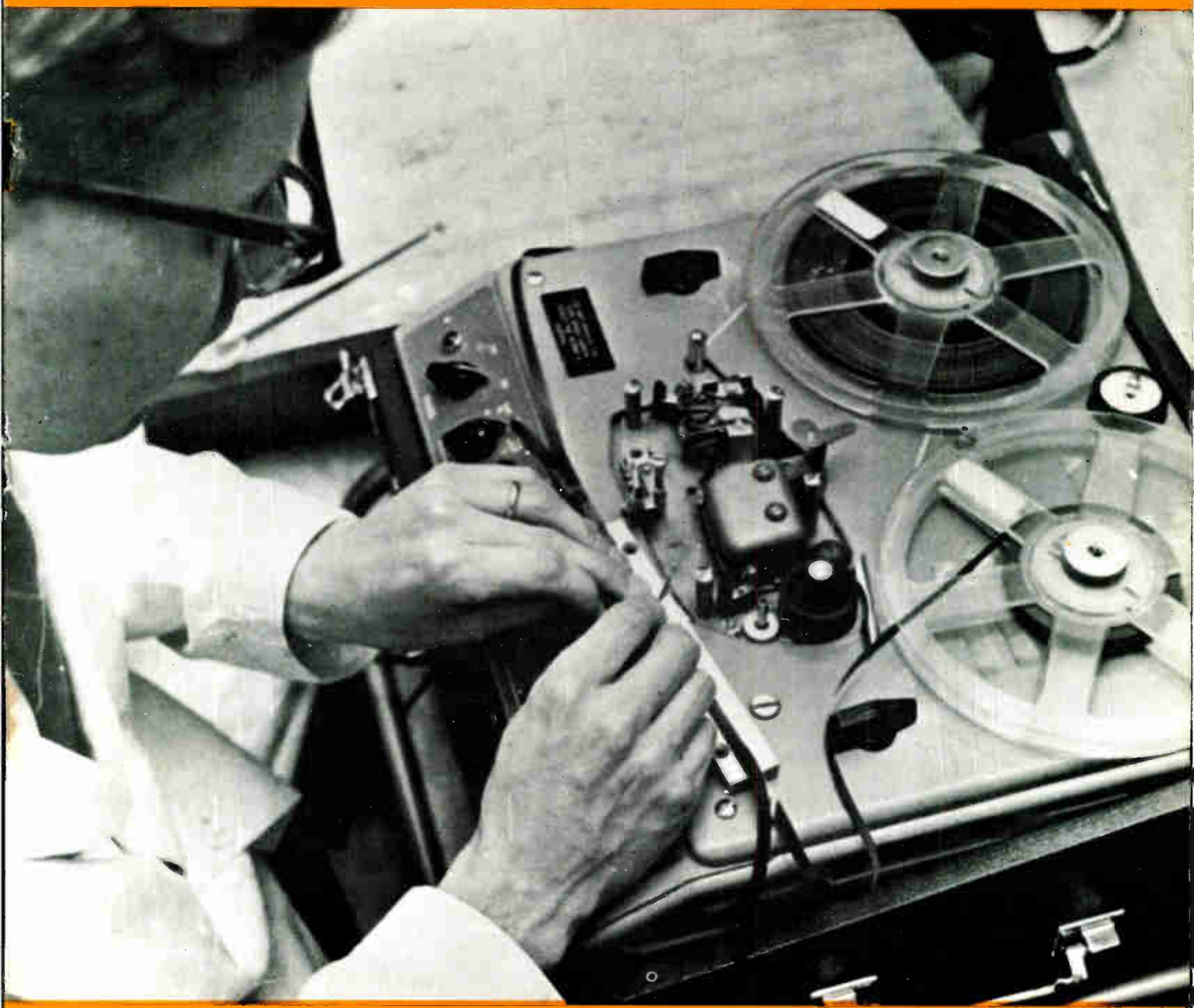
the TAPE RECORDER

price 2/-

OCTOBER 1963
VOL. 5 NO. 9

INCORPORATING "SOUND AND CINE"



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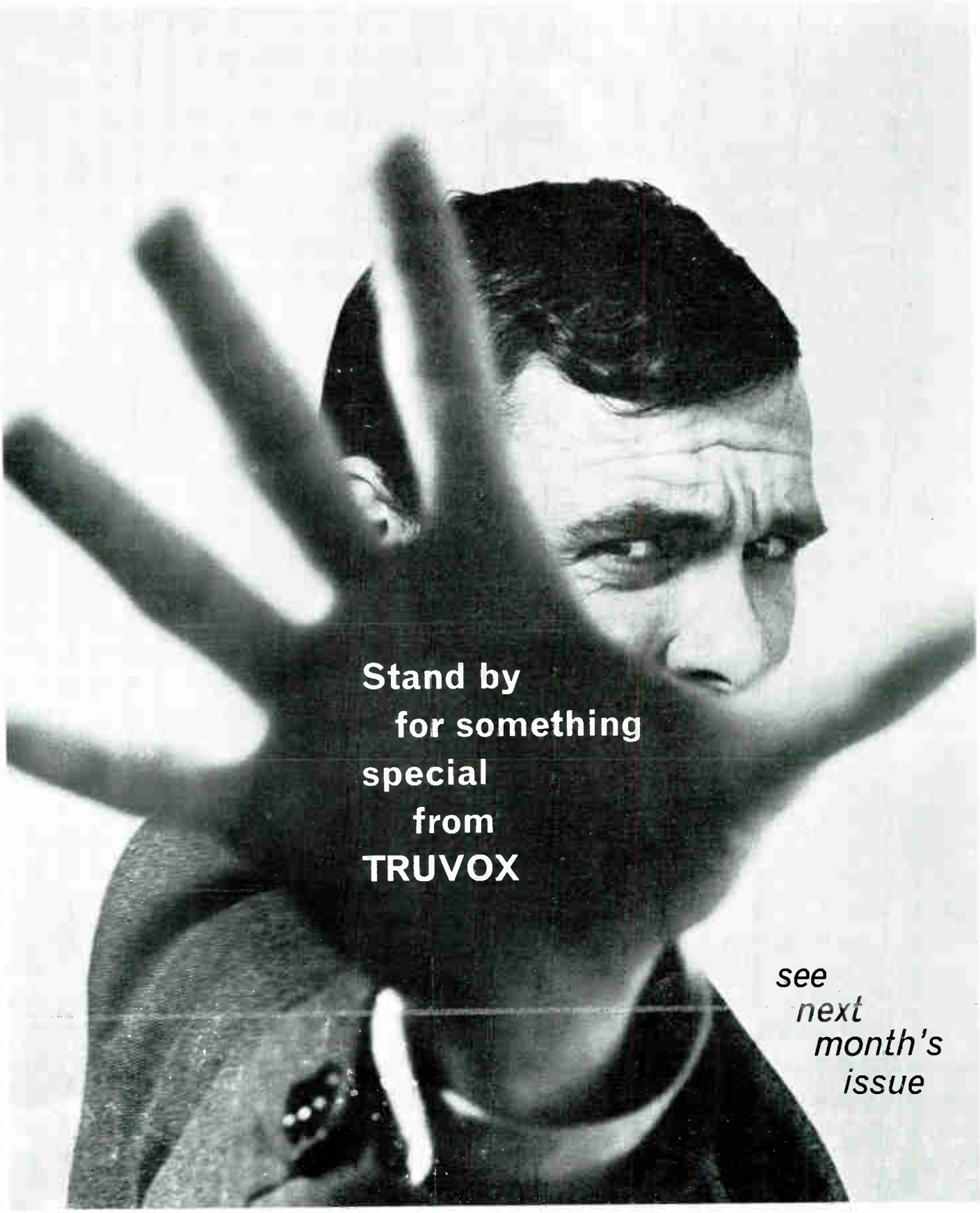

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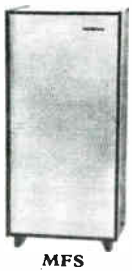

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HI-FI STEREO 6-WATT AMPLIFIER

Model S-33. Attractively styled. Printed circuit construction. 0·3% distortion at 2½ W/chal. 20 dB N.F.B.; sensitivity 200 mV. U/L output, ganged controls. **£13.7.6**

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Model S-33 H. De luxe version of S-33 with many refinements. Ideal for use with Decca Deram pick-up. **£15.17.6**

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ET 92

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TR.4

the TAPE RECORDER

OCTOBER - - - - - - - - - - 1963

VOL. 5 - - - - - - - - - - - - - - - - No. 9

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★

MEMBER OF THE AUDIT BUREAU OF CIRCULATIONS

CONTENTS

EDITORIAL

ONE of the big mysteries about the big and increasing volume of tape recorder sales (and we mean machines: not copies of this magazine!) is the question: "*where do they all go?*" and another big puzzle is: "*what are they all used for?*". Many people would like to know the answers to both those questions, and in particular the manufacturers of both machines and magnetic tape. During the past year or so, we have made some penetrating researches; and, as a result, we have stumbled upon some very interesting facts. These facts, and others which we are still collecting, will form the basis for several features in this magazine in the months ahead; but we are still a long way from finding out the answers which we thought we should succeed in getting. The bulk of the tape recorders that are sold each month just seem to vanish without trace, so far as details of use and grouping of ownership go. Increasing sales of spools of tape show that a large number of them are in active use. Sales of tape records, also on the increase, show that many people are using them for the reproduction of music.

At one time we used to think that our own sales of this magazine were in some way a reflection of what was going on. Possibly they are, in a roundabout way, but we have long since realised that a very great number of our new readers are "browsers"—people who have planned to contemplate the scene, and to find out what tape recording is all about, before buying a recorder. We have also discovered, from readers' letters, that an unbelievably large proportion of tape recorder buyers take away their purchases without bothering to find out even the most elementary things about them. One example—slightly off the beam, perhaps, but a symptom—is that a lot of people who decide to record from radio are quite amazed to realise that it is not necessary "to keep silent" during a recording, and that the practice of placing the microphone in front of the loudspeaker of the set is not the right way of going about things. This, despite the fact that in many cases a special lead and plug is provided for the purpose of direct interconnection.

We have learned that moves are afoot to provide information about tape recording to all and sundry, for the very sensible idea of promoting greater interest in the subject and for stimulating all round sales as a result. Our own opinion is that a good initial move in this direction would be an enlargement of the annual hi-fi and audio event, and in such a place that a really large slice of the public would have a chance to see what it is all about. We devoted this column to these views only a few weeks back. What is happening, we think, is that the public as a whole are taking to tape recorders in much the same way as they have (though much more rapidly) taken to television. We have always held the view that the tape recorder would one day become a domestic utility, on the entertainment side—partly because it is a medium for playing music, but much more so because it is potentially a wonderful medium for a form of self-expression and creation. Events of the past two years tended to disillusion many people who were originally inclined to share our views, but as we have already said, many times and at length, the set-back that overtook the industry as a whole was the result of a period of badly made products, poor servicing facilities and a general lack of interest in the customer, once he had made his purchase. Now that those days are well behind us, we are on the way to a steady build up of interest by the public; and we firmly believe that one of the big answers to the mystery: "*where do they all go, and what are they being used for*" is the beginning of this steady adoption of tape recording. In other words, the answer may well be: "*they are not going anywhere in particular, nor being used for anything spectacular. They are just being bought, and used, in much the same way as record players and cameras are bought and used, normally and naturally*". We have never departed from our original belief that this would happen. We think it has begun to happen. And we therefore repeat what we said recently—the time has come to end the annual club outing, in terms of a small exhibition. What is needed now is bold, intelligent planning. A lively exhibition, with live attractions to support static displays—opportunities for live-versus-recorded performances—studios where visitors can see what can be done with tape recorders—a show at which dealers, as well as manufacturers, can meet the public, and where experts can answer questions. Perhaps, even, some form of encouragement for the enlistment of service engineers for the years ahead. Lectures. Examples of the use of tape in many fields—not forgetting its natural tie-up with films and slides.

SUBSCRIPTION RATES

The subscription rate to *The Tape Recorder* is 27/6 per annum (U.S.A. $4.00) from The Tape Recorder, 99 Mortimer Street, London, W.1. Subscription + Index, 30/- (U.S.A. $4.25). The same rates apply to *Hi-Fi News*.

COVER PICTURE

THIS month's front cover photograph shows a recording engineer editing a tape which has just been recorded at Livingstone Recording Studios new premises at New Barnet, Hertfordshire. The machine is an E.M.I. TR 52 and the splicer an E.M.I. Jointing Block.

This beats everything !

THE SUPERLATIVE **TK6**

A new-era Grundig. No machine like it anywhere. Mains-operated transistorised portable tape recorder. Own built-in battery *or car battery* operated. Next-century design. Concert hall quality. Two speeds. Four hours play-back. Ask your Grundig Dealer for a demonstration of this brilliant new model. 65 gns. including microphone and triple play tape.

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- Speeds 3¾ and 1⅞ i.p.s. • Frequency Response up to 13,000 c/s • 13 Transistors and Diodes
- Revolutionary HF controlled and transistor stabilised motor • Recording Level Meter—Battery indicator
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TR/10

NEWS FROM THE WORLD OF TAPE

Tannoy Buys More E.M.I. Tape Recorders

TO MEET their expanding recording commitments, the Tannoy group of companies have found it necessary to extend their range of recording equipment, and have now purchased four RE301 professional tape recorders from E.M.I. Electronics Ltd.

These were recently used for the first time—at the Royal Albert Hall—during one of the largest international congresses ever held in the United Kingdom. 33 hours of recording were made in two languages, edited to six hours of highlight, copied 100 times, flown to 56 different countries, edited again to a three-hour tape, copied many hundreds of times and distributed for world-wide use.

Since then the machines have been used for other recording and copying commitments in conjunction with several E.M.I. TR51s, TR52s and TR90s which are used by Tannoy for an average of 14 hours per day, six days per week, every week of the year.

★ ★ ★

Twin Track Versus Half Track

IN a letter to the Geneva International Electrotechnical Commission Mr. F. Buurmeyer, of Philips Electrical Limited brought up the need for a standard definition of the tracking system. He suggested that the confusion over whether a recorder is two-track, twin-track, half-track, or two-track stereo should be eliminated by manufacturers specifying that their machines are either one-track (mono), two-track (mono), two-track (stereo), four-track (mono), or four-track (stereo). Mr. Buurmeyer, who is Dutch, goes on to say that the problem is just as confusing in the French and German languages.

★ ★ ★

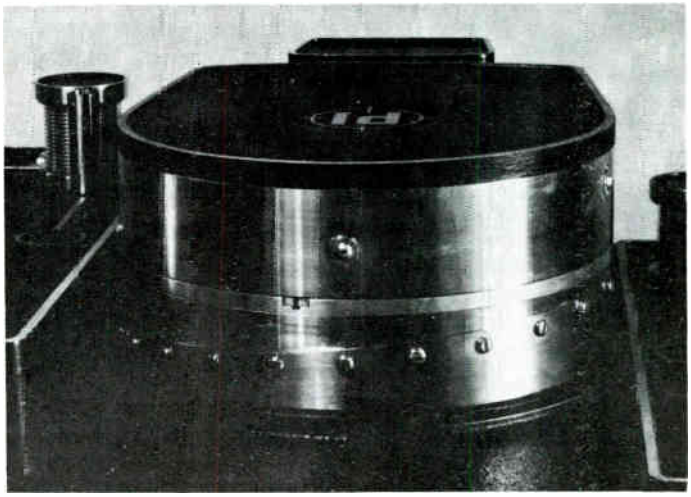
The "new look" for "SCOTCH" Magnetic Tape. Boxes are now colour carded to distinguish types.

