AUGUST 1967 TWO SHILLINGS

tape recorder

SURVEY OF TAPE RECORDING ACCESSORIES – CLOSER LOOK AT WOW AND FLUTTER
MAKING HOLIDAY TAPES — SONY TC800 REVIEW AND FIELD TRIAL TAPED CHESS

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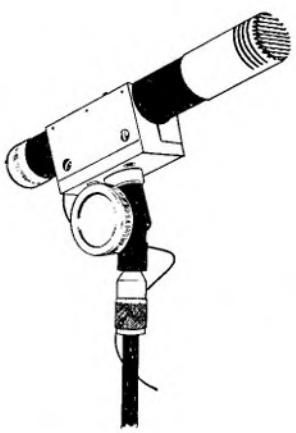

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AUGUST 1967 VOLUME 9 NUMBER 8

INCORPORATING
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COVER PICTURE

High over Thruxton Aerodrome, a short interview between two parachutists is being recorded on an *Ampex* battery portable, details of which are given on page 315. The nature of the conversation is left to the reader's imagination; they may be describing the superb view to be had of *Tape Recorder's* former Thruxton printing works, which ought to be visible somewhere in the background.

SUBSCRIPTION RATES

Annual subscription rates to *Tape Recorder* and its associated journal *Hi-Fi News* are 30s. and 38s. respectively. Overseas subscriptions are 32s. 6d. (U.S.A. $4.50) for *Tape Recorder* and 38s. (U.S.A. $5.40) for *Hi-Fi News*, from Link House Publications Ltd., Dingwall Avenue, Croydon, CR9 2TA.
Tape Recorder is published on the 14th of the preceding month unless that date falls on a Sunday, when it appears on the Saturday.

WE WERE RECENTLY involved in conversation with an ambitious British manufacturer who, having developed the prototype of a new semi-professional recorder, wished to know whether he had omitted any features of importance. The discussion ranged from solenoids to push-button counters, peak-programme meters to accidental-erasure safeguards, tape speeds to idler wheels, concluding with price.

In designing a tape recorder, the engineer is faced with compromise not only in the mechanical sphere but in his lack of knowledge regarding public demand. Should a recorder be made to function horizontally? Should it be designed to give its best in a vertical position? Or would it be safest to employ a compromise mechanism capable of working reasonably well in both planes?

A few months ago, we requested readers' cooperation in describing just what they expected of a tape recording journal. The enormous response enabled us to build an accurate picture of the average recording enthusiast's needs, interests, and equipment.

Now we are preparing a survey of more direct interest to the industry and even greater benefit to the enthusiastic customer. The results of this survey will be published down to the last detail for the benefit of manufacturers and for the interest of the consumer. As an additional incentive, a competitive element will be added, with the *Ferrograph Company* kindly donating a *Model 632H* or *Model 634*, as preferred by the winner, in a gesture of support. The survey, which will again be reply-paid, is being prepared for our September issue.

"How much wobble can you tolerate?" is one question that will *not* appear in the design survey. As Wilfred Myall describes on page 318 of this issue, the whole subject is too elaborate and insufficiently explored for such light treatment. We must confess embarrassment at being forced continuously to quote the unqualified wow and flutter figures (and 'frequency ranges', whatever they are) put out by the Public Relations industry. There is rarely time to chase an importer or manufacturer for clarification of simple percentage figures and we are left to guess, with the reader, whether the figures are peak variations in tape velocity, peak-to-peak variations, RMS variations, RMS, or a simple blanket maximum figure below which the customer is expected not to complain.

We have devoted much space to tape recorders and their performance over the years and have decided, by way of a change, to concentrate this issue on the many accessories that exist to support the hobby. Our survey commencing on page 328 provides a thorough tabulation of all products currently available in the limited spheres of endless cassettes, splicing equipment, head degaussers, and so on. The most obvious accessories—microphones—have been excluded for the simple reason that they would have taken as much space as the rest of the accessories put together. Interested readers are referred to the *1966/67 Hi-Fi Year Book* which, though now a little out of date, is the most comprehensive guide currently available.

Finally, we would like to comment on a particularly intriguing fact that has emerged from our April Questionnaire. Some readers appear to have an aversion to the space 'allocated' to advertising and would like to see a 100%-editorial magazine. Several readers gave 'Too much advertising' as their reason for not reading our fat sister *Hi-Fi News*. The simple truth is, however, that the amount of editorial space in any magazine is dictated by the profit reaped in advertising. Thus, the more advertisements a publication contains, the more profit there is to channel back into editorial space. Haul us over the coals for technical errors by all means, if you can find them, but please do not complain about the presence of advertising!

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WORLD OF TAPE

TAPING CONCORD'S ENGINES

NOT adhesive tape (*Concord's* future passengers may be relieved to know) but magnetic tape is being put to substantial use by *Bristol Siddeley* in development of the *Olympus 593* engines which will power the aircraft. One-inch-wide *Scotch 499* instrumentation-tape records the changing characteristics of resistance-wire strain gauges attached to discs and shafts within the engines. The gauges are affixed to turbine blades with a specially developed ceramic cement capable of withstanding the red heat generated in this region. Recordings are later checked to determine whether the vibration levels are acceptable. With each engine developing four times the power of a *Comet 4* aircraft and operating at a higher temperature than any previous civil engine, the tests play an important role in insuring against premature metal fatigue. A similar system, employing ¼in. Scotch tape, has been installed in a modified *Vulcan* flying test-bed, up to 300 performance parameters being recorded simultaneously.

NEW DEVELOPMENT IN TEACHING BY TAPE

A NEW approach to the employment of conventional tape equipment in education has been studied by research workers at Bulmershe College in Reading. It centres on a feature of hitherto limited importance—the track selector. A simple ¼-track replay machine is threaded with a 'pre-programmed' instruction tape. The pupil is then presented with a question requiring a positive or negative response through the medium of the track selector. Initial experiments have proved the value of the system, elaborated by a series of code whistles, clicks and buzzes, in teaching young children the alphabet. Multi-channel devices of this kind hold promise of as great an effect on the recording industry as conventional single-track record/twin replay language laboratories.

AGFA PRICE REDUCTIONS

RESALE price maintenance has been ended on *Agfa-Gevaert* tapes and accessories. Reductions in the nominal prices of *Magneton* tape have also been announced, ranging from 6d. from the price of a 4in. LP *PE31* reel to 10s. from a 7in. TP *PE65* reel.

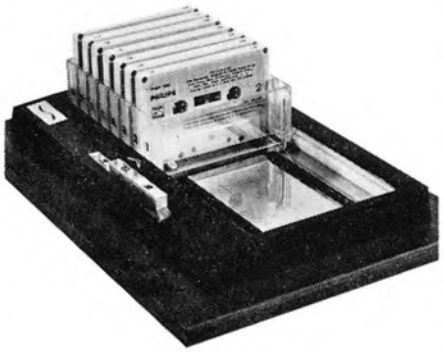
A FAIR PRIZE

BRUCE Sinclair, an engineering designer of Little Chalfont in Buckinghamshire, was recently announced the winner of the 'Guess the Sounds' contest organised by *Scotch* at the Audio Fair. 248 competitors endeavoured to identify 13 sound effects ranging from waves on a beach to the innards of Big Ben. Mr. Sinclair achieved the greatest success with ten correct definitions and was presented with a *Bang and Olufsen* stereo recorder. The £90 addition to his audio system, which has taken a decade to collect, has been well received by its owner who did not previously possess a recorder.

GARRARD DEVELOP CASSETTE CHANGER

GARRARD are now producing a tape mechanism intended as the nucleus of a motor-car music system. From this unit they have developed the first cassette-changer ever designed for the Philips C60. This, too, is claimed sufficiently compact for installation in motor vehicles.

The prototype changer will accept up to eight cassettes and will play its load without interruption before switching itself off at the end of the last cassette. The load may then be reversed and the second tracks played. Additions or changes to the load may be made without interrupting reproduction.



COMPOSING WITH A BTR4

AS an aid to memory in musical composition, the tape recorder can be of great value. For composer Barry Gray, an EMI BTR4 and two variable-speed EMI recorders fulfill an even more productive role in the production of twelve-tone and electronic music. As musical director of *Century 21 Productions*, much of his work goes into writing and recording themes for television. Extensive use is made in his scores of the electronic organ, electric guitar and ondes martenot. A fully-equipped recording studio was recently built at the composer's Esher home.

NEXT MONTH

YOUR OBEDIENT SERVANT is the title of a series by H. W. Hellyer, commencing in the September issue with a short history, from Poulsen's *Telegraphone* to the occupant of *Mariner Four*, and continuing into the realm of computer devices. Alec Tutchings will review the *EMI L4* while John Ashcroft contributes *Music From Clockwork*. Readers may care to assist in a tape recorder design study. See Editorial, page 313.

FILM INDUSTRIES MOVE SOUTH

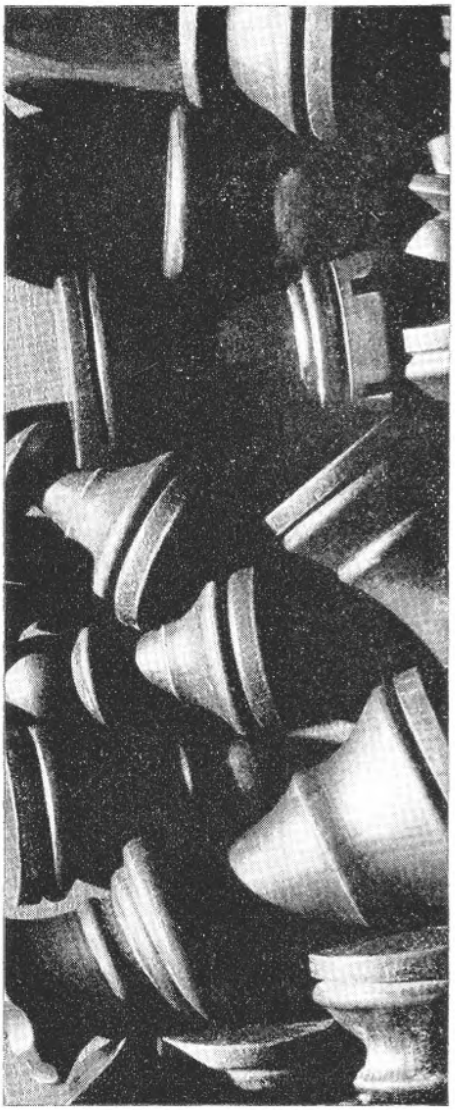
INCREASED demand for their microphones and accessories, creating a need for greater production facilities, has resulted in *Film Industries Ltd.* moving to new premises. Their address is now **Station Avenue, Kew Gardens, Surrey (Tel. Richmond 8078).**

AMPEX BATTERY RECORDER

LAST month in this column we described a battery video recording system introduced by *Ampex*. Now the company have announced its first professional battery sound recorder, the *AG-20*, which will be marketed in Britain from November at a basic price of some £300. The AG-20 was developed by the English subsidiary of *Ampex International* and features three tape-speeds with a choice of 15 or 1⅞ i/s in addition to 7½ and 3¾ i/s. Full-track or ½-track heads and either DIN or *Cannon XL* connectors may be specified. Frequency response is 50Hz-16kHz±1.5dB at 15 i/s (—10dB recording level). Signal-to-noise ratio at this speed (full-track) is 60dB peak recording level to unweighted noise (including bias, erase and playback amplifier noise).

A closed-loop DC servo system maintains tape speed over a wide temperature and humidity range, compensating for reel size and battery condition. Spool capacity is 7in. with the hinged lid open and 5in. closed. Fast-wind speed is described as 50 i/s (average).

Among the accessories available for the AG-20 are an automatic gain control unit giving constant level over a 35dB input range, remote pause switch, voice-operated relay, AC converter/charger, rechargeable battery pack, and a leather carrying case. The recorder is designed to take ten *U2*-type cells. Weight is 12lb. excluding batteries and dimensions are 12½ x 9¼ x 3¼in.



en passant

Tape recorded chess for the blind

by John Graham

THE blind find it difficult to play active games in which sight plays such a large part in directing the feet or hands. Therefore chess, which provides all the adventure and excitement you could possibly ask for, in a field of only 64 squares, is a popular pastime.

Sighted players need to distinguish between black and white squares, black and white pieces, and between the types of pieces themselves. Also, the sighted player wants to line up pieces along ranks or diagonals to see lines of action and interaction. He also wishes to scan the board and so get a general feel of space and mobility available to each side. In competition play he needs to record his moves and use a clock. Finally, he likes to refer to books for instruction and to magazines and newspaper columns for the latest lines of play, and for the general background to his hobby.

How can a blind player do all these things? For many of them he uses his hands. Special boards have sunken white squares and white pieces are made each surmounted by a small spike and his hands can also assess the position on the board and gather most of the information normally obtained by eye. His clock is a braille version and his pen and paper record is replaced by a paper tape punch which produces braille characters.

However, if he is a competitive player he has to rely on outside readers for his information from books, newspaper columns and magazines, and readers are not always easy to find. *En Passant*, the tape-recorded service for blind chess enthusiasts, was formed to supply this necessary information. Established in 1964, *En Passant* approaches the task in many ways . . . a magazine, a literature review, a library, personal recordings, instruction and help of many kinds.

En Passant is a chess term meaning 'in passing' and it was so named to describe the original intention of a circulating magazine. However, it was soon apparent that this system did not work efficiently because of postal delays and so each listener is now sent his own copy of the magazine.

The 30-minute monthly magazines are distributed to over 70 individuals and organisations in 12 countries. There are branches of the organisation in Israel and South Africa as well. They go out on *BASF* 2½in. letter tapes on two tracks at $1\frac{7}{8}$ i/s, or to another formula if the listener cannot play at that speed. The tapes are returnable and are sent in specially designed boxes easily used by the blind, with simple fasteners and a reversible label. No postage is required, as *En Passant* complies with postal regulations concerning the postage of articles for the blind. Members are charged 1s. per year for the magazine, which contains news, games, positions, articles, reviews, interviews and all kinds of material that is normally published in ink-print journals.

Very soon after the magazine appeared one listener wrote to say that the blind were hungry for such information: thanks for the biscuit, but what he needed was meat. Thus our personal recording service was started. A start was made by recording selections of a chess research publication, *Chess Archives*, on 5in. library tapes. Now *En Passant* has a library of over 100 hours including several books on opening analysis, biographies, live interviews, middle-game and end-game-play, etc. Any listener can get a copy of anything in the library on his own tape, and indeed 24 listeners partake of this specialised service. They can use the library as much as they like during one year for 10/-, which goes towards new library tapes. The library tapes are recorded by volunteer readers all over the country. A quarterly review tape tells members about what is new in chess literature and what they will be able to ask for in this personal recording service.

Not only are the more advanced players catered for, but a 3½ hour chess course in 12 lectures was written for complete novices and over 30 people are learning chess in this way. It is designed for the blind and it will enable them to reach a reasonable playing standard in a short time. This course is sold for the price of the tape alone. It has also been accepted by the *Nuffield Talking Book Library* for the blind—so it is also available to 23,000 people who partake of that service.

Besides these facilities, *En Passant* also runs an advisory service on chess and tape recorders. We help by acting as reference journals when correspondence chess is played, by advising novices, by supplying equipment, and so on. The work is entirely non-profit making with only voluntary staff, and it receives grants from the *British Chess Federation* and the *Royal National Institute for the Blind*. In this way it just keeps solvent and manages to expand its membership and its work each year.

In setting up the service, innumerable firms were contacted for help, official organisation for grants and affiliations, and advice, individuals for donations and chess information. Indeed, over 500 letters in two years have been needed for the early stages. Our helpers have been far too numerous to mention individually, but we are no less grateful for that.

Our listeners are, almost without exception, intelligent, lively people with apparently more natural humour than those who have their sight. Their professions range as widely as any other set of chess players, teachers, mathematicians, physiotherapists, attorneys, doctors, typists, machine operators and students. The thing they have in common is a hunger for reading material, which is what we try to supply.

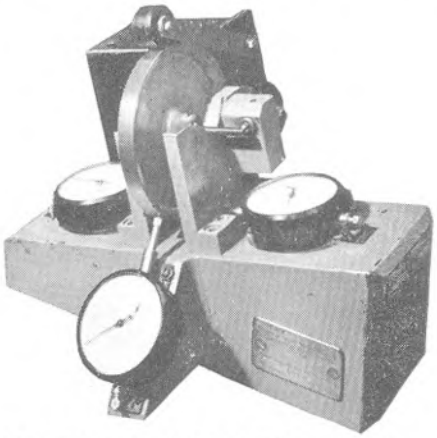
Two members in the United States play their chess with each other by ham radio and we only send one copy of the magazine to them as it is transferred over the air from one to the other. Several other members are keen tapespondents and, of course, we have received personal tapes from them.

There is the delightful story of the blind Yugoslav player in an off-hand game at an international match who declared mate in 23, and this before starting the game! Soon after the start of the game he set up a mating net and after persistently asking his opponent how many more moves there were to go, duly mated on move 23! This same player challenged the whole British blind team to play a simultaneous match . . . they did not all accept, but he beat the remainder by 2½ to ½.

We also get interesting non-chess requests for help from our listeners. One wanted some practice at mental arithmetic for a computer aptitude test for which he was entering, while another needed readings in German from some material he was translating into English. (We managed both.) Yet another needed bridge information (sacrilege to a chess player!). *En Passant* magazines are normally produced in English, although French copies are made for some listeners. We have, however, had to refuse requests for versions in Esperanto and Arabic.

So if you know of a blind person, whether or not he plays chess, let him know about the work of *En Passant*. He may well be interested and all he needs to do is write in ink or braille to *En Passant, Sound Magazine for the Blind, (Chess)*, 325 *Chickerell Road, Weymouth, Dorset.*

a closer look at wow and flutter



Measuring equipment employed by *Thorn* to ensure accurate flywheel machining

SEVERAL years ago, whilst trying to improve the wow and flutter performance of my own tape deck, I found myself groping in the dark on two counts. Firstly, I did not quite understand the nature of what I was trying to remove and, secondly, I had no means of knowing whether it was any lower, or greater, than it had been a few moments before.

As it was obviously going to be cheaper to rectify the misunderstanding than to cure the faults, I decided to take them in that order. I was in for a shock. Visits to a large book shop in town and the reference rooms of several public libraries produced little or nothing. Quite a thick volume on sound recording and reproduction devoted about six lines to the subject.

The next thing was a verbal and written enquiry directed at what I thought should be informative sources. Still no luck. Everybody, it seemed, knew all about it in vague terms, but in reply to specific questions nothing was forthcoming.

In fact, one gem of a reply—which I still have—left me in no doubt that if I was conscious of being in a mist, the writer was in a thick fog, and unconscious of it ! The only solution was to sort it out for myself. What follows is largely the result of these experiments and the conclusions drawn. Whilst I am not going to lay down the law on a single point, some confidence may be gained from the fact that a simple flutter meter subsequently built on the basis of this article has proved anything but unsuccessful.

I should like at this stage to offer acknowledgements to Mr. Tutchings for the assistance given in confirming one or two of the conclusions arrived at, without at the same time wishing to pass the buck for any that may be shot down !

It would be impudent indeed to suggest that the majority of readers of this magazine need to be told the meaning of 'wow and flutter'. For the benefit of newcomers, however, to whom the words may mean nothing at all, I shall beg the indulgence of the many for a few lines and trust that their interest will be aroused a little further on.

Sound recording is normally carried out via a medium (tape, disc, film, etc.) moving at a constant linear or angular velocity. The most obvious reason for the choice of a constant velocity might be that this type of motion is the easiest to repeat exactly, and we do of course need to repeat it, often time and time again, in order to reproduce the recorded sound.

Note that 'easiest' is not synonymous with 'easy'. It is not in fact at all easy to produce the degree of constancy required for even a nominal standard of reproduction, not to mention the more stringent demands of the hi-fi enthusiast. The tendency towards ever lower recording speeds in the interest of tape economy aggravates the problem still further.

If we are to finish a spool of tape with the same mean velocity as we started it, then any speed variations that occur must involve both acceleration and retardation. In order to take a closer look at this let us borrow from some hypothetical character an equally hypothetical tape recorder—one which is capable of transporting the tape at a perfectly constant velocity. Using a speed of, say, 7½ i/s we record a 3kHz pure tone (sine-wave). Now if we re-play this tape at the same mean speed but on a more practical machine, one which is *not* capable of maintaining a perfectly constand velocity, the reproduced frequency will be above 3kHz while the tape speed is greater than 7½ i/s and lesst han 3kHz when the speed is less than 7½ i/s. If the resulting rise and fall in the pitch of the re-played tone is sufficiently slow for the ear to follow and recognise as such, we call it *wow*.

If, on the other hand, it is too fast for the ear to follow we call it *flutter*, the subjective effect being difficult to describe, a sort of roughness to the sound or superimposed buzz. At this stage, and in accordance with the policy outlined in these columns recently, it may be as well to abandon the words 'wow' and 'flutter' in favour of the single word *wobble* to mean tone deviations at all rates within the usual bandwidth (0.5—200 Hz).

Looking more closely at the conditions which exist between the tape and the head, it is clear that the velocities involved can be separated into two components, a large constant velocity giving the mean frequency of 3kHz and a small changing velocity responsible for the wobble.

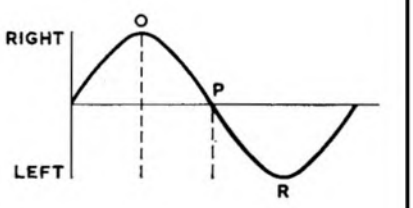
Now this small changing velocity is going to displace the tape alternately from one side of the head to the other relative to the position it would have occupied in the presence of the constant velocity alone. In order to get a clear picture of what is happening it is necessary to consider both the displacement of the tape and its velocity at any instant.

SIMPLE CASE

Taking the simple case in which the changing velocity is of sine waveform, that is a sinusoidal wobble, plotting the displacement of the tape and its corresponding velocity gives us **figs. 1** and **2.**

Assume tape travel to be from left to right.

FIG. 1 TAPE DISPLACEMENT

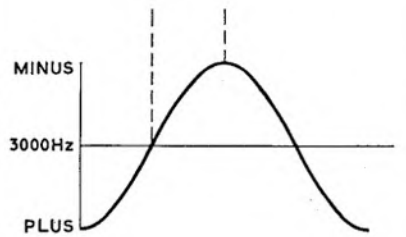


Commencing at the instant when the tape has reached maximum displacement to the right (O **fig. 1**), it is moving at its correct (mean) velocity and the frequency is therefore 3 kHz. If there is any doubt about this, consider the following. If the velocity at this instant was greater than the mean value, the displacement would still be increasing and consequently not a maximum ; if less than the mean value, the displacement would be less than maximum, and decreasing. The frequency deviation curve will therefore meet the 3kHz axis at this instant. Immediately after the instant of maximum displacement to the right, the velocity falls below the mean value and the displacement will eventually become a maximum to the left of the head (R **fig. 1**). This is the next convenient point to plot in **fig. 2** because the mean velocity is again attained and the frequency is once more 3kHz.

RATE OF CHANGE

Referring to **fig. 1,** the slope of the curve at any point represents rate of change of displacement, which of course is velocity. We know that the steepest part of a sine-wave occurs where it meets the axis, so the point P must correspond with minimum tape

FIG. 2 FREQUENCY DEVIATION



velocity (the slope being negative), and as minimum velocity means lowest frequency we have found a third point on the frequency deviation curve which, as we can see, is displaced by 90°.

It is interesting to consider the slope of the frequency deviation curve (**fig. 2**). This clearly represents the rate of change of frequency, which is itself a rate of change and must represent an acceleration (plus or minus).

SAME MAGNITUDE

Let us now take a wobble of the same magnitude, that is of the same peak frequency deviation, but of twice the repetition rate. Now, if it is to have the same peak frequency deviation, its tape displacement curve must have the same slope as the **fig. 1** curve at the point P because, remember, it was this slope which determined the peak frequency deviation in **fig. 2.** Drawing a curve meeting this requirement and having twice the repetition rate of the previous curves gives **fig. 3,** from which it is immediately apparent that the peak-to-peak displacement is only half that of **fig. 1.**

INTO WORDS

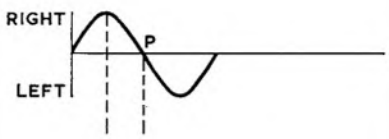
Putting this into words, we can say that for a constant peak frequency deviation the peak displacement of the tape is halved each time the wobble rate is doubled.

To complete the picture we can draw **fig. 4** from **3** in the same way we obtained **fig. 2** from **1.** Here the most obvious feature is the slope, being twice as steep as in **fig. 2,** from which we conclude that the rate of change of frequency has doubled. Again, we can put this into words by saying that for a constant peak-frequency deviation the tape is subject to an acceleration which increases with the wobble rate. This probably accounts for the higher wobble frequencies (flutter) rapidly becoming non-existent.

It is important to remember that what we have been measuring is a changing velocity of the tape with a view to expressing this as a percentage of the constant velocity. The fact that we have been dealing with cycles per second (Hertz) does not mean that the foregoing depends in any way on the frequency recorded on the tape in the first place. On the contrary, dealing in Hertz is merely a means to an end. Wobble is entirely a function of the tape transport and the tape; it is necessary to include the tape because one will not necessarily get the same wobble figure after changing to another tape.

So far, then, we have, I hope, built up a fairly detailed picture of the nature of wobble

FIG. 3 TAPE DISPLACEMENT



from which it should be clear that the maximum frequency deviation occurs at the instant when the velocity of the tape is furthest removed from its mean velocity and will usually occur somewhere around the mid point between the extremities of the displacement. We have, of course, only considered a single frequency wobble, and of sine waveform. In practice the waveform will almost certainly be complex to some degree. The definition of wobble as a percentage applies to a sine waveform and is given in many textbooks as:

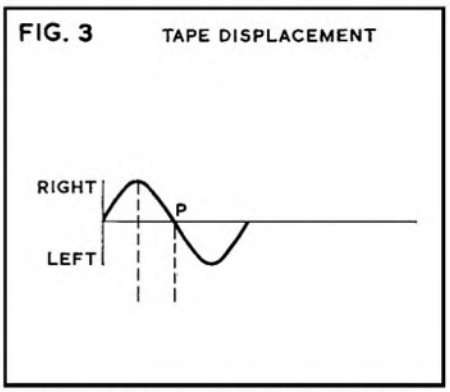
$$\text{Wobble (\% RMS)} = \frac{\triangle fo}{\sqrt{2}\ fo} \times 100$$

where fo = recorded frequency

$\triangle fo$ = peak deviation of fo

To clarify a few of the points made. If we can return to the point O **fig. 1,** there may be some who are still pondering whether or not the frequency is in fact 3kHz at this instant. It may not be easy to contemplate a frequency of 3kHz for a small fraction of a second (in theory an infinitely small fraction). The usual practice in such cases is to try to show why it cannot be otherwise, and if I have succeeded in doing this then it must surely be agreed it is 3kHz.

FIG. 3 TAPE DISPLACEMENT



The fact that carrier frequency (fo) appears both above and below the line in the expression for percentage wobble should make it clear that whatever frequency is chosen for fo will not alter the value of the expression because $\triangle fo$ will change in direct relation to fo.

MACHINE/TAPE COMBINATION

In suggesting that the tape could not be ruled out as a contributor to wobble, I was not implying that it is necessary to go wobble-hunting among the many brands of tape, but rather that wobble figures strictly belong to a machine/tape *combination.* In the majority of cases the difference would be negligible, at least between the better quality tapes, but there is such a thing as 'screech' which, as I know from experience, can send the meter right off the 1% scale. Things like warp and varying thickness of base also suggest themselves; some tape decks are not too happy with the thinner tapes, either—including my own.

There was once a tendency on my part (and it might be shared by others) to regard the higher flutter frequencies as being comparable to the grain of the oxide on the tape. It is worth getting things into perspective, especially if one is engaged in locating the source of a flutter. Taking the highest flutter frequency of 200Hz and a tape speed of 7½ i/s, it is easy to arrive at a tape length of 0.037 in. (37 thou'), corresponding to one flutter cycle, which came as something of a surprise.

A final, but hardly significant conclusion can be drawn from **figs. 2** and **4.** The acceleration here is expressed in Hz^2. If we convert this to i/s^2 by dividing by the number of cycles per inch of tape, we can see that the acceleration associated with a given wobble decreases with the mean tape speed. This suggests that wobble is easier to come by at low recording speeds than with higher ones, which will not be news to anyone.

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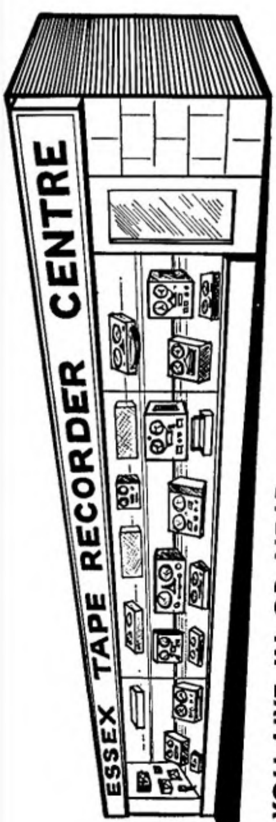

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SOUND INSTRUCTION

a new approach to teaching by tape by John Bourne

MANY novel methods have been devised to fill the need for organised class activity at a time when interest is flagging or the class has reached a stage where the pupils are just waiting for the holidays or promotion to a new class or school. Such a period occurs in the summer term at a Junior school. The top class have finished with the eleven-plus, or its equivalent, and are just waiting to progress to the next stage of their education. There is an air of 'that's the end of that' and the youngsters find difficulty in concentrating on a programme in its traditional form.

This, then, is the time to introduce a new approach ; to appeal to the imagination and to lay the foundation that will be so useful in the next stage of their education.

TRIED AND TESTED

This approach, which has been tried and tested at the 11-year-old level, fires the youngsters' imagination, encourages self reliance and industry, produces encouraging results even from the most backward child, and establishes a teacher-child relationship which overcomes the shyness of practically all children and better prepares them for the transition from Primary to Secondary education.

There are certain basic requirements needed for the experiment, plus the usual items to be found in most Primary schools. The layout of the classroom and the tape will be discussed in detail later.

You will need a tape recorder, a pair of headphones, a 7in. reel of tape and a few hours of preparation. My tape listed 750 tasks and was recorded over a period of ten weeks during the Autumn and Winter terms. 75 tasks were devised and recorded each week. The tasks were divided into the following sections : *Mathematics*, *Nature Study*, *Geography*, *History*, *Art*, *Craft*, *Leisure and Pleasure* and *Games*.

FREE RUN

Before deciding to try out this approach you must be prepared to accept the following as essential. Children must be allowed to work the tape recorder themselves by following simple instructions ; they must be allowed free run of the school within certain limits ; the material needed for the work must be available at all times by careful preparation by the teacher ; and at least six weeks must be made available for the experiment, although a whole term is much better. Do not expect startling results in the first two weeks, for the new approach and new-found freedom must be carefully planned and the children allowed more latitude than in the formal approach.

WELL MIXED

The tasks are listed on paper in the order they are recorded on the tape. They are well mixed : Mathematics followed by History, then Art, then English, and so on. The recording of each task is then made and I use the following form. Take for example a Mathematics task :

"*Task 29*. You will need a pencil, a tape measure and a piece of squared graph paper. Obtain these from the Maths table in the classroom. Take your notebook and go into the playground. Measure its length and width. Draw a scale drawing on the paper when you return. Use as your scale : 1 inch equals 20 yards. Take a friend with you to help you measure the playground. If you do not understand this task ask the maths monitor. End of task. Switch off recorder."

LIST OF TASKS

The maths monitor is a pupil who is good at mathematics. The child has a list of all the mathematical tasks with their numbers, and the teacher has discussed this with him at the start of the experiment. This child is then in a position to help other children with their difficulties. In Task 29, for example, he would be able to explain the use of a scale to the more backward child and the use of squared paper would be a great help.

A notice is pinned above the recorder to tell the child how to work the machine and this must be adapted to suit the recorder in use. My instructions were as follows :

"1. Put on the Headphones.
2. Switch on the recorder.
3. Listen carefully to task.
4. At end of task switch off recorder.
5. Place headphones back on hook."

The headphones are plugged into the output socket of the recorder and children must be instructed to write down the number of each task they do. This allows the teacher to check the work from his list of tasks and takes into account the child who forgets the instructions. Should a child hear the same task twice he must listen to the next task on the tape, but I can assure you this is very unlikely. The last task on each side of the tape should be followed by this instruction.

"This is the last task on this tape, please tell your teacher that the tape needs attention."

A 7in. reel of LP tape running at 3¾ i/s will accommodate up to 800 tasks.

Each child in the class was allowed to make his own loose leaf folder and all written work was carried out on quarto paper. The art work used crown size paper. All written work and art and craft work is kept by the child and he is allowed to take home, at the end of the experiment, all work which has reached the required standard.

SATISFACTORY STANDARD

As the child completes each task he takes it to the teacher who marks it and either accepts it or requires it to be re-written or revised. When the work has reached a satisfactory standard, bearing in mind the child's ability, a star is affixed and the work takes its place in the child's folder.

The classroom should be laid out so that each child knows the position of all items he may need. The recorder should occupy a central position. There should be a reference library in the classroom or somewhere in the school. Art and craft materials should be readily available and the teacher's desk

(*continued on page 325*)

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THE CONSTITUENT PROPERTIES OF A HA'PORTH OF TAR

BY H. W. HELLYER

EVERY now and again the perfectionists burst into print with ambitious descriptions of what constitutes their ideas of a perfect tape recorder. One advocates a fully-automatic robot, after William Henry's heart; another requires unit facility so that he can buy his machine as we used to buy our *Meccano* sets, progressing along a scale of numbers; and the next requires cassetted portability with a negative percentage of wow.

Your correspondent is a modest sort of chap, and being a service engineer he neither craves nor could afford perfection. But after handling many different types, seeing a few of the things that can happen to them in use, and answering innumerable queries from frustrated owners, he is prompted to wonder, as Peter Turner did last year, about "the nature of the beast". More specifically, he wonders why so many manufacturers miss out dismally by neglecting that little extra that can mean so much. Not the obvious extras that may put their competitive machine into a higher price bracket, but the small points of circuit and constructional design that should really have been thrashed out before the new model was produced.

Peter Turner was concerned with design as it affected him in practice. He had a number of penetrating and cogent things to say. For any enthusiast who missed his article and feels he would like to brush up a few prejudices, I recommend a flip back through Volume 8. *The Nature of the Beast* appeared in June 1966, and a public duel between Mr. Turner and David Kirk enlivened the pages of the August issue. Subsequent correspondence showed that readers had very decided views on styling and operational design. Even more revealing was the collection of letters that appeared in February 1965, responding to a query about "the ideal tape recorder" made by our Editor in November 1964.

My purpose is not to stir up yet more controversy. (*Why not* ?—Ed.) I am concerned with the peculiar lack of the obvious on some machines whose makers one would think knew better. For example, record interlock.

This is one of the first things we learn about when handling our original machine. How clever, we think, a foolproof way of preventing our spoiling those precious feet of Grandma cooing to a silent baby. Yet on at least one leading machine it is possible to switch the electronics to record while replaying a tape, with the result that a massive 'thump' appears in the middle of a treasured passage. And on another very famous model the tiny red button that is supposed to stop us from wrenching the massive knob inadvertently to the record position all too often eases and becomes little more than a colourful reminder. (Incidentally, wrenching was the right word. What about that 'silken touch' of quality machine controls that Mr. Turner urged us to look for?)

PLASTIC PEG

On yet another model, the record button is a plastic peg that has a disconcerting habit of disappearing into the innards whenever we try to take the decorative front head cover off for routine maintenance. And on more than one other, we need three hands to select, adjust and then start recording without the elusive button popping up as the spools begin to revolve. We will settle for a two-handed operation, if need be, like the *BSR* design which is simple and effective, and cheer even more at the *Philips* models that need only *two fingers* of one hand for a positive and uncompromising action. Presumably the right answer is to forget all safety interlocking and trust us to remember that the record knob, key or switch is distinctively coloured. What do our readers think?

Again, on the subject of knobs and controls, why is it necessary to make them either too flimsy to be removed, impossible to calibrate unless we add to the design with our own transfers, or dinkily recessed into delicate wells that must defy most masculine fingers? The best knobs are those chunky, wide-louvred types with a practically unbreakable neck. And they certainly look neat and distinctive, regardless of passing fashions.

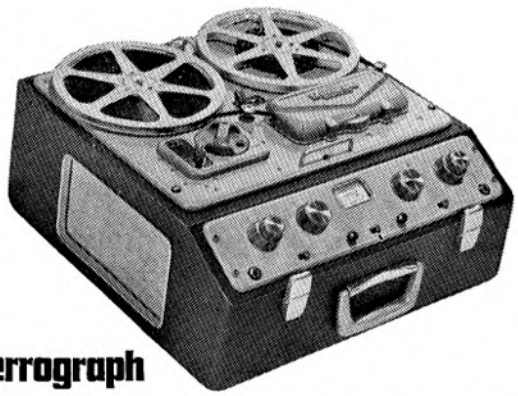
SMALL SINS

Even the *Revox*, regarded as peerless from many points of view, falls down on the score of knobs and buttons! Those plastic clear knobs are good, but the selector keys and the tiny red and black track-change buttons are on long and wavering spindles that need a lot of patient juggling when trying to replace the top plate after repair. Nevertheless, we can forgive them their small sins for the excellence of the rest.

Still on controls—the pause lock is a device that seems hardly worthy of special mention—yet so many tape recorders have a pause control that needs to be held. All very fine for the hesitant dictator who needs wit-gathering seconds while he thinks what to say next, but for the chap who wants to edit or make other adjustments without neutralising the machine, a pause lock is imperative, and not so very difficult to arrange. As for

(*continued on page 325*)

What have the happiest Hi-Fi enthusiasts in common with the Fire, Police and Defence services...with theatrical producers and concert impressarios?



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Specially designed to use with the DP4, in order to cut down wind noise is the Windshield — as illustrated here.

There is also the "Grampian" Parabolic Reflector. Where it is not possible to place a microphone close to the source of sound such as when making recordings of bird songs, weddings, car and train noises etc. the Parabolic Reflector has been proved over and over again to be of enormous value.

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machines with no pause at all—a murrain on them !

We have mentioned neutralising—by which I mean reverting to a 'stop-ready' state, with the main switch on but nothing moving (except perhaps the capstan motor). Now there is a catch at this point. To get a good start, it is advisable to have the flywheel run up to speed at the moment of applying pinch pressure. Most of us have met the machine that whoops up to correct pitch for half an opening bar, and deplore it. Operating such a machine often means that a double-jointed manoeuvre of 'amp-on, deck-on plus pause, release pause' is needed if we are doing something like a Desert Island Disc lecture. This can be overcome by the aforesaid pause lock, or by a control layout that is determined more by logic than expediency.

Where key operation is arranged, neutralising should remove pinch wheels and idlers from driving surfaces when stop is selected. Several machines need both stop action and then deck neutralisation to achieve this. The latter is usually by intermediate selection of the speed control. Inevitably, we switch off in a hurry and forget to neutralise the deck. David Kirk has nightmares about flattened idler wheels—sometimes I feel a twinge of sympathy. Solenoid action is the solution, but tends to be expensive. Direct selection is the other method, but this tends toward a less perfect drive.

Either way, the single knob control which is coming back to popularity, presumably because it is cheaper to fabricate, leads to some strange sequences. When it requires that one shall shoot through the fast wind and rewind positions to get back to replay, something has gone sadly amiss at the design stage. Yet this is so on quite expensive machines. One of the most opulent actually needs a drive reversal between the fast winding positions. As it happens, the excellent braking system of this machine prevents tape spillage and other more horrific possibilities. It doesn't make life easy if one has to cue rapidly back and forth, as in a drama rehearsal.

SUBMERGED FEAR

This poor character has always had a submerged fear of superimpose buttons—ever since the day he carried out a tricky oscillator coil replacement, and then found the erase head down on one track, and then —yes, that's right—fitted a new head and got no erase at all. The superimpose button had jammed. It looked as if it was up, but the switch was sneakingly down. Do you ever get the feeling the tape recorder is smirking at you? Superimpose buttons should always, always, *always*, revert to normal when the stop key is pressed. And, if we are going to have superimposition at all, the bias should be automatically reduced to prevent self-erasure and that annoying degradation of the original signal. *Ferguson* could do it on their cheaper machines by switching in one small capacitor.

There should be no ambiguity about superimpose buttons. Recordings are too precious for us to take chances. When someone can reach over and say "What's this button?" and spoil our competition entry, there must be room for improvement.

Another trap for the unwary is the 'straight-through amplifier' switch. As a form of second-rate monitor, this facility has its uses. On the best machines, the amplifier really is a well-planned circuit. On too many, it is the normal play circuit with the head switched out and the inputs switched in—like a simple crossover arrangement. Consequently, the signal we pump through the machine has the full equalisation applied to it and is about as hi-fi as an election-meeting loud-hailer. I mustn't grumble about this, knowing from bitter experience how difficult it is to adapt a circuit to 'straight-line amp' when the equalisation is anything more ambitious than a loop of frequency-selective feedback from the anode of one stage to the cathode of the preceding one. But why is it necessary to juggle with gain controls each time we select this function?

EQUIVALENT LEVEL

For amplification, and for monitoring, the setting of the gain control should be equivalent to playback level. *Reps* can do it most effectively. You really can make a direct source comparison with tape signal on their *R10*. You can very nearly do it on the *Wyndsor Vanguard*, but, of course, as with the *Brenell Mk. 5M* and the *Revox* among other notables, the third head and separate amplifiers makes for wide facilities. But on less ambitious machines it should still be possible to arrange matters so that the audio output from a fully modulated tape = the monitor output when the meter or magic-eye indicates full modulation=the amplifier output when the input controls are at the same setting. More often, switching between functions blasts one out of one's shoes unless the controls are adroitly twitched.

Monitoring is possible on most machines, by headphone or external amplifier, if not via the internal circuitry and loudspeaker. But it is extremely helpful to have a quiet indication of what is going on the tape, even if we can't afford a three-head model and select what is actually there via a playback circuit. Something like the *Grundig TK6* is a good idea, where an attenuated signal is applied to the output stage, which can be switched out by the loudspeaker switch when the wife complains you are not listening to *her*. Yet so many machines have no internal monitoring whatsoever. I know it is difficult when you have a combined output/oscillator stage. *BRC* plan to get over it using a transistorised oscillator in the cathode circuit of the output valve. One interesting solution is a small transistor amp., fed from the hi-level output but using the tape recorder's internal speaker, via the external speaker socket. Some machines do not permit this without switch modification, but for those who do not want to juggle with extra speakers and who abhor headphones, this would appear to be the answer.

However, I digress. This is not the sort of accessory we can expect the manufacturer to provide. What we can, and *should* expect is a removable head cover that really does allow us to see the head facings and get at them easily for cleaning. Some models need the touch of a chiropracter even to lace up the tape, let alone get at the heads and pressure pads. How one is ever expected to do any effective editing with such models is a mystery.

Finally, a word about portability. Not, please note, about portables as such. Michael Gordon has covered this subject much better than I could, and Mr. Kirk's fieldwork shows what is being done. At this point I am concerned with the transportable tape recorder. If it has a handle on, then it is presumably expected to be carried at some time. If so, we need at least one hand free to hold on to our hat. We do not want to carry mains lead, microphone and other smaller accessories festooned about us. There should be a stowage hatch of decent proportions on all machines. Too often, it is either absent or inadequate.

The lid should be secure, clamped with some sort of lockable catch, not the spring flipper that flies open as we rush for the bus. And when the lid closes, it should hold the tape and spool in place. Even a couple of pads of felt or extruded-whatsit are better than the hollow rattle that forewarns a damaged tape.

Space restrictions prevent mention of the many undesirable features that are more apparent to the service engineer, and which a little extra design thought could have improved. Many of the points raised in previous articles have been omitted from the preceding notes —readers will be able to fill in the gaps themselves. Motor switches, genuine tape position indicators—not laughable decorations, warning lights, meters that can be read, magic-eyes that float rather than flutter, and so on. My correspondence shows that many readers feel strongly about such things. Let's hear from you—what little extra could *your* machine have had to make it a better bargain?

should be so placed that children waiting for attention do not hamper those working on their tasks.

The amount of material needed to enable the scheme to run successfully will become apparent after the first week and readers are advised not to underestimate the potentials of the children. An exhibition of work was held after our experiment and the material produced by the children filled two classrooms and a large portion of the school hall.

The folders for the children can be made in a craft lesson during the preceding term, and once the task tape has been recorded it can be used, with possible revision, for many years.

After the initial attempt at this experiment I found that monitors could be selected by the teacher to be responsible for the supply of materials. Before school each day these children checked on the material available and replenished it where necessary to ensure that the day ran smoothly and the supplies outlasted the demand.

It is apparent that the success of the scheme depends on considerable preparation by the teacher, but the results will amply repay the effort expended.

the tape recorder questionnaire

CONCLUDING OUR REPORT ON THE APRIL ENQUIRY

HAVING discussed the relative popularity of editorial columns and articles, and the balance of tape recorder ownership, we turn this month to an analysis of the remaining general-interest facts revealed by our April Questionnaire.

As much as 41¼% of our readership is in the 20-35 age group, judging from the 10% response to the Questionnaire. 24¾% fall in the 36-50 group, whilst 19¾% are under 20 and 14¼% are over 50 years of age.

How many readers envisage buying a recorder in the near future?—35¼%. This particular fact should be digested with one published last month, which showed that 2.1% of readers possessed no recorder whilst the 'average' reader owned 1.624 machines. These figures are supported by our general postbag, which divides fairly evenly into requests for past reviews and recommendations, and advice in servicing older models.

We appear to enjoy a creative readership, since 70¾% of readers possess at least one microphone other than that supplied with their recorder. Another surprisingly high percentage relates to the possession of stereo equipment: 53¾% have stereo equipment of one sort or another. 48% of readers have purchased at least one commercial tape record, though cryptic notes on many replies indicated widespread dissatisfaction with the quality of these products.

Does the price of recording tape deter you from greater use of your equipment? 70⅛% said no, suggesting that most readers have had favourable experiences with cheaper tapes. Since even the best-known brands are sometimes advertised at 30% and even 50% below recommended price, raw tape seems no longer to present a financial burden.

Most readers (90%) have never belonged to a tape correspondence organisation, 7¼% currently being members whilst the remaining 2¾% are former members. These figures correspond closely to the proportion of local-tape-club members. 89% have never belonged to a tape club, 7⅜% being members and 3⅛% ex-members.

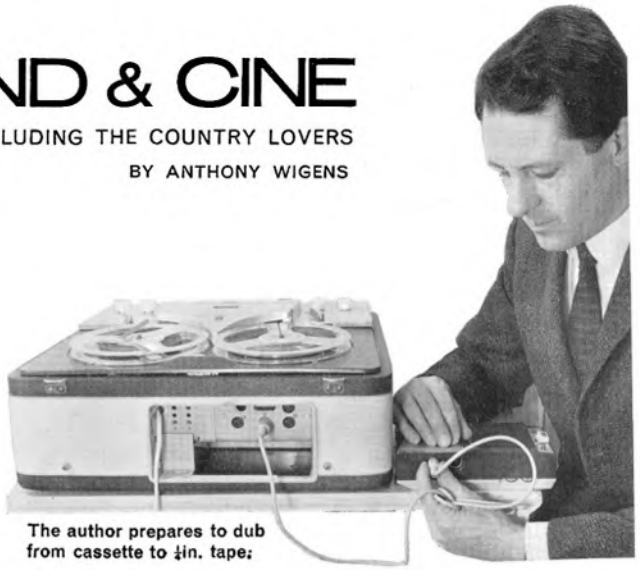
Nearly two-thirds of readers (64¾%) do not wish to see tape club meetings and activities reported in the magazine. Little correlation was observed between readers who did want such coverage and those who actually belonged to clubs. A substantial number of overseas readers, however, do seem to desire closer contact with English amateur recording activities through a club-news column. Nevertheless, the *Bulletin* issued at regular intervals by the *Federation of British Tape Recording Clubs* covers this field so well that we would neither hope nor choose to compete with them.

By far the most popular application of readers' tape equipment is recording from the radio—thoroughly immoral and quite uncreative; we do it ourselves. Half as popular is recording from gramophone records, whilst only a little less popular than this is live recording at home. Live location recording comes lower on the scale, with about two-thirds the following of the radio enthusiasts. Tape correspondence is the least widespread application.

SOUND & CINE

CONCLUDING THE COUNTRY LOVERS

BY ANTHONY WIGENS



The author prepares to dub from cassette to ¼in. tape.

WATCH a colour rotary press start its run, and you will find all the images emerge at first in an incoherent jumble. But the minder will adjust register of the separate colour plates and suddenly, with a small movement, the colours will visually click into register, and something with no more meaning than a palette of colour turns into a picture.

It is like this with sound and image. Embarking on the final stage of lip synch production, I had my palette. On it were feet of tape containing wild track recordings made while I filmed and labelled shots, all overlength for every stage of the script, and also out of order. Certainly incoherent! My job was to pull it into register.

The first task was to sort out what I had. I decided to transpose the actual wild track 'takes' on to ¼in. tape, eliminating all the chat that had accidentally been recorded on my Philips cassettes, through my omitting to turn the portable recorder off. It proved a long job, and by the second evening I was a nonchalant expert.

Having linked up the two recorders, I started the portable on playback. As soon as I reached the point where a voice started to say "Scene X, take Y" I stopped, back-pedalled, started again and switched the *EL 3534* to record. Then, when the director's voice cried "Cut!" I pressed the stop button on the mains model, letting the portable burble on.

Burble is the word. At one time I realised that I was able to cope mentally with three different sounds in the room. I was playing back the ¼in. recording to check that the balance was OK while the portable gave out the inconsequential rhubarb which was me talking to the actors and at the same time I was listening to *Radio London*. You may gather from this that, as a creative exercise, I rated this a bit of a drag . . . However, we found it helpful later on to have all the wild track recording on one tape, so it was not time wasted.

There was no waste running time on the camera, of course, and the film consisted of take after take, clearly identified by clapper board both as to content and starting frame for sound matching.

Professionals would be matching the clack on their tapes to the visual contact moment of the clapper board to give themselves their lip synch—but only if the recording carried a pulse synchronising track. I had originally determined to try this method myself, trusting that on short takes loss of sync could be rectified by splicing in or cutting out, either on the tape or the film. My plan was frustrated by the extraneous noises that showed up on every foot of tape. However, I will try it anyway some time, just to see if technically it is feasible.

For now, I could only rely on post-synchronisation of actors' voices to their lip movements on screen.

With a notebook to hand, I ran all the film through a couple of times. Where there was a choice, I noted what seemed to be the best of the repeated takes in one short sequence, lasting about a minute.

These I cut out of the film and joined up in correct running order. Because I wasn't attempting to match them to my existing sound track, I topped and tailed each shot, losing the clapper board, and just keeping in the relevant action. One run through of this edited sequence showed where action needed to be tightened, particularly where I had shot cuts on action. From here on I worked on the editor-viewer for convenience and to avoid damaging the film by repeated showings. At this stage I decided to bring a close-up reaction shot in at a different point in the film, to improve continuity. All cutting had to be completed before the film went for striping.

Where I required lip sync I had decided to work in sequences, recording one loop of film at a time, then joining the loops up to make a complete film. This does virtually rule out continuous music track, but there is no reason why this should not be recorded conventionally on the long sections of the film where no lip sync is called for. In the conversational sections, I decided to leave out music. My only requirement then (as explained in a previous article) was to see that each loop began with a shot at least 56 frames long requiring no recording of any kind.

From my remaining unrequired film I was able to make a list of the shots that were missing, and with this 'shopping list' I turned to my ¼in. wild track recording to compile a track of the actual words that matched my edited picture. Of course, the actors had a script to refer to, but very often they hadn't kept accurately to the script. Looking at the picture on screen, I anticipated that they might have trouble fitting the syllables all in. I was proved right. A playback of my recording compared with the script showed several discrepancies, and the actors made 'corrections' to their scripts.

We were now ready to record a loop. I studied the geography of my home and decided that I would run the projector in the spare bedroom, with the picture projected on to a screen on the landing. Actors Jess and Kay could sit out on the landing with the microphone away from the sound of the projector, but with the screen in view.

This was when I really began to learn something about post synch. Two rules emerged at once: 1. Actors must know their lines, so that they can watch the screen, not the script. It's clearly best that they know them before filming, so that they don't have to learn their own mistakes afterwards—doubly difficult! 2. The cameraman must see that actors' mouths are in view all the time, or certainly at the start of any particular speech, otherwise the actors have no start mark to set them off.

The loop system worked well. To remind you, the film is started on record and the actors speak their lines to picture. At the end of the loop, the projector is stopped, then restarted on playback. A listen through, and perhaps a word of advice from the director, then back to record. If, after a recording has been made, the director knows that the result is not acceptable, he can carry straight on, letting the erase head wipe out the previous recording unheard, while the actors try again.

With bright actors like mine, the third or fourth recording may well be the one that is right.

Then, like the colour printing press images coming into register, the playback pulls all the elements together, picture has continuity, sound has continuity, they are in sync—in register. The picture is complete.

BULK TAPE ERASERS

AKAI (Pullin Photographic Ltd., 11 Aintree Road, Perivale, Greenford, Middlesex).

ATE-7. Spool Sizes: 3-10½in. On/off switch incorporated on spool shaft. **Price:** £13 2s.

AMOS OF EXETER LTD., Weircliffe Court, Exwick, Exeter.

Model 6. Spool Sizes: Up to 8½in. Maximum width: 1in. Capacity for 180-400 reels per hour. Weight: 43lb. Dimensions: 11½ x 12½ x 7½in. **Price:** £32.

Model 7. Details as for Model 6. Designed for 8 x 8in. cassettes of ¼in. tape. **Price:** £32.

Model 8. Spool Sizes: Up to 14½in. Maximum width: 2in. Capacity: 100-400 reels per hour. Dimensions: 20½ x 20½ x 10½in. Weight: 92lb. **Price:** £90 (ex works). Models available for 115V 60Hz.

ELSTONE ELECTRONICS LTD., 81 Kirkstall Road, Leeds 3.

WAL Tape Eraser. Spool Sizes: 5-10in. Push-button operated. 111-125V 60Hz models also available. **Price:** £6 18s. 6d.

HARVEY ELECTRONICS LTD., Farnborough Road, Farnborough, Hampshire.

Type 100. Spool Sizes: 3½-5in. Dimensions: 7½ x 5½ x 4½in. Weight: 6lb. 10oz. **Price:** £6 5s.

Type W100. Spool Sizes: 3½-5in. Maximum width: 1in. **Price:** £6 17s. 6d.

Type 102. Spool Sizes: 3½-8½in. Maximum width: ½in. Weight: 7lb. 8oz. Dimensions: 9 x 6 x 4½in. **Price:** £8 15s.

Type W102. Spool Sizes: Up to 8½in. Maximum width: 1in. Weight: 8lb. 9oz. Dimensions: 9 x 6 x 4½in. **Price:** £9 9s.

Type 104. Spool Sizes: 3½-12in. Maximum width: ½in. Weight: 9lb. 12oz. Dimensions: 12 x 7 x 4½in. **Price:** £14 5s.

Type W104. Spool Size: 3½ - 12in. Maximum width: 1in. Weight: 12lb. 1oz. Dimensions: 12 x 7 x 4½in. **Price:** £15 15s.

OSMABET LTD., 46 Kenilworth Road, Edgware, Middlesex.

Instant Eraser/Head Demagnetizer. Hand-held unit. **Price:** £1 15s.

LEEVERS-RICH EQUIPMENT LTD., 319 Trinity Road, Wandsworth, London S.W.18.

LeeRaser Junior ER30A. Price: £7 10s.

Standard ER31B. Price: £10.

Senior ER32B. Price: £20.

HEADPHONES

AKAI (Pullin Photographic Ltd., 11 Aintree Road, Perivale, Greenford, Middlesex).

ASE-9. Dynamic stereo headphones with tone-control. Impedance: 8 ohms. **Price:** £5 19s. 6d.

AFH-10. Electrostatic headphones. Complete with mains-powered adapter. Impedance: 8 ohms. **Price:** £20 5s.

AKG (Politechna (London) Ltd., 182-184 Campden Hill Road, Kensington, London W.8.)

K50. Dynamic headphones. Ear pads available. Impedance: 75 ohms. **Price:** £7 10s.

AMPLIVOX LTD., Beresford Avenue, Wembley, Middlesex.

Jetlite JL25. Dynamic headphones. Impedance: 200 ohms. Boom microphone versions available. Prices on application.

BEYER (Fi-Cord International, Charlwoods Road, East Grinstead, Sussex).

DT48. Dynamic headphones. Impedance: 5 or 25 ohms. **Price:** £30 15s. 6d.

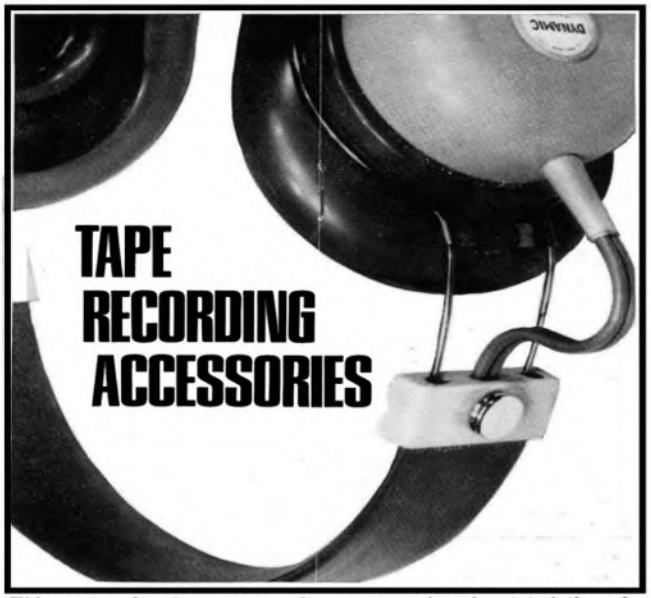
DT49. Dynamic earpiece. Impedance: 15 ohms. **Price:** £10 5s.

DT90. Dynamic headphone. Impedance: 200 ohms. **Price:** £18.

DT96. Dynamic headphones. Impedance: 100 ohms x 2. **Price:** £10 14s. 6d.

DT98. Lightweight headphones with lip microphone. Impedance: 100 ohms x 2. **Price:** £21 9s.

DT508. Lightweight headphones with potentiometer and LR7 lead. **Price:** £10 5s.



This survey has been prepared as a comprehensive tabulation of accessories currently available under the published headings. Illustrations and individual specifications have been kept to a minimum to avoid compromising completeness with space. The survey is as complete as manufacturers' co-operation permits.

S. G. BROWN LTD., King Georges Avenue, Watford, Hertfordshire.

Dynamic 3C.1100. Moving-coil headphones. Impedance: 8 ohms x 2 at 1kHz. **Price:** £6.

Type F 3C.400. General-purpose dynamic headphones. Impedance: 12K at 1kHz. **Price:** £3 4s.

Canada HA10 3C.1000. Dynamic headphones. Impedance: 8 ohms x 2. **Price:** £17 15s.

Diplomat 3C.606. Dynamic headphones. Impedance: 300 ohms x 2 at 1kHz.

Princess (E/M) 3C.607. Light-weight headset. Impedance: 10K (total per pair) at 1kHz.

EAGLE (B. Adler & Sons (Radio) Ltd.), 32a Coptic Street, London W.C.1.

S.E.2. Stereo headphones with individual volume and balance controls on each earpiece. Impedance: 8-16 ohms. **Price:** £8 6s. 9d.

S.E.21. Stereo headphones incorporating 2½in. bass unit and ½in. treble unit. Impedance: 16 ohms. **Price:** £8 6s. 9d.

GRUNDIG (GREAT BRITAIN) LTD., 40 Newlands Park, Sydenham, London S.E.26.

Type SE3. Single earpiece with ear clip and three-pin plug. Impedance: 200 ohms. **Price:** £1 13s.

Type SE6. Single earpiece with ear clip and two-pin plug. Impedance: 200 ohms. **Price:** £1 13s.

Type SE5. Single earphone with three-pin plug. Impedance: 4K. **Price:** £1 13s.

KOSS (Tape-Music Distributors Ltd., 11 Redvers Road, London N.22).

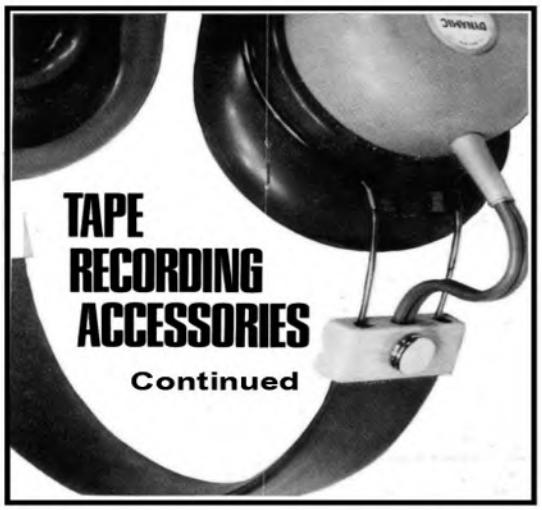
SP3X. Stereo dynamic headphones. Impedance: 4-16 ohms. **Price:** £9 18s.

PRO-4. Stereo headphones. Impedance: 4-50 ohms. **Price:** £17 10s.

MB ELECTRONIC (Denham and Morley Ltd., Denmore House, 173/5 Cleveland Street, London W.1.).

K64. Dynamic stereo/mono headphones. Impedance: 200 ohms. **Price:** £6 6s.

K65. As Model K64 but with boom dynamic microphone. **Price:** £10 10s.



MB ELECTRONIC (Denham and Morley Ltd., Denmore House, 173/5 Cleveland Street, London W.1.).

K85. Dynamic stereo/mono headphones. Impedance: 200 ohms (standard). 50-ohm, 100-ohm, 700- ohm and 1.5K versions available. **Price:** £13 2s. 6d.

PEARL (C. E. Hammond and Co. Ltd., 90 High Street, Eton, Windsor, Berkshire).

Type D-42. Dynamic stereo/mono headphones. Impedance: 200 ohms x 2. **Price:** £7 7s.

PHILIPS ELECTRICAL LTD., Century House, Shaftesbury Avenue, London W.C.2.

Stethophones. Intended for use with *Philips/Cossor/Stella* recorders. **Price:** £3 10s. (mono), £5 10s. (stereo).

PIONEER. (Swisstone Ltd., 26 Leigh Place, Cobham, Surrey).

SE-21. Stereo headphones with 2½in. LF and ⅜in. treble units in each phone. **Price:** £10 10s.

SENNHEISER ELECTRONICS (Audio Engineering Ltd., 33 Endell Street, London W.C.2.)

HD.110. Range of stereo headphones. Details on application.

STC LTD., Electro-mechanical Division, West Road, Harlow, Essex.

Stereo Headset. Stereo dynamic headphones. Impedance: 300 ohms. **Price:** £7 7s.

TELEFUNKEN (AEG Ltd., Lonsdale Chambers, 27 Chancery Lane, London W.C.2).

Telefunken 3N. Mono stethophones. **Price:** £2 17s. 6d.

Telefunken 3NS. Stereo stethophones. **Price:** £4.

THORN ELECTRICAL INDUSTRIES LTD., Thorn House, Upper St. Martins Lane, London W.C.2.

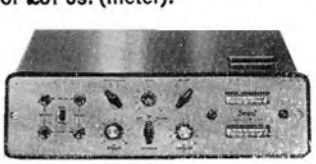
TA/13. Monitoring stethoset for 5½in. spool Thorn recorders. **Price:** £1 3s. 6d.

TA/15. Monitoring stethoset with DIN plug for 7in.-spool Thorn recorders. **Price:** £1 3s. 6d.

TAPE HEAD AMPLIFIERS AND REPLAY EQUALISERS

BRENELL ENGINEERING CO. LTD., 231/5 Liverpool Road, London N.1.

Mk. 5 Series 3 Record/Playback Amplifier. Frequency Correction: for 15, 7½, 3¾ and 1⅞ i/s. Replay Tone Control : 9dB lift at 100Hz. Microphone Sensitivity: 2mV at 1M. Gram Sensitivity: 75mV at 220K. Headphone Output: 2K-4K. Preamplifier Output: 500mV. Power Amplifier: 2.5W. May be employed as straight-through amplifier. Power Requirement: HT—300V at 50mA; LT—6.3V at 2A. (Mains power pack included in price or available separately at £5.) Dimensions: 15½ x 4½ x 6in. deep. **Price:** £26 (magic-eye) or £31 5s. (meter).



Hi-Fi Tape Link. Stereo tape preamplifier. Frequency Response (with specified heads): 40Hz-15kHz±2dB at 15 i/s, 40Hz-14kHz±3dB at 7½ i/s, 40Hz-11kHz±3dB at 3¾ i/s and 40Hz-6kHz±3dB at 1⅞ i/s. Equalisation: CCIR. Sensitivity: 75mV at 1M. Output: up to 1V (variable) at 47K. Dimensions: 15½ x 4½ x 8¾in. deep. Off-tape monitoring facilities. Twin peak programme meters. Variable bias. **Price:** £46 (including power unit).

DAYSTROM LTD., Gloucester.

Heathkit TA-1M. Mono tape preamplifier. Frequency response (with specified heads): 40Hz-17kHz±3dB at 15 i/s, 40Hz-15kHz±3dB at 7½ i/s, 40Hz-8kHz±3dB at 3¾ i/s, 40Hz-7kHz±3dB at 1⅞ i/s. Equalisation: CCIR. Sensitivity 0.5mV at 2M (microphone); 250mV at 0.5kHz (gram). Output: Adjustable. Dimensions: 13½ x 4½ x 12in. deep. Twin magic-eyes. **Price:** £19 18s. (kit) or £28 18s. (assembled). (Excluding power pack.)

Heathkit TA-1S. Details as for Model TA-1M. Stereo version. **Price:** £25 10s. (kit) or £35 18s. (assembled). (Excluding power pack.)

MGP-1 Power Supply: To suit TA-1M and TA-1S. **Price:** £5 12s. 6d. (kit) or £7 2s. 6d. (assembled).

PHILIPS ELECTRICAL LTD., Century House, Shaftesbury Avenue, London W.C.2.

EL3787A. Tape replay preamplifier. **Price:** £6 10s.

SHIRLEY LABORATORIES LTD., 3 Prospect Place, Worthing, Sussex.

TW/PA4. Mono tape preamplifier. Valve-voltmeter modulation indicator. Designed for Wearite decks but versions available to suit all decks. Dimensions: 10 x 5½ x 5½in. Price: £34 13s. (Excluding power pack.)

TW/PA4 Power Pack. **Price:** £6 16s. 6d.

TWA/1515HG. Complete stereo record/replay amplifier. Inputs: radio—50mV; gram—5mV (RIAA); mic—2mV; tape—3mV. Output: 12W per channel (17W peak). Frequency Response: 45Hz-25kHz=1dB (radio input). Valve-voltmeter modulation indicator. Dimensions: 23 x 7½ x 7in. **Price:** £115 10s. including power pack.

STERN-CLYNE LTD., 3-5 Eden Grove, Holloway, London N.7.

HF/TRs Mk. 2. Tape amplifier to *Mullard* design. Three-speed equalisation with optional 15 or 1⅞ i/s. Output Power: 3W. Suitable for Brenell and Magnavox decks. **Price:** £13 13s. (kit) or £19 (assembled). including power unit.

THORN ELECTRICAL INDUSTRIES LTD., Thorn House, Upper St. Martins Lane, London W.C.2.

SA100. Replay amplifier. Designed to permit replay of stereo tapes from mono *Thorn* recorders. Incorporates 8in. elliptical speaker. Mains-powered. **Price:** £13 2s. 6d.

TAPE HEAD DEGAUSSERS

AKAI (Pullin Photographic Ltd., 11 Aintree Road, Perivale, Greenford, Middlesex).

AH-6. Price: £2 10s.

EAGLE (B. Adler & Sons (Radio) Ltd., 32a Coptic Street, London W.C.1).

TD.79 Price: £1 9s. 6d.

TD.109 Two-probe model. **Price:** £1 18s. 9d.

ELSTONE ELECTRONICS LTD., 81 Kirkstall Road, Leeds 3.

WAL D-Mag. Price: £2 10s.

WRIGHT AND WEAIRE LTD., 84 Blackfriars Road, London S.E.1.

Wearite Defluxer. Price: £2 10s.

SERVICING AND CLEANING EQUIPMENT

CONCORDIA FILMS, 117/123 Golden Lane, London E.C.1.

Filmagic FM-LL 200. Two glass bottles of head cleaner (red solution) and lubricant (blue solution). **Price:** 17s. 6d. (postage 1s. 6d. extra).

(continued overleaf)

Filmagic Pylon Kits. Conditioning chemicals with applicator guide. (Specify suction base **FMKSC**, flange base **FMKF** or screw-in base **FMKSI.**) **Price:** £1 15s. (postage 1s. 6d. extra).

GLOBAL PRODUCTS, 14 Underwood Road, Rothwell, Kettering, Northants.

Head Cleaner. Plastic-covered aluminium with fibre scraper and felt polishing pad. Cannot harm head faces. **Price:** 5s.

METROSOUND MANUFACTURING CO. LTD., 19a Buckingham Road, London N.1.

Metrostrobe. Stroboscopic tape speed indicator. **Price:** 12s. 6d.

Metrobrush. Soft-gauge nylon cleaning brush. **Price:** 2s. 6d.

Klenzatape. Head and guide cleaner. (No longer rubber-backed.) **Price:** 13s. 6d. (Spare tapes: 6s. Fluid refills: 4s.)

Lubrication Kit. *Regent ROB, ROG* and *Starfak 2* lubricants for transcription motors and tape mechanisms. **Price:** 6s.

Mechanical Maintenance Kit. Comprising *Klenzatape, Metrobrush, Metrostrobe, Lubricating Kit* and *Cleaning Buds.* **Price:** £1 16s.

MULTICORE SOLDERS LTD., Multicore Works, Hemel Hempstead, Hertfordshire.

Bib Instrument Cleaner. Non-smear anti-static liquid for tape heads, plastics and instrument panels. **Price:** 4s. 6d.

TAPE RECORDER SPARES LTD., 323 Kennington Road, London S.E.11.

Tape Head Cleaning Brush. Slim brush with angled tip for cleaning heads and guides. **Price:** 4s. 3d.

TUTCHINGS ELECTRONICS LTD., 14 Rook Hill Road, Friars Cliff, Christchurch, Hampshire.

Head Alignment Kit. Comprising 40ft. full-track white-noise tape, 2in. length of magnetic rubber, and instructions. **Price:** 5s.

SPLICERS, SPLICING KITS AND ACCESSORIES

AGFA-GEVAERT LTD., Magnetic Tape Division, Great West Road, Brentford, Middlesex.

PE 31S. Sound editing tape. **Price:** £1 5s.

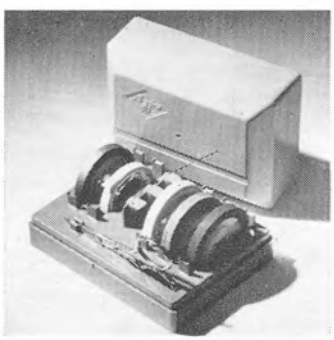
Splicing Tape Dispenser. **Price:** 6s.

Splicing Tape. 80ft. x ¼in. **Price:** 7s. 6d.

Splicing Tape. 80ft x ½in. **Price:** 16s.

Leader Tape. 80ft. x ¼in. in red, green, white or yellow. **Price:** 3s. 6d.

Silver Stop Foil. 33ft. x ¼in. **Price:** 6s. 6d.



Editing Kit. Comprising red, green and white leader tape, adhesive tape, stop foil, scissors, reel clips and splicing template. **Price:** £1 10s.

AKAI (Pullin Photographic Ltd., 11 Aintree Road, Perivale, Greenford, Middlesex).

AS-3. Semi-automatic tape splicer. **Price:** £1 1s. 6d.

BASF UNITED KINGDOM LTD., 5a Gillespie Road, London N.5.

BASF Cutter Box. Comprising semi-automatic splicer, marking pencil, 33in. of 0.7in. splicing tape, 80ft. of red, white and green leader tapes, fifty 6in. stop foils and 25 spool labels. **Price:** £2 12s. 6d.

COLTON AND COMPANY (LAPIDARIES) LTD., The Crescent, Wimbledon, London S.W.19.

Call Boy. Three-digit tape position indicator. Suction pad fitting. Will suit almost all recorders. **Price:** £2 2s.

EMI TAPE LTD., Blythe Road, Hayes, Middlesex.

Emitape Jointing Compound. AP35 for acetate-based tape; AP77 for PVC. **Price:** 7s. 6d. bottle.

AP102 Jointing Tape. $\frac{7}{32}$in. wide. **Price:** 4s. 9d. per reel.

AP103 Jointing Tape. ¼in. wide. **Price:** 4s. 6d. per reel.

Leader Tapes. AP38/1 (white), **AP38/2** (red), **AP38/3** (yellow), **AP38/4** (blue), **AP38/5** (orange), **AP38/6** (green), **AP38/7** (grey). **Price:** 4s. 6d. each.

AP39 Non-ferrous scissors. **Price:** 16s.

AP125 Stop Foil. Sufficient for 50 tapes. **Price:** 6s. 6d.

LENNARD DEVELOPMENTS LTD., 7 Slades Hill, Enfield, Middlesex.

Dry-Splice. Envelope of 24 joints with cardboard applicator. **Price:** 3s. 9d.

Splicer. 4 x 1in. block with four holes for screw fixing and adhesive back. Permits vertical and 45° splices. (Price to be decided.)

MASTERTAPE (MAGNETIC) LTD., Prescot Road, Poyle Trading Estate, Colnbrook, Slough, Buckinghamshire.

Splicing Kit. Comprises plastic splicer, five reels of coloured leader tape, one reel of adhesive tape and one reel of metallic stop foil. **Price:** £1 1s.

Leader Tape: 45ft. reels of red, blue, white, yellow and green. **Price:** 2s. 6d. per reel.

Adhesive Tape. 18ft. reel. **Price:** 4s. 6d.

Metallic Stop Foil. 22ft. reel. **Price:** 4s. 6d.

METROSOUND MANUFACTURING CO. LTD., 19a Buckingham Road, London N.1.

Metrosplicer. For tape and 8mm. cine film. **Price:** 15s.

MST 17. Splicing block and cutting blade. **Price:** 9s.

Leader Tape. Available in five colours. 50ft. lengths. **Price:** 4s. 6d.

Stop Foil. Price: 4s. 6d.

Metro-Tabs. Spool labels with index. **Price:** 3s. 11d.

MINNESOTA MINING AND MANUFACTURING CO. LTD., 3M House, Wigmore Street, London W.1.

Splicing Tape. 66ft. x $\frac{7}{32}$in. **Price:** 4s. 6d.

Splicing Tape. 66ft. x ¼in. **Price:** 6s. 6d.

Splicing Tape. 12½ft. x ½in. **Price:** 3s. 6d.

Leader and Timing Tape. 100ft. **Price:** 6s.

Stop Foil. 12½ft. x $\frac{7}{32}$in. **Price:** 14s.

Tape Clips. Packet of ten reel clips. **Price:** 2s. 6d.

Accessory Kit. Comprising splicer, adhesive tape, white leader and ten tape clips.

MULTICORE SOLDERS LTD., Multicore Works, Hemel Hempstead, Hertfordshire.

Bib Tape Splicer. Supplied with cutting blade. **Price:** 18s. 6d.

ENDLESS TAPE CASSETTES

(TELEFUNKEN) AEG Ltd., Lonsdale Chambers, 27 Chancery Lane, London W.C.2.

Telefunken Endless Tape Magazine. Standard fitting. **Price:** £2 17s. 6d.

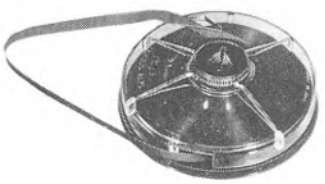
AGFA-GEVAERT LTD., Magnetic Tape Division, Great West Road, Brentford, Middlesex.

PE 31G Endless Loop. 200ft. reel. **Price:** £2 18s.

PE 41G Endless Loop. 300ft. reel. **Price:** £3.

AKAI (Pullin Photographic Ltd., 11 Aintree Road, Perivale, Greenford, Middlesex).

Model AE-1. Standard fitting. **Price:** £3 11s.



COUSINO (DTV Group, 126 Hamilton Road, West Norwood, London S.E.27).

Audio Vendor. Standard fitting; versions for clockwise or counter clockwise spooling. Friction-free tape. **Price:** £3 7s. 6d. (3-minute cycle), £3 15s. (5-minute cycle), £4 16s. (15-minute cycle) and £9 (30-minute cycle).

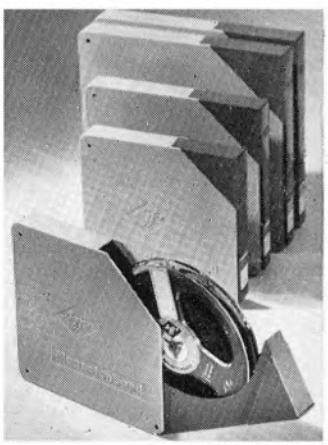
PHILIPS ELECTRICAL LTD., Century House, Shaftesbury Avenue, London W.C.2.

Model EL1907/50 Continuous Cassette. Standard fitting. 40 minutes cycle at $\frac{1}{16}$ i/s or 80 minutes with simple adjustment. **Price:** £3 10s.

TAPE CONTAINERS AND RACKS

AGFA-GEVAERT LTD., Magnetic Tape Division, Great West Road, Brentford, Middlesex.

Universal Cassette. Unbreakable plastic box with Phonopost labels. Available only with 3in. reels of *Agfa* tape. **Price:** 8s. (*PE 31* long play), 13s. (*PE* 41 double play) and £1 (*PE 65* triple play).



Novodur Library Boxes. Shatterproof two-tone grey plastic swivel boxes. **Price:** 6s. (4½in. and 5in.), 7s. 6d. (5¾in.) and 8s. 8d. (7in.).

BASF UNITED KINGDOM LTD., 5a Gillespie Road, London N.5.

Tape containers. Plastic swivel containers. **Price:** 5s. 6d. (5in.), 6s. 6d. (5¾in.), 7s. 6d. (7in.).

Library Boxes. Three-in-one plastic swivel containers. **Price:** 12s. 6d. (5in.), 15s. (5¾in.), 17s. 6d. (7in.).

COLTON AND CO. (LAPIDARIES) LTD., The Crescent, Wimbledon, London S.W.19.

Tape/Book Rack. Heavy-gauge welded wire with black polythene finish. Capacity for 21 tapes. Smaller quantities supported by sliding frame. **Price:** 22s. 6d.

GRUNDIG (GREAT BRITAIN) LTD., Newlands Park, London S.E.26.

Library Containers. Grey and white plastic swivel containers. **Price:** 5s. 6d. (5¾ and 7in. versions).

LENNARD DEVELOPMENTS LTD., 7 Slades Hill, Enfield, Middlesex.

Play-Fair Storage Rack. Suitable only for 7in. reels in cases. Adjustable width. **Price:** £2 12s. 6d.

(TELEFUNKEN) AEG Ltd., Lonsdale Chambers, 27 Chancery Lane, London W.C.2.

Tape Containers. Dustproof plastic swivel containers. **Price:** 4s. 6d. (5in.), 5s. (5¾in.), 5s. 9d. (7in.).

SLIDE SYNCHRONISERS

ABBEY TAPE RECORDERS, 5 Shakespeare Road, London N.3.

Slide Synchronising Unit. Designed for Thorn recorders. **Price:** £7 7s.

GRUNDIG (GREAT BRITAIN) LTD., 40 Newlands Park, Sydenham, London S.E.26.

Sono Dia. Mains powered. **Price:** £18.

REVOX (C. E. Hammond & Co. Ltd., 90 High Street, Eton, Windsor, Berkshire).

Slide-o-Matic. Designed for, and powered from, Revox recorders. **Price:** £17 17s.

THORN ELECTRICAL INDUSTRIES LTD., Thorn House, Upper St. Martins Lane, London W.C.2.

Thorn TA/01. Designed for, and powered from, ¼-track Thorn recorders. Incorporates additional preamplifier for second-channel playback. **Price:** £9 9s.

MIXERS

ASSOCIATED ELECTRONIC ENGINEERS LTD., 10 Dalston Gardens, Stanmore, Middlesex.

Astronic A.1446. Six-channel electronic mixer with GPO jack sockets. Inputs: Five low-impedance (10/30 ohms at 0.5mV) and one high-impedance (250K at 0.2V). Outputs: Four sockets giving 0.7V at 600 ohms. Controls: Individual level controls and master fader. Indicator lamp on each channel. Power: AC mains. Dimensions: 9 x 11 x 8½in. **Price:** £58 10s.

BRENELL ENGINEERING CO. LTD., 231-5 Liverpool Road, London N.1.

Mixer Unit. Three-channel passive mixer with GPO jack sockets. Inputs: Three high-impedance. Controls: Individual input attenuators. Dimensions: 4½ x 2½ x 2in. **Price:** £2 18s.

DAYSTROM LTD., Gloucester.

Heathkit TM-1. Four-channel transistor mixer with GPO jack inputs and coaxial output socket. Inputs: two low-level (1.5mV at 1M switchable to 4.5mV at 2.5M on one channel) and two high-level (180mV at 250K). Output: 200mV at 600 ohms. Controls: Individual gain controls and master fader. 'Speech/Music' switch on one channel. Power: *PP9*-type battery. Dimensions: 12 x 7½ x 3¾in. **Price:** £11 16s. 6d. (kit), £16 17s. 6d. (assembled).

EAGLE. (B. Adler and Sons (Radio) Ltd., 32a Coptic Street, London W.C.1.

Model MM.4. Four-channel microphone mixer. Inputs: 1.5V at high-impedance. Output: 2.5V. Controls: Individual gain controls on each channel. Power: 9V battery. Dimensions: 6 x 3½ x 2in. **Price:** £2 19s. 6d.

ELECTRONIC AND SCIENTIFIC INSTRUMENTS (WORTHING) LTD., (Shirley Laboratories Ltd., 3 Prospect Place, Worthing, Sussex.

Esimix Major. Four channel electronic mixer. Inputs: Two low level (2mV for 200mV output) and two high level (100mV for 200mV output). Output: Cathode follower. Power: AC mains. Power: AC mains. **Price:** £19 19s. (Four-microphone version available at £21.)

Esimix Minor. Details as above. Power: 250-300V DC, 10mA, and 6.3V, 0.6A. **Price:** £12 12s. (Four-microphone version available at £13 13s.).

EVT ELECTRONICS (C. E. Hammond & Co. Ltd., 90 High Street, Eton, Windsor, Berkshire).

Model MX5. Five-channel transistor mixer with GPO jack sockets. Inputs: four low level (60mV RMS) and one high-level. Output: 600mV RMS. Power: 18V (two PP6-type batteries). **Price:** £22 1s. Dimensions: 14 x 4½ x 4in. Controls: Separate gain controls on each channel.

MX4. Four-channel transistor mixer with GPO jack sockets. Inputs: three low-level (50mV maximum) and one high-level. Output: 425mV. Controls: Separate gain controls on each channel. Bass (+ 6— 5db at 100Hz) and treble +7(—10dB at 10kHz), continuously variable control. Power: 18V (two PP6-type batteries). Dimensions: 14 x 4½ x 4in. **Price:** £23 2s.

GRAMPIAN REPRODUCERS LTD., Hanworth Trading Estate, Feltham, Middlesex.

Series 16/6. Six-channel transistor microphone mixer with damped output-meter. Inputs: 25 ohms at 200μV, 200 ohms at 450μV or 500μV at 600 ohms, balanced or unbalanced, to order. Output: 600 ohms floating. Controls: Individual gain controls and switchable master fader. Power: AC mains. (Battery version available to order). Dimensions: 19½ x 7 x 6½in. **Price:** on application.

Type 18/4. Four-channel transistor microphone mixer with bass and treble controls. Inputs: (for 0.775V output) 25 ohms at 0.2mV, 600 ohms at 0.8mV, 10mV at high impedance, and 100mV at high impedance. Output impedance: 600 ohms, floating. Power: *PP9*-type battery. Dimensions: 11½ x 7 x 3in. **Price:** on application.

Type 20/3. Three-channel transistor mixer with GPO jack sockets. Inputs: Three high-impedance. Output: 100K optimum impedance. Controls: Individual gain controls on each

(continued on page 340)

elements of tape recorder circuits

PART 3 □ ALTERNATING CURRENT

So far in this series, in our discussion of simple resistor, capacitor and inductor circuits, we have been dealing with direct current (DC) which is said to flow from the positive side of the battery through the circuit to the negative side—the electrons, of course, travelling in the *opposite* direction. This month we shall focus our attention on alternating current (AC) and see what happens when such a current is applied to these components.

A simple alternating current is one which passes through a complete cycle of changes at regular intervals in a simple harmonic fashion. An every-day example of simple harmonic motion is the movement of the pendulum of a clock. The movement has constant frequency and amplitude and moves either side of a mean position which the pendulum would occupy at rest. In a similar way an alternating current swings, positive in one half cycle and negative in the following half cycle, about a mean value. To make this clearer let us consider the diagram in **fig. 1** for a simple alternating current, which represents a simple harmonic graph or sinusoidal waveform.

The *cycle*, which is the name given to a complete set of variations of the alternating current, is shown from O to B and from B to C. The maximum value or peak value of the current I_m is represented by X-Y and is known as the *amplitude*, and the number of cycles the current goes through in one second is the frequency. Frequencies in the range 20-20,000 Hertz (cycles per second) will be familiar to most of us as audio frequencies, and when sound waves are converted by a microphone into an electrical signal an alternating voltage with frequencies in this range are obtained. The commercial AC supply in this country has a constant frequency of 50 Hz which is within the audible range, and as we shall see later, with mains tape recorders care is needed to reduce the mains hum in the audio output to an acceptably low level.

In practice AC current is measured as the root mean square value (RMS) which is effectively the same as the steady current which produces the same heating effect per second in a given resistance. The RMS value is found to be approximately 0.7 times the AC peak (I_m).

Before going on, it is worth pointing out that there are many alternating currents which have waveforms other than a sine curve as shown in **fig. 1.** One obvious example that comes to mind is the audio waveform, which is extremely complex, representing as it does the context of complex sound waves. Fortunately, whatever shape the waveform may be, it can always be analysed (this is a complex business) into the sum of a number of sine waveforms and our discussion based on a sinusoidal alternating current still applies.

Last month it was shown that for a current to flow in a conductor it was necessary to apply a voltage, the voltage if you like, supplying the necessary force to drive the current round the circuit. In alternating current a similar situation occurs and an alternating voltage has to be applied to maintain the current flow. It will be clear from **fig. 1** that during the positive half-cycle, OD, the electrons will flow in one direction round the circuit, whereas in the following half-cycle, DB, this flow will be reversed. Therefore the flow of electrons through an AC circuit, and hence the flow of current, will be continuously alternating from positive to negative.

When an alternating voltage is applied to a pure resistance, R, Ohm's law still hold good and the relationship between the root mean square values of the current and voltage is $I = V_{RMS} \div R$. Hence if $230V_{RMS}$ is connected with a 200 ohm resistor the current flowing is 230/200=1.15 amps. In mathematical terminology, the waveform for a simple alternating current can be represented by the formula: $I=I_m \sin 2\pi ft$, where I_m is the maximum value of the current, I its value at any instant t, and f its frequency. Similarly the equation $V=V_m \sin 2\pi ft$ applies for alternating voltage. Now, substituting these values for V and I in the Ohm's law formula it is easy to show that $I_m=V_m/R$, therefore the maximum values for the current and voltage obey Ohm's law, and are always in phase with each other as shown in **fig. 2.** One other important factor to remember is that a resistance in an AC circuit has no effect on the frequency.

Now let us consider an alternating voltage of frequency f connected to the plates of the capacitor in **fig. 3** (a). Since the charge Q on the plates is given by $Q=C \times V$, and the voltage is varying, a varying charge appears with electrons accumulating first on one plate and then on the other. Thus although the plates are separated by an insulating medium, an alternating current flows in the circuit. With a DC supply the current starts to flow before the voltage is built up across the plates ; the current therefore leads the voltage. Similarly, when AC is applied to a capacitor, the current flowing in the circuit leads on the voltage across the plates, and the amount by which it does so is 90° as shown in **fig. 3b.**

COMPLETELY INDEPENDENT

In a given resistance circuit the magnitude of the current, being completely independent of the frequency, depends only on the applied voltage. In an AC capacitor circuit, on the other hand, this is not true ; for the magnitude of the current is found to increase with the frequency and also with the capacitance. Hence the *opposition* to alternating current flow in a capacitor circuit is *inversely* proportional to the frequency and capacitance. At low frequencies the current flow is small, and when the frequency is zero, we have DC, and once the plates have been charged no current can flow.

In the same way as resistance measures the opposition to current flow in a resistor, so *reactance* (X_c) measures the opposition to alternating current through a capacitor. Its relationship to the frequency is represented graphically in **fig. 4** (a) and mathematically by the expression $X_c=1/2\pi fC=V/I$.

An inductor also offers opposition to an alternating current, but unlike the capacitor, it increases with frequency. When the current in a coil is changing, the magnetic flux linking it at any instant is proportional to the current at that instant. Now the induced EMF is proportional to the rate of change of flux, therefore as the current varies in the coil an induced EMF is set up in opposition to it, which is proportional to the rate of change of current. The latter is given by the slope of the AC waveform and is greatest at positions where this slope is maximum (where it crosses the time axis in **fig. 1**). At the peak of oscillation, the rate of change of current is zero and therefore there will be no induced EMF at this instant, it being merely the point where it changes its direction.

Without translating all this into mathematical language, the best way to understand the effect of frequency is to visualise what happens to the AC waveform as the frequency is increased. The curve will, in fact, be squashed up and this results in the slopes being increased also. From the above discussion, then, this means that the rate of change of current, and hence the induced EMF will be increased and therefore the opposition to AC will be increased also. Opposition to AC in an inductor is therefore proportional to the frequency.

As with capacitance, this opposition is known as the reactance X_L, which is measured in ohms. Its relationship to the frequency is shown graphically in **fig. 4** (*b*) and mathematically by the expression $X_L = 2\pi fL = V/I$, where f is the frequency, L the inductance, and V and I the RMS values of the voltage and current respectively.

Doubling the frequency does not *necessarily* double the resistance of a coil because, unfortunately, the effective inductance can change with change in frequency. This is because the relative permeability of the iron core, which is one of the deciding factors, tends to alter with change of frequency. In an inductance circuit the voltage developed across the coil leads on the current by 90°.

In practice, a coil always has some resistance as well as reactance and the combined effect is termed *impedance* which is given the symbol Z. A loudspeaker, for example, of 15 ohms impedance might have a measured resistance of only ten ohms, the other five ohms being contributed by the reactance of the coil. We shall have more to say about impedance in due course, but let us now consider some circuits in which capacitors, resistors and inductors are combined.

In the circuit shown in **fig. 5** (a) a capacitor

by G. T. ROGERS

and resistor are arranged in series. The same current I will flow through both components and the voltage V will equal the resultant of the voltages V_r and V_c developed across the resistor and capacitor respectively. Now remembering that in AC the voltage across the capacitor lags 90° on the current, and the voltage across the resistor is in phase with the current, we have to use what is known as a *vector diagram* to determine their resultant or sum. This is shown in **fig. 5 (b).** If O—V_r represents the magnitude and direction of V_r, the voltage across the resistor, then V_c, which is 90° out of phase, can be represented in magnitude and direction by O — V_c. Completing the rectangle and drawing the diagonal O—V then gives the direction and magnitude of the voltage across the combined components.

For those of us who remember elementary mathematical concepts, it will be evident that the relationship between the three voltages V, V_r and V_c can be expressed by Pythagoras theorem thus : $V^2 = V_r^2 + V_c^2$. Substituting $V_r = IR$, and $V_c = IX_c$, it can be shown that $I = V/\sqrt{R^2 + X_c^2}$. As noted above, the combined effective resistance and reactance ($\sqrt{R^2+X_c^2}$), is the impedance Z ; thus I=V/Z. This is an important result for it enables the impedance of the circuit to be calculated from a knowledge of the applied voltage and the current flowing in the circuit.

Using a similar approach to that described above, it can be shown that the current flowing in an inductance-resistance series circuit is given by $I = V/\sqrt{R^2 + X_L^2}$ where $\sqrt{R^2 + X_L^2}$ is the impedance Z; thus I=V/Z.

In the R—C parallel circuit, **fig. 5 (c),** the same voltage V is applied to both components, and this time the currents I_r in R and I_c in C are out of phase, in fact, I_c leads by 90° on I_r. Now since C and R are in parallel, the current I is the vector sum of I_r and I_c and using a similar approach to that described for the series R — C circuit it can easily be shown that the *currents* are related by the square law $I^2 = I_r^2 + I_c^2$. A similar relationship holds good for an R — L parallel circuit.

When a capacitor and an inductor are combined in a circuit there will be one frequency, known as the *resonant frequency*, at which their reactances X_c and X_L are the same. This will become clear if we draw the reactance-frequency curves for both components on one graph as shown in **fig. 6 (a).** Since it increases with frequency, inductive reactance is always given a positive sign, whereas capacitive reactance has a negative sign. Now in a capacitor-inductance series circuit **fig. 6 (b),** or an *acceptor* circuit as it is called, the reactances cancel out at the resonant frequency and the impedance is a minimum, the only opposition to AC being provided by the pure resistance of the circuit. From Ohm's law, therefore, the current flowing is a maximum at the resonant fre-

(*continued on page 344*)

FIG. 1

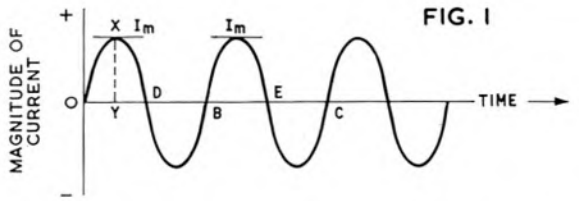


FIG. 2

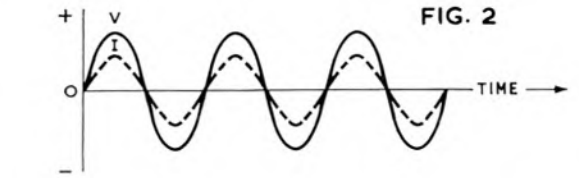


FIG. 3

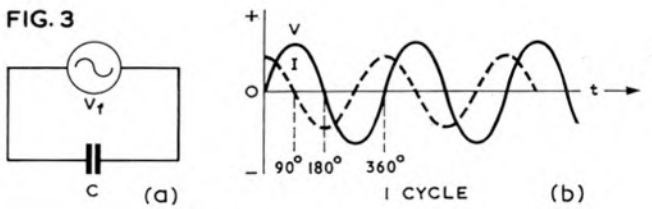


FIG. 4

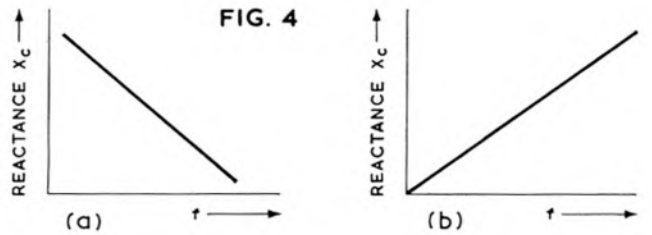


FIG. 5

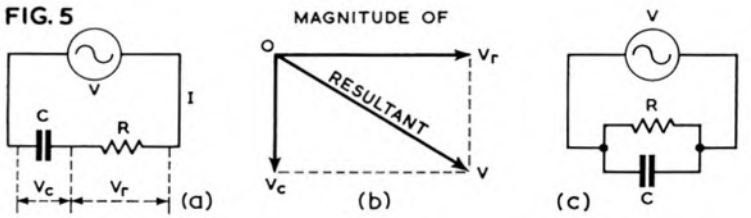


FIG. 6

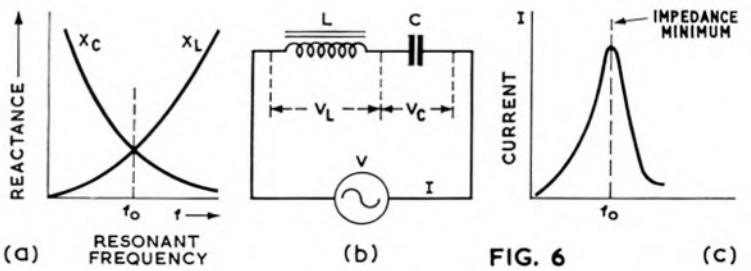
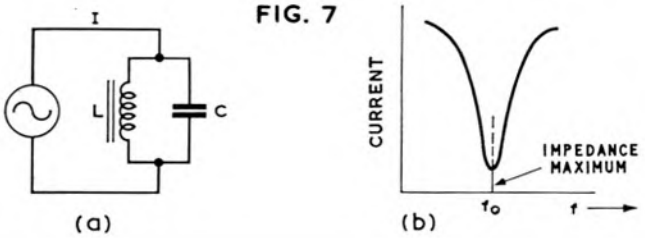


FIG. 7



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Stella 462	62 gns.
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*Tandberg Series 12	105 gns.
*Tandberg Series 8	54 gns.
*Tandberg Series 9	69 gns.
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Telefunken 200	32 gns.
*Telefunken 204 Stereo	106 gns.
Telefunken 203	69 gns.
Telefunken 201	44 gns.
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Truvox R104	89 gns.
*Truvox PD102	105 gns.
*Truvox PD104 Stereo	105 gns.
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*Vortexion WVA 3-speed	£96.7
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Grampian Ribbon	£11.10.0
Grampian DP/4 Dynamic	£8.5.0
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AKG D.119	£20.0.0
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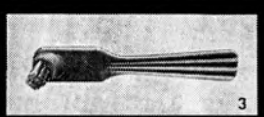

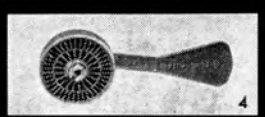

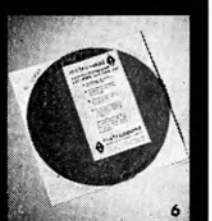

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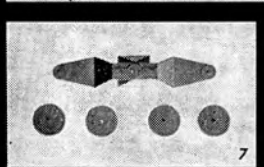

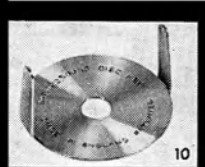

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A TRAVELLER'S GUIDE

Dresden, East Germany

points to remember when packing the suitcase

BY DEREK LYONS

IN spring, we all know to what a young man's fancy turns, but it is summer now and tape-fanciers at least should be turning to other things. That summer holiday, for instance. Yes, you have renewed your passport but did you renew your microphone, or bulk-erase your tapes, or stock up with fresh batteries, or solder that dodgy lead?

A little forethought can avoid later recrimination or indeed, for the enthusiast, perhaps the ruination of the entire holiday. However kind the weather, appetising the food or intoxicating the wine, however come-hithering the girls, I doubt if I would get much pleasure from an overseas holiday if I could not successfully store those halcyon days on tape. So here, in order of importance, are the forethoughts:

WITHOUT BATTERIES

Firstly, take a good light tape-recorder of proven reliability and of sufficient quality to allow later copying and re-copying of the master tapes. There is an excellent and well-tried portable which the manufacturers claim weighs "only eight pounds", but remember weight is often quoted without batteries. After a two-hour stroll round some strange city on a hot day even 8lb. can seem pretty heavy. "Next time," you swear, "I'll leave it at the hotel".

But, of course, next time you will be out, light-headed and light-handed, in the hot sun when, behold, what is that a-strollin' towards you but an exceedingly gaily bedecked band of mandolin-plucking minstrels. At times like this, one realizes the meaning of self-control.

So the moral is: take a portable recorder that really is portable. There are some that weigh little more than a camera, yet are capable of quality work. Remember, if you are buying one, that the machine's playback abilities are not as important as its recording potential, since normally one would expect to play these tapes later at home on larger domestic machines.

OTHER FACTOR

One other factor that should be considered is the speed of the recorder to be taken abroad. One well-known, good quality lightweight machine is only satisfactory at 7½ i/s, and this can be very inconvenient. Large numbers of reels can be a nuisance, and even a weight factor if flying; and it is also difficult to change reels when one is trying to capture that once-in-a-lifetime sound likely to outlast the seven or eight minutes duration of a small reel travelling at 7½ i/s.

Nevertheless, at the other end of the scale, a very slow speed, which tends to smother the high frequencies, may leave one too little reserve quality to allow the tape to be copied and played around with at some later date.

So weigh up the pros and cons carefully. In the final analysis no hard and fast rules can be laid down; it is a matter for the individual to decide according to his own specific needs.

NEXT THING

The next thing to consider is the microphone, which in many cases comes with the recorder, for better or for worse. Before going away it should be carefully examined to see if the leads are firmly soldered at both ends; to ensure that it is working reliably; and, most important, to devise some kind of windshield for it. Some microphones are more prone to wind than others. Unfortunately, unlike babies, a smart pat on the back is no cure. But a nylon stocking stretched over a caged support is effective in quite a stiff breeze.

Ribbon microphones are unlikely to be good travelling companions. They are too delicate and the province of the studio technician. At least one British manufacturer, Grampian, makes an excellent range of moving-coil microphones with made-to-measure windshields as an optional, but decidedly worthwhile, extra.

The final consideration, so far as microphones are concerned, is that the size should be unobtrusive. There are times, perish the thought, when one wishes to record without being stared at or even noticed. I am not recommending a bugging device hidden in a wrist watch but, within reason, the smaller the size the lighter it will be to carry around and the easier it will be to use.

TANGLES AND SNAPS

Now let us think about tapes. You will presumably have discovered the foibles that recorders are prone to and will know whether yours, for example, tangles triple-play or snaps standard acetate.

Obviously, if you can take triple-play or even quadruple-play tape much longer recording time is obtainable on low-capacity machines. Acetate-based tapes are more likely to break than other types, which stretch when under stress. A broken tape can be a nuisance on holiday, unless one has had the foresight to bring splicing tape. Broken tapes should not be joined with *Sellotape* as this, particularly in a hot climate, oozes out and layers of tape start sticking together, gumming up the heads, and causing more problems than the broken tape ever thought of doing.

BULK ERASER

Although most portable recorders are efficient at erasing tapes, I think it is a wise precaution to take clean tapes, and a bulk-eraser (some cost as little as thirty shillings) is a quicker and more effective way of wiping out past sins than laboriously running each tape through a large mains-recorder.

Lastly, remember the batteries. Some of the obscure little ones now in use quite commonly here have never been heard of in Sidi-Bel-Abbes. Even the ubiquitous *U2* is seldom obtainable in its high-powered form, except in large cities. Some recorders eat batteries more hungrily than others, but at least two sets should be taken. By changing them at intervals it is possible to conserve each set; by resisting the urge to playback unnecessarily you can further prolong their lives. Above all, wind back by hand whenever possible. Nothing takes the guts out of batteries more than fast rewinding on their power.

OPTIONAL EXTRA

In conclusion, there are one or two small points worth mentioning. My experience has been that an extra couple of take-up spools are very handy; so is a carrying-case with shoulder-strap for the recorder. Many have their own available as an optional extra, but for those who spurn an easy answer to this problem it is a simple matter to buy a small shoulder bag (an airline bag, for instance) and the machine plus all its accoutrement can be carried without tears.

I may have forgotten to mention some very vital item, but I sincerely hope that you will not forget to pack it!

TAPE RECORDER SERVICE

CONTINUING THE BRENELL RANGE

BY H. W. HELLYER

SOME while ago, when we were all chewing over the necessary virtues of the perfect tape recorder, more than one reader stated emphatically: "No machine should be produced without separate record and playback amplifiers".

Well, that is all very fine—I wish my car had automatic transmission. I would even settle for a few of the gew-gaws that my rallying son has had fitted to his buzz-beetle. But I have not managed to come up on Ernie yet, so must be satisfied with the staid family saloon. Much the same argument must apply to tape recorders and their associated equipment. It is desirable to have separate amplifiers, at least three heads, dual control systems, etc. It would be very nice to make all machines as comprehensive as, for example, the *Bang and Olufsen 2000K*. This has ¼-track record and play, mono, stereo, double and what-have-you, plus an extra head just for the purpose of playing back four-track tapes. (And the first man to say "What about ¼-track record?" gets sent from the room!).

Where a tape recorder has to be made to suit a particular price bracket, it is just not an economic proposition to separate the amplifiers. The necessary changes have to be made by switching. But there are right ways and wrong ways of doing this. Many of the cheaper machines settle for the easy methods and are beset by hum and noise, and have a response curve (and correction characteristics) that are more of a joke specification. *Brenell* do things more decorously and have an amplifier unit capable of a genuine 2½W output (into 15-ohm speakers) and with a frequency response from 40Hz to 20kHz ±3dB, with a signal-to-noise ratio of 45dB.

LITTLE OUTSTANDING ?

Yet, when we look at the circuit of **fig. 1**, there appears to be little outstanding about it. This is the main amplifier circuit. The power unit and the magic-eye and meter circuits are omitted to save space—we shall need it this month. Reference can be made to last month's circuits, which are the same, except for the interconnections.

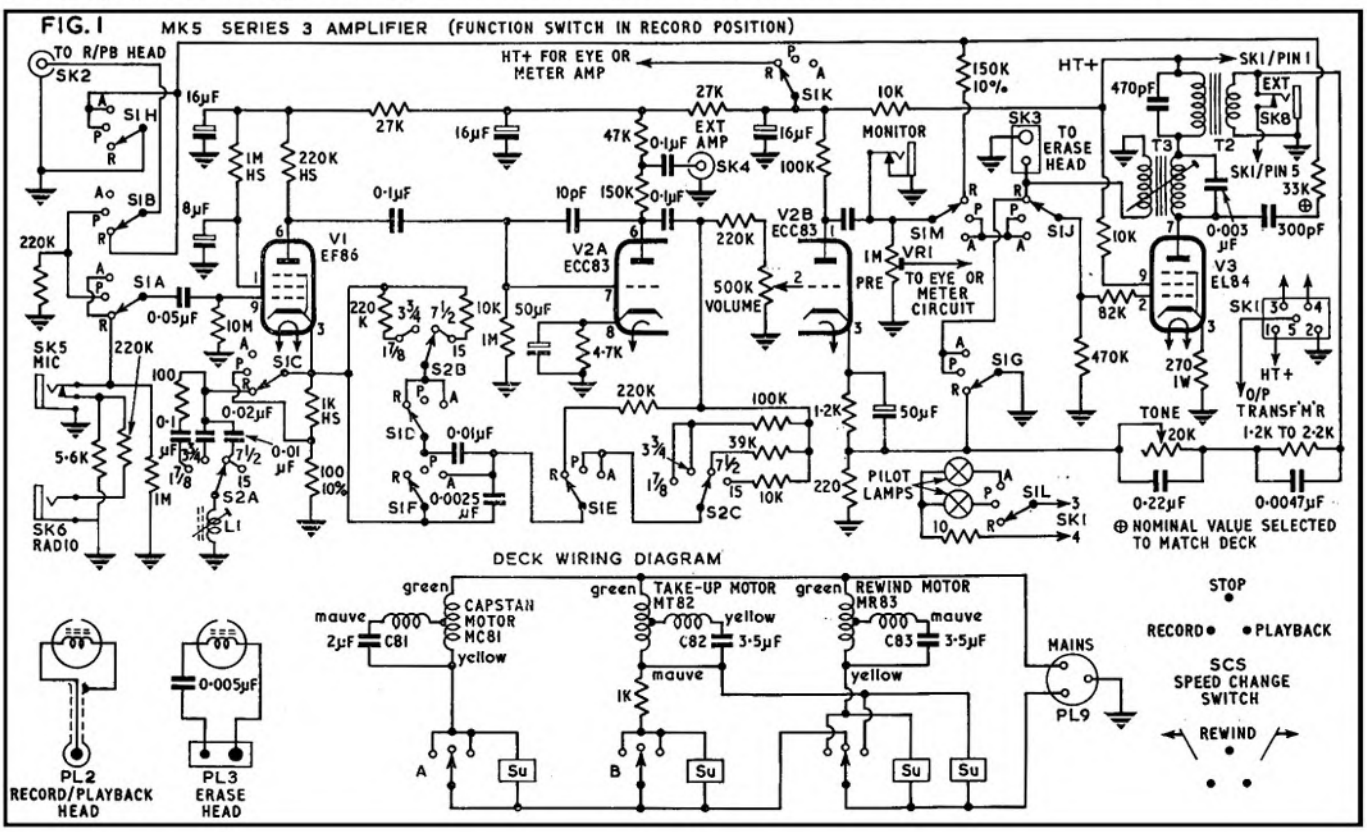
This amplifier, with power supply, is available as a separate unit, at a recommended price of £26 for the magic eye version and £31 5s. 0d. for the meter version. The power unit is also a separate item at £5, and the basic deck can be obtained for £38 in the Series 3 version of the Brenell Mark 5. As a further matter of sales interest, there is room for up to four heads on the deck and a complete range of different head assemblies can be supplied; ½- and ¼-track mono and stereo in different combinations. This, plus the provision of extended shafts on the record/play and rewind switches, means that one can easily build up a very comprehensive rig from Brenell equipment.

Whether or not this is the right way to do it is quite another matter. We shall be dealing later with the *Tape Link* and the *STB* versions and need not enter into the 'building block' argument at present. Let's just take a closer look at what we have actually got.

Just as with the previous version, we have a three-way function switch, for record, playback and amplification. Note that in this drawing the upper position of the switch removes the correction circuits and provides a 'flat' amplifier. To consider this in detail: S1C shunts the 1K upper resistor of the cathode bias section of V1, as for playback, removing the correction components; S1D and S1E complete the feedback loop from the anode of V2A when in the playback mode, but this is modified by S1F. The equalisation is arranged so that the correct straight-through-amplifier response is obtained when the speed switch is in the 3¾ i/s position. So we note that this shunting action of S1F

(continued on page 339)

FIG. 1 MK5 SERIES 3 AMPLIFIER (FUNCTION SWITCH IN RECORD POSITION)



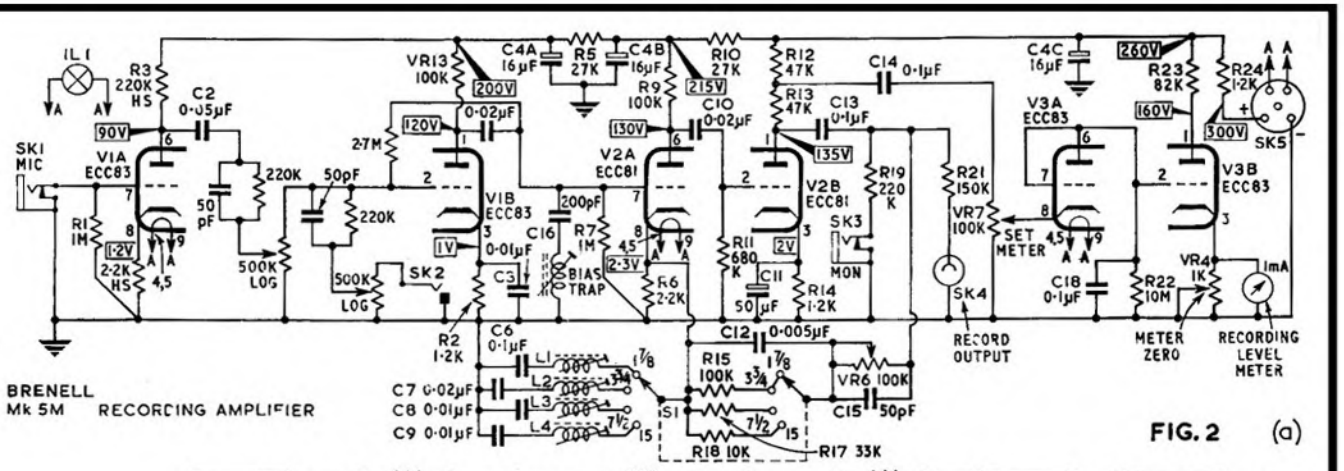
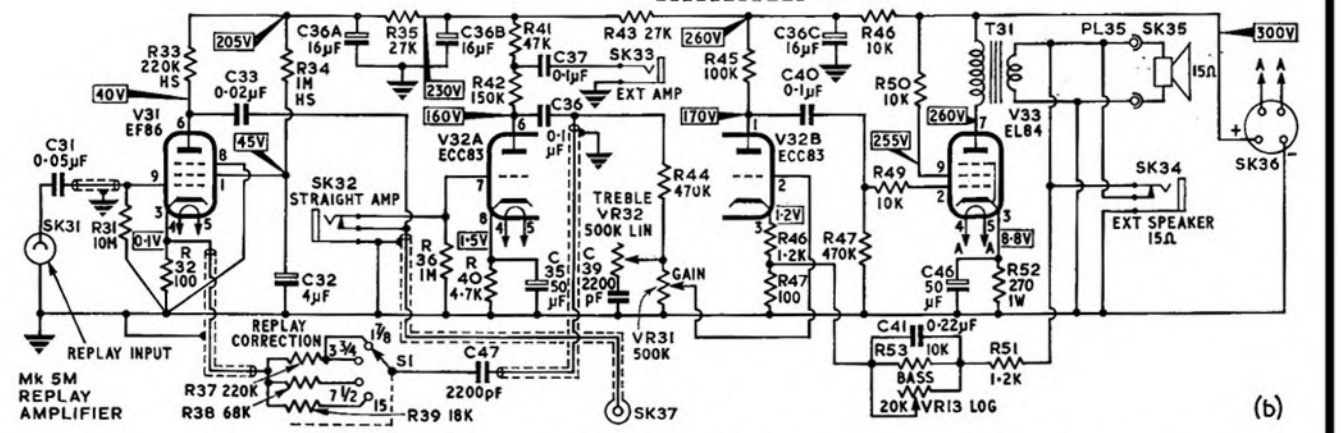


FIG. 2 (a)



(b)

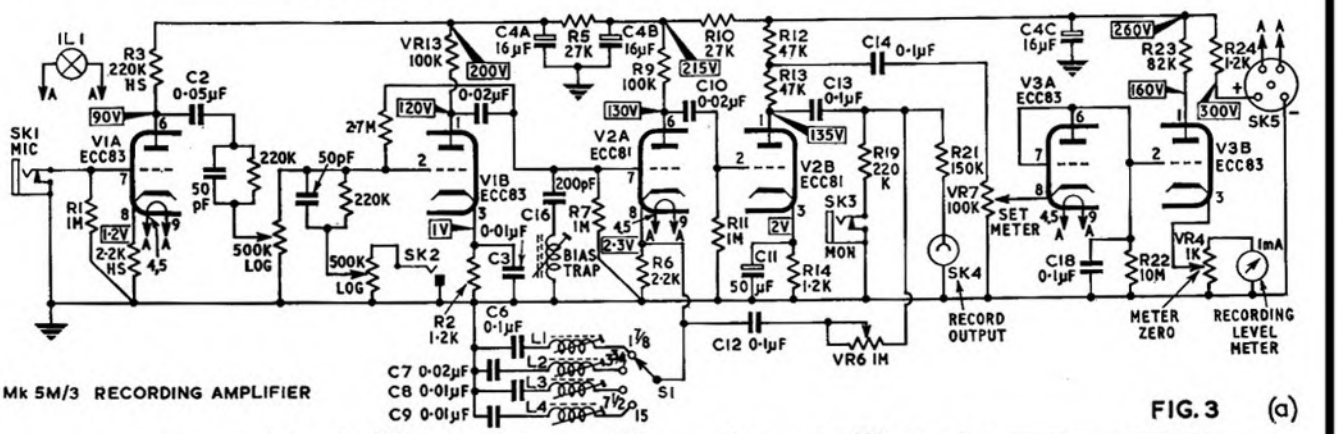
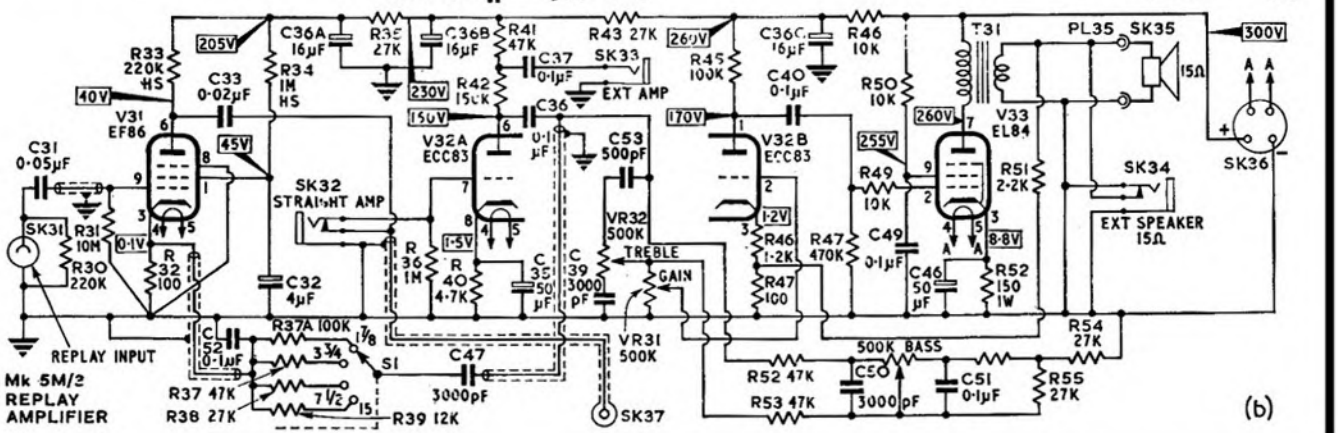


FIG. 3 (a)



(b)

effectively joins the wiper of S2C (speed correction switch) directly to the cathode of V1, bypassing the series R-C circuit and providing, in the 3¾ i/s position, a 100K feedback.

Note that, unlike the *Ferrograph* arrangement, the speed correction switch on the amplifier of the Brenell does not affect the deck switching, so we can run the deck at one speed while correcting for another, and get some curious tonal effects if we happen to overlook the need to match the two selectors. Anyone who has experimented with dubbings from one Brenell to another and the curve changes that can be produced by speed and correction alterations, will be well aware that these equalisation circuits really do work. From the servicing angle, this leads us to the need to check feedback components when we get reports of distortion, lack of treble, or even 'too much top and bottom and no middle'.

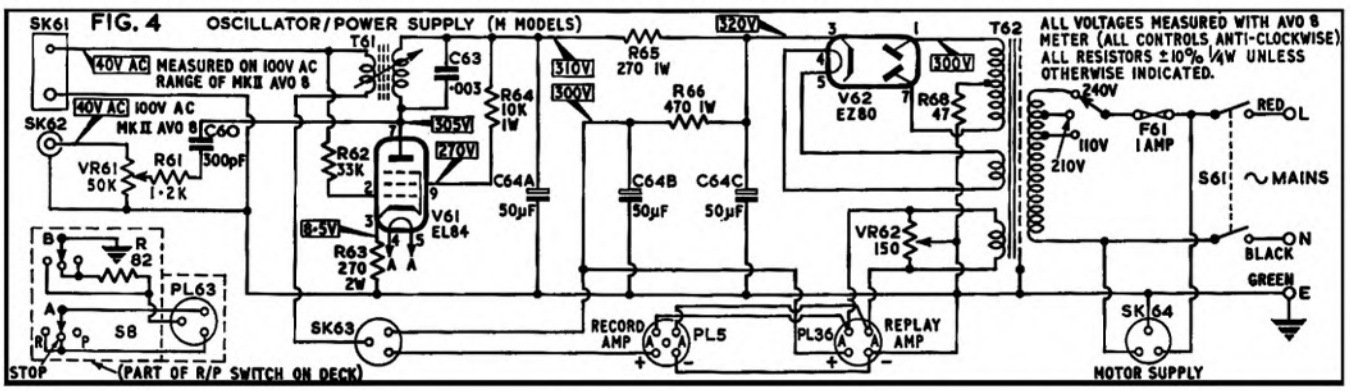
between the M and the MS3 oscillator packs and that is the change in erase series capacitor from 2,500pF in the original version to twice this value in the later, and also by the inclusion of a resistor shown as R82 in the dotted portion of **fig. 4.** This is a 220K component and it completes the shunting circuit across the erase output during play and amplification functions.

The first thing that will be noted on the M versions is that there is no amplifier position of the switch. To operate as a straight-through amplifier, one plugs the source into the third jack from the right, adjacent to the meter zeroing control. This has a sensitivity of 30mV at an impedance of 1M and by using a switched jack the first stage is muted during this function.

Putting the deck in the stop function also mutes this output, by virtue of the line from SK37, but if it is required to keep this circuit open the removal of the plug, adjacent to the output transformer, gives one an extra facility.

The differences in both record and replay circuits are somewhat the same as in previous *Series 2* and *Series 3* circuits, notably in the equalisation switching and in the tone control arrangements. But one important difference should be noted. This is the 220K resistor, R30, across the replay head of the Series 3 version. Omission of this component—as we had on one teasy production model when they first came out—causes a peculiar long-term instability that is kicked off by certain low-frequency combinations of recordings. Note also the differences in correction components to the cathode of the first stage on replay, and that very important 0.1μF capacitor.

The output stages differ in small points, but these are arranged to take into account the extra feedback of the bass tone-control circuit of the Series 3. It would not be advisable to try simple modifications to convert the M to the MS3—this is one of those circuits that is a well-balanced design and to change it demands an all-or-nothing rebuilding. For my part, I am content to let the lads at North London do the brainwork. I think we may assume that performance of the later models has proved the point.



Switches themselves are easily cleaned on these models, and do not give a great deal of trouble. The rest of the R/P/A switching is fairly self-evident, consisting of coupling from V2B to V3 and the addition of the feedback loop from the output to the cathode of V2B, with an extra 220 ohms in the cathode of this triode on playback and amplification.

For the rest, servicing is largely a matter of valve voltage testing, where the most clues can be obtained. To aid matters a table is given, with the correct readings that should be obtained in the various modes of operation.

By comparison, the *Mark 5M* is a much more comprehensive machine—as it certainly ought to be, for £92. Yet if we study the circuits of **figs. 2, 3** and **4**, we see that there are basic similarities with those noted before. This is not mere conservatism—simply the fact that having produced a good design, Brenell make the small changes needed to extend its functions. For a personal preference, I should have liked to have seen a more ambitious output stage, giving a bit more than 2W, but perhaps I am just greedy!

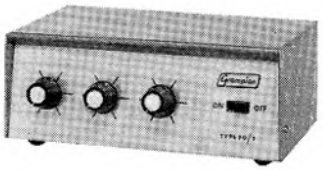
On both the Mark 5M and the *M Series 3*, the oscillator and power pack are combined units, and although the circuits are very like a combination of those we have seen previously, servicing is made easier by presenting it as in **fig. 4.** It will be noted that bias level is variable, by the 50K pot mounted on the forward angle of the sub-chassis, and quite easily accessible. There are, in fact, two more subtle differences

TABLE OF OPERATING VOLTAGES

Bias measured on AC valve voltmeter with deck and amplifier to record. All other voltages measured on Avo 8 with deck to stop. Amplifier to record or playback with volume control minimum.

	TEST POINT	RECORD	PLAYBACK
V1 EF86	ANODE (6) SCREEN (1) CATHODE (3)	45 50 1	35 42 .04
V2 A ½ECC83	ANODE (6) CATHODE (8)	170 1.6	175 1.8
V2 B ½ECC83	ANODE (1) CATHODE (3)	165 1.2	185 1.3
V3 EL86	ANODE SCREEN CATHODE	300 270 9.5	305 275 9.6
V4 EZ80	ANODES (AC) CATHODE (DC)	300-0-300 330	300-0-300 330
V5 EM87	ANODE (6) ANODE (9)	230 50	0 0
V6 ECC83	ANODE (1) CATHODE (3)	165 very low	0 0
HT LINE	SK 1 PIN 1	310	310
BIAS ERASE	SK 2 SK 3	35 to 40v 45 to 50v	0 0

ACCESSORY SURVEY CONTINUED



channel. Power: Single *UUII* cell or equivalent. Dimensions: 6¼ x 4¼ x 2¼in. **Price: £10 10s.**

LUSTRAPHONE LTD., St. Georges Works, Regents Park Road, London N.W.1.

Model MU577. Four-channel transistor mixer. Inputs: Two low-impedance (microphone) and two high-impedance (gram). Output: High-impedance, 20dB gain on low-impedance inputs. Controls: Individual gain controls on each channel. Power: Single Mercury battery. Dimensions: 9 x 4¼ x 4¼in. **Price: £21.**

PENCO PRODUCTS, 36 Coniston Road, Kings Langley, Hertfordshire.

Epigram Mix/4. Three-channel mixer. Inputs: Two 15/30 ohms and one high-impedance. Output: High-impedance. Power: 4½V battery. Dimensions: 12 x 3 x 2¼in. **Price: £15 15s.**

PETO SCOTT LTD., Addlestone Road, Weybridge, Surrey.

ET 1042/10. Four-channel electronic mixer. Inputs: 50 ohms, 0.2mV. Output: 200mV at 50K or 10mV at 6.5K. Controls: Separate gain controls on each channel and master fader. Power: AC mains. Dimensions: 12¼ x 7 x 3in. **Price: £35.**

SOUND NEWS PRODUCTIONS, 10 Clifford Street, New Bond Street, London W.1.

Unimixer 1. Three-channel mixer. Inputs: Two microphone channels (separate 30 ohm and 400K sockets on each channel) and 400K gram. Output: 500K. Controls: Individual gain controls on each channel. Self-powered. **Price: £9 9s.**

Unimixer 2. Three-channel mixer. Inputs: Two microphone channels (separate 300 ohm and 500K sockets on each channel) and 500K gram channel. Output: 500K. Controls: Separate gain controls on each channel. Power: 200-300V HT at 5mA and 6.3V LT at 0.3A (balanced). May be powered direct from *Ferrograph* or *Vortexion* recorders. **Price: £15 15s.** (Power supply available.)

(TELEFUNKEN) AEG Ltd., Lonsdale Chambers, 27 Chancery Lane, London W.C.2.

Telefunken Echo Mixer. Three-channel transistor mixer. Controls: Individual slide controls on each channel. Continuously variable reverberation from internal spring unit. **Price: £52.**

Telefunken Model TR. Three-channel transistor mixer. Controls: Individual slide controls on each channel. **Price: £15.**

TELE-RADIO (1943) LTD., 189 Edgware Road, London W.2.

Master-Mixer. Four-channel electronic mixer with GPO jack sockets. Inputs: 3mV per channel at high impedance. Output: 250mV. **Price: £22 1s.** (self powered). (Low-impedance version available to order.)

UHER (Bosch Ltd., 205 Great Portland Street, London W.1).

Model A121. Five channel stereo/mono transistor mixer. Input: 0.1mV at 2K. Output: 30mV. Controls: Individual slide faders on each channel. Power: 9V battery. **Price: £47 6s. 9d.**

VORTEXION LTD., 257/263 The Broadway, Wimbledon, London S.W.19.

Three-way Mixer/PPM. Three channel valve mixer with peak-programme meter. Mains powered. **Price: £60.**

Four-way Mixer. Four-channel valve mixer. **Price: £40 8s. 6d.** (basic version).

Six-way Mixer. Six-channel valve mixer. **Price: £57 0s. 6d.**

Eight-way Mixer. Eight-channel valve mixer. **Price: £72 5s.**

Ten-way Mixer. Ten-channel valve mixer. **Price: £87 10s.**

Twelve-way Mixer. Twelve-channel valve mixer. **Price: £98.**

2 x 2 Stereo Mixer. Price: £47 5s.

3 x 3 Stereo Mixer. Price: £65.

4 x 4 Stereo Mixer. Price: £83.

5 x 5 Stereo Mixer. Price: £98.

equipment reviews

SONY
TC800
MAINS/BATTERY
PORTABLE

MANUFACTURER'S SPECIFICATION. Mains/battery ¼-track portable with manual and automatic gain. **Tape Speeds:** 3¾ and 1⅞ i/s. **Frequency Range** (respective): 50Hz-13kHz and 50Hz-7kHz. **Output Power:** 1W maximum. **Power Requirement:** 12V DC (8 *U2*-type cells), 110V, 120V, 220V or 240V 50 or 60Hz. **Microphone Input:** 0.195mV at 600 ohms. **Auxiliary input:** 0.055V at 100K. **Line Output:** 0.775V. **Dimensions:** 12¼ x 10¼ x 4¼in. **Weight:** 12lb. with batteries. **Price:** £61 19s. **Distributor: Sony U.K. Sales Division, Eastbrook Road, Gloucester.**

THIS is the second automatic-gain *Sony* recorder to be reviewed. The first one, the *TC357*4, was tested in October, 1966.

It is an extremely neat little machine with a fold-away carrying handle, a front facing speaker, and a solid-feeling plastic cabinet. Three press tabs provide for tape movement at fast forward, fast rewind and normal speeds, as selected by the tape speed control near the left-hand spool. A large stop bar is placed directly behind the press tabs. A pull-forward record lever is positioned near the control tabs so that it can be operated by one finger while another finger of the same hand presses the start tab.

A meter record level indicator is provided for manual setting of recording level, and this is flanked on one side by the auto-manual switch and on the other by the record level control. The playback volume control and tone control are placed on the front face of the machine adjacent to the speaker grille.

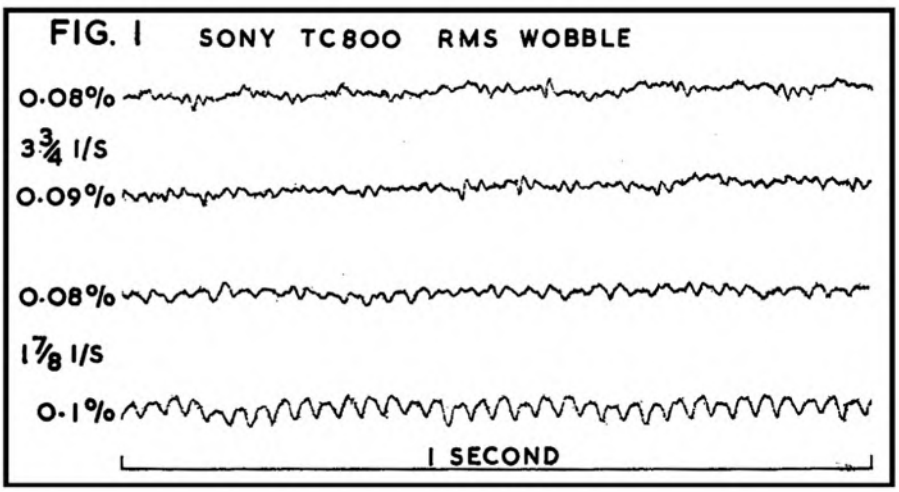
A row of miniature jack sockets on the right-hand side provide microphone, remote control, speed control and auxiliary input connections together with line or monitor output, and a slide switch allows the record level meter to be switched to measure battery voltage ; it can also be used to switch off the internal speaker while recording.

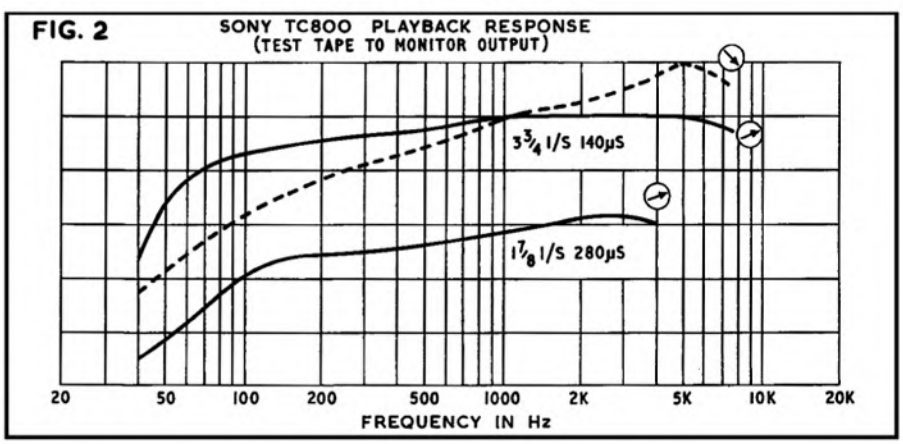
The instruction booklet mentions a 'Servo-control Motor', but as no circuit diagram was provided, I can give you no further information. I assume it is a multi-transistor circuit similar to those used on the *Uher* and *Telefunken* portables recently reviewed. Whatever the system, the performance is certainly extremely good as shown by the fluttergrams of **fig. 1.** RMS readings of 0.08% to 0.09% at 3¾ i/s are more than adequate for the most demanding portable work, and the slight 35Hz flutter at the lower speed of 1⅞ i/s is satisfactory for such a light-weight portable machine. Motor noise is very low, both mechanically and electrically.

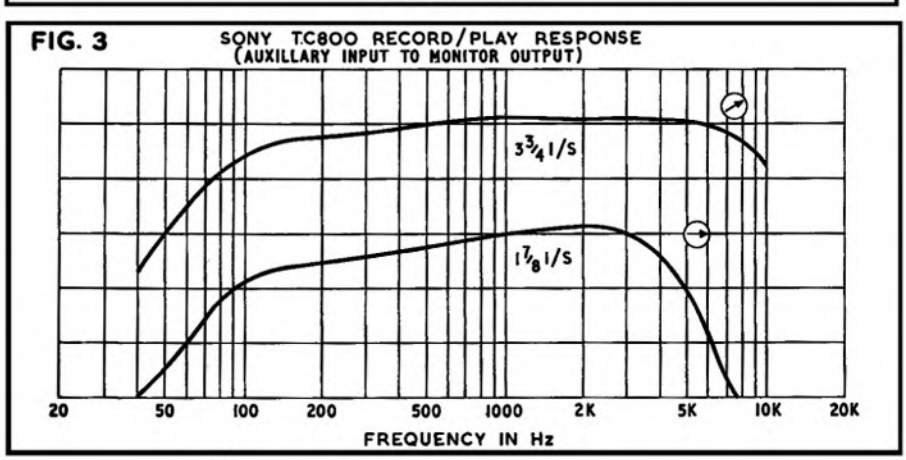
As the tone control was in fact a variable time-constant equaliser, the response of any test-tape could be brought reasonably level. The arrows on **fig. 2** show the approximate settings and responses obtained from our standard 140μS and 280μS test-tapes.

System noise with no tape passing the heads, was at the phenomenally low level of 47dB below test-tape level. This was low enough to show the real tape noise under different conditions ; bulk erased tape was 41dB below test-tape level ; tape recorded and erased on the machine was 38dB below test-tape level.

(*continued overleaf*)







Overload recording tests showed that a signal 12dB above test-tape level could be recorded with negligible distortion, so that the practical signal-to-noise ratio was better than 50dB.

Record/play tests to line output produced the responses shown in **fig. 3** which are almost identical to those of the test tapes, at roughly similar tone control settings, up to the highest frequencies on the test-tapes and falling gradually at frequencies above the test-tape range.

The overall electro-acoustic response was obtained in the usual way by recording 25 one-third octave bands of filtered white noise and measuring the sound output of the speaker as the noise bands were replayed. The responses obtained at different tone control settings are shown in **fig. 4.**

Finally, the front and rear responses of the directional cardioid microphone supplied with the recorder were measured in a white noise sound field to give the responses of **fig. 5.** This is a fantastically good response and front/back ratio for what must be a relatively cheap microphone, and the resultant sound quality is a revelation on what can be done on extremely portable light-weight equipment. Even at $1\frac{7}{8}$ i/s, the low noise, low wow and flutter, and smooth frequency response of both the recorder and the electro-acoustic input and output transducers combined to give voice reproduction which outclassed anything I have heard on much more elaborate and expensive equipment.

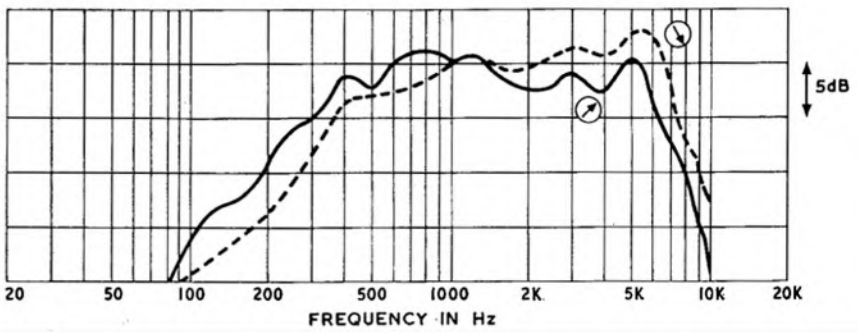
The automatic level control also seemed to perform very well and, although I made no exact time-constant measurements, the performance on speech and casual background noises, such as would be recorded on a portable recorder, seemed to be fully adequate for this kind of recording.

COMMENT

I would place this high on my list of light-weight portable recorders.

The overall sound quality could have been the result of fortuitous cancelling of a peak in response of one element against a dip in another, but the individual response of each element in the chain from microphone to loudspeaker is so exactly right that I would prefer to think that this is a designer's dream come true, where all the attention to detail has resulted in a near perfect performance within the limits of the size and weight of this excellent little recorder. **A. Tutchings.**

FIG. 4 SONY TC800 ELECTRO-ACOUSTIC RESPONSE (SPEAKER AXIS)



FIELD TRIAL

ASK any recording enthusiast to describe the probable shape of the next generation of tape equipment and he is likely to point, albeit with regret, to the miniature cassette models. My own wavering finger, however, is now aimed at the *Sony TC800*—the first non-professional recorder ever to offer a reliable continuously-variable speed control. There are other reasons for this choice: in design and construction this recorder is far ahead of its contemporaries. In performance, ease of use and versatility it approaches European models costing well over £100.

From correspondence with potential musique-concrète composers, I am confident that the variable-speed feature alone will sell a substantial number of TC800s. For this reason a few paragraphs on the general topic of variable-speed devices may be worthwhile.

The motors employed in modern mains-powered recorders are dependent on AC frequency rather than voltage. Reducing the voltage has little effect on speed within a limited range and renders the drive unstable outside this range. In practice this would simply create ever-increasing wow as the motor voltage was reduced. The solution is to vary the frequency of the motor supply, which in turn, involves construction of a variable-frequency oscillator operating in the 50Hz region, feeding the output through a powerful amplifier to the motor. A 60W amplifier would be adequate for most capstan motors.

Several attempts were made, in the dim and distant 1950's, to produce variable-speed decks employing a mechanical, rather than electrical system. The long-obsolete *Reflectograph RR 101* employed a conical idler between motor and capstan, variation between 8 and $3\frac{3}{4}$ i/s being obtained by moving yet another idler up or down the cone. A stroboscope indicated $7\frac{1}{2}$ and $3\frac{3}{4}$ i/s speeds. Unfortunately, in all such mechanisms the speed tended to alter itself at inconvenient moments.

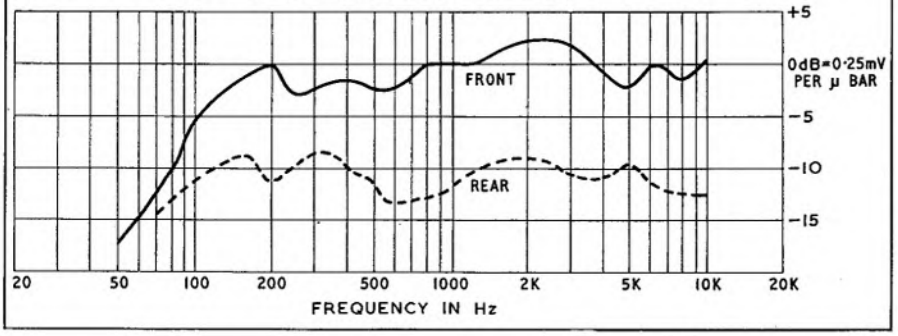
In the meantime a device called the *Gramdeck* was developed which, when dropped on to a variable-speed gramophone turntable, made a versatile little unit. Quality, however, was somewhat limited.

Variable-speed over a limited range was ultimately provided by *Kudelski*, whose *Nagra* can be made to follow exactly the smallest variation in speed of a cine film.

A number of low-priced Japanese battery recorders have featured yet another form of speed control. The DC motors which these employ are dependent on voltage for their speed and a simple variable-resistor arrangement gave a wide range of tape velocities. DC motors employed under these conditions, however, are thoroughly unreliable and lack both the short- and long-term stability demanded even for dictation.

And so we come to the Sony TC800. This machine incorporates a switched-frequency oscillator which feeds a tone to the motor to control the speed. Twisting the speed control doubles or halves the oscillator frequency and, correspondingly, doubles or halves the speed. When running on record or playback, the tone is fed both to the motor circuitry and to a socket at the side of the cabinet. This tone may be taken out via a normal miniature jack plug and fed to an external amplifier or recorder. By monitoring the tone and manually slowing the reels, a reduction in pitch may be detected. It is possible to stop the tape without stopping the motor, slip taking place at the capstan, so the system could not be 100% accurate for cine work. As an experiment, a stereo recording was attempted with the Sony taking the left-hand channel while a separate stereo recorder took the right-hand signal. The oscillator tone was fed to the spare track of the stereo recorder. A short guitar recording was made, after which the two machines were rewound and switched to playback. Now the tone was being fed back into the Sony in the hope that speed fluctuations on the stereo recorder would be followed, keeping the two channels in synchronisation. To ensure that the system was functioning, the reels of the stereo recorder were slurred by hand. As expected, the Sony endeavoured to wow in the same manner. When the stereo machine was slurred to a stop, the TC800 simply

FIG. 5 SONY TC800 MICROPHONE RESPONSE



referred back to its internal oscillator and proceeded at its original speed. Releasing the spools of the stereo machine, however, brought the recorded tone back within range of the servo circuitry and, to my surprise, pulled the speed down by about a semitone. The source of this speed reduction was traced to the stereo machine, which had reduced speed during playback as the mechanism became warm.

The experiment showed, when the two recorders were locked together for the duration of the three-minute sequence, that the two machines were much closer in speed than could be expected of any two domestic recorders in the same £60 to £100 category.

The Sony TC800, therefore, will not meet the needs of the lip-sync cine enthusiast but, purchased with a *Model RM-5* variable-speed unit, it has great attractions for the musically creative. An RM-5 was not supplied for the field-test, but a convenient signal source was found in the shape of a slide synchroniser. This generated a fixed-frequency tone which, when fed to the TC800, raised the tape speed to some 8 i/s. I had feared that this would fall outside the motor-servo range, causing the internal oscillator to take over the drive but this did not prove to be the case.

So much for this particular feature. No reference is needed to the very low wow and flutter on this machine, as Alec Tutchings' pen recordings—page 341—speak for themselves.

The TC800 was no more sensitive to lateral movement than the average portable. I have come to the conclusion, however, that for anything more demanding than dictation a recorder, mains or battery, must be placed on a stationary flat surface, and not held in the hand. If a wall, the bonnet of a car, or a clean pavement is available, then why work from the end of a 3ft. human pendulum?

Four press controls on the right of the cabinet govern all mechanical functions. The layout is more than sensible—it is perfect; all press tabs and the replay gain control can be reached when holding the TC800 from its metal handle, and they are equally convenient for horizontal operation. Three press-tabs permit selection of rewind, start and fast-forward, from left to right respectively, whilst the stop tab occupies a larger area at the rear. A red slide-lever to the left of the rewind tab interlocks with the start tab to engage record.

Recording gain is governed by a rotary control to the left of the VU-meter. If desired, this may be over-ridden by an AGC circuit, at the flick of a switch to the right of the meter. The meter does not operate when the AGC is in use.

Automatic gain control circuits exhibit 'personalities' as strong as those of human recordists. Most have sensible speed characteristics—like the TC800's less expensive sister, the *TC900*—and follow fairly close to the 'ideal level'. The Nagra AGC displays an exceedingly nervous characteristic which literally turns sustained piano notes into the constant amplitude tones of an organ. The TC800 is quite the opposite; it will reduce modulation level instantly if the incoming signal shoots into distortion, but displays no hurry in returning to its former level. If you desire to demonstrate the near-magical properties of AGC, this is no recorder with which to do so. After speaking loudly at close quarters to the microphone, I engaged in a low-level discussion with a visitor, at the opposite end of the room. We then returned to the machine to find that our two-minute talk had been too short for the AGC to regain a sensible level. Subsequent experiments confirmed that the AGC was capable of adjusting to the required level.

These are extremes, however, and if your subjects are mumbling in the distance it is wisest to move closer, request that they speak louder, or switch to manual control. Another more general point in relation to AGC: severe wind noise or cable-rattle can easily pull the input gain to a point so low that the actual subject of the recording becomes lost.

Indoor music recordings made with automatic and manual gain control proved very successful. Both the microphone and the internal speaker were of very acceptable quality, with a treble cleanness that greatly exceeded expectations. Background noise was very low, a slight motor buzz being audible in the monitor speaker only at full volume level. This sounded like commutator noise but, lacking information regarding the internal circuitry, it is not possible to be certain.

Battery consumption is not unduly high, being quoted as 10 hours per set of 8 high-power cells. With *Ever-Ready HPU2* cells and their equivalents selling for some 1s. 6d. each, this seems a very reasonable hourly rate. In fact standard leakproof LPU2's were fitted when the supplied batteries fell below useable voltage and these have performed for several hours intermittently without sign of fading. Battery life is conserved all the more by rendering the VU-meter/voltage indicator switchable. A switch at the side of the case brings the pointer across the scale on playback when required.

Insertion of the batteries presented no problems and extraction is quite straightforward provided the last pair of cells are threaded through the nylon band attached to the battery-housing cover. Pulling the cover drags the first two cells out, making way for the remaining six. Of course, if one forgets to deploy the nylon band, a screwdriver or similar tool is needed to lift the first pair of cells.

The TC800 incorporates a mains power-pack, a small lamp in the meter indicating when mains is connected. There is no provision for disconnecting the mains other than removing the supply cable.

Disappointing, in these days of push-button automation, to find Sony adhering to knurled-wheel spool revolution counters on the TC800.

Rewind speed is very acceptable on this recorder and very much faster than on most single-motor mains recorders.

Generally speaking, battery and mains/battery recorders offer poorer value than mains machines, since much of the cost pays for miniaturisation, development of light-weight drive systems, and transistorisation. To my mind, the Sony TC800 represents better value than any other battery portable on the market. In terms of performance, I would place it in third place behind a £358 professional portable and a £108 semi-professional model. The TC800 costs £61 19s. and is worth every penny. **D. K. Kirk**

quency, fig. 6 (c). It should be pointed out that the voltages V_L and V_c across the inductance and capacitor respectively, are 180° out of phase and their numerical sum is zero at the resonant frequency. The resonant frequency itself is determined by the values of L and C and is independent of the resistance of the circuit. Mathematically this is given by $f_o = 1/2\,\pi\,\sqrt{L\,C}$.

An important feature of the L–C series circuit is that the voltage across the capacitor can be as much as 100 times larger than the applied voltage; however, the *vector* sum across the inductor and capacitor is equal to the applied voltage.

In the parallel resonant circuit fig. 7 (a), called a *rejector* circuit, the impedance of the coil and capacitor is a maximum at the resonant frequency, $F_o = 1/2\,\pi\,\sqrt{L\,C}$. and decreases on each side of this frequency, which is opposite to the effect with the series circuit. The current-frequency curve will thus take the form shown in fig. 7 (b).

The importance of resonant circuits will be

READERS' PROBLEMS

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

STEREO MICROPHONES

Dear Sir, I have a *Revox 736* recorder and wish to buy a suitable stereo microphone. I am a lecturer in music and need to make illustration tapes. These will be recorded under domestic conditions in a 22 x 12 x 8ft. room which is slightly on the reverberant side. Recordings would be mainly of piano but will extend to voice, chamber music and the occasional orchestra.

My choice seems to lie between the *Lustraphone VR65/NS Stereolus* and the *Hammond M.100* capacitor with a stereo power-pack to which another M.100 could be added later. I understand, however, that the omni-directional M.100 is unsuited to cross-pair arrangement, which would impose a spaced microphone technique.

Yours faithfully, **B.S., London, N.14.**

For stereo recording you must have directional microphones. Whilst the Hammond M.100 is good, stereo produced with two spaced microphones is never very real and satisfying. Blumlein showed the right way. While cardioids are very nice, good quality models tend to be rather

discussed when we explain the working of equalisers and oscillators later on in this series, but let us conclude this month's contribution by introducing another very important component—the transformer.

This device depends for its working on the principles of electromagnetic induction and consists basically of two insulated inductance coils situated closely together and wound on a laminated soft-iron core. If a varying voltage V_p is applied to one of these coils, the primary, a varying current will flow in it and a varying magnetic flux will be obtained through it which induces a varying voltage V_s in the other coil, the secondary. With a perfectly efficient transformer the flux density in the two coils will be the same and if the areas of cross-section of the two coils are identical, the ratio of the flux through the primary to that through the secondary will equal the ratio of turns in the primary to the turns in the secondary. Hence $^{V_s}/_{V_p} = {}^{n_s}/_{n_p} = t$. The transformer can therefore be used to convert from one voltage to another by adjusting the number of turns on the primary and secondary coils. In a step-up transformer the ratio t, in the above formula, is greater than unity, and since the power taken from the transformer cannot be more than the power put in, when the voltage is increased the current available is proportionally decreased.

Since impedance $Z = V/I$, the transformer can also be used to convert from one impedance to another. This application is important since it enables low impedance devices, such as ribbon microphones, to be matched to the considerably higher impedance of the amplifier. When the output impedance of a source (microphone) equals the load impedance (amplifier), maximum power will be delivered; however, since, as we shall see in due course, amplifiers have a limited linearity, it is necessary to match the source and load impedances so that maximum *undistorted* power is delivered. In such cases the two impedances may be far from equal.

By now we will be familiar with the basic effects of resistive, capacitive and inductive components in an AC circuit, and our efforts will be rewarded when we see how these components are actually used. Next month we shall make a start by considering the power supply circuit, and see how a steady DC HT voltage is obtained from the mains supply.

costly. Ribbons are generally the most satisfactory and the Reslo VRT will give good quality and reasonably high output. Practically as good, and much cheaper, is the RBT. Used on their stereo mount they will give quite good results whilst, for mono, a single microphone may be employed, with the acoustic filter pad if recording close speech.

The Revox takes a high-impedance input and for serious stereo you will need to use as much as 100ft. of cable between microphone and recorder. The RBT/L version may be used in this manner, however, with a pair of LTU1 coupling transformers within a foot or so of the recorder.

SLOW-RUNNING FERGUSON

Dear Sir, I have a *Ferguson 3214* three-speed recorder which, when first switched on, runs slow on $3\frac{3}{4}$ i/s. Flicking the speed-change control brings the speed to normal for 10 to 15 minutes, after which the trouble returns again. Can you help?

Yours faithfully, **J.F., Wexford, Eire.**

There are two or three possible causes of slow running from cold with the DC43 deck used in the Ferguson 3214 model.

First, check that the motor pulley is not slipping when play is engaged. There is a spring between the upper section of the pulley and the stepped capstan below. The tension of this spring must be correct to keep the pulley in a 'binding' position, making it, in effect, part of the spindle. There is no grub-screw fixing.

Next, check that the tension spring of the intermediate wheel is not weakened or distorted; make sure that this wheel is free and the bearing has not seized or is too dry.

Note that the intermediate wheel drives a clutch device which couples to the flywheel, and there is another spring beneath the lower plate of this device. It is important that no oil should get on to this clutch section and that the spring is not binding but evenly compressed.

You should ensure that there is no excess oil about—it is quite important with this deck that driving surfaces preserve correct friction.

Finally, as the machine apparently runs well when warm, we would advise checking the motor, particularly its lower bearing and fan boss. Ensure the former is correctly seated and lubricated and the latter is not too far up on the spindle, binding on the support.

A TK.5 SWITCH

Dear Sir, I am trying to locate a couple of toggle switches for my vintage *Grundig TK.5* 1955 model. Grundig say they no longer make them and, although the machine is old, it still produces reasonable sound for my purposes.

The switches control the motor and record/playback operated by two cams above the plate switch. I did think of fitting manual switches, but should the sequence be wrong then something might burn out.

Yours faithfully, **G.C.S., Liverpool 21.**

There is scant hope of obtaining the switch toggles you need. These are items that are prone to failure and, as Grundig say, are now obsolete. Some service establishments take old machines in part exchange deliberately to obtain parts like this, and the lack is a real problem.

One solution is to use a Radiospares double-pole 2A toggle-switch and cut a slot in the toggle. This needs a good saw blade and a drop of paraffin as lubricant, as the steel is really quite hard. There may be other suitable types on the market, and indeed, we remember seeing slotted dolly toggles for sale some while ago, but have not seen them listed recently. The other problem you have to face is, of course, the restricted space.

For the latter reason we would advise fitting simple small micro-switches and fixing spring strips to the cam to operate these. It is a bit of a fiddle but, as you say, better than an external switch. You would not burn anything out, incidentally, as these are on/off types for power switching. You could, if necessary, add signal lights.

CLASSIFIED ADVERTISEMENTS

Advertisements for this section must be pre-paid. The rate is 6d. per word (private), minimum 7s. 6d., Box Nos. 1s. 6d. extra. Trade rates 9d. per word, minimum 12s., Box Nos. 2s. extra. Copy and remittance for advertisements in SEPTEMBER 1967 issue must reach these offices by 17th JULY addressed to: The Advertisement Manager, Tape Recorder, Link House, Dingwall Avenue, Croydon, CR9 2TA.

Replies to Box Nos. should be addressed to the Advertisement Manager, Tape Recorder, Link House, Dingwall Avenue, Croydon, CR9 2TA, and the Box No. is quoted on the outside of the envelope. The district after Box No. indicates its locality.

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4½" 900' (BASF)	30/-	24/-
5" 1200'	42/-	33/8
5¾" 1800'	55/6	44/6
7" 2400'	77/6	62/-
TRIPLE PLAY		
3" 450'	22/-	17/8
4" 900'	39/-	31/3
4½" 1200' (BASF)	49/-	39/3
5" 1800'	66/-	52/10
5¾" 2400' (BASF)	90/-	72/-
7" 3600' (BASF)	115/-	92/-

SCOTCH

	List	Our price
STANDARD PLAY		
5" 600'	20/6	16/4
5¾" 900'	27/6	22/-
7" 1200'	35/-	28/-
LONG-PLAY		
3" 300'	9/6	7/6
4" 450'	14/6	11/8
5" 900'	27/6	22/-
5¾" 1200'	34/6	27/6
7" 1800'	49/-	39/-
8½" 2400'	72/6	58/-
STANDARD (ACETATE)		
5¾" 850'	24/6	19/6
7" 1200'	30/-	24/-

	List	Our price
DOUBLE PLAY		
3" 400'	16/6	13/2
4" 600'	24/6	19/6
5" 1200'	41/9	33/6
5¾" 1800'	55/-	44/-
7" 2400'	76/6	61/-
TRIPLE-PLAY		
3" 600'	24/9	19/6
4" 900'	38/6	30/6
DYNARANGE (L/P)		
5" 900'	32/3	25/10
5¾" 1200'	40/6	32/6
7" 1800'	57/6	46/-
8½" 2400'	83/6	66/10

POSTAGE AND PACKING 2/- — **ORDERS OVER £3 POST FREE**

BASF TAPE – 33⅓% Reduction

A SPECIAL OFFER OF THIS FAMOUS PREMIUM GRADE TAPE

Brand new, boxed, with full leader, stop foil, and polythene sealed. Multiples of three can be supplied in the BASF 3-Compartment Plastic Library Cassettes at no extra cost.

TYPE	DESCRIPTION	LIST PRICE	ONE	THREE	SIX
LGS 26	600' D/P 4" reel	25/-	17/-	49/-	93/-

Post and Packing 2/-. ORDERS OVER £3 POST FREE.

GRUNDIG TAPE—45% OFF

Brand new, fully guaranteed, Premium Grade Magnetic Tape. Complete with the specially designed Grundig Tape Storage Container. Full leader and stop foil at both ends and suitable for use with all makes of tape-recorder.

DON'T MISS THIS RARE OPPORTUNITY, SEND NOW!

Type	Description	List Price	One	Three	Six
GL 18 (TLP3) ...	1800' L/P 7" reel	50/-	29/9	86/-	165/-
ALSO AVAILABLE AT SUBSTANTIAL REDUCTIONS					
GL 15 (TLP2) ...	1200' L/P 5¾" reel	35/-	24/6	71/-	137/-
GD 15 (TDP8) ...	1800' D/P 5¾" reel	52/6	42/6	126/-	246/-

Post and Packing 2/-. ORDERS OVER £3 POST FREE.

TRIPLE PLAY TAPE – HALF PRICE!

A large purchase from a "SHY" world renowned manufacturer enables us to make this unique half-price offer. Brand new, fully guaranteed, premium grade Polyester Base Tape with FULL LEADER and stop foil. In original maker's boxes and polythene wrapped at these EXCEPTIONALLY LOW PRICES!

	List Price	One	Three	Six
1800' on 5" reel	66/-	34/-	101/-	198/-
ALSO AVAILABLE AT SUBSTANTIAL REDUCTIONS				
450' on 3" reel	22/-	14/-	40/6	78/-
600' on 3" reel	27/6	17/6	51/-	99/-
900' on 4" reel	39/-	24/6	72/-	140/-
2400' on 5¾" reel	90/-	55/6	165/-	324/-

Post and Packing 2/-. ORDERS OVER £3 POST FREE

Don't forget our other ACCESSORY BARGAINS!

Tape Head Demagnetiser, essential for any enthusiast! Ready for immediate use. Fully guaranteed. Worth 50/- ... ... **Only 27/6** P. & P. 2/-
Tape Splicer, fully auto., no razor blades. Worth 32/6 **Only 16/6** P. & P. 2/-
International Polyester Tape 2400' 7" reel (boxed) **Only 25/-** P. & P. 2/-
Gevasonor 10" 3600' L/P Polyester (boxed) ... ... **Only 64/-** Post Free
Gevasonor 3" 300' L/P Polyester (boxed) ... ... 6 for **37/6** P. & P. 2/-

20% off all Grundig and Philips equipment

SEND FOR LISTS OF OTHER TAPE AND HI-FI BARGAINS

K. J. ENTERPRISES, (Dept. TR), 17 THE BRIDGE, WEALDSTONE, MIDDLESEX (OPPOSITE HARROW & WEALDSTONE STATION)

01-427 0395 (CLOSED P.M. WED. & SAT.) **REFUND GUARANTEE**

AGFA TAPE—HALF PRICE!

Brand new, Premium Grade, Polyester Base Tape from this famous manufacturer. Boxed with full leader, stop foil and polythene sealed at exceptionally attractive price.

TYPE	DESCRIPTION	LIST PRICE	ONE	THREE	SIX
PE 21	1200' S/P 7" reel	35/-	19/6	55/6	105/-
Also available at substantial reductions :					
PE 31	1200' L/P 5¾" reel	35/-	24/6	71/-	137/-
PE 31	1800' L/P 7" reel	50/-	32/6	95/-	180/-

Post and Packing 2/-. ORDERS OVER £3 POST FREE.

ILFORD TAPE NEAR HALF