard play, to minimise print-through; glued two lengths back-to-back. Diabolical job I had aligning them; still, genius triumphed."

"Look out," I said. "It's got tangled here—hey!"

A scrawny arm knocked aside my reaching hand. "Don't straighten it," he said urgently. "Can you do the Mobius Twist?"

"Eh? Doubt it, though I was Southport's Charleston Champion in 1927, and—"

"Tcha. Tcha!"

"No—even that's too hectic," I confessed, regretting my debauched youth.

"Arrrrgh," he said, in tones of reeking evil. "Get a tape. Loop it, but turn one end over first. You get the endless, single-sided Mobius strip. Topology, you twit. Make the tape usable both sides. What have you got?"



"Crossed eyes and a fat commission for *Ebenezer Optics Limited*," I suggested.

"No. You've got literally endless replay through both sides!"

Sanity began crumbling as I visualised a thirty-two track endless loop. Then the customer came in. Ebenezer deftly puffed the dottle from the deck, pocketed his pestiferous pipe, and greeted him with heart-warming enthusiasm.

"Listen, sir!" He spun the volume knob. A rasping voice went into distorted ecstasies over *Krakatoa, the Ultimate Breakfast Kornflake*, and was followed by distant music whose quality made me flinch.

"Endless loop, 16 tracks each way at $\frac{1}{8}$ i/s, with automatic head-switching," explained Ebenezer. "Two inch by threequarters elliptical speaker; signal-to-noise ratio fully 16 dB; wow and flutter 12.73462 per cent, peak-to-peak; frequency response substantially flat from 500 right up to 650 cycles, with . . ."

Helplessly the non-technical customer asked me for a candid opinion. With my normal blend of loyalty and absolute honesty I confessed that never in all my life had I encountered a comparable specification.

The customer looked happier; then he frowned, said: "Here, the tape's all twisted," and reached out and flipped it over with a plump forefinger. Next thing, he and Ebenezer were screeching like close-harmony steam-whistles, and I was rooted to the spot with quaking horror. The customer's finger had vanished; its stub was a curious burr. He uttered plaintive noises and tugged backwards. His finger popped from nowhere; the released tape twanged and spun. The machine shimmered spookily—I saw the bench through it—and then bent itself out of rational perspective and quietly slid off round an invisible corner.

Silently the three of us studied an empty bench where an oddly forlorn mains lead curved abruptly into nothingness.

At last the customer spoke. In tones that dripped acid accusation, he said: "It won't work, McPhee. There's *nothing* up with my eyesight; I'm *not* buying those Japanese transistorised contact lenses." Then he burst into tears and fled.

Ebenezer began dancing like spit on a stove-lid and muttering about Klein Bottles, tesseractes, and the warping of three-dimensional thingummies into a mystic multi-dimensional continuum. I was

(continued on page 170)



IN the fight against friction, dust, heat and pressure are the enemies. Our best weapons against them are scrupulous cleanliness, temperature control and lubricants.

That does not mean that we keep our precious tape recorders and gramophone decks in glass cases fitted with extractor fans, occasionally sloshing around with an oilcan. With lubrication—as with much else in life—a little at the right time, in the right place, is infinitely more effective.

Friction is a force that resists movement. Weight, or increased pressure, causes greater friction. It can also *overcome* the friction and stimulate movement, but in doing so will cause premature wear of the moving parts—a factor that is too often forgotten when adjusting driving pressures of tape and gramophone deck mechanisms. Friction generates heat, which can be useful if you are rubbing dry twigs together to start a campfire, but is a positive drawback when you are operating a machine already well endowed with glowing valves and over-run resistors: the outcome again is more wear.

The answer is to impose a film with little friction between the moving parts, so that they do not rub against each other. Part of the answer also, of course, is to polish the moving parts to obtain an even surface; but however smooth the parts may appear to the naked eye, a magnified photograph would show the surfaces to be as pitted as a Moon landing base. As any handyman who has dabbled with a bit of metal fitting will know, polishing two surfaces and using no lubricant makes them appear to grip all the harder, after a certain stage.

When we are considering electrical contacts, such as switch wipers, variable controls and even earthing springs, the problem is even greater. Bad contacts cause higher resistance (electrical resistance in this case as well as mechanical). This impedes the flow of current and tends to set up a higher voltage than is desirable between the contacts, especially at the moment of making or breaking. The result is arcing, and the next consequence is pitting of the contact surface, yet more resistance, more arcing; and so the vicious circle goes on until we have to call in the Fire Brigade to make good the results of our neglect.

All very elementary, you say. So we apply a drop of oil!

Like many simple solutions, this one has more to it than at first appears. The research and development budgets of the companies that deal in lubricants give painful evidence of this. Lubrication is nowadays a very sophisticated business. There are oils, greases,

LUBRICATION

MAINTAINING MECHANICAL AND ELECTRONIC COMPONENTS



solvents and some solids, for all manner of purposes, from the unmentionable to the unbelievable.

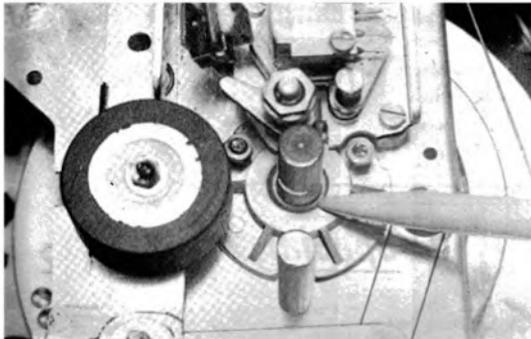
Luckily, we are not concerned with getting a diesel engine working in the middle of an iceberg, nor jockeying up a centrifuge at the temperature of space re-entry. Despite this, we need to know which of a wide range of lubricants is suitable for our machine, how much to apply, and how often. In preparing this article, I have drawn freely upon information provided by those directly concerned with the subject and would like to acknowledge the help of the *Molyslip* people, *Lloyd's Industries (Automotive) Ltd.*, Mr. Kingsbury of *Electrolube Ltd.*, Richard Arbib of *Multicore Solders Ltd.*, Alfred Rose of the *DTV Group*, and *Filmagic Products Ltd.* And to confound those readers who are always complaining that they get no help from manufacturers, I am grateful for advice from Mr. Paul Spring, Technical Director of *Grundig*, the *Philips* boffins at *Amalgamated Electrical Services Ltd.*, and the Technical Service Department of *The Ferrograph Company Ltd.* I am also indebted to colleagues for certain comments—but nevertheless shall go on writing!

Oil and grease are the obvious lubricants. But these have frictional properties of their own. Using a heavy grease where a light oil is intended, as at a motor bearing of a tape or gramophone deck, will soon demonstrate this. Coating slide-lever surfaces with petroleum jelly will also prove the point as they begin to bind. There is a further, electrical, reason for using the correct lubricant at certain mechanical pivots and slides, as we shall note later.

Moving parts will generate a certain amount of heat however good

the lubrication. They will often be in positions of fairly high ambient temperature, anyway. This heat, and the pressures involved, tends to squeeze the oil into the valleys of the surface—if we regard the surface microscopically, we shall see that the 'high points' would be left literally high and dry, and excessive friction would occur unless a type of oil or grease was used that tended to grip the surface when applied. Under normal gravitational forces, and under the centrifugal force of a rotating part, the lubricant will tend to spin off or run away from the part where it is most needed. Take the example of your car: the greatest wear to the engine is caused during the first few minutes of running, before the oil pressure has built up and the moving parts are adequately protected; especially if you have left the choke out and flooded away what little oil has arrived with a surfeit of petrol! Your car, not mine, for I never neglect my upper-cylinder lubricants.