Reduction in "Scotch" Tape Prices

THE 3M Company have just announced considerable price reductions of Scotch tapes. This has been made possible by the opening of a new factory in South Wales. Examples of the new prices are:

5 in. No. 200 Double Play down from 45/- to 41/-.
5¾ in. No. 150 Long Play down from 35/- to 32/6.
7 in. No. 150 Long Play down from 50/- to 44/6.

The tape-containers have been redesigned and now employ a colour coding system: black for standard play, green for long play, and blue for double play.



The helical scan head assembly which forms the heart of the PI-3V video recorder

News From the World of Video

THE announcement of the *Telcan* video tape-recorder seems to have triggered off a string of events in the world of vision-on-tape. An American firm, for example, has just introduced a domestic telerecorder with a built-in time-switch that will tape your favourite TV programmes . . . presumably the ones you miss when out in your private plane! The recorder costs £10,000.

Considerably cheaper is the *PI-3V* recorder recently introduced by the *Precision Instrument Company*. Costing £4,340, the PI-3V gives a playing time of 115 minutes on a 10½ in. spool of 1 in. tape. Tape speed is 6·25 i/s and, weighing only 68 pounds, the recorder is the lightest on the market and can be lifted by one man. *Continued on page* 355

★

Video recorder type PI-3V by the Precision Instrument Co. gives a playing time of 115 minutes on a 10½ in. spool of 1 in. tape. Tape speed is 6¼ i/s and weight is 68 lbs.

★

Trade Mark

Scotch

Magnetic Tape

REDUCES THE COST OF TOP QUALITY RECORDING

Down comes the cost of top-quality tape recordings. The makers of "SCOTCH" Magnetic Tape are pleased to announce price reductions throughout their range. For example, 5" No. 200, double play was 45/- — now down to 41/-. 5¾" No. 150 long play was 35/- now down to 32/6. 7" No. 150 long play was 50/- now down to 44/6.

MORE GOOD NEWS

— A new standard play tape, polyester-backed No. 175 brings down the price of top quality polyester recording. **And** there's an exciting new pack, colour coded for easy identification. Now more than ever before, insist on "SCOTCH" Magnetic Tape. Get full details of the new prices and alterations in the range from your nearest "SCOTCH" stockist.

3M MINNESOTA MINING AND MANUFACTURING CO. LTD. 3M HOUSE, WIGMORE STREET, LONDON, W.1.

Ten *RCA TR-22* transistorized video tape recorders have been ordered by the BBC. Two recorders will be sent to studios in Cardiff, one to Scotland, and two for use as mobile recording units. The rest will be used for the BBC Channel Two at the Television Centre, Shepherds Bush. The recorders can be used on 405, 525 and 625 line standards, and are at present being tested by BBC and RCA technicians before going into service.

Finally, an engineer in Wolverhampton, Mr. Colin Mason, claims to have invented a gramophone record capable of reproducing television pictures and sound. The record is played at 33⅓ r.p.m. on a specially designed gramophone using a normal TV receiver as a display screen. They think of everything!

★ ★ ★

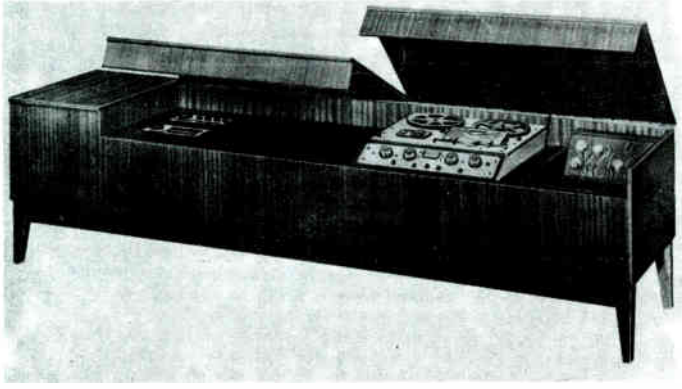
E.M.I. Recorders Help Solve Aircraft Noise Problems

THE Rolls-Royce Flight Research & Development Establishment is now using E.M.I. two-channel professional recorders to help solve problems of suppressing aero engine noise. Recordings of the engines are made to determine which section is noisiest. By careful microphone positioning a polar diagram of an engine can be determined. Analysis of noise levels can also be made in flight with E.M.I. portable recorders. Without using tape recorders it would be necessary to run the engines for several hours, consuming large quantities of expensive fuel.

★ ★ ★

Three New Hi-Fi Cabinets

THREE new hi-fi cabinets have been brought out by **Record Housing** with *Lowline* Scandinavian styling. Designed to take all standard hi-fi amplifiers, pre-amplifiers, radio tuners, tape decks and turntables, the



Lowline Five has pneumatic lid stays and adjustable mounting boards. The cabinet is finished in satin mahogany. The amplifier is housed in a separate, ventilated compartment to prevent hum and overheating. Overall size is 81½ in. long x 22 in. wide x 16 in. high. **Price: £34 13s.**

★ ★ ★

Emitape Leaflets

READERS new to the world of tape will find useful the informative leaflets published regularly by E.M.I. Tape Limited. Written by John Borwick they deal, in non-technical language, with such topics as outdoor recording, tape indexing, and adding sound to slides. They can be obtained free-of-charge from **E.M.I. Tape Limited, Hayes, Middlesex.**

★ ★ ★

Reader A. Kirby of 6 *Second Crescent, Gloucester Avenue, Slough, Bucks.* would like to hear from any reader who can supply him with a service sheet for the amplifier of his Magnafon tape recorder.

★ ★ ★

DR. IVOR ROSEN, of 2916 Bloor Street West, Toronto 18, would like to hear from other readers in Toronto interested in tape recording.

Canadian Radio Station Uses English Equipment

THE well known British columnist, Jack Oldham, who last year became the news and features editor of C.K.E.Y., Toronto, one of Canada's largest independent radio stations, uses the station's first E.M.I. L2 portable battery tape recorder. Previously station C.K.E.Y has used American equipment almost exclusively. Jack Oldham, a former war correspondent, was a columnist for Kemsley Newspapers Limited and also appeared on A.B.C. television programmes in Britain before going to Canada. The photograph was taken beside one of the station's mobile sound equipment trucks by Kenneth Smith, Assistant Chief Engineer of station C.K.E.Y.

★ ★ ★

By GRAHAM BALMAIN

PROFILE OF A DROPOUT

DROPOUTS—THE MANUFACTURER'S PROBLEMS

The third and last part of an article about tape output fluctuations

PRODUCING tape which is at least one street ahead of popular requirements demands from the manufacturer not only a persistent and imaginative development effort, but also continuous and very strict quality control of the raw materials, the manufacturing process, and the product itself. Lack of vigilance can affect any or all aspects of tape performance, but none more than the regularity of the coating. At one extreme there is the long-term uniformity, which determines how little the sensitivity varies within reels and from reel to reel; at the other there is the evenness of the granular dispersion, which strongly influences background noise and modulation noise.

Somewhere between these two extremes lie the short-term variations in sensitivity, the discreet fluctuations of the output level which may occasionally cause dropouts under unfavourable conditions (remember that we have defined "dropouts" as those fluctuations which are *audible*). The lengths of recognisable dropouts are typically 10-100 milliseconds, the depths upwards of 2-3 dB. They have two main causes, as my former colleague Dr. Noble pointed out, and I cannot do better at the moment than quote him on the subject (*Brit. I.R.E.*, October 1960).

" . . . tape is not the perfectly homogeneous medium which is desirable; the inhomogeneity is inherent in the structure of the magnetic coating and the nature of the base material on which it is spread. The inhomogeneity persists even in tape made under the cleanest possible conditions of manufacture and will continue to do so in spite of the improvements which will be made in the dispersion of oxides and in the production of uniform base materials. Such precautions naturally mean that the inhomogeneity will be less extensive, but this does not mean that its effects will be less than they are at present, because by then the demands made on the tape will be greater."

★ ★ ★

These last few words are indeed a cry from the heart, to audio engineers as much as to the computer engineers to whom the paper was addressed. He continued: "In facing this fact and setting aside the myth of 'perfect' tape, the questions which remain to be answered are, '*How much* error will the tape introduce?' and 'How can it be measured'. It is possible to give more fundamental and satisfactory answers to these questions than to the question, 'Is this piece of tape perfect?' Economic advantages and improved performance can be obtained by this approach".

So we have the two causes, dirt, and structural irregularities in the component materials; the one is avoidable, the other inevitable in some degree but capable of being reduced by improvements in manufacturing techniques. Assuming mastery of the first, the aim in dealing with the second is to reduce them so that their effects cannot be heard under any popular conditions of tape use which can reasonably be envisaged. Equivocal though this may sound, it is nevertheless the only practicable way to set an objective which is visible—and attainable!

More about that later. For the moment, let us follow up last month's rather academic discussion of dropout shapes by examining the kind of equipment which can be used to detect and count fluctuations, and thus to tell the manufacturer how successful his efforts are.

"Count" rather than "measure", you notice, for separate measurement of each disturbance is quite impractical in a routine test and is not generally necessary. Since one is setting a reasonable limit to the size of fluctuations rather than trying to eliminate them altogether, it is enough for the equipment to detect and count those which exceed the limit.

The method of doing so is essentially very simple. Treating the electrical output from the tape playback amplifier as a modulated carrier signal (a steady tone modulated by the fluctuations, as described last month), each fluctuation which remains after demodulation is compared

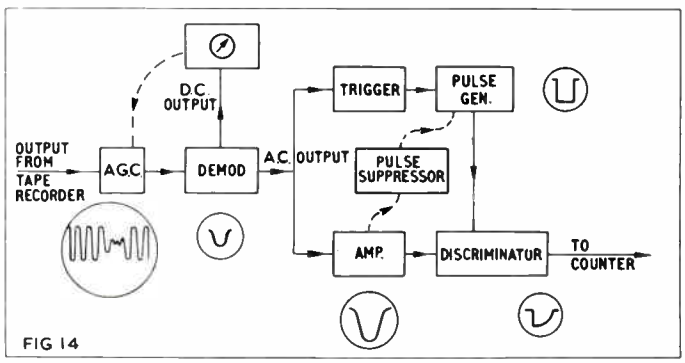


Fig. 14: *Simplified block diagram of typical dropout counter circuitry, explained at length in text. Circular insets indicate typical waveforms expected at these points.*

with a time and amplitude reference, fixed according to the limits set. If the fluctuation is both longer and deeper than the limits, it operates an electronic counter; if only one, or neither, nothing happens.

We can follow the process in slightly more detail from the much-simplified block diagram in **fig. 14**. The output from the tape recorder is fed via an automatic-gain-controlled amplifier to a demodulator, which removes the steady-tone carrier component but leaves the envelope fluctuations intact.

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At this point the D.C. output from the demodulator, proportional to the peak value of the carrier signal, is fed back to control the gain of the A.G.C. amplifier and thus to keep the long-term carrier input to the demodulator reasonably constant (the A.G.C. must not operate within a time approaching that of the largest interesting fluctuations, of course, or they will be attenuated). For convenience, the D.C. is also used to operate a meter.

The fluctuating component of the demodulator output is now fed to two separate channels, one of which—the lower one in **fig. 14**—is merely an amplifier with a control to adjust the amplitude of the fluctuations fed into the discriminator during calibration of the equipment. The other consists of a trigger circuit, which decides whether each disturbance

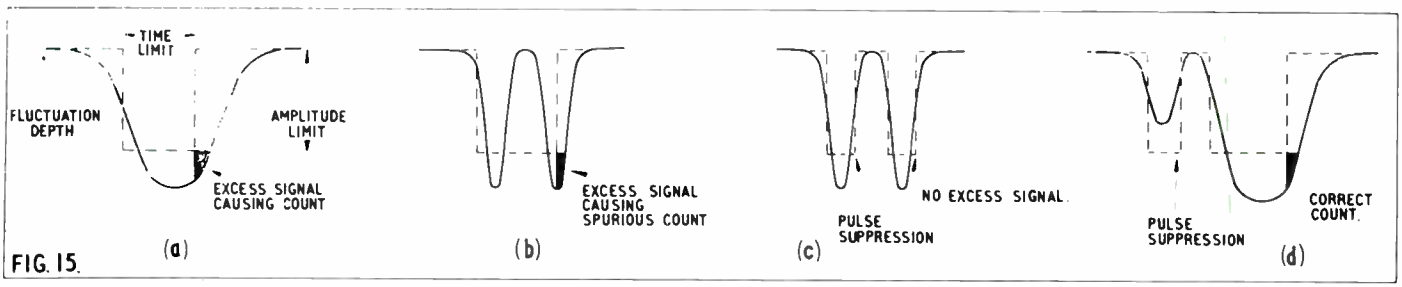

Fig. 15: *Operation of discriminator, and effect of pulse suppressor: (a) Normal, correct counting condition. (b) Spurious counting condition caused by double fluctuation with no pulse suppression. (c) Spurious count eliminated by suppression. (d) Correct count allowed, with suppression.*

as it arrives is likely to be interesting or not, followed by a generator which produces a pulse of adjustable length and fixed amplitude whenever the trigger circuit "fires" it. This pulse arrives at the discriminator at the same time as the amplified fluctuation.

The discriminator incorporates the amplitude control of the reference pulse, and a "gate" which passes only as much of the fluctuation as exceeds the pulse in both length and amplitude (the shaded part in **fig. 15a**) and suppresses the rest. The excess, if any, operates the counter and registers a dropout.

The function of the suppressor connected between the fluctuation amplifier and the pulse generator is as follows: Suppose we had the condition, shown in **fig. 15b**, where two short, deep fluctuations occurred close together. The first one would trigger the reference pulse generator but would in itself be too short to cause a count. However, the second could occur just at the right time to produce an apparent excess, and a dropout would be registered even though the two short fluctuations could not be held to have the same effect as one of the same overall length. To prevent this, an output taken from the fluctuation amplifier is made to stop the pulse and return the generator to the steady condition immediately if the fluctuation ends before the pulse has done so (**fig. 15c**).

Thus spurious counts are avoided, but without prejudicing proper counting of, for instance, long fluctuations preceeded by short ones (**fig. 15d**).

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The details are naturally not *that* simple, especially as there is usually more than one way of tackling each: the generation of the known pulse, for instance, or rather the exact time at which it should be generated. One possible approach is to argue that a sharp drop in output such as occurs between q and p in **fig. 16a** is likely to be the start of a significant fluctuation and can therefore be used to trigger the pulse generator by virtue of its rate-of-change. Some dependence on the actual amount of change is also necessary if every little whisker is not to appear important: a threshold of 2-3 dB is a reasonable compromise.

But even with that precaution there are likely to be many small disturbances which will cause triggering. So what now? Two things: firstly, it is difficult to make the pulse suppressor act rapidly enough in all cases to prevent the pulse generator from sometimes being unready to fire again when triggered; secondly, the relatively frequent useless pulse generation and suppression which is the natural consequence of "impulse triggering" may make interference with other parts of the circuit more difficult to suppress than it need be. A further source of uncertainty, in timing, is that fluctuation shapes do vary considerably, even for the same overall depth and length; but obviously one must make some assumptions about shapes if the equipment is to be of any use at all.

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Another approach which—although more difficult to put into practice—overcomes these snags (in part at least) is to arrange that the pulse generator is triggered only when and if the depth of the fluctuation reaches the set limit (**fig. 16b**). Since short fluctuations are much less likely to reach the critical depth, false operation of the pulse generator is greatly reduced. This "threshold triggering" is also more consistent, since shape is not involved in the triggering process itself. However, a timing uncertainty due to variations in shape still exists, as for impulse triggering.

You will see from **fig. 16** that these two methods of triggering will make the same fluctuation, compared to the same reference pulse, appear to have different lengths; or, if you like, that a shorter reference pulse is generally required for threshold triggering than for impulse triggering to give a count from the same fluctuation.

Which is right? Neither, necessarily, nor any other possible method of triggering. One could argue quite reasonably that the only correct method of triggering is that which acts at the instant the fluctuation becomes audible. In the absence of any such method, let alone any reliable subjective information on which to base it, we can only make intelligent guesses.

We must therefore assume some average shape of fluctuation if different methods of triggering are to produce similar dropout counts on a given set of fluctuations. It is then usually necessary to adjust only the actual length of the reference pulse to set a nominal dropout length.

This can be expected to work only on a statistical basis. Obviously each individual fluctuation cannot necessarily produce the same result on every method of triggering, but a correct choice of average shape should lead to similar long-term average results. At present it seems reasonable to assume that the average fluctuation shape is a sinusoid, as in **fig. 16**, and equipment working on this assumption (**fig. 17**) has been found to give results which are consistent and reasonable according to our present knowledge.

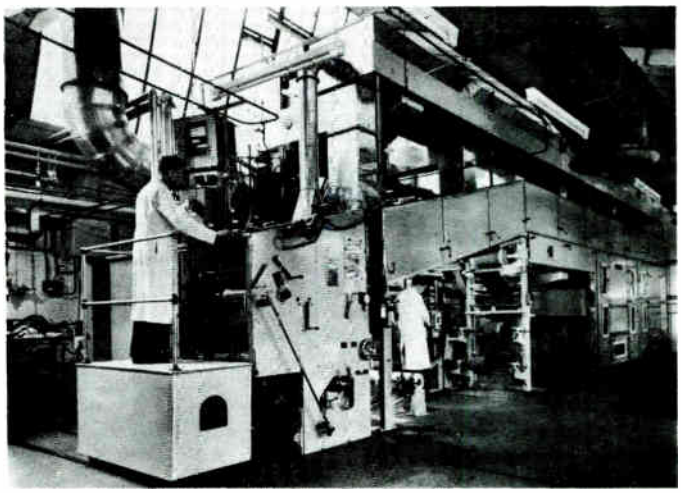

Fig. 19: *A modern coating machine about 50 ft. long, weighing 16 tons. Roughly three-quarters of the weight and volume consists of air filtering and conditioning equipment. The precision coating head, at near end, is under the close supervision of a skilled operator, here shown controlling a "dry" practice run. Speed of coating: 200 ft. per minute on to a foil 15 in. wide and up to 7,500 ft. long. (Photo by permission of M.S.S. Recording Co. Ltd.)*

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The equipment shown can count fluctuations of 1, 10, 20, 40 and 75 milliseconds length and of 2, 3, 6, 10, 12 and 20 dB depth. The case on the left, behind the tape recorder contains circuitry basically similar to that shown in **fig. 14**. The counter is in the middle unit, together with a timing device to control the print-out unit on the right. As now used, the equipment scans a ten-minute sample of tape in each reel tested, counting and printing-out the total at the end of each successive minute and also printing the accumulated total at the end. The routine test is normally at 1⅞ i/s on a quarter-track machine, although, of course, any machine and any speed can be used as required.

One usually tests for fluctuations which are considerably smaller than seem, in fact, to be audible (e.g. 3 dB at 10 mS.), partly with an eye to the future and partly because one commonly gets very low counts, often none, when the equipment is set to what might be considered audible limits. (These seem to lie somewhere between 3 dB/10 mS. and 6 dB/40 mS.). It is obviously better to compare the dropout quality of tapes on fairly high counts, where differences show up more readily than on low counts, if short samples are tested.

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Despite the confident look of the apparatus, the dogmatic style of the printed results (**fig. 18**) and their usefulness to date, the basis for the measurement is still somewhat arbitrary. What *is* the length or depth of a dropout as it is *heard*? Are we even justified in assessing fluctuations on length and depth only? Should we perhaps measure areas, mean values, R.M.S. values, peak values, shape factors or any one of a host of other things, as well or alternatively? Instead of treating the tape output as an amplitude-modulated carrier, might we rather not consider it in terms of an envelope waveform subject to random waveform distortion? (See *Electronic Technology* for April and May 1961 for a discussion of this.)

One cannot emphasise too strongly that the whole object of the exercise (as with any other audio measurement) is to arrive at results which mean something in relation to what one hears. The methods and equipment are only the means to that end; hence the large dose of technical philosophy in this article, since we have not yet arrived at our objective.

Meanwhile, what measures are taken in production to maintain a given standard and, if possible, improve it? Obviously one must keep the place clean, in a technical sense. A filtered air intake system which maintains a slight pressurisation of the working areas is essential, together with treatment of floors, walls, ceiling and all working surfaces; also

Continued on page 359

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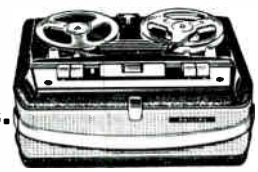

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Profile of a Dropout—*cont.*

"dust-lock" entrances and exits, staff changing rooms, special clothing, and all the paraphernalia otherwise associated with clean working areas. All material containers, piping, trunking and anything else whatsoever which enters the building must be scrupuously clean.

The plastic base material for the tape has additionally to be cleaned immediately before use, as it unrolls on the spreader, and at the same time have static charges dissipated by radio-active isotope irradiation to prevent attraction of chance particles (and also, incidentally, to prevent disturbances in the wet coating; static charges can be strong enough to cause the paint to spray off the base in small amounts).

The structural irregularities need more directly attacking in the materials themselves. The base material cannot be much improved in this

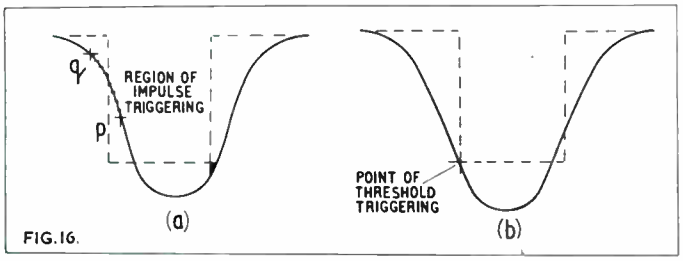

Fig. 16: *Effect of two different methods of triggering reference pulse: (a) Impulse Triggering. (b) Threshold Triggering. Apparent differences in fluctuation length require shorter reference pulse length in (b) to produce same counting condition as in (a).*

respect after its manufacture, so it must be selected for extreme regularity and smoothness before it ever gets near a tape factory. Similar considerations apply to the various solvents, binders and other additives which go into the paint.

But the magnetic oxide itself is the most inherently inhomogeneous ingredient. There are three obvious points of attack. First, on the dry oxide, judicious sieving—either mechanical or magnetic—can remove the larger of the granules which inevitably form during its processing and often contain cores of useless non-magnetic oxide. Second, during mixing of the paint, the normal ball-milling process breaks up granules in the paint satisfactorily.

However, when the paint is stored before use, the particles tend to form up into rather looser assemblies called aggregates. Ultrasonic agitation during storage helps to prevent aggregation, but has to be

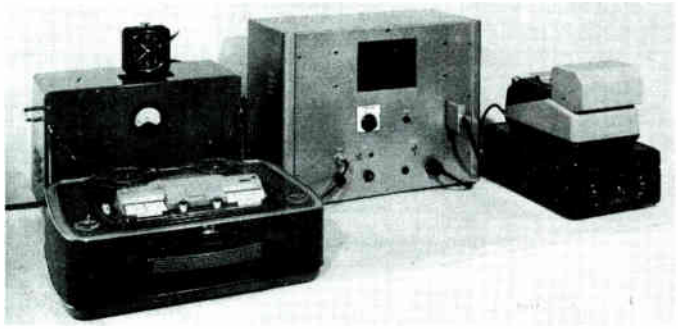

Fig. 17: *A dropout-counting equipment used for routine production testing. Left-hand unit contains circuitry as in* **fig. 14**, *centre unit is the counter and timing control for the printer, right. The clock works with the timing unit and rings to warn operator at end of set period. (Photo by permission of M.S.S. Recording Co. Ltd.)*

reinforced by continuous filtering right up to the time of use to ensure effective freedom from harmful lumps. This is the third point of attack.

Filtering, by the way, is not quite the same thing as sieving. A sieve will pass all particles below a certain size and stop all others, which is useless here as it clogs rapidly and needs frequent replacement, entailing the risk of introducing dirt and allowing excessive aggregation during the change. A filter consists of a series of sieves which are closely layered and arranged so that their meshes do not coincide. Each sieve, on its own, will pass larger particles than need to be stopped, but the assembly, though not actually putting a dead stop on particles above a certain size, makes life progressively so much more difficult for the larger ones that they hardly know the difference. Any particles collected are distributed fairly evenly among the layers, so the filter takes a reasonably long time to clog and actually improves its filtering properties during its life.

You may think all this is rather a lot of fuss for what is essentially a piece of painted plastic. Consider this, then: A 7 in. reel of long-play tape has roughly the same active surface area as both sides of your front door. Imagine trying to paint this, not only so that the average thickness

A	B	C	D	E
28	18	3	2	3
24	8	6	—	2
23	2	1	—	3
24	6	4	—	1
37	4	2	—	3
23	3	3	—	3
20	7	5	1	1
35	2	1	—	3
49	8	2	—	3
19	17	—	—	—
282	75	27	3	22

Fig. 18: *Typical dropout counts for very poor tape (a-d) and for excellent tape (e). (a), 3 dB/10 mS; (b), 6 dB/20 mS; (c), 6 dB/40 mS; (d), 10 dB/75 mS; (e), 3 dB/10 mS, no counts recorded at other settings.*

varies by not more than 5%, but also so that there are no streaks, no lumps, no bubbles, no dust. Each batch of tape the manufacturer spreads will involve these requirements over perhaps 200 times that area, with a much thinner coat than you would apply in normal painting. No mean feat!—and precision engineering of a very high order.

To return finally to the title of Part 1, "When is a Dropout *not* a Dropout?" Had I asked instead only "What *is* a Dropout?", the answer might have occupied a page or so (to the great relief of some readers, no doubt). As it is, we have seen some of what is, to me at any rate, the more interesting side of dropout chasing. I hope you will agree that there is more in dropouts than meets the eye; but not more than meets the ear, uncertain though this is. Perhaps you will also agree that this kind of work, beyond merely answering the obvious questions, requires that one asks the *right* ones if a realistic answer is wanted. Without that it is indeed not much better than reading bumps (phrenologically).

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I regret some errors in the printing of Part 2, due entirely to my having left the Editor insufficient time in which to have the proofs checked.

(a) In last complete paragraph above **fig. 8**, the last sentence should read: "Reducing either R or h to one-quarter of these *values* . . . ", etc.

(b) Under heading "Assumptions examined": "those in **fig. 10**" in line 2 should read "that in **fig. 9**, on the left". The last sentence in this paragraph should read simply: "The allowances for these effects are sketched in **fig. 11b**". (**Fig. 9** originally contained several examples of each kind of profile, most of which had to be omitted for space reasons).

(c) In Appendix A, the square root sign applies to the *whole* of the expression to the right of the second equals sign ( ).

Expression (1) should read:

$$q = \sqrt{2Rh} \text{ approx.}$$

Expression (2) should read:

$$T = \frac{2\sqrt{2Rh}}{v} \text{approx.}$$

In line 7 of the right-hand column of p. 315, the square root sign should cover the whole of the right-hand side of the expression.

Expression (3) then reads:

$$S = \sqrt{R^2 + (q-p)^2} - R \text{ (or } S = \sqrt{[R^2 + (q-p)^2]} - R)$$

in which $q = \sqrt{2Rh}$, from (1)

Expression (4) and the two immediately above are all approximations.

Expression (5) should read:

$$A = \frac{55(\sqrt{2Rh} - p)^2}{2R\lambda} \text{ dB}$$

(d) In Appendix B, substitute "=" for "λ" in the first expression and the second. The whole of the right-hand side in the second is covered by the square-root sign. Thus, expression 6 should read:

$$S = \sqrt{(R + h)^2 - p^2} - R \text{ (or } S = \sqrt{[(R + h)^2 - p^2]} - R)$$

Expressions (7) and (8) are approximations.

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TAPE RECORDER SERVICE

TANDBERG 6

By H. W. HELLYER

FIRST a confession: this is not the sort of machine that comes the way of the average serviceman. My scanty notes on the *Tandberg* range, jotted at the workshop bench, would hardly fill a column. Consequently, this article had to be prepared from a single machine, loaned by a colleague so that all the points in the manufacturer's excellent service manual could be checked, and some of the most interesting features passed on.

The reason for this unfamiliarity is not hard to find. Regular readers will no doubt have noted the review of the two-track stereo version of the *Tandberg 6* in the April 1962 issue of this magazine, and perhaps have turned up, as I did, the February 1961 review, which dealt with the four-track version. In the April review, Mr. Tutchings made no bones about the high quality of this product. And as the reviewer's daily grind brings him into contact with much professional equipment, we can take it that the words of praise held authority. After my brief encounter with this version, I, too, could "bear to live with it"—if only I could afford the 110 guineas.

A 'Basic' Machine

For the benefit of those readers who have not seen details of the *Tandberg 6*, it is necessary to point out that this is a "basic" machine. It has no power amplifiers or loudspeakers, the outputs from the two playback channels being fed via cathode-followers to sockets on the connector panel, giving 1·5 volts *rms* at 3% distortion for a fully modulated tape. The load impedance should be above 10 K-ohms. At this, the distortion is less than 0·2%, but if the load is reduced to the minimum permissible, 2 K-ohms, with the same output voltage the distortion rises to 2%.

To get this business of distortion in perspective, it should be remembered that this is distortion measured on playback (and, incidentally, well below the average level that one comes to expect with even hi-fi equipment). From the recording amplifiers, again two quite separate channels, at maximum recording level the amplifier distortion is less than 0·5%. If we record a test note of 400 c/s at maximum level, then on playback there is still below 3% distortion.

A quick study of the circuitry does not tell us why the quality of signal should be cleaner than average. (Also, the noise level is practically non-existent, certainly better than the quoted 53 dB below signal level.) The individual circuitry must help, and **fig. 1** shows the separation between channels, from the electronic point of view. It does not show the rather complicated switching, which allows a wide variety of functions. Briefly, the circuit consists of two recording pre-amplifiers, with their own gain controls, plus record-level setting controls prior to connection

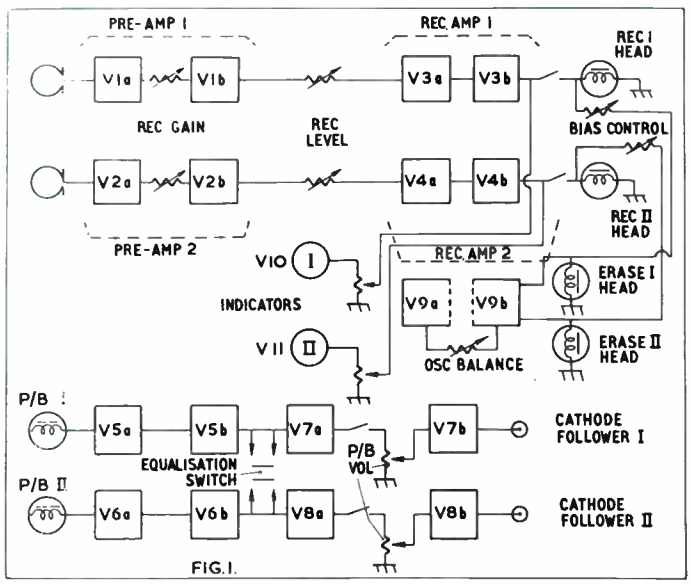

FIG.1.

to the recording amplifiers. The two playback amplifiers are three-stage units with switched equalisation, operated by the speed-change control, between second and third stages, a variable level control from each feeding the cathode-followers. Both the Record-Level and the Playback-Volume controls are dual potentiometers.

Magic Eye Pre-set Adjustments

A push-pull oscillator, with its own balance control, supplies bias voltage and an erase current to the third head. Bias and erase frequency is 78 Kc/s. There are two magic eyes, EAM86 type valves, mounted side-by-side to the left of the recording channel. A preset adjustment gives a setting for the light beams to just touch when the recording current is adjusted (Rec. level) for a 400 c/s input from signal generator

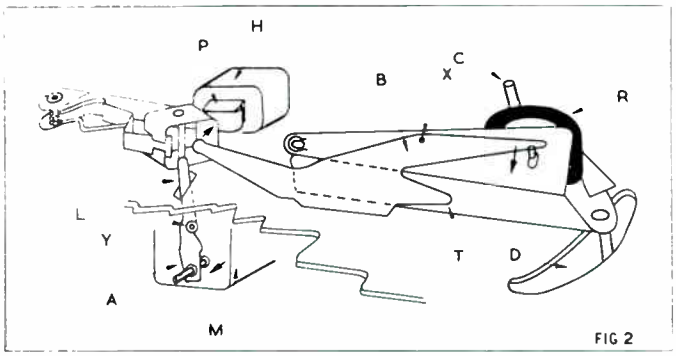

FIG 2

giving a 1·5 volts reading on a valve voltmeter connected to the output terminals, with the playback controls set at maximum. Preset playback level controls are also provided, prior to the switching that is indicated in the block diagram.

There are five push-buttons, the centre one being the stop-start, the two left-hand buttons controlling the recording amplifiers and the two right-hand the playback amplifiers. When either record button is pressed, the appropriate channel is selected, but the switching allows input mixing if either is pressed individually, the outputs from the two pre-amps being combined into the selected recording amplifier. When both buttons are pressed, the inputs go straight through to the separate windings on the record head. A safety interlock, in the normal manner, mechanically prevents the record buttons being pressed except when the operating control is in neutral, and returns the buttons when the operating control is switched to neutral again after recording.

Playback Button Functions

The playback buttons operate rather differently. As is seen from **fig. 1**, the playback head windings are connected directly to the amplifier. The buttons select the connections to the cathode-followers, but when both buttons are up, the cathode-followers are connected to the record pre-amplifier, thus giving a monitoring facility. According to the position of the Sound-on-Sound switch, this function is further developed so that the signal can be monitored not only just prior to recording, but also sampled and amplified for monitoring just after recording.

The S-S switch has three positions (on the 4-track stereo machine earlier models had no "Normal" position). In the Normal position, mono and stereo can be both recorded and played back. The two input channels are mixed for mono, as stated above, and the same playback signal is available to both outputs. In the A-B test position, with playback buttons depressed, the playback amplifiers are connected to the cathode-followers. Releasing the playback buttons then allows the machine to act as a pre-amplifier for stereo or two-channel mono. Alternatively, a single mono programme can be fed to both channels with the A-B position selected and the machine set to Record. This gives an immediate comparative check of the two channels.

The S-on-S position breaks the connection between the cathode-followers and allows monitoring in the following way: with one playback

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button depressed, the circuit is from the head, through this channel, but the other cathode-follower is connected to the Record pre-amplifier. An external link can now be fitted from the output of the first channel to the high-level input. Then, with the microphone fed to the other channel, the Record button depressed and the Start button operated, the master programme will be re-recorded on one track while the microphone input is recorded on the other simultaneously; mixing levels can then be set. From the second cathode-follower an output can be taken, which comprises the complete recording.

So much for the fundamental operation. How does this help us to check the machine? Take, for example, a quick test of the playback amplifier. Feed a signal to one channel and depress the appropriate Record Playback buttons and the Start button. Turn the two playback volume controls, one up, one down, alternately. The signal should appear in each cathode-follower output alternately. Do the same with the other input, noting that outputs are similar. Then load a test-tape, press both the Playback buttons and the Start button and check the frequency response on output meters connected to each output. There should be no more than 3 dB difference between the curves at any frequency (zero dB is set at 250 c/s, using the NAB test-tape).

Checking Erasure

Again, a quick test of microphone input and erasure. Record on both tracks with maximum recording level setting. The programme can be played back simultaneously with all buttons depressed. Now rewind and set the Record volume control to zero. Press the two Record buttons and the Start button; the tracks are now erased. Rewind again and check playback for complete erasure.

To check the parallel recording facility, switch to S-S, press the first Record button, both Playback buttons and the Start. Record on the appropriate track with a microphone input. Check both outputs for both the recorded signal and the previous signal on the other track of the tape.

The setting of the three heads can be made with a test tape. Both Record and Playback heads are mounted on a sprung plate with individual height adjustment screws at the front of each plate. The record head should have about 3 thou' of the facing visible above the upper edge of the tape and the playback head is adjusted for the upper edge of the tape running even with the upper gap. The main mounting plate and the head mounting plates should be parallel. The playback head has a large azimuth alignment screw for final setting. The playback head can also be rotated for maximum, and pulling the pressure pad gently from the erase head should not decrease the signal more than 3 dB.

Test Tape for Head Setting

This contact angle can also be checked on Record after the Playback head has been set with the aid of the B-test facility (recorded signal heard immediately, by playback via the P/B head). The head should be adjusted for maximum signal from the cathode-follower output, while recording a 10 Kc/s signal at the 7½ i/s speed. After this, the azimuth alignment of the record head can be checked.

The mechanical arrangements of the recording channel are partly shown in **fig. 2**. The pressure pad P rests on the erase head facing (H) with an inward pressure of only 100 grams. This pressure is used to halt the tape cleanly when the start-stop button is released, and the pressure roller R is held off from the capstan C by the action of lever B, pivoted at X.

When the button is released, the electro-magnet M is energised, pushing the lever A away from its pole, (pivot Y) and engaging the left tongue of B which is illustrated with the directional arrow. This tongue can be bent for correct clearance of roller from capstan, ½ to 1 mm. The other tongue, T, which rests against the flat face of the roller bracket, can be bent for clearance of a millimetre between the right tongue of B and the roller shaft when the start button is engaged and the magnet is de-energised.

There is an adjustable tape-guide between the pressure pad and the other point of contact, the roller-capstan. But this is, it should be stressed, only a guide. The adjustment of the heads should be such that the tape runs correctly across the facings with adequate contact, and this guide is set to prevent unwanted movement. The right-hand tape guide acts as the contact for the auto-stop.

In addition to the operation of the stop-start mechanism outlined above, the whole pressure-arm assembly is moved away by the action of a roller attached to the assembly, which slides along an eccentric segment connecting the main operating lever. The connecting rod moves in the slot D of the main plate, shown cut away.

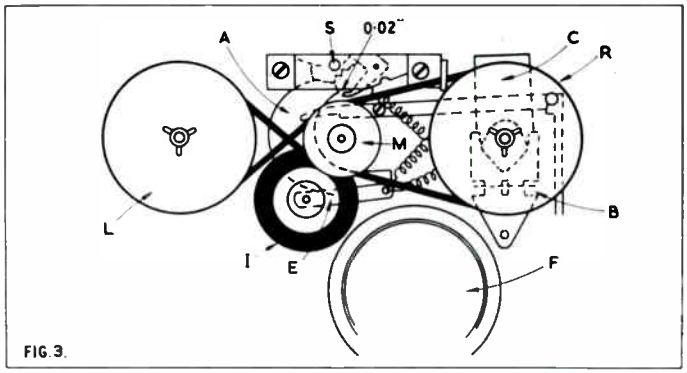


FIG. 3.

Other levers connected to the main operating control select the tape drive; the principal components are illustrated in **fig. 3**. The motor pulley has stepped diameters and belt grooves. The two belt grooves enable the crossed traverse of the drive belt, so that both turntable clutch discs come into action as soon as the motor is switched on. The three steps are engaged by the idler E, when the speed change control, (spindle S) is rotated. This lifts away the idler, raises or lowers it and re-engages, by the curved lever A, to which the idler support arm E is attached. Springs tend to hold the idler in engagement, but the finger arm shown dashed adjacent to the arrow of A holds the lever away until the Forward Drive is selected for Record or Play.

The speed selector mechanism may be adjusted by loosening two screws in the transfer bracket and positioning the idler so that it comes within a millimetre of the lower mounting plate and is parallel with it, when switched to 1⅞ i/s. Care must be taken to see the arm does not touch. The lifting away of the idler is also important, and the tongues at the end of the transverse arm should be bent for correct action (between functions) at all speeds. This action must take place as the lever is being operated and before the micro-switch comes into action, breaking the circuit.

The clutch action is achieved by a "see-saw" motion of the plate arms B and C. Note that the two sides are not similar; the right one is shown, and although the principle is the same the left one has a slightly different shape.

Clutch Adjustments

The boss of the lower clutch plate has a protruding key which sits between the flange of the upper and fork of the lower lever, C and B respectively. As the functions are selected, the plate B is rocked, raising or lowering the boss, engaging or disengaging the clutch felt with the upper turntable underside. The turntables must be levelled and adjusted (twist the bearing) so that the tape is level and true through the flanges of the fixed tape-guides. In cases where adjustment of the bearing is not sufficient, turbax washers may have to be added. When Fast Reverse is selected, the left clutch lever, its inner end resting on a steel ball, is lowered, allowing the boss to be raised by its axial spring, engaging the clutch. The right spool is oppositely engaged. On Normal forward Drive, the left lever can be adjusted by bending for a clearance of disc to felt of ½ to 1 mm. The compression spring has a higher tension on this side, and the friction torque during Fast Rewind is 400 gm./cm.

The right clutch lever should allow a ½ mm. clearance between felt and pulley disc during Fast Rewind, full engagement during Fast Forward and partial engagement during Take-up (which is automatically correct if the Fast Reverse is set).

The actual switching of motor current takes place when the operating lever is about half-way from neutral to any function. This gives an electro-mechanical starting operation which must be preserved for clean action. The important point to note is the positioning of the micro-switch bakelite mounting plate. There are two screws which should be slackened and the plate moved for correct placing of the micro-switch with respect to the actuating lever and the main operating lever tip. This is done during movement towards the fast winding position. Then, and only then, the screws should be tightened, and correct micro-switch operation adjusted for Normal Drive and Fast Reverse by bending the tip of the actuating lever. The Stop Magnet is also part of this assembly, and slotted holes are present to allow adjustment so that the cylindrical part of the brass end of the armature just contacts the actuating lever as the micro-switch is operated. Over-adjustment will result in too much relay current being drawn.

A REVIEW OF

IN these articles we aim to give details of tapes which provide good entertainment at a level appropriate for the music in each case. This means that the performances must at least be reasonable-to-good and that the recording quality is such as to give satisfying reproduction on moderate tape recorders. This month, after applying the above "means test", the initial batch of eighteen mono tapes was reduced to half that number, a few of the abandoned nine being rejected as musically unsatisfactory and the remainder for recording (or copying) faults.

As we remarked last month, commercial tape copying techniques are not absolutely reliable—particularly at 3¾ i/s—so that drop-out, distortion and a general scrawniness of sound quality are not infrequent offenders. Some of the tapes we have rejected on these grounds may have been made from excellent masters, but we have no alternative to passing judgement on recordings as received for review.

★ ★ ★

Our mixed bag of tapes comprises recordings of three symphonies, two orchestral pieces, one swing session, two jazz recitals, an operetta, one piano recital and a musical. The last item is *The Sound of Music* on *HMV TA-CLP 1453*, being the London production of this famous and successful Rogers and Hammerstein show. The performance is supervised and directed by Jerome White, with musical direction by Robert Lowe and the original London cast.

All sixteen of the key set-pieces from the show are included, and presentation is tuneful and bright. The words throughout are distinct and clear, the children's voices being particularly good; the orchestral accompaniment is also very fine. This is a gay and excellent recording of good family entertainment.

We now move from light human drama and comedy to the realm of Northern mountains and forests in the figure of Sibelius. The *Karelia Suite* and *Symphony No. 5 in E flat major* are featured on *World Record Club TT42*, with the Sinfonia of London conducted by Tauno Hannikainen. The symphony is good tough Sibelius which repays re-listening until one is familiar with the gaunt style of this Finnish master. The Karelia Suite is more easily assimilated and parts of it will be familiar to many readers. The performances are fine and catch the spirit of this unique composer very well.

★ ★ ★

At the other extreme of 20th Century music, apart from "pops", there is *The Modern Jazz Orchestra* directed by Joe Gallivan on *WRC TT211*. This recording consists of eight pieces arranged by Don Vincent in the "modern jazz" style, but without the rather cerebral and seemingly abstract approach of such groups as the Modern Jazz Quartet. The items are given a lively performance with good instrumentation and a fresh, clear recording.

★ ★ ★

From a fairly small group we move back to something larger (and very tuneful) by the ever-popular Gilbert and Sullivan. This is *The Gondoliers*, on *WRC TT129*, with the Westminster Symphony Orchestra and the Linden Singers under the direction of Alexander Faris. This is an absolutely delightful selection of pieces, with the true Gilbert and Sullivan spirit coming across right from the start.

The tunes and rhythms are wonderfully catchy and all of Gilbert's very witty words are clearly audible. The various soloists put over their character-parts excellently. It is a constant surprise with Gilbert and Sullivan how many very well-known tunes there are from the Savoy Operettas, and there must be as many in this as any other of the series.

Another infectiously extravert recording is *Let's Swing*, with Wendell Tracy and his Orchestra on *Saga STG 8060*. This is "big band" music in the American style, with a very solid beat running through every item. Eight pieces are presented, each arranged for maximum effect in the big brassy style. The recording is firm and clear.

★ ★ ★

In utter contrast is music by Haydn on *WRC TT206*. The South West German Chamber Orchestra conducted by Friedrich Tilegant plays *Symphony No. 45 in F sharp minor*, and the West German Mozart Orchestra under Walter Schulten plays *Symphony No. 73 in D major*.

The earlier symphony is known as the *Farewell*, because of the circumstances of its composition and the form of the last movement. The story is that the players in the court orchestra badly needed a holiday to

TAPE RECORDS

go home to their families, but their master would not hear of it; sympathising with his fellow-musicians, Haydn composed a symphony in which the last movement permitted each player to leave the orchestra in turn, snuffing out his candle as he left. The "orchestra" is reduced to two string players at the end, and it was hoped that the hint would be taken; there are various accounts of what ensued. No. 45 receives a good all-round performance, and its rather leisurely character comes through excellently.

The other symphony is known as *La Chasse*, as various sections in the last movement have a hunting lilt. This is a pleasant good-humoured work, gaily performed with crisp pointed rhythms.

★ ★ ★

Back to jazz again for the Lucky Thompson Quintet in *Jazz Session*, on *Saga STG 8046*. The soloists are: Lucky Thompson, tenor saxophone; Jimmy Hamilton, clarinet; Billy Taylor, piano; Oscar Pettiford, string bass; and Osie Johnson, drums. This is reasonably enjoyable jazz in a semi-modern fashion, with excellent solo playing and good rhythms.

★ ★ ★

Remaining modern, but going over to the full orchestra, we have Bartók's *Concerto for Orchestra* on *WRC TCM36*. The Houston Symphony Orchestra is conducted by Leopold Stokowski in a fine, taut, well-controlled performance. Stokowski has something of a reputation as a showman, but here—apart from disciplining the orchestra well—he treats the music as a classic. This is appropriate, as this piece is (in our view anyway) a masterpiece of 20th Century orchestral music. It is indeed a showpiece for orchestra, as every section is used in turn and is required to play with great virtuosity.

The recording is magnificent, and for 3¾ i/s mono quite outstanding. The dynamic range seems wide and the orchestral details are caught with clarity yet with a proper fullness. We tried this tape on some very expensive hi-fi equipment just to see how good it was—it scored very well.

★ ★ ★

The last tape brings another contrast, this time from a large orchestra to solo piano. Shura Cherkassky gives an excellent recital on *WRC TT58*, the items being Schubert's *Sonata in A*, Schumann's *Fantasiestücke* and the *Grand Galop Chromatique* by Liszt.

These are sound musicianly performances clearly recorded. The Schubert is satisfying and relaxing, the Schumann interesting and dramatic, and the Liszt is (essentially) a quick, light whimsy

SHURA CHERKASSKY

SCHUBERT SCHUMANN LISZT

TAPES MENTIONED IN THIS REVIEW

Concerto for Orchestra (Bartók)	WRC TCM36
Gondoliers (Gilbert & Sullivan)	WRC TT129
Jazz Session	Saga STG8046
Let's Swing	Saga STG8060
Modern Jazz Orchestra	WRC TT211
Sonata in A (Schubert), Fantasiestücke (Schumann), Grand Galop Chromatique (Liszt)	WRC TT58
Sound of Music	HMV TA-CLP1453
Symphony No. 5, Karelia Suite (Sibelius)	WRC TT42
Symphonies No. 45 and 73 (Haydn)	WRC TT206

By M. F. Woodward

FUNDAMENTAL BUILDING

PART TWO

THE last article dealt exclusively with the reverberation period of a room, in other words, sound as it exists in time. Now we must turn our attention to the behaviour of sound in space, and having considered the basic principles, a further article will examine individual problems associated with rooms having special functions.

Behaviour of Sound

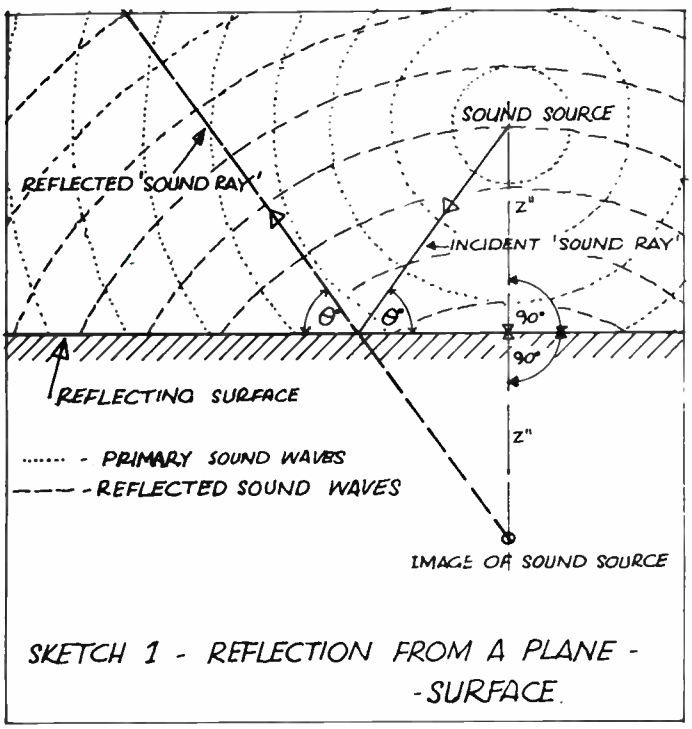
The behaviour of sound in space is, for simplicity, generally analysed graphically in two dimensions. A word of warning is necessary here, for drawings of the propagation of sound rely upon the use of arrows showing sound "rays" rather like the arrows beloved of physicists to show the behaviour of light in lens and mirror assemblies. Such indications are necessary in order to simplify matters. Do not forget though that a sound source radiates ever increasing concentric compressions and rarefactions of the air (sound waves) like (two dimensionally) ripples in a pond caused by a stone thrown in, or (three dimensionally, and more accurately) like a child's balloon being blown up.

Partly Absorbed, Partly Reflected

With this true picture in the back of the mind, consider a sound radiating from a source. Directly this sound hits a surface it will be partly absorbed and partly reflected at an angle normal to the surface (**fig. 1**). On meeting a second surface the remnant sound is partly reflected again and so on and so forth from succeeding surfaces until it is all absorbed. Not all surfaces are conveniently plain however and curved surfaces can be a nuisance or blessing at times. Concave surfaces focus sound, whilst convex surfaces diffuse it; likewise re-extrant angles can return sound from whence it came. (**fig. 2.**)

The focussing properties of a concave surface need qualification, for the focussing effect will only occur at frequencies the wave lengths of which are approximately equal to, or above, either the diameter of curvature of the surface or its least width or length. In a large building, a 2 ft. diameter cove will focus sound from about 500 c/s. (the wavelength of which is about 2 ft.) and above, to a point close to the cove, not a very serious matter. A wall, say 20 ft. high, 50 ft. in length and 120 ft. in diameter is a different matter though, such an item will focus a lot of sound from the lowest frequencies upwards. If this focus "line" is occupied by listeners, they will be conscious of a strong secondary reflection of the sound arriving after the direct sound—in other words—an echo.

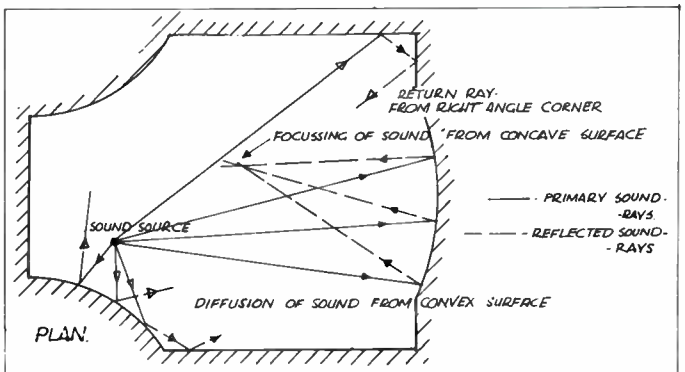
A large radius dome of large diameter (in plan) would focus sound at a particular point and this would be worse, the famous Albert Hall dome (now covered by a suspended ceiling) being a classic example.



SKETCH 1 - REFLECTION FROM A PLANE - SURFACE.

Basic Graphic Analysis

Having assimilated the foregoing principles, a basic graphic analysis of sound wave propagation in rooms can be made by drawing accurate plans and sections, and setting on these drawings a diagram showing the sound source, the listeners, and the various direct and indirect sound paths between them.



SKETCH 2 - REFLECTION FROM COMPLEX - SURFACES.

The most important sound path to be considered in analysis is the direct path between the source and the listeners. Due to the comparatively longer wavelengths of sound, obstacles like columns and so forth do not block sound to the degree experienced with light rays. However an obstacle will form an acoustic shadow behind it and will block or attenuate sounds of wavelengths shorter than (approximately) its own least dimension. This effect can be quite serious when dealing with high frequencies and speech transients. Moreover, direct sound travelling at "grazing incidence" over the heads of an audience will in effect be "sucked in" and absorbed. Thus, the rule is, if you want to hear it, be sure you can see it *well and truly*.

Note the importance of comparing direct and indirect paths, if a listener hears a strong reflection of a sound which has travelled an excess path of 50 ft. more than its direct path, then an echo will result. Sound travels at about 1,100 ft. per second and an excess path of 50 ft. means $\frac{50}{1100}$ = ·05 second—quite enough to upset the intelligibility of speech transients and to have a muddling effect on some types of music. On the principle that a sketch is worth a hundred words I refer you to **fig. 3** with the remark that it's not surprising the hall shown is almost empty! The ideal decay of sound is shown as **fig. 4**, and all graphical analyses should be checked so that any unwanted excess paths are avoided, especially bearing in mind the focussing properties of concave surfaces. Remember that you are dealing with three dimensional sound, and it may be necessary to combine in the mind both a plan and section or even two sections to get a true three dimensional picture of sound behaviour.

Highly Reflecting Surfaces

Another use of graphical analysis is to design highly reflecting surfaces immediately around the sound source, so that direct sound going to the extremities of a large room is reinforced by powerful reflections which do not, however have to travel an excess path to carry out

ACOUSTICS

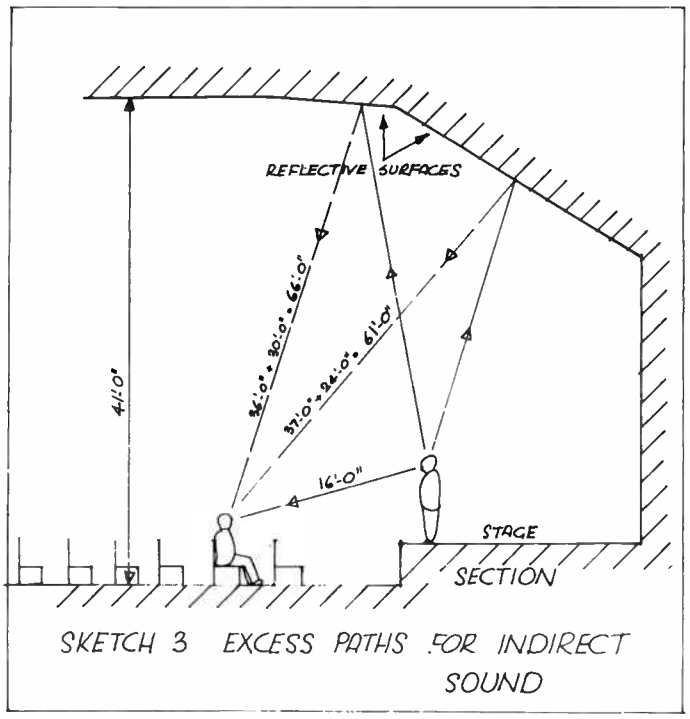
their duty (preferably not more than 30 ft.). Sound diffusion is also very important, and large plain surfaces, especially those distant from the sound source, should be broken up. Remember the projecting galleries plaster enrichments and boxes of the classical music rooms, the projecting boxes at the Royal Festival Hall, the decorative plaster panels of the modern cinema and the coffered ceilings of the now defunct St. Andrew's Hall, Glasgow, and new Manchester Free Trade Hall, all of which have functional duties.

Lower Frequency Sounds

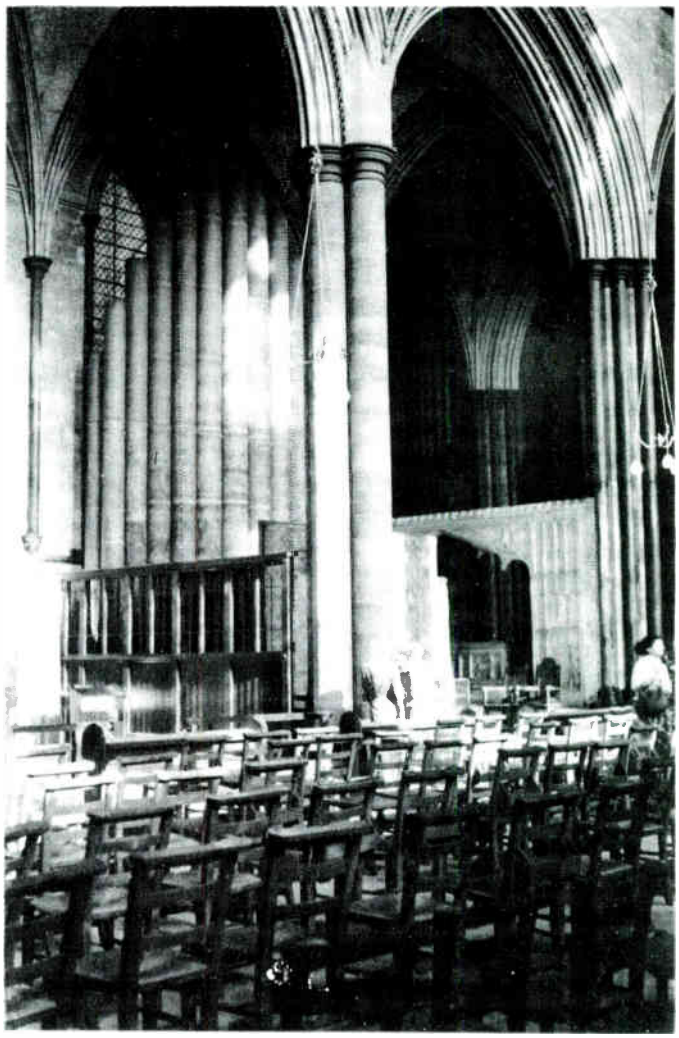
Diffusion is a great ally in defeating undesirable phenomena due to room shape. Lower frequency sounds sometimes approach in wavelength one of the dimensions of a small to medium size room or they may be a simple fraction of that dimension such as a half, third or quarter. When a chord containing that frequency is played in such a room instead of an even "die away" the frequency so favoured may die away more slowly giving an unsatisfactory and unmusical effect. These "Eigentones" or "Resonances" as they are called can occur between reflective parallel surfaces in a room and even between diagonals. Description of theoretical equations to establish eigentones is beyond the scope of this article; but if a room suffers from them, as a "do it yourself" expedient for keen ears, an analysis of the note which seems to linger should be made to get the wavelength (frequency x wavelength = 1100) and a search made for a room dimension to equal it or a multiple thereof. After that, a little experimenting with a movable screen of reflecting or absorbing material on one of the suspect areas and more listening tests should pin-point the problem. Once the critical area is found, a permanent diffusing screen angled to deflect the favoured notes should effect a cure. Note that the diffusing screen should be itself of multiple surfaces, if plain, it may start more trouble at a different frequency.

Eigentones

Eigentones are confined largely to rooms with one or more dimensions under 35 ft., especially if the dimensions are related by simple ratios such as 1.1:2 or 1.2:3. Only slight adjustments are needed to the ratios to reduce the nuisance.

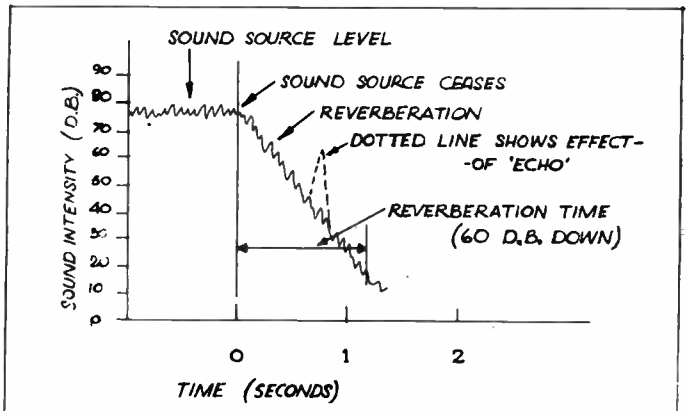


SKETCH 3 EXCESS PATHS FOR INDIRECT SOUND



Flutter Echoes

"Flutter echoes" can be a nuisance at medium and high frequencies, and are caused generally by short bursts of sound echoing between parallel walls. The effect can be very distracting for a (human) speaker set between the parallel surfaces, as the position can be critical and an audience sitting some feet away can be unconscious of the problem. Once again experimenting with movable screens can locate the problem and a cure effected by a permanent diffusing screen.



SKETCH 4 - IDEAL DECAY OF SOUND

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PRICE **93** GUINEAS Inc. microphone and L.P. Tape

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FUNDAMENTAL BUILDING ACOUSTICS — Continued

Summing Up

To sum up, the sound quality of a room depends equally upon: (1) the direct path between sound source and listeners. (2) Upon the volume (which directly affects the secondary reflections). (3) The combination of secondary reflections (after modification by the area and quality of absorbents) and the direct sound to give a long or short reverberation period, as required for the particular function. (4) A reasonably even decay of sound, and proper reinforcement of sound for those parts of the room remote from the sound source.

Note the importance of volume, *ideally* the volume of a room should be so selected that under normal conditions of use and materials of construction the reverberation period is right for the duty and does not require to be shortened by the introduction of further absorbents. Far better to have a room of small volume in which all the secondary sound is reflected usefully to the listeners than one of greater volume where the secondary sound has to be strangled and mopped up tp cut down unnecessary reverberation. Even when dealing with existing buildings it might be worth lowering a ceiling to reduce the volume rather than to pad the place with the said absorbents.

Next Month

The next article will deal with specialised applications of the general principles, with the warning, perhaps unnecessary, that no one on reading these articles is then qualified to set up as acoustic consultant for a new Concert Hall!, so much necessarily has to be omitted for reasons of space and for simplicity. These notes are best viewed as a basis to assist in assessing sound problems and to develop more critical and informed judgement on the general subject.

★ ★ ★

PROBLEM

Unbalanced Stereo

Dear Sir, A few weeks ago I purchased a new Harting HM8 Stereo tape recorder and find it to be a wonderful instrument. At the same time I bought two pre-recorded stereo tapes but later realised that these were two track tapes, my recorder being four track. Even so I found the stereo to be quite good except that I cannot get enough gain on channel two although there is quite sufficient on channel one. (This occured with both tapes.) Is this due to the fact that I am not using the full half track or is this normal on pre-recorded stereo tapes? When I record my own stereo the gain is quite balanced from both channels. Could you also tell me: (1) Is there a firm who would re-record these tapes to four track? (2) Can one obtain four track pre-recorded stereo tapes as I cannot recall ever seeing them advertised?

Yours faithfully, **J. A. P., Leicester.**

The problem of replaying half-track tapes on a quarter-track machine, such as your Harting HM8 Stereo tape recorder is largely one of relative track dimensions—relative, that is, to the tape width.

A half-track recording on a ¼-inch tape, has each track 100 thou' wide, with a 30 thou' separation zone in the centre of the tape, leaving an average 8 thou' clearance at the edge of the tape. The quarter-track head scans right to the (upper) edge of the tape, is 43 thou' wide, with a 25 thou' clearance between tracks 1 and 2: this means that whereas the top track "loses" approximately 8 thou' of the recording, the lower track loses only about 2 thou'. Thus, the output from one channel can be appreciably higher than the other when half-track stereo pre-recorded tapes are played back on a quarter track stereo machine. Which is precisely what you are experiencing. The problem does not arise when making your own recordings, and could be overcome if you really wanted to make an alteration, by lowering the R/P head slightly.

This is definitely not advisable in your case. If you want to make a Tape-to-tape transfer, and cannot get together with another enthusiast for the purpose, you may care to approach Ilford Sound Recording Service, 445 High Street North, Manor Park, London, E.12, who provide such facilities. Although ¼-track stereo tapes are not widely advertised, they are available, and your best approach is for the catalogue of Teletape Ltd., Dept. T.R.4, 33 Edgware Road, London, W.2. This costs 1/-, but if you want to spend a little more, there is an interesting publication called The Stereo Index, at 7/6, by The Wilson Stereo Library Ltd., 463 Streatham High Road, London.

Readers' Problems

★ Readers who encounter snags, or who run into trouble with their tape recording equipment, are invited to write to this editorial office for advice, marking the envelopes "Readers' Problems—Tape". Replies will either be sent direct by post, or published in this column if the subject is of general interest. However, we must emphasise that this advisory service cannot include requests for information about manufacturers' products when such information is obviously obtainable from the makers themselves. It is also essential to keep the queries reasonably short and to the point, and to limit them to one specific subject if at all possible. And, please, in no circumstance confuse such letters with references to other matters which have to be dealt with by other departments in our office.

Oscillation on Playback

Dear Sir, I have a Stuzzi 4M Junior Tape Recorder which is capable of good quality sound when used with large extension speakers. When the volume control is advanced beyond ¾ rotation a low-frequency oscillation takes place. The oscillation is approximately ten c/s and only occurs when a tape is played back, not when using it as a straight-through amplifier. The oscillation causes the magic eye to flicker backwards and forwards and the speaker cone can be seen to move in and out. I have noticed that this oscillation takes place between the grids of the EL84 and have replaced this valve as well as the EZ81 rectifier. There is also a rather high hum level at ¾ volume when used with speakers having good bass response.

Yours faithfully, **L. E., Catford, S.E.6.**

The low frequency oscillation on Playback that you are experiencing with your Stuzzi 4M tape recorder is probably due to unwanted feedback. As the trouble does not occur during straight-through amplifier operation, it is probable that the pick-up of unwanted signals is in the input of the first stage. (Although this stage is also operative during Record, the fault would not have the same effect because the high level output is eliminated).

The fact that the speaker cone is moving in sympathy with the oscillation, and the EL84 grid is arcing over, is incidental to the fault, the result of periodic overloading as the signals come in phase.

Does this happen when the large loudspeakers are removed sufficiently from the tape recorder? The trouble could be a form of acoustic feedback due to a very high level output and pick-up in the head wiring. Make quite sure that the screening of the head wiring is adequate, that the head shield is properly fixed and earthed to chassis. Clean off the contacts beneath screw holes of the latter. Check the 0·01 mfd. decoupling capacitor of the screen grid of the first stage, and the 50 mfd. cathode bypass. Make sure that the loudspeakers are not too close to the machine, and that the vents face away at an angle. If you are using two loudspeakers, make sure that these are in phase. To check, put a torch battery across the L/S leads, note whether the cone pulls in or out, mark one lead, call it A, then do the same for the other speaker, reversing the polarity of the battery until the speaker goes the same way as the previous one, marking its corresponding lead A. It does not make any difference which way round you connect speaker leads to the tape recorder, provided you have both the A leads to the same terminal when using two speakers. If the hum level remains when the gain is more than ¾ advanced, check the smoothing capacitors.

★ ★ ★

Pressure Pads

Dear Sir, I own a Philips EL3549 tape recorder (four track) which was new six months ago. Recently, recordings have been faint and distorted on the two outside tracks (one and four) whilst track two and three record and replay normally. On examination of the record/playback head for the purpose of cleaning I discovered that the felt pressure pad had come off and was lying loose on the deck. I gather that a new pad, complete with new backing plate, will be needed.

I should be interested to know if this is a common occurence and whether any adjustments could be made to avoid it. If a detached felt pad can be satisfactorily replaced I should be glad to hear of the method. Can an ordinary bonding adhesive cause damage to tape or head?

Yours faithfully, **V. T. D., Harpenden.**

The dislodged pressure pad on the Philips EL3549 is undoubtedly the cause of your loss of quality on the outer tracks of the four-track system.

It is quite simple to replace the pad on its bearing plate with a small drop of adhesive, such as Evostik, but care must be taken to allow the glue to set properly before using the machine, in case the pressure against the face of the pad causes the glue to seep around the edges. Avoid the use of too much glue, as the pad is absorbent, and when the glue sets, may result in an over-hardened pad. You certainly do not need to go to the expense of a complete pad and plate assembly—even supposing you could obtain one without recourse to a service agent and the subsequent bill.

I can assure you that this is not a common occurence on these machines. Much more frequent is the misalignment of the pressure pad plate, due to bending of the spring mounting, usually after some attempt at cleaning has been made. Note that the plate sits against the overhang of the mumetal shield.

★ ★ ★

Crosstalk

Dear Sir, I would like to ask your advice with regard to a problem which I have. I am using a Ferrograph 422 recorder and the Armstrong A20 amplifier with the PCU25 pre-amplifier. My trouble appears to be an excessive amount of crosstalk from the lower to the upper track. I usually have the top track playback gain control set at 6 and the pre-amp set at about half rotation. If a quiet passage is played on the upper track it is quite easy to hear break-through from the lower track. This can be most annoying and I am told it cannot be avoided, but would like your views just the same. I have tried varying the value of R74 as stated in the manual but without success.

Yours faithfully, **M. G. O., Huddersfield.**

Crosstalk can certainly be avoided on the Wearite Deck (Ferrograph 422 tape recorder). But it seems that you are tackling this from the wrong end. Your problem, I would surmise, is mainly one of head misalignment. The alternative is that you are over-modulating, but as this would give rise to secondary symptoms that are quite obvious, I presume my diagnosis is more likely.

If the R/P head is slightly low, the first track recorded will be nearer the centre (horizontally) of the tape than it should be. Now, when we invert the tape, the other track is also too near the centre, hence the edges of the magnetised tracks mingle and crosstalk results. A secondary symptom here is that usually the erasure is slightly weak, as the erase head is not acting fully on the same width of track as the R/P head is recording. Try making a recording on a clean tape, then erasing this portion of track and playing it back. Record at your normal level. If my diagnosis is correct, some residual magnetism will cause apparent incomplete erasure. The remedy is to raise the head slightly—an easy matter on this deck with the adjustment screw provided.

MARK 5 Series 2

Spotlight on quality . . .

The Mark 5 Series 2 tape recorder is a high quality machine capable of making outstanding recordings.

It is tastefully finished in medium grey with chromed fittings, and designed not only for use as a complete portable recorder but for incorporation into a Hi-Fi installation. (Deck, amplifier and power unit are available as separate items). A low level compensated output socket is provided for driving an external Hi-Fi amplifier.

Specification:
4 speeds 1⅞, 3¾, 7½ and 15 ips • frequency correction at all 4 speeds • 3 independent motors • exceptionally low wow and flutter content • double-gapped ferrite erase head to minimise erase noise • narrow-gapped record/playback head to give extended frequency response • pause control • superimpose control • recording level indicator (meter extra) • takes 8¼ in. dia. reels • fast rewind (1200 ft. in 45 seconds) • digital rev. counter.

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by Richard Golding

SOUND AND CINE

THE SPONSORED FILM

SOME of the services outlined in this present series of *Sound and Cine* may seem to be far above the financial capacity of the average amateur but at least some idea is being given of the value of being able to call in the professional when there is a little more money to spare.

With sponsorship there is so much more that one can make of one's film in this respect, for when there are sums of around £100 available there is the chance to add a professionally laid sound-track (in part at least) as well as being able to spend, say, £40 on filmstock alone. With more than £100 the hiring of extra equipment, pulse-sync recording or Colortran light units for instance, is a possibility that is attractive in itself.

Local organisations provide the most usual sources and it would not be difficult for a club to find sponsorship for at least one film per year a social documentary, or a publicity film—to keep its membership and its accounts happy. The only thing against this type of film to my mind is that it is limiting to a certain extent where originality of idea is concerned.

The ambitious amateur or erstwhile professional film producer with a completely original idea but without sufficient funds to set it down on film has, however, another and perhaps less limiting source of sponsorship.

The B.F.I. Experimental Film Fund

In 1952, The British Film Institute started an Experimental Film Fund intended to give encouragement to originality of approach in film making as much as to experiment in a technical sense. Since then, 43 films have been produced under the scheme and sums advanced have ranged from just under £100 for the cheapest—*The Maestro*—to just over £2,000 for the most expensive—*Together*.

The Maestro is described by its director Terry Nunn as an "anti-film" and is the story of a strange bearded young man who sets up a rostrum on the steps of the Albert Memorial and then starts to conduct an imaginary orchestra. We hear the music but suddenly the score goes blank and the music on the sound-track stops. In his search for the lost notes he meets some extraordinary characters—a mad porter and a man with a lion's paw in place of a hand. It is a more chaotic film than Lorenza Mazetti's *Together* which lasts for 50 minutes and which is a straightforward account of the relationship of two deaf-mute dockers in London's East End. These two films are completely different in all ways except that they were both completely original in approach and that no one could have produced either as a commercial proposition.

On the technical side there have been at least two noteworthy efforts, one, the dynamic frame *The Door in the Wall*, where the shape of the picture changed at every change of mood and the Grasshopper Group's *Bride and Groom* which used a single frame camera throughout but, mainly, the films have been experimental in theme.

Susan reacts in alarm to the arrival of the foreman (Techet)

The Shirt Factory

One of the latest films to be produced under the scheme is a musical performed by the children of Markfield secondary modern school in North London and the whole idea began with a visit to a local shirt factory, as part of the careers guidance programme. The children were much impressed by the monotony of the piece-work system, and on their return to the school they used these impressions of the factory as an exercise in their Music and Movement lesson. Their teacher, Marjorie Sigley, recognised the possibilities of this exercise and used it as the basis for a set of dances which the children performed at the end-of-term concert. The dances were a great success and Marjorie thought that they would make good film material. Cyril Fleisher, a friend and a member of the Grasshopper Group, agreed with her and persuaded several other members of the Group to lend a hand. The B.F.I. agreed to make a grant, the school's Parent-Teacher Association chipped in, and the *Shirt Factory* was in business with Fleisher as production manager and Hazel Swift as director.

The story of the film is quite simple: the workers arrive at the factory and punch the time-cards; they are hurried along by Crump, the foreman, and go into the workshop. As the machines start up and the day's work begins the girls are full of lively chatter but when the foreman appears they settle down to the monotonous repetition of simple actions. The foreman stands watching them and they get on with their work, stitching, smoothing, pressing, cutting—the same action repeated over again. After a while, Susan, one of the girls, notices that the foreman has gone. She switches on a small transistor radio and, as the dance music pours out, the whole shop breaks into a whirling dance, each girl having for her

(*Continued on page 375*)

partner the shirt on which she has been working. Susan dances through the crowd, spinning her shirt high above her head but suddenly sees that Crump has returned. Horrified, she lets the shirt go and it flies out of her hand draping itself over the foreman's head.

The music stops abruptly and the scared Susan runs away chased by the infuriated Crump. The other girls return meekly to work. The machines pound away and, gradually, the noise of the machinery turns into a voice giving commands—"Stitch on buttons! Press the seam! Smooth the collar! By this time the girls' faces have become utterly blank and their eyes, dull and sullen; they are turning into machines themselves, taking orders from the disembodied voice of the Machine. "Stitch! Stitch!" commands the voice and the girls obey. Suddenly, Susan appears again with her radio and looks in through the factory window. The voice of the machine is drowned in a sudden crash of drums; a clarinet squeals and the girls come back to life and fling themselves into a tremendous Charleston, which brings the film to a triumphant close.

Too Much Light!

Apart from the shirts themselves there were very few props; the action was conveyed entirely by mime and dancing and the setting consisted of a number of screens decorated with cut-outs of shirts, cotton reels, scissors and so on. The film was shot in the main hall and the biggest problem, since Markfield is a very modern building, was that in having too much light! The high windows down one side of the hall let in so much sunlight that Dennis Miller, the cameraman, complained of unfair competition and, very often, the screens that were supposed to be part of the scenery were whisked up to the roof to be used as sunshades.

Since the film had to be finished at top speed and, since the set consisted only of moveable screens, the director, Hazel Swift, dispensed with the usual time-consuming method of changing camera angles and light-stands. First, all the shots from the front position were made, then, the change to side-angles was made not by moving the camera and lamps but by moving the sets and the dancers. This called for quite some home-work on Hazel's part and a good deal of faith on the part of the crew who got a little dizzy trying to work out things in their heads. The only people who took the whole thing as a matter of course were the children who didn't care which way they were facing so long as they could keep dancing.

Problems of the Sound-track

Hazel Swift, talking about her sound problems, says: "The children had actually learned their dances to commercial recordings in the first place and we filmed them dancing to these. We had no sync device to link the Cameflex 16 mm. camera with the Ferrograph and when I look back on it now I can only assume that I was completely mad to attempt such a thing. The fact that it actually worked was a matter of luck and I certainly wouldn't tempt providence by trying it again. Another complication was that this music was copyright and we couldn't possibly afford the fees. Luckily, we were able to get Barbara Killalee, the well-known writer of pop music (*Casanova* and others), to rewrite the music in its entirety.

The film was then edited to the original music-track and then screened in the recording studio with the George Ferguson Group playing the new music to fit the picture. I was full of admiration for the musicians; for two hours they sat in the studio, playing music they hadn't seen before that evening and, what's more, playing it in perfect sync with the screened movements, a form of discipline none of them had ever attempted before. By the end of the recording session they must have been just about cross-eyed, but they came out of the studio beaming and saying that they had actually enjoyed the experience."

Musique Concrete

The new music composed for the dancing is very catchy and played in fine style by the musicians but there is another kind of music involved and this was composed and mixed by Stuart Wynn Jones on his twin Brenell recorders. This Musique Concrete track is mostly gay and amusing where it underlines the titles and the mimed sequences, but is also used to great effect where the machine noises turn into human voices.

Applications for Grants to the B.F.I.

Applications for grants should be accompanied by a short film treatment and a carefully drawn budget and sent to Mr. Ralph Stevenson, the B.F.I., 81 Dean Street, London, W.1, for consideration by the

16 mm. frame enlargement of Charlie Crump, the foreman, appearing on the scene (Sabot Films)

Committee. The present members of the Experimental Production Committee are Sir Michael Balcon (Chairman), Sir Arthur Elton, Lord Brabourne, Anthony Havelock Allan, Bryan Forbes, Baynham Honri, Karel Reisz, John Taylor and Basil Wright. The treatment should do full justice to the idea but need not contain full dialogue or completed shooting instructions. Indication should be given when sending in the application as to the amount of experience that the author or director has had and also whether any test sequences of film are available for screening. The Fund is open to both amateur and professional, the Committee making no distinction between the two. 35 mm. and 16 mm. are the most likely gauges to be favoured but 8 mm. is not out entirely and, indeed, must be more favoured in the future as presentation facilities continue to improve. The subsidy can be full or in part and there appears to be no set maximum (a recent grant of £10,000 by the Gulbenkian Foundation has set the Fund on a very healthy footing) but, nevertheless, expensive productions would have to meet with very careful consideration indeed.

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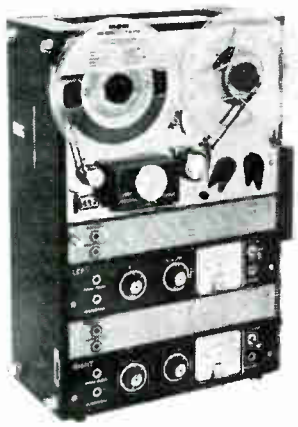

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AKAI-M6

Offered at the unbelievable price of 89 Gns. (less microphones) they show a tremendous saving on the official LIST PRICE of £136, making these recorders an unrepeatable bargain!!! There is little need for us to detail this amazing recorder's performance, it is universally accepted as being the finest recorder in its class bar none. Look at the fabulous specification and judge for yourselves. Used by many leading recording studios throughout the world and accepted as a standard by which to judge others. The superb Freq. response ensures that every recording is a masterpiece and the 12 watts undistorted output enables you to enjoy to the full this recorder's amazing capabilities.

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Frequency Response at $7\frac{1}{2}$ i.p.s. 30–20,000 c.p.s. Frequency Response at $3\frac{3}{4}$ i.p.s. 40–14,000 c.p.s. 3 Speeds $3\frac{3}{4}$, $7\frac{1}{2}$ and 15 i.p.s. Wow and Flutter under ·07 R.M.S. 7″ tapes, Automatic tape stop. Operates vertically or horizontally, Hysterysis Synchronous Motor. Two inline. 100% accurate V.U. meters. Precision position indicator. Direct from Head and pre-amp outlets. 4 or 2 track stereo/mono record/playback at turn of tape selector control. Completely independent record/replay amplifiers on each channel. Out-put 6 watts per channel 12 watts total. Will fully drive 12″ speakers. Signal to Noise ratio better than 45 dB. Cross channel separation better than 80 dB. Dimensions $14'' \times 20\frac{1}{2}'' \times 8\frac{1}{4}''$.

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This fabulous 4 track Stereo recorder recently introduced by SONY incorporates every latest development. Listed at £99 we are able to offer a limited number at the amazingly low price of 69 Gns. (Less Microphones). Look at the impressive Technical Specification. One of the few recorders offering special inbuilt facilities for Sound on Sound. There is no other comparable recorder available today at under £100 and once our existing stocks are exhausted we shall be unable to repeat this offer.

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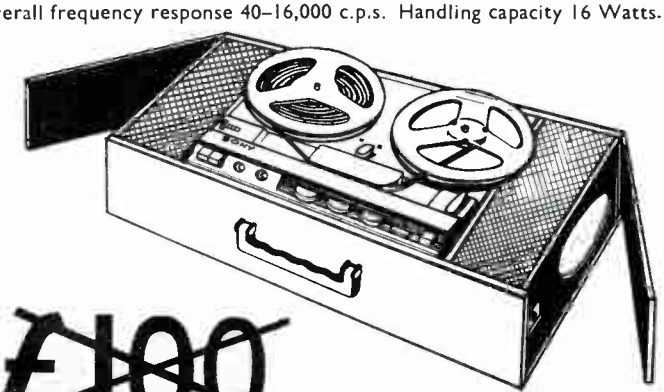

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4-Track-Stereo/Monorecord Replay. Sound on sound enabling new recording to be made whilst listening to other through either internal speakers or headphones. Ideal Cine use. 2 high-flux density speakers. Frequency response 40–15,000 cs. 2 magic eyes. Independent volume controls for record/replay. Tone control. 2 speeds $7\frac{1}{2}$″ and $3\frac{3}{4}$″. Signal to noise ratio 45 dB. Weight $37\frac{1}{2}$ lb. Superb mono and stereo reproduction.

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TAPE, RECORDERS & ACCESSORIES

FIRST DETAILS OF NEW PRODUCTS

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

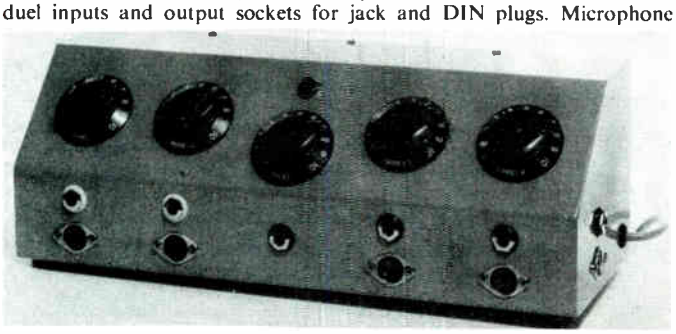
★ PHILIPS EL3585 TWO-TRACK RECORDER ★

PHILIPS Electrical Limited recently announced a new and improved version of their popular EL3585 portable tape recorder. While retaining the same basic design, the **EL3586** has a charcoal grey speaker grille and matt aluminium control panel. An edge-operated tone control has been added and improvements made on the record/playback head to give greater efficiency and improved frequency response: 80 c/s-8 Kc/s ± 3 dB. The microphone and output sockets have been made more accessible and remote control facilities have been incorporated. A standby button allows the user to set the recording level without starting the tape-transport, thus saving battery life. The optional mains unit can now be connected via a socket without removing the batteries; the battery circuit is automatically cut out. Manufacturers: **Philips Electrical Limited, Century House, Shaftesbury Avenue, London, W.C.2.**

★ ★ ★

"Esimax Major" Four-Channel Mixer

THE Esisolder Iron Company have just announced a new electronic mixer, the *Esimax Major*. A development of the *Esimax Minor*, it has duel inputs and output sockets for jack and DIN plugs. Microphone



inputs are high impedance, and the output impedance is 600 ohms, up to 200 mV, suitable for gram input of a tape recorder. The model has two high-level and two low-level inputs and built-in power supply. The mixer is manufactured and distributed by **Esisolder Iron Company Ltd., 98 Dominion Road, Worthing, Sussex.**

★ ★ ★

LZ.27 Tape Recorder

A NEW *Elizabethan* Tape Recorder, the price of which has not yet been announced, is the LZ.27. It is a two-track machine with speeds of 3¾ and 7½ i/s. Inputs are provided for microphone, radiogram and telephone adaptor. A low impedance (3/5 ohms) output is provided for external speakers and a high impedance (220 K) output for monitoring. The recorder, complete with a seven-inch reel of tape and microphone, is manufactured by **Elizabethan (Tape Recorders) Ltd., Bridge Close, Old Church Road, Romford, Essex.**

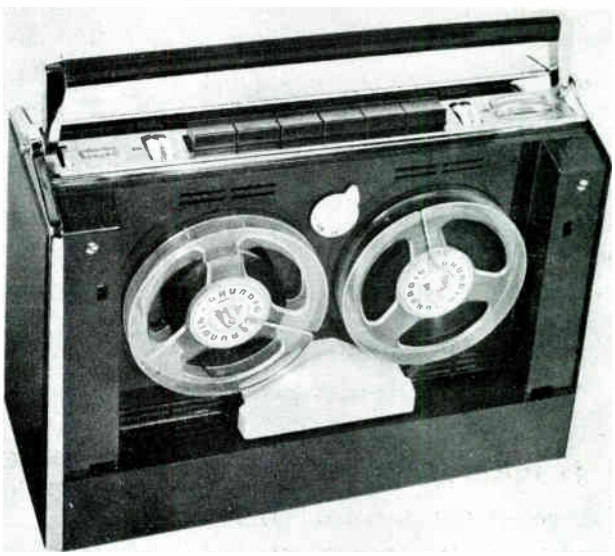
Kodak Recording Tape

KODAK LIMITED have just announced a new range of recording tapes aimed at the amateur enthusiast. They are available in four types, standard-play, long-play, double-play and triple-play. The tapes are attractively packed and labelled for easy identification. An informative booklet "*Kodak*" *Sound Recording Tape* will be available shortly free of charge. The tape is manufactured by **Kodak Limited, Dept. 106, Victoria Road, Ruislip, Middlesex.**

★ ★ ★

A NEW mains/battery portable tape recorder has been introduced by Grundig. Weighing 14 lbs., the **TK6** has two tracks and speeds of 1⅞ and 3¾ i/s. Frequency response is claimed as 50 to 9,000 c/s and 50 to 13,000 c/s respectively. The tape is driven by a high frequency controlled motor, although wow and flutter figures are not given.

Recording level and battery life can be read from an edgewise moving-coil meter. Maximum playing time is four hours on a 4¼ in. spool



of triple-play tape, which is supplied together with a high impedance moving-coil microphone, spare spool and connecting lead. The recorder, price £68 5s., is manufactured by **Grundig (Great Britain) Limited, Newlands Park, Sydenham, London, S.E.26.**

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*Tandberg Series 7—7½, 3¾, 1⅞ i.p.s.	97 13 0
Sony 464 CS—7½, 3¾ i.p.s.	98 14 0
Philips EL.3534—7½, 3¾, 1⅞, ⅞ i.p.s.	96 12 0
OUTSTANDING TWO-TRACK STEREO RECORDER TELEFUNKEN M98. SEPARATE RECORD/REPLAY HEADS. ALL FACILITIES	99 15 0

STEREO TAPE UNITS

*Ferrograph 422 U, 2 track—7½, 3¾ i.p.s.	£115 10 0
*Ferrograph 424 U, ¼T playback—7½, 3¾ i.p.s.	115 10 0
*Tandberg Series 6, 2 or 4 track—7½, 3¾, 1⅞ i.p.s.	115 10 0
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*Telefunken M.96—7½, 3¾, 1⅞ i.p.s.	£72 9 0
Philips EL.3549—7½, 3¾, 1⅞, ⅜ i.p.s.	65 2 0
Philips EL.3541—3¾ i.p.s. only	37 16 0
Philips EL.3541/H—3¾ i.p.s. only	44 2 0
Elizabethan LZ.29 (illustrated)—7½, 3¾, 1⅞ i.p.s.	37 16 0
Elizabethan Popular 400—3¾ i.p.s. only	26 5 0

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*Reflectograph Model A (3 head system)—7½, 3¾ i.p.s.	£110 5 0
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*Ferrograph 5A/N (modernised)—7½, 3¾ i.p.s.	89 5 0
*Telefunken 85 "The Classic"—7½, 3¾ i.p.s.	87 3 0
*Telefunken 95—7½, 3¾, 1⅞ i.p.s.	61 19 0
Elizabethan LZ.30—7½, 3¾, 1⅞ i.p.s.	33 12 0
Optacord 403 (with monitoring)—3¾, 1⅞ i.p.s.	47 5 0
Elizabethan Popular 200—3¾ i.p.s. only	23 2 0
Sony TC.103—7½, 3¾ i.p.s., with built-in medium wave radio	66 3 0
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EQUIPMENT REVIEWED

★

LUXOR MAGNEPHON STEREO TAPE RECORDER

★

Manufacturer's specification: Four-track Stereo. Self contained power amplifiers and loudspeakers. **Three speeds:** 7½ i/s, 3¾ i/s and 1⅞ i/s. **Frequency ranges:** 7½ i/s 45-20,000 c/s, 3¾ i/s 50-12,000 c/s, 1⅞ i/s 80-6,000 c/s. **Power output:** 2 watts each stereo channel, 4 watts mono. **Dynamic range:** 50 dB. Channel separation: more than 30 dB over whole frequency range. **Wow and flutter:** 7½ i/s ±0·1%, 3¾ i/s ±0·2%, 1⅞ i/s ±0·35%. **Reel sizes:** up to 7 inch. 4 pole induction motor. Printed circuit amplifiers. Twin magic eye recording level indicators. Tape consumption indicator. **Weight** approximately 22 lbs. **Dimensions:** 14⅛ in. by 11⅛ in. by 6¾ in. **Price:** £80 17s. **Distributors: Britimpex Ltd., 16-22 Gt. Russell St., London, W.C.1.**

THE Scandinavian countries seem to favour a "furniture" approach to tape recorder cabinets, and this Swedish recorder is no exception. The dark teak base and grey plastic control panel will blend with most furnishing arrangements. One startling innovation is to place all input and output sockets under a removable escutcheon on the *front* of the cabinet. This will appeal to the technical side of the household, as all sockets are fully visible and plainly marked—no more peering around the back of the cabinet for that elusive *Ext. L.S. outlet*—but the distaff side may take a dim view of any leads which are left semi-permanently connected in this way.

Joy stick controls are fitted for tape motion and speed control and a compact group of push keys allow instant selection of alternative input

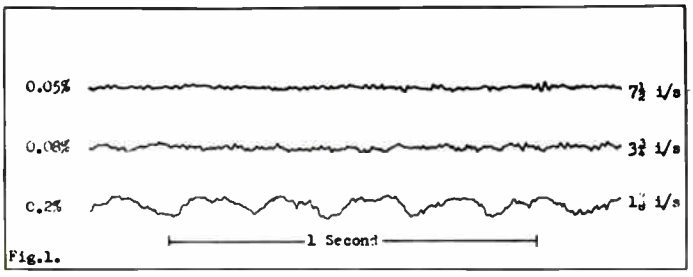


Fig.1.

sources. The twin magic eye record level indicators are placed on the front edge of the control panel in such a position that they can be clearly seen from either a sitting or standing position. So much then for the styling and presentation, now let us see what the technical performance is like.

Wow and Flutter

Fig. 1 shows the fluttergrams, or high speed pen recordings, for the three tape speeds together with integrated R.M.S. readings against each trace. It will be seen that the tape motion is very steady for the two higher speeds, but that a 4-5 c/s wobble shows up at the lowest speed of 1⅞ i/s.

Playback only Responses

C.C.I.R. test tapes of 100, 200 and 400 microseconds time constant were played on the recorder and the outputs measured at the radio outlet socket. **Fig. 2** shows that the playback equalisation is close to the C.C.I.R.

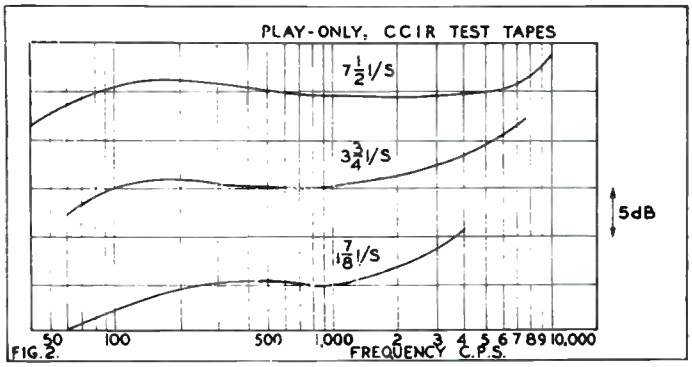


FIG.2.

recommendation at 7½ i/s, but that the high note response is over equalised at the two lower speeds. A high note roll-off will be required in any external power amplifier if C.C.I.R. tapes are to be played on this recorder, and an even more vigorous top cut will be needed to reproduce N.A.R.T.B. recordings satisfactorily.

System noise, with no tape running, was only 25 dB below test tape level; this proved to be almost pure 50 c/s mains hum and, although it was only just audible on the built-in loudspeakers, it is much too high for feeding wide range amplifier-speaker combinations. It was identical on both channels and did not seem to be due to electromagnetic pick-up on the heads. In addition the bottom channel suffered from an intermittent crackle and high hiss level.

Record Replay Responses

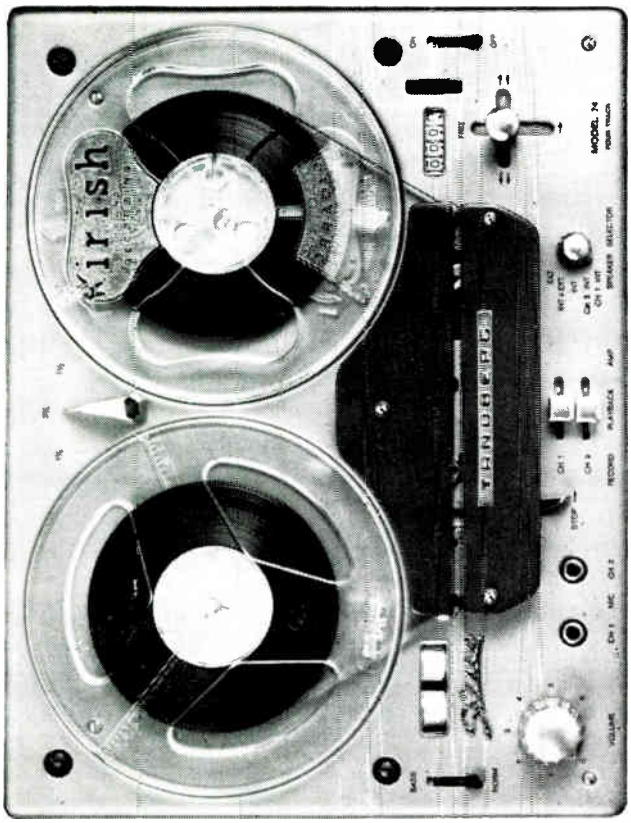
Fig. 3 shows the overall record replay responses. A sharp bass cut at 100 c/s is evident at 7½ i/s together with slight over emphasis of the higher frequencies. At the two lower speeds, the top rise noted in the test tape responses are still in evidence and this, combined with a steady fall in response at the lower frequencies, gives a tilted top heavy response which will need both top cut and bass lift to give anything like a level response in external power amplifiers.

The playback hum made it difficult to measure recorded hum or hiss, but careful listening tests indicated that recorded noise due to bias and erasing was very low, and playback tests at twice the speed of the unmodulated test recordings proved that negligible hum was recorded on the tape.

Acoustic Responses

The quality on the two built-in loudspeakers sounded rather thin, and operation of the three position tone control, which only acts on the pentode output stages, made the response sound woolly and muffled on any position other than full top response. To check this, 25 one third octave bands of filtered white noise were recorded at 7½ i/s and the sound output measured on playback on each of the two internal speakers. **Fig. 4** shows the responses with the tone control set to the full top posi-

Continued on page 381



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As a result of the great interest shown in these units at the London Audio Fair, the Planet UI and UI/15 are now available with semi or fully remote control operation.

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The Fully Remote Deck has only one emergency stop button on the deck facia. The remote panel is attached by a cable giving stop and start, rewind left and rewind right facilities. The buttons on this panel are electrically inter-locked and also a space is left for amplifier switching. Price (standard UI ½-track) £65.

The standard UI and UI/15 decks are being continually praised by experts throughout the world for outstanding quality, reliability and value for money. Send today for independent test reports.
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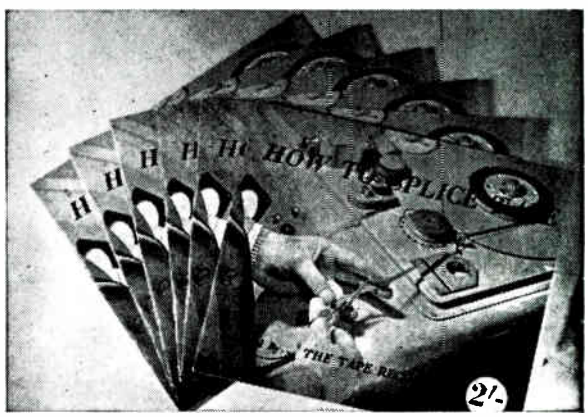

HOW TO SPLICE TAPE

★ If you use tape, sooner or later you will need to know how to splice tape—how to repair simple or complicated breaks—how to edit your material—how to cut out words or syllables, etc. All this is described in this well-illustrated booklet, in which stage-by-stage photos and text provide the complete answer to professional tape splicing.

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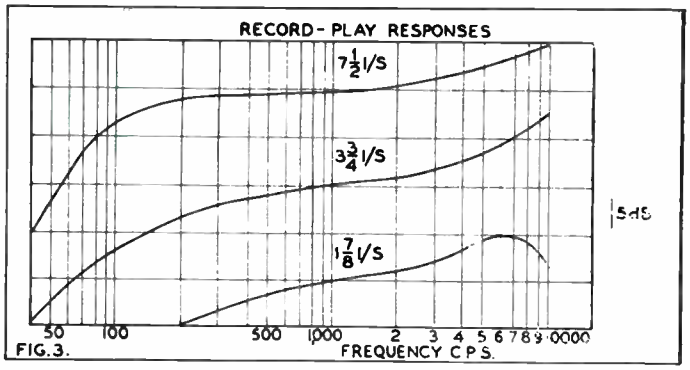

FIG.3.

tion; at the two lower settings the high frequency response was cut by approximately 10 and 20 dB at 10 Kc/s. The 700 c/s peak is a cabinet resonance, and the 250 c/s peaks are speaker cone resonances which have been pushed up in frequency due to the added stiffness of the air in the compact cabinet.

Comment A glance at the inside of this recorder makes it obvious that this machine has been tooled up for very considerable production. The mechanical engineering of the deck and the competent way in which the various sub assemblies have been packed into the very limited space available shows a high degree of mass production know-how, but somewhere along the way the electronics engineer has been squeezed out of contact with his brain child. He probably knows very well that certain things have gone wrong, but is powerless to halt the progress of the juggernaut of mass production.

The service manual, which was sent to me with this machine, reflects this obsession with production. Every component down to the last nut

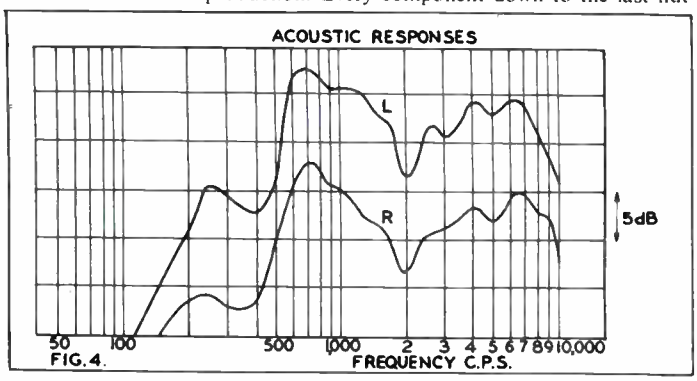

FIG.4.

and bolt is listed and given a part number. No less than 22 circuit diagrams, with coloured lines to trace the signal paths in the various switching configurations, are provided—*but*—the end result, to my way of thinking, is hardly worth the trouble.

To summarize, this is a nice looking, well engineered recorder which will produce a tolerable sound on its own built-in speakers, but its electronic imperfections will show up pretty badly if its outputs are fed to wide range speakers or hi-fi amplifier-speaker combinations.

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,, TK.55	63/–*
,, TK.60	75/–*
,, TK.830/3D	63/–
,, Cub	35/–*
Telefunken 85	65/–
,, 75/15 & 76K	55/–
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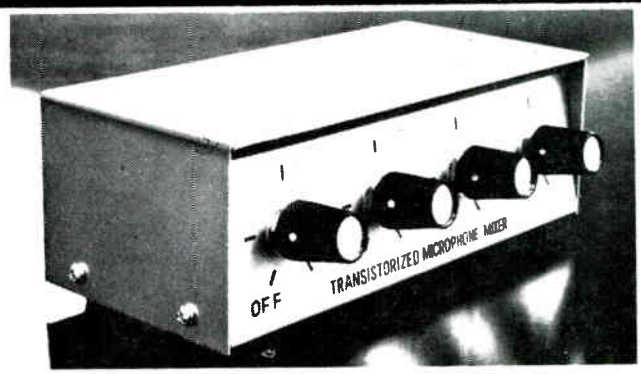

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MORE READERS PROBLEMS

Noise on the TK6

Dear Sir, I have just bought a second-hand Grundig TK6 which, being only two months old, is as new. When recording from the microphone the machine seems to pick up electrical and mechanical motor noises. This occurs even when the microphone is at its full extent from the recorder, a distance of about eight feet, but not from the radio lead. When the recording level is above half-way the noise is recorded on to the tape. It is also apparent when the machine is running and the deck is not in operation. Is the machine in need of lubrication?

Yours faithfully, **B. W., Larne, County Antrim.**

You should certainly not be experiencing motor noise on the Grundig TK14 to the extent you describe if the machine is only two months old. Unfortunately, the microphone used on this model is very sensitive and omni-directional, and thus prone to pick up such unwanted noise. The problem resolves to one of eliminating the source of the trouble.

If, as you say, the noise can still be heard when the motor is running and the deck not operating, the trouble is mechanical, and there are several possibilities. Lubrication should certainly not be needed on a fairly new machine. But if the machine has at any time been dismantled, it may have been re-assembled in such a way as to accentuate motor vibration. Check that the fixing screws of the top plate are correct. The right front one inserts just over a lever and must clear this, and so must be shorter than the others. Try pressing the top plate gently as the motor runs and note if any change in noise is apparent. Check the zeroing wheel of the tape position indicator, which does not have a great deal of clearance through the top-plate and sometimes bears too hard against it, giving rise to ratchet chatter.

Next, look to the side-plates in which the handle locks; these locate in small cut-outs and must sit correctly. Likewise, the cabinet, being a "shelf" formation, must be evenly and correctly fitted, or vibration is conveyed to the table via the feet. Check that the feet screws are fully home—these tend to be rather tight in their threads and often give the impression they are fully screwed in when, in fact, they are not. This allows the cabinet to vibrate very slightly. Having checked these points, try mounting the machine on a foam rubber mat, and note if the noise is reduced appreciably.

If not, remove the top-plate (press keys, lift front and swing forward and up) and check that you have not got "belt-slap", especially where the flywheel belt passes over the right-hand clutch lever. Note also the cable harness to the heads, which passes along the rear of the recording channel plate, and which has very little clearance to the flywheel, a slight rub here producing a very elusive "singing" noise. The trouble could also be due to slight misalignment of the flywheel top bearing and the whole sound plate with its three fixing screws may need adjustment.

Finally, check the screening plate over the printed circuit panel, which is secured with long screws and distance pieces. If these are not tight, the distance pieces can set up a rattle, or the plate itself vibrate. I hope the foregoing notes, which embrace the various fault sources I have encountered on this range of machines, apart from actual motor faults, will assist you in tracking down your annoying noise symptoms. As a last resort, you could put an audio shield between the microphone and the machine to reduce direct pick-up of noise. Even a simple bookend helps in this respect.

★ ★ ★

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Advertisements for the November issue must arrive not later than October 4th.

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Continued on page 386

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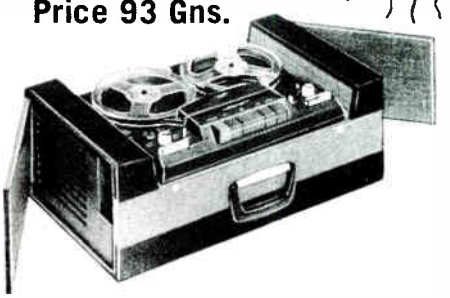

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