This problem, of retaining oil where it will do the most good, is partly solved by the use of sintered bearings. Sintering is a process of forcing oil, under great pressure, into the porous metal of the bearing during manufacture. The bearing is then said to be self-oiling, and, in fact, adding oil in a misguided attempt to lubricate such a bearing will cause the new oil to wash away some of the protection of the sintering process. The ultimate result is a bearing that binds more than before servicing was attempted. Which is why the makers of



BY WILLIAM HENRY

tape recorders and gramophone mechanisms warn us not to oil motor and flywheel bearings. They are not implying that their product is everlasting—simply saving us from our own good offices.

The obvious advantage of this magical method is that heat and centrifugal force will not tend to spin or squeeze the oil away. If we now add the wrong kind of oil, such as a cheap vegetable oil type of nameless squeeze-can lubricant, the heat will cause oxidation, and exposure to air and what is politely termed 'foreign matter' results in a mixture that turns to a 'varnish'. Eventually the bearing seizes and the motor complains—often audibly! In the interim we have suffered from wow and flutter and sluggish take-up or starting. The type of household lubricant shown easing the gramophone record size selector pivot in fig. 1 is excellent for its own purpose, but is not intended for the bearings of motors and flywheels.

One or two drops of light oil after about 1,000 hours running is the recommendation from the average manufacturer. As they are not in the 'link-commercial' business, which recommends a certain make of washing powder for a certain washing machine (kidding none but the most moronic) (*And foaming as against non-foaming detergents apart!* Ed.), makers of tape recorders and gramophone mechanisms are understandably cagey about the make of lubricant they recommend. For the type of bearing entry shown in fig. 2, the upper flywheel bearing of a popular tape recorder, a penetrating oil is useful, providing it has the necessary 'clinging' property we have already seen to be needed. For the ball bearing at the lower end (fig. 3), where additional pressure is allied to a different type of enclosure, a slightly heavier

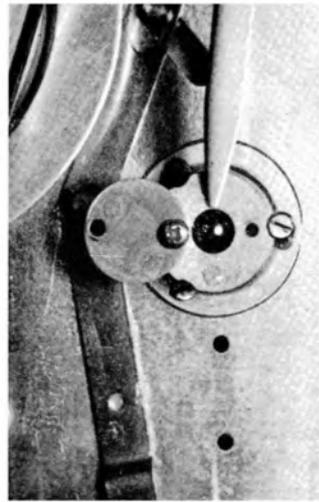


Fig. 7 (far left): Backstage switch-board at Golders Green Hippodrome

Fig. 4 (bottom left): Electrical contact aerosol lubricant

Fig. 3 (immediate left): Lower ball-and-cup bearing after application of non-congealing grease

Fig. 1 (below): Household lubricant applied to pivot point

Fig. 2 (below left): Minimum lubrication with fine oil for capstan mounting. All excess must be wiped away



type of grease would be suitable, but with the same property. In each case, it is essential that the property is not lost with movement and heat. The answer is a lubricant with an oxide inhibitor, and with this clinging property 'built-in'.

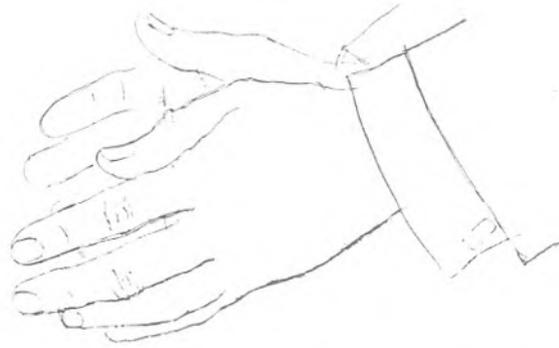
There are several suitable lubricants, and where a particular type is recommended by a manufacturer—such as the reference to *Aeroshell—No. 3* in the Ferrograph Manual, and *Vitreous Oil* in another leading maker's sales literature—it may be best to stick to the recommendation. But for a more up-to-date general-purpose solution, we can follow the lead of the motor manufacturers and look for oils and greases that have the properties we need. The *Moly slip* range illustrates the sophistication of these lubricants.

Molybdenum Disulphide, MoS₂, is refined from Molybdenite ore; it was not only gold they found in the mountains of Colorado. Its particular chemical feature is that it remains stable at temperatures from 60° below up to 750° Fahrenheit—which is a lot hotter than our machines are likely to get, even after an all-night session. It actually becomes *more effective* under high pressures, will not react to acids, and is a good moisture repellent. The particles, which consist of bonded sulphur and molybdenum atoms, tend to cling to metal, but slide across each other. So between the two moving metal surfaces, the oil in which the MoS₂ is suspended forms a kind of slipping sandwich, giving the type of lubrication we require. Incidentally, the oil used is a form of mineral oil, which again has its advantages for electronic equipment, where vegetable oils would set up an insulating barrier.

(continued on page 169)



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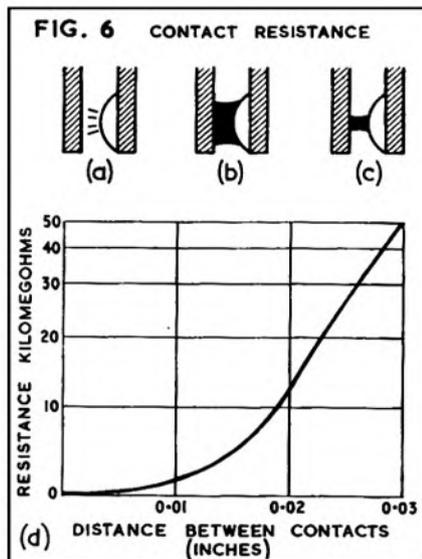
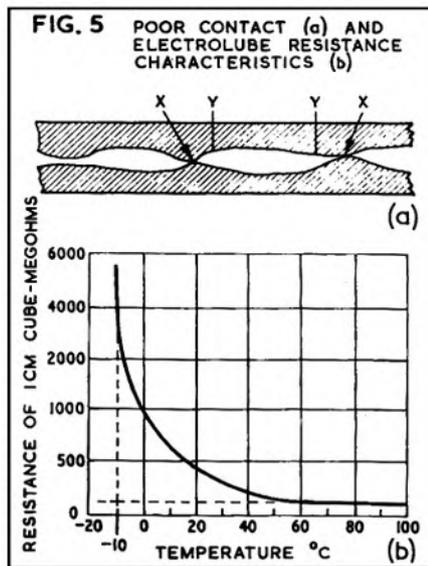
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Supplied complete with 2 dynamic microphones, demonstration tape, recording leads, full instructions and makers 12 months guarantee.
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★ 6 Watts Stereo Output
★ Transistorized Pre-Amplifier Stage
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We have known strange grating noises to have been picked up by sensitive heads, amplified and reproduced, simply because metal parts had the wrong lubricant and tiny eddy-currents were set up. Hence the wide use of graphite grease by some makers, which solves a number of problems but is not always a solution where it is necessary to ensure the lubricant retains its viscosity through wide ranges of temperature and pressure. The Moly slip process solves this, and gives the moving parts a kind of 'slippery plating'—there is no better term.

Although we can cadge a smear of grease from the garage now and then—there is usually enough left on the steering wheel and upholstery after my lads have done a monthly service—it is better to lay in our own small stock of lubricants. For more than one reason: tape and gram-decks have a number of rubber and neoprene parts. Getting lubricants on these can be a disastrous hobby. At the least it leads to a loss of drive power and an increase of the wow and flutter we are trying to circumvent. The lubricants are made up in small dispensers, with spouts, nozzles and even aerosols for the purpose of applying the right amount in the right place. A five-ounce tin of the penetrating oil costs only 2s., and the M.P. grease can be supplied in a three-ounce tube for 3s. 3d.

In addition, a penetrating oil with releasing fluid, also at 2s. for a five-ounce tin, is available for those odd cases where parts have seized up, and, to prevent this sort of thing happening, an anti-seize compound with copper and lead base, called *Copaslip*, can be applied

when re-assembling. Costing 4s. 6d. for the three-ounce tube, this is invaluable for those tight screws in places where they may need quick future removal.

If this reads like an advertisement, please forgive the author, who is only recommending from personal experience. There are a number of other lubricants with similar properties, but few that combine the advantages of constant viscosity, oxide inhibition, low electrical resistance, and ease of application from handy-sized containers.

To sum up a few of the foregoing points: motor, flywheel and other sintered bearings require infrequent oiling, and then only with one or two drops of the light oil. Idler bearings, whether steel or phosphor-bronze, may need a touch more often with a slightly heavier oil, or a light grease. If the bearing can be dismantled for lubrication, grease may be advisable, but if pads or washers are fitted, use oil and let it penetrate to where it is needed. Sliding levers need a non-hardening and non-insulating grease, lightly applied. Remember that many of these parts may be exposed to dust, and in these cases over-lubrication can cause a pretty pudding of frictional mud. Pivot points need only a single drop of light oil, as in fig. 1, remembering that if this tends to run it can reach parts that do not need it, such as rubber drive belt and wheel surfaces. Where oil has reached these unwanted places, wipe with a damp cloth, finish with a dry cloth and apply French Chalk. Do not use petrol or similar solvents, which may attack rubber or plastic.

One solvent specially developed for use on electronic apparatus, by *Multicore Solders Ltd.*, is *Bib Instrument Cleaner*, which is available in a handy dispenser. Its astatic properties also ensure that surfaces do not attract dust, and it is quite suitable for cleaning tape heads, guides, pinch-wheels, etc. This astatic property has been amply discussed in this magazine and *Hi-Fi News*, with special reference to Cecil Watts's protective devices for gramophone records. Their efficacy can be proved by the simple expedient of rubbing a fountain pen on your sleeve, then attracting small pieces of paper. After treatment with the solvent, this static attraction is completely absent.

Electronic Chemicals market a similar product in an aerosol tin, suitable for plastic radio and television cabinets, plastic and glass guards, tubes, etc. *Spray-clean*, by *Spectra Chemicals Ltd.*, removes dirt, grease and atmospheric pollution from most materials, is not harmful to metals or plastics, and leaves no deposit.

The *Filmagic* cleaning accessories distributed by Concordia Ltd., were reviewed in *January Tape Recorder*. They comprise a cleaning solvent, specially developed for tape heads, and a lubricant which can eradicate a lot of those squeaks and flutters that readers sometimes experience, especially with very fine thickness tapes. Rather expensive, at 17s. 6d. plus 1s. 6d. postage for the kit, or 25s. with self-dispensing pylon; but for the enthusiast, money well spent.

The business of lubricating tapes to prevent squealing can be solved by fitting polytetrafluorethylene guide pillars, or by coating friction points in PTFE for an ultra-smooth surface; but this seems, to one observer at least, to be tackling the problem from the wrong end.

Perhaps the best known electrical lubricant is *Electrolube*, which combines the properties of cleaning solvents, such as the original types of *Servisol*, intended to clean electrical contacts, with the protecting and lubricating properties somewhat similar to those oils we have been discussing. Lately, this product has been developed into several specialised lines, but the principal advantages that we require for our type of apparatus are combined in the *2A-X* aerosol. With its novel protecting cap and nozzle device, this handy pack, shown in fig. 4, is a highly efficient mechanical lubricant which also has low electrical resistance and is completely compatible with plastics, and natural and synthetic rubbers.

This matter of low resistance contacts, already touched upon above, is extremely important. We know that even the smoothest surface is actually a microscopic assault-course, and a cross-section of two adjacent parts of switch contact might appear when magnified rather like fig. 5a. Actual electrical contact is only made at points X-X, through which points, at first, the whole current flows, causing arcing and a rise in contact temperature. Low areas Y-Y, caused by previous pitting, do not make contact. Adding an ordinary lubricant to the contact only aggravates the problem. It might fill the spaces between the contact surfaces, enabling them to slide more easily on each other, but does not improve electrical matters. Indeed, if the oil is an insulator, or has high resistance, matters will become worse and soon the heat rise will burn out the contacts completely. We can leave vegetable oil to the back axles of imported cars.

(continued overleaf)

Special properties of the lubricants developed for electrical contacts include a high negative temperature coefficient, and a low specific resistance. In plain language, this means that as the heat at the point of contact rises, so the efficiency of the lubricant as a conductor also rises. The resistance drops and current flows more easily. In fact, as shown in fig. 5b, Electrolube has a specific resistance of $0.4 \times 10^3 \text{M/cm}^3$ at room temperature, against the considerably higher 10^8M/cm^3 of an ordinary lubricant. Moreover, its negative temperature co-efficient enables it to balance out differences, as in the region Y-Y, where a pitted contact may have caused a larger gap, and less current. Heat flow pulls the resistance down and evens out the overall current distribution. It is claimed that Electrolube can lower voltage drop across contacts by a factor of as much as 10 to 1, and increase the effective gain of a low-signal circuit such as TV aerial switching, by as much as 3dB. Again, if this reads like an advert, I can only state that my toolbox is never without the small (18s.) snorkel bottle of green No. 1, and I usually have the pen-size red No. 1 (10s.) in my dustcoat pocket. Now I shall have to modify the toolbox to take the rather larger 2A-X tin—it's a hard life!

Other similar lubricants are marketed, such as *Chemtronics Tune-O-Lube*, and all have the special property useful for tape recorder mechanisms that use relays. As can be seen from fig. 6, dry contacts arc at 'make' and 'break' positions. The lubricant 'coats' the contact surfaces and as they move from (or toward) each other, the effective low-resistance area of contact increases, inhibiting the arc, reducing the high inductive pulse due to sudden current drop, and incidentally cutting down radiated interference. As can be seen from b and c in fig. 6, as the contact pulls away, the contacting film pulls away and grows thinner. In effect, the resistance of this 'pillar' of lubricant rises as the contacts draw farther apart and current falls gradually, so the inductive voltage rise is smaller and when the break finally occurs there is much reduced tendency to arc.

Again, it is necessary to remember that a little applied at the right time and in the right place is the secret of success. The title photo shows that even the humble tumbler switch benefits. In fact, this was the 'home-made' switchboard backstage at the Golders Green Hippodrome, North London. Without contact lubricant, the arcing had caused embarrassing breakdowns from time-to-time; when contacts of switches had failed, excessive resistance prevented lighting relays from being energised, and probably the Demon King had popped up to the splutter of fuses. The use of contact lubricant eased matters considerably, we are told. Probably a modern lighting console would help matters still more, but that's another story.

TAPE RECORDER SERVICE CONTINUED

treble and best distortion factor. They will often be quite close together—particularly if the value of by-passing capacitor is fairly large.

At this stage, you may note that the magic-eye seems to be misbehaving, indicating an overload where the ear tells us this is not happening. In this case, although some authorities advocate alteration to the series resistor if the magic-eye is tapped from the same network, I would always tackle the problem from the other end, reducing the amount of signal fed to the magic-eye by inserting additional resistance into the take-off line. In any case, another subject arises: replacing the older types of magic-eye with later, more efficient and perhaps more attractive types. An EM87 in place of the EM81 or 84 for example. But this is something that will have to be dealt with at another time.

As for the equalising circuits, again we must make the alterations experimentally. A test-tape or recorded steady tone may be best for the initial test, and much depends on the type of equalising circuit in use. Where a change is needed both to the treble-boost frequency and the overall amount of treble boost, even more care is needed. The frequency can be increased by reducing the tuning capacitors, while the amount of boost is altered by adjustment to the parallel resistors used to damp the tuned circuit. An increase in resistance increases the boost, i.e., reduces the treble feedback.

Remember that any changes made will also be dependent on tape

speed, and more minor alterations may be needed to the components switched in at the various speeds to compensate for the improved efficiency of the new heads. In general, the above notes should have made clear just what those changes should be, and where component values should be increased or decreased, and it is hoped that this rather unwieldy digression has been of some help to what our dear Editor describes as 'the owner-driver'.

All of which has taken us far away from our muttons. The accompanying circuit is largely self-explanatory, however. A low-noise input stage common to both record and playback, feeds a two-stage amplifier. Equalisation is over the first stage of this double-triode, and some pre-emphasis is afforded by a network across the grid of V2a during record. A 10-100pF trimmer allows adjustment of feedback for equalising purposes, and speed changing is self-evident. Signal is taken off at the anode of V2b and fed to the pentode output stage, which doubles as oscillator during Record. Bias feed, however, is via a 500K variable resistor and should in this case be set so that the recorded signal gives maximum replay. It is near the EL84, inside the angled screen on the obverse of the bias panel. On the same panel will be found the bias trimmer, while the equalisation trimmer is near the long tag-strip of the main amplifier panel.

Note the plug and socket connections between panels, as shown in the diagram. These can give a bit of trouble, especially where HT tracking may have taken place due to humid conditions if the machine has been in disuse for any length of time. Another sufferer in this respect is often the audio output transformer. Not particularly highly rated, this part will break down if overworked and could well be replaced by a better version.

The metal rectifier, again, is a common cause of trouble. There are several alternative types of contact-cooled bridge rectifiers that can be used in its place—but always check whether the prime cause was an HT failure. Signs of the 1K smoothing resistor overheating are an obvious guide. There are a number of electrolytic capacitors used in this well-smoothed circuit, and again, disuse is the enemy.

PERSONAL BIAS CONTINUED

just overtaking the customer, eighty-seven yards up the High Street, when a distant penetrating screech of triumph brought me sheepishly back. The machine had returned. But it looked worn and dusty; you know, not damaged, but somehow obviously well used.

And the tape had new contents—mostly a metallic whistly voice chanting in some ungodly language, with here and there an interlude of excruciating caterwauls.

"It's a message," whispered Ebenezer. "And those other bits are music."

Music? I tried to smooth down my hair, but it pushed my hand upwards.

The entire tape was full. "A temporal discrepancy," gloated Ebenezer. "So that's why the machine aged; it was gone for weeks, relatively." He plugged in the microphone, jabbered some greetings, and twisted the tape about. Again the machine vanished. "You get used to it," said Ebenezer. I felt glad.

Within minutes the machine returned, more worn, with new contents. I grew excited. "Let's communicate," I urged; "try counting, mathematics—"

With immense dignity Ebenezer disconnected the machine and closed its lid. Sternly he demanded: "Do you realise what this might lead to?"

I thought he was worried in case he let loose on the Earth a festering horde of bug-eyed monsters from an alien dimension. I should have known him better.

"Think of the electricity bill," he snapped. "Remember the machine's gone for weeks, relatively, eating *my* juice all the time. And this ageing effect—within another half dozen trips the whole machine will crumble into dust."

Wistfully I said: "What are you going to do, then?"

Eyes glinting under white thickets of brow, Ebenezer began thumbing through his address book. "Saw it last week in a magazine," he muttered, "and jotted it down. Ah—here. Bloke wants really unusual tapespondents. "Will spond with anyone, anywhere, must be off-trail," he said. Sounds well off, too. I think I can do a deal . . ."

So, if a fellow named McPhee replies to your advertisement, I think it's only fair to warn you . . .



Supersound four-speed record-player. The unit incorporates mixing facilities and costs £19 19s.

SOUND AND CINE / the sad sound of music

BY ANTHONY WIGENS

TO the ambitious film-maker, the radio and television set are a constant source of frustration. Time and again he hears music which admirably suits the theme of films latent in his mind, or actually in production. I buy the occasional record myself, driven to the act because the music cries out for a visual image to accompany it—but I know I will never make the film because of the risk attached to it.

No matter how personal the film, how private the theme, the thought lingers that one day you might want to show the film in public. And the licence for a public performance of the music could cost a packet.

At one time, the risk was worth taking, or seemed so. People had been used to silent 8mm. for so long that the problem only concerned advanced workers. And 8mm. only rarely achieved the distinction of a public performance, a freak which had slipped through the competition net designed to catch 16mm. amateur works of merit.

All that has changed. 8mm. has its own competitions (8mm. *Movie Maker's* 'Top Eight' contest, notably), and with the advent of *Super 8* the technical feasibility of large screen projection of 8mm. or blow-ups from 8mm. is increased.

It is for this reason that keen film-makers desert their cameras in the winter to practise with guitars or mouth-organs. The copyright of your own music is your own . . .

You can buy sound track music which is ready-licensed for performance. There is a new LP available through photographic dealers, called *Custom Music for 8mm.* (price £2 9s. 6d. for 40 minutes of mood music and sound effects) which is stated to be for use at private performances only. However, the distributors have said that provided the hall used is covered by the appropriate Performing Rights Society licence, there would be no objection to the music being used at a public performance given by an amateur cine club.

The limitations are clear enough though: do-it-yourself music is probably pretty bad, and readily available music is probably pretty corny. So many people will be using it, that even the best tracks will become distressingly familiar.

A further alternative is to go to the Mood Music libraries, run by most of the big sheet-music publishers. You will have to pay for public performances, but the charges are not likely to be so high. Once you start putting a film to professional use, they soar, depending on the likely audience. For a professional 8mm. film limited to invited showings on an exhibition stand, open for a week, I had to pay £1 17s. 6d.

Most film-makers negotiate for their music and licences through the *Institute of Amateur Cinematographers* (administrative secretary Miss P. D. Johnson), 8 West Street, Epsom, Surrey. The IAC has come to an agreement with music publishers to provide music at reduced dubbing fees. A sample fee for one 10in. disc might be 12s. 6d. for an amateur convened show, with the cost of the disc extra.

Most mood records are 78 r.p.m. to make it easier to pick up the

sound track in exactly the correct groove. There are a number of devices made for track selection, but it is possible to lay a cardboard strip on the record, with a hole punched in one end to allow it to travel smoothly with the stylus while anchored to the spindle. On this you mark the entry point for the stylus, lowering it close to the disc until the card catches on it, then moving the pickup along the card to the marked point for final connection with the groove.

For complex tracks, a twin turntable unit is ideal. Some permit interchangeable use of the pickup arms so that you can have both running on the one record simultaneously, fading out one track as you fade in another on the same side. The unit illustrated is designed so that the centre pickup can be used on either turntable, and has mixer controls incorporated.

Mood Music catalogues are available from *EMI Special Recording Department, Abbey Road, London, N.W.8*; *Francis, Day & Hunter Ltd., 16 Soho Square, London, W.C.2*; *Chappell & Co. Ltd., 50 New Bond Street, London, W.1*; or *Boosey & Hawkes Ltd., 295 Regent Street, London, W.1*.




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ALBUM No. 1 HI-FIDELITY - MONO



battery powered tape recorders

LAST month we investigated a simple voltage-regulated mains-derived power supply suitable for operating battery-powered tape recorders. Circuits were given in figs. 1 and 3. Details were given of the type of mains transformer and zener diode, and it was shown how to calculate the series resistor in the zener diode circuit. However, nothing was said about the bridge rectifier and electrolytic capacitors.

So far as the rectifier is concerned, suitable bridge assemblies are available to the constructor from most firms specialising in radio and electronic components. It is also possible to employ four separate semi-conductor diodes which can be connected together to form a bridge circuit. The diodes must be of the same type, of course, and they must have ratings within the required voltage and current demands of the recorder.

Small silicon diodes are highly suitable for this purpose, and devices capable of delivering half an ampere at relatively high voltages have a diameter of less than $\frac{1}{8}$ in. and length of about $\frac{1}{4}$ in. A typical example is the *REC50A* marketed by *Radiospares*. This can deliver 0.5A at 125V. Other suitable devices are *Mullard OA210* power diodes and *International Rectifier 5E4's*.

Generally speaking, the higher the value of the electrolytics, the better the smoothing of the supply. Normally, however, values in the order of 100 μ F are suitable; though the value can be increased if mains hum seems troublesome when the recorder is powered from the unit. The low impedance of the zener circuit assists with the smoothing action under some conditions.

Now, some recorders require two supplies, one for the amplifier and the other for the motor. The circuit in fig. 1 shows how this can be achieved. Here are two positive supplies, +1 and +2, relative to supply negative. The drive motor may need, say, +6V and the amplifier +9V. Alternatively, the machine may need two negative supplies relative to a common positive line. Some of the *Grundig* battery-powered models are of this nature.

It is not difficult to obtain these requirements simply by reversing the circuit, as shown in fig. 2. It is extremely important, however, to make sure that supplies of the correct polarity are coupled to the recorder. If the supplies are wound the wrong way the transistors in the amplifier will almost certainly fail. Moreover, many electrolytic capacitors are used in the amplifier circuits, and these can also fail due to the presence of a supply at the wrong polarity.

The zener diodes in the circuits must have a zener voltage rating as close as possible to the output voltages required for the recorder. For example, if No. 1 supply is 9V, then a zener (ZD1) of that rating must be used. Similarly, if No. 2 supply is 6V, say for the drive motor, then ZD2 must have a similar rating.

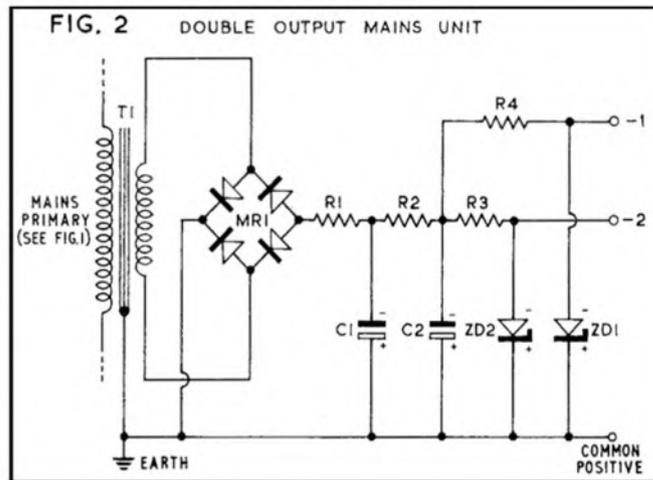
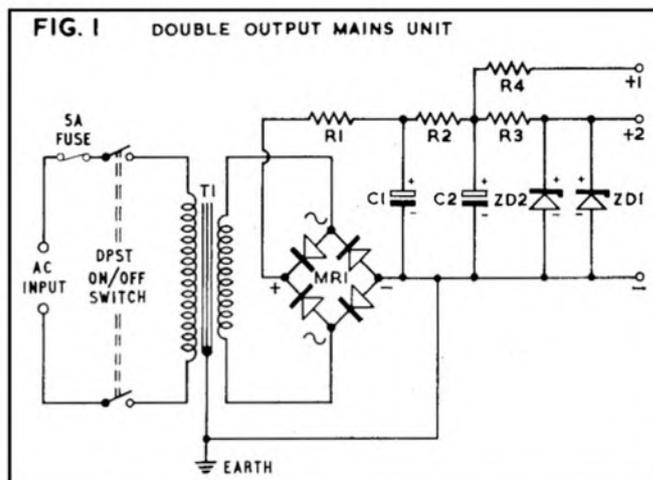
Last month we saw the importance of the maximum power rating of a zener diode, and this applies equally to the zeners used in fig. 1 or 2. The zener supplying the motor current will generally have a larger power rating than that supplying the amplifier, and the power rating can be upgraded by mounting the device on a heat-sink, as explained last month.

Now for some illustrative design details in terms of component requirements. Let us suppose that the DC output from the bridge rectifier, as in last month's circuits is 50V (based on a transformer with a secondary winding delivering about 50V RMS), that the amplifier calls for -9V at 10mA quiescent current and 50mA for full music output, and the drive motor for -6V at 250mA for full load.

Now, when both the amplifier and motor are running at full load, resistors R1 and R2 are carrying 250+50mA plus the zener current of both diodes. Under these conditions, therefore, R4 will be carrying 50mA plus the zener current of ZD1 (assuming that No. 1 output is the 9V for the amplifier) and R3 will be carrying 250mA plus the zener current of ZD2.

The zener diodes must pass more than the maximum load current at minimum load requirements, as explained last month. The minimum load of No. 1 output is 10mA, so under that condition ZD1 must pass more than 50mA. Say, 90mA. Thus, at full load the amplifier will take 50mA and the zener diode will take 50mA. At minimum load the amplifier will take 10mA and the zener diode 90mA.

The minimum load of No. 2 output is zero mA and maximum load 250mA. At minimum load, therefore, ZD2 must pass in excess of 250mA—say, 300mA.



From the foregoing then, we can see that R4 will be carrying a fairly constant 100mA and R3 a fairly constant 300mA, irrespective of load conditions. Thus, R1 and R2 will each carry a fairly constant 100+300mA, or 400mA.

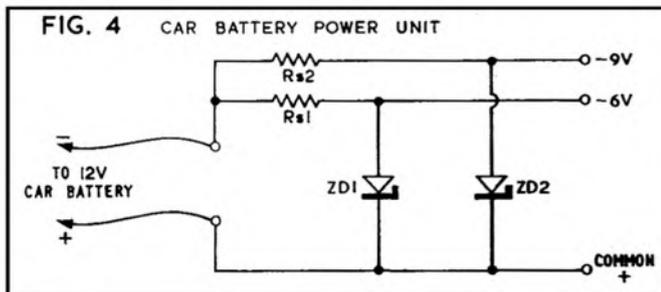
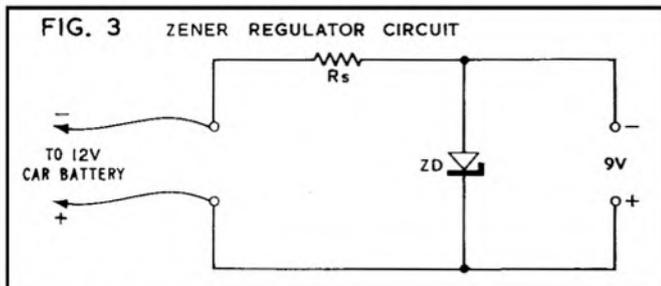
Since the DC voltage from MR1 is 50, we can afford to drop 30V across R1 and R2 together, leaving 20V at the junction of R2, R3 and R4, which is plenty to supply the outputs of 9 and 6V. The more we can drop across R1 and R2, the better the overall smoothing of the circuit.

We can now calculate the values for R1 and R2. By Ohm's law $R1+R2$ is equal to the voltage to be dropped divided by the current in amperes. That is, $30/0.4$, which works out to 75 ohms. We could make this up by two resistors, one of 15 ohms and the other 60 ohms. Actually, it is best to make R2 of greater value than R1 for the best smoothing, so R1 could be 15 ohms and R2 60 ohms. When the secondary voltage from the mains transformer is somewhat below 50V, R1 can be deleted.

Now about their wattage rating? Well, the wattage is equal to the current squared times the resistance value. 0.4A squared is 0.16, times 15 gives a little under 2.5W, and times 60 gives a little under 10W. Thus, for an adequate safety margin, R1 could be 5W and R2 15W. A 10W resistor would do for R2, but it would get pretty hot. Such resistors are easily obtainable through dealers and suppliers; *Radiospares* market them.

Next we must calculate R3 and R4. The current in R3 is 300mA and we require 6V. The supply is 20V as we have already calculated, so R3 must drop 20-6, or 14V. Thus, R3 equals $14/0.3$, or a little

PART SIX—SOME ROUTES TO ECONOMY



under 47 ohms. The wattage rating is 0.3 squared times 47, which works out to 4.4W (0.09 x 47). Thus, a 6 or 10W component would suit.

The current in R4 is 100mA and we require 9V. R4 must, therefore, drop 20-9V, which is 11V. Its value is equal, then, to 11/0.1, which works out to 111 ohms. Its wattage rating is 0.01 x 111, or 1.1W, a 3W component would suit here. Of course, the resistance would be taken to the nearest obtainable value. R3 would probably be made 50 ohms and R4 100 ohms.

The zener diodes must finally be considered. ZD1 must have a nominal zener voltage of 9 or as near as possible to that voltage, while ZD2 needs to be as near as possible to 6V. ZD1 passes a maximum of 90mA (at minimum supply load). This current at 9V gives a wattage rating requirement of 9 x 0.09 (that is the voltage times the current in amperes) That works out to a little under 1W. A suitable device is the Mullard SZ91A, which has a nominal zener of 9.1V and a 1.5W power dissipation at 40.C

ZD2 passes a maximum of 300mA (when the motor is not running). This current at 6V gives a wattage rating of 6 x 0.3, which works out to 1.8 watts. A zener above that rating, say, 2.5W, would be suitable. Of course, a power zener, such as the Mullard OAZ223, could be used quite well. This has a nominal zener of 6.2V and a rating of 7W at 45°C. The construction of this device was shown in last month's article.

The electrolytics should be at least 100µF and suitable for the voltage across their points of connection C1 should have a working voltage of 50, and C2 30V at least. However, it is not good policy to

employ electrolytics of a working voltage well above the voltage that they are likely to receive in the circuit, as this could impair the electrolytic action and reduce the capacity of the components.

The foregoing information should be sufficient to enable any enthusiast to construct his own mains power supply for a battery-powered tape recorder. The unit can be made on any substantial chassis of size to cater for the mains transformer and to avoid cramping around the wire-wound power resistors and zener diodes.

The rating of the mains transformer, of course, must be equal to the full current requirements of the unit plus, preferably, a 100% margin. The same applies to the bridge rectifier system which, as already mentioned, can be silicon semiconductor power diodes or even bridge selenium rectifier assemblies. The latter are available from Home Radio Ltd.

So much, then, for a mains power supply; but what about if it is required to run a battery-powered recorder from a 12V car battery. This can often be desirable for certain field and location activities, as is well appreciated by many readers.

The technique is rather the same as running from a mains supply, only the battery is used to deliver the DC voltage instead of the mains transformer and bridge rectifier system. Smoothing is not usually necessary; but interference from the car electrical system will also be examined.

Most car electrical systems operate on a nominal 12V supply, but they may furnish as much as 14-16V under conditions of high charging rate while, conversely, the voltage may be down to about 10-11V when the car engine is not running and the battery is low.

Some enthusiasts feel all that is necessary to run, say, a recorder needing 9V direct from the battery, is a simple resistor in series with the supply to drop it from a nominal 12V to 9V. This is not a very good thing to do, for the load of the recorder is not constant under all conditions, as we have already seen. The load current may be as low as 30mA with the amplifier alone running and as high as 300mA with the motor running. Thus, if the dropping resistor value is calculated on a basis of maximum load current, the voltage across the amplifier would be excessively high with the motor off. Conversely, if the calculation is based on minimum load, the voltage would fall drastically with the motor switched on.

Again, the zener diode solves these problems. Let us suppose that the recorder calls for a single 9V supply and that under minimum load conditions it takes 25mA and under full-load (motors running, etc.) it takes 250mA. Moreover, let us suppose that the input voltage can range from 11 to 16V. The requirement, then, is for a constant 9V output under loads from 25 to 250mA with input voltages from 11 to 16.

Perfect regulation is not possible (simply) under these conditions, but practical regulation can be achieved by the simple circuit shown in fig. 3. This is the basic zener diode regulator circuit that has already been considered.

The zener will have to pass a maximum of about 350mA at minimum load (25mA), so the total current in Rs will be 350+25mA, or 375mA. On full load (250mA) the zener current will be 350-250mA, or 100mA.

Now, to calculate the value for Rs, we will assume the worst state conditions. That is, minimum load current and maximum supply voltage. The difference, then, between the supply voltage and the load voltage is 16-9, or 7V. Thus, using Ohm's law again, Rs equals 7/0.375 (the voltage to be dropped divided by the resistor's current in amperes). This works out to a little under 19 ohms. The power dissipated in the resistor would be the current in amperes through it times the voltage dropped across it; that is, 0.375 x 7, or 2.625W. A 5W wire-wound resistor would serve well here.

The diode would have to have a 9V zener rating and a power rating equal to 0.35 x 9W, which works out to a little over 3W. Again, the Mullard 7W device would be suitable: that, with a nominal zener of 9.1V, is type OAZ227. This should be heat-sink mounted.

Fig. 4 shows an arrangement to provide two outputs, one for the motor, say, and the other for the amplifier. In this case, it is best to use two completely independent regulator circuits, the calculations being made separately for each along the lines already discussed fully in this article.

Next month we shall look at motor interference troubles and continue with information on simple battery charging circuits.

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*Grundig TK46 4 Tr. St.	107 gns.
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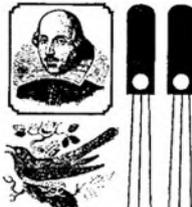
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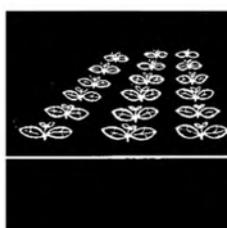
The showrooms will be open to the trade exclusively on the first day, 14th April, and to the public from 11.0 a.m. to 7.30 p.m. on 15th and 16th April.

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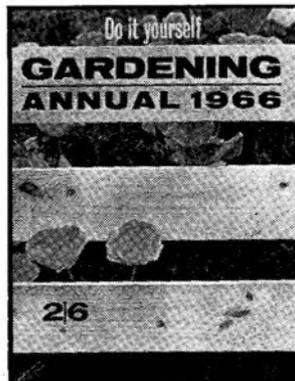
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2/6

From newsagents and bookstalls
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equipment reviews

THIS machine uses mainly valve circuits and a glance under the deck raises the question: how can so many facilities be provided with only four valves? Closer inspection shows that two of the valves are double triodes and one a double output-pentode. Further investigation discloses two input transistors, and the circuit reveals that the triode sections of the magic-eyes are pressed into service as audio stages during playback. The remaining valve is the bias and erase oscillator.

The secret lies in clever, if rather complicated, switching. The bottom track amplifier can be switched to the top track play head for monitoring from tape during mono recording. The separate playback head, in combination with the left-hand amplifier, makes track-to-track transfer with added signal from the right hand microphone or line a simple matter.

The position of the separate playback head can be varied continuously over a distance of nearly 2 in. to give variable delay echo effects.

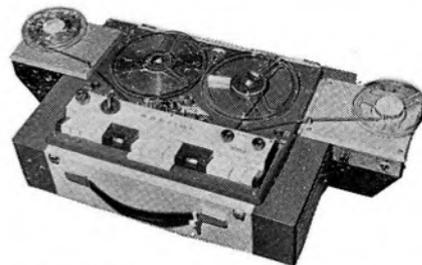
The track-to-track transfer facilities are used for tape dubbing by providing a separate path for the master tape which by-passes the erase and record heads. Clip-on turntable units support and drive the extra reels. Dubbing involves a transfer of the tracks from 1 to 3 or vice-versa, so that stereo dubbings will have the tracks reversed and the speakers will have to be interchanged for correct stereo.

I was glad to see that at last a designer has provided variable bias so that the user can get the best results from any tape or speed, and can make his own compromise between super wide-range frequency response and low distortion and intermodulation. The effect of the switched bias will be discussed in detail later.

The usual preliminary listening tests showed a nicely balanced response and a remarkably good stereo effect from such a relatively small cabinet. The controls are well placed for effortless use; the seldom-used controls, such as echo delay and level, and bias, are kept off the main control panel. Standard DIN sockets are provided for a wide variety of inputs and line outputs and reversible Ext. L.S. sockets are fitted for convenient attachment of separate stereo speakers.

The absolute tape speeds were within limits of $\pm 1\%$ at all parts of normal 5in. and 7in. reels. Small 3in. reels on the supply side reduced

KORTING MT3624 STEREO



MANUFACTURER'S SPECIFICATION: Quarter-track stereo tape recorder. **Speeds:** $7\frac{1}{2}$, $3\frac{3}{4}$ and $1\frac{7}{8}$ i/s. **Output power:** 3W per channel. **Speakers:** two 7in. elliptical. **Spool capacity:** 7in. **Level indicators:** two magic-eyes. **Weight:** 35lb. **Dimensions:** 20 $\frac{1}{2}$ x 14 x 8in. **Features:** separate record/play heads. Clip-on turntables, additional preamplifier for stereo dubbing, microphones and headphones available as extras. **Price:** £102 18s. 0d. **Distributor:** Europa Electronics Ltd., Howard Place, Shelton, Stoke-on-Trent.

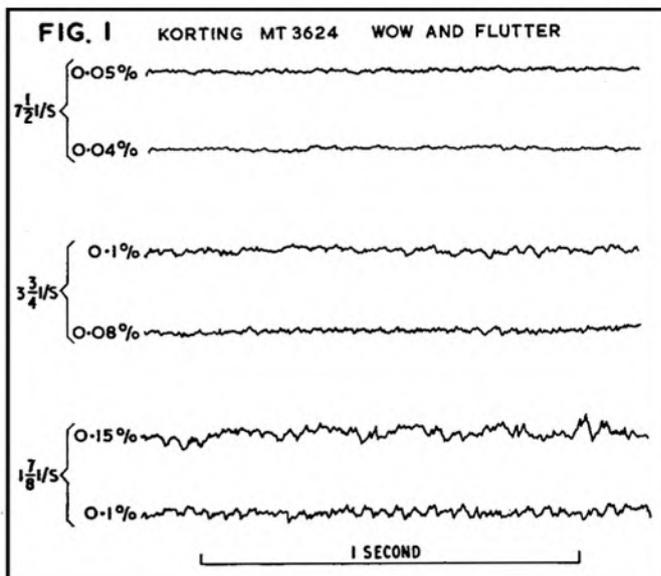
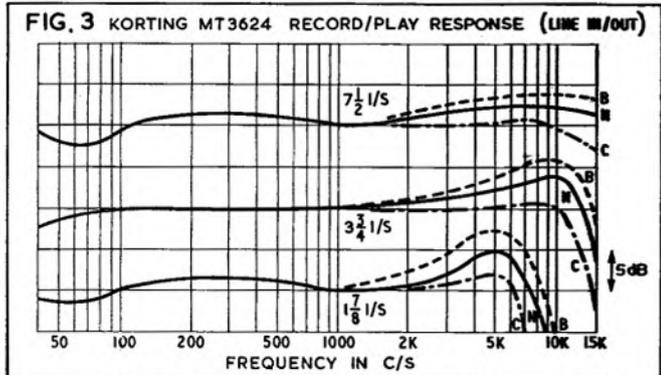
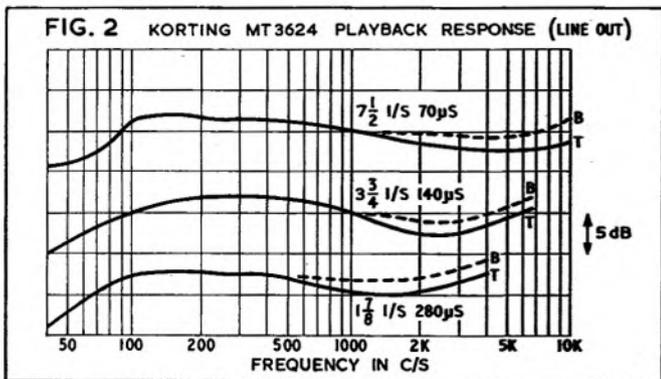
the speed by nearly 2% at $7\frac{1}{2}$ i/s due to the small hub amplifying the back-tension.

Short-term wow and flutter performance was excellent at all speeds, as shown by the fluttergrams of fig. 1. Only at the lowest speed was there any evidence of wow, audible only on a sustained tone.

Standard test-tapes were used to measure the playback-only responses and the resultant curves are shown in fig. 2. It will be seen that the frequency response is level within ± 1.5 dB limits from 100 c/s to the highest frequencies on the test-tapes on the bottom track, falling by a further 1.5dB above 1 Kc/s on the top track. The mean responses are close to those of the test-tapes at 70, 140 and 280 μ S for $7\frac{1}{2}$, $3\frac{3}{4}$ and $1\frac{7}{8}$ i/s.

The record/play tests shown in fig. 3 reveal a good bass response down to 40 c/s at all speeds and demonstrate the effect of altering the bias on the high frequency response of a given tape. The letters against the high note responses require some explanation, as they correspond to the calibration of the bias switch positions. N means Normal, B means Boost—of top response *not* bias, and C is for Cut (top response). In terms of bias, the top and bottom calibrations are reversed, but this is a small point compared to the provision of this much needed facility. The bias variations from 'normal' were approximately $\pm 15\%$, and the responses of fig. 3 provide an object lesson on the change of high note response to be expected for such a bias change.

500 c/s recording overload tests proved that a level 11dB above test-tape level was recorded without distortion at 'normal' bias with
(continued overleaf)



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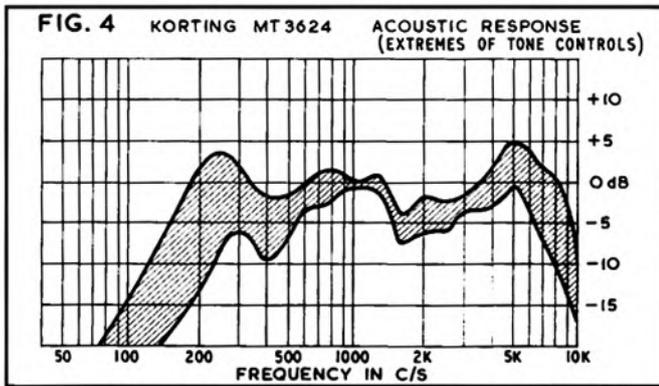
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the magic-eye record level indicators just closing. Low bias showed slight overload at only 10dB above test-tape level, and high bias allowed a +12dB signal to be recorded without distortion.

System noise with no tape passing the heads was 32dB below test-tape level, so that full bias gave a dynamic range of 44dB. Bias and erase noise was low, indicating a good oscillator waveform.

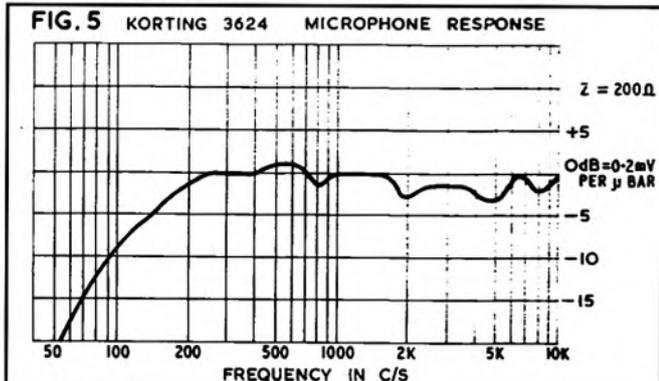
Input transformers were fitted to match the 200-ohm moving-coil microphones to about 4K to maintain a good signal/noise ratio on the relatively weak signals occasionally encountered in stereo mic placement. In an earlier Korting recorder, reviewed a few years ago, we encountered earth-loop hum pick-up on the input transformer wiring, but this time hum was negligible.

The bass and treble tone controls acted only on the output stages, which are mainly used to feed the internal speakers. Accordingly the overall acoustic response was measured at the extremes of the tone control settings by playing a white-noise test-tape and measuring the sound output of one of the speakers in one-third-octave bands with a calibrated microphone. Fig. 4 shows that mid settings of the controls gives a reasonably level response from 200 c/s to about 8 Kc/s with the 5 Kc/s peak holding up the mid-high frequency response when listening off the speaker axis, as in normal stereo monitoring conditions.

The free-field response of one of the microphones was measured to give the very satisfactory response of fig. 5. The bass response falls below 200 c/s, which will help speech recording considerably under poor acoustic conditions; but for high quality live music recording the recorder is worthy of a good ribbon microphone, particularly if the tapes are to be heard on wide-range stereo speakers.

COMMENT

I like this machine as it makes a brave effort to break away from the usual run-of-the-mill two-speaker, two-amplifier, stereo recorder by making the widest possible use of the second amplifier and separate head for off-the-tape monitoring and track-to-track transfer. The tape dubbing facility may be regarded as a gimmick by the 'two recorder' brigade, and indeed it is very reminiscent of 'add-on' decks and schemes described in this magazine some five or six years ago to pull two tapes through a recorder using the same capstan drive with a gramophone turntable for the extra take-up reel. I think an extra deck and pre-amplifier nowadays would be the better way, but at least this machine goes all the way in meeting Martin York's plea in the April issue of this magazine for a 'double decker' machine. **A. Tutchings.**



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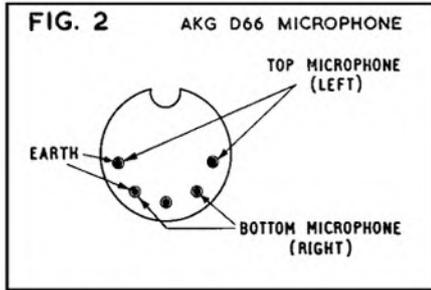
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THE two elements of this microphone are separately cased and are held together by an ingenious plastic clip which allows them to be mounted coaxially one above the other and set to any desired angle for use in the 'coincident', 'crossed-pair', or 'X-Y' system.

Alternatively, they can be separated for the 'spaced' or 'A-B' system which nowadays is mainly used for 'gimmick' recordings using close microphone technique. Two three-legged table stands are provided with the microphones.

Each microphone shows a true cardioid directional characteristic over most of the frequency range, and the frequency response remains reasonably constant for all angles of sound incidence. The response curves of fig. 1 show the responses for front, side and back. It will be seen that the front-to-back ratio is better than 10dB at all frequencies above 200 c/s and that the 90°, or side response, is down by 5-6dB.

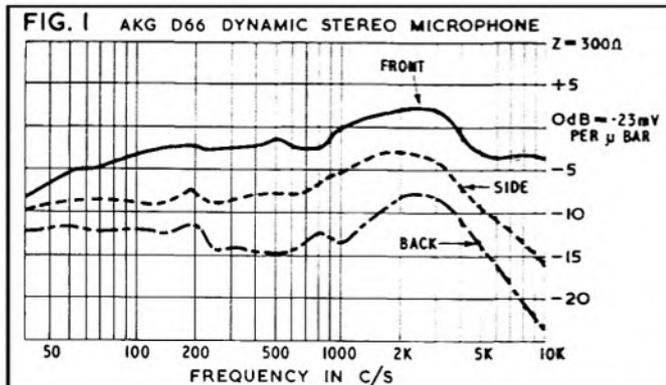
The mean response shows a level bass response and a broad peak at 2-3 Kc/s which gives 'presence' to recordings made under domestic conditions where sound absorption is often high in the mid-high frequency range.

The impedance is mainly resistive at 300 ohms and the sensitivity of approximately 0.25mV per dyne per Cm² is well suited to feeding transistor amplifiers. With high impedance valve amplifiers, step-up transformers with a ratio of 10:1 will be required.

The top microphone is meant to face left (from the rear) and the bottom microphone feeds the right-hand channel. Each microphone is marked with an arrow to show in which direction it should point for conventional stereo pick-up.

There seems little standardisation yet on the connection of stereo microphones to DIN plugs. On this microphone a 5-pin DIN plug is used with the top microphone connected to the top pair of the semi-circle of pins and the bottom microphone to the lower pair; the lowest centre pin is not earthed nor is the body of the plug. Fig. 2 shows the screen connections, looking into the plug.

This is a well designed microphone, or pair of microphones, for high quality domestic stereophonic recording. Both the styling and acoustic performance are excellent.



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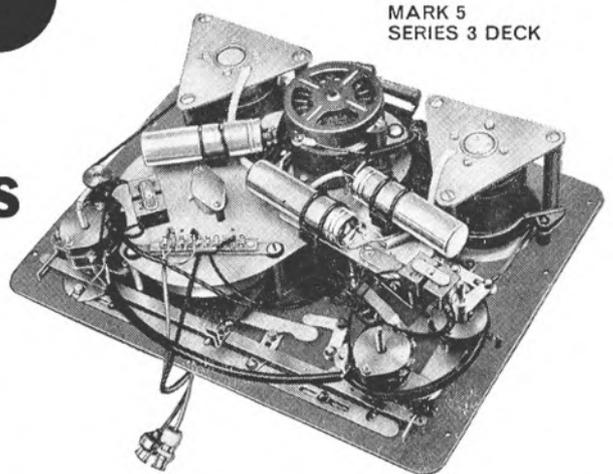
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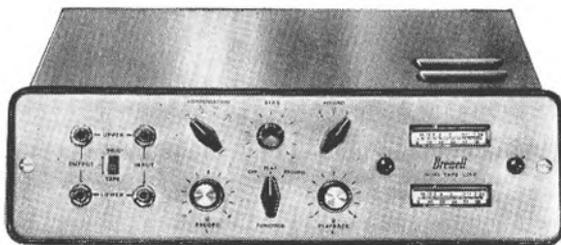
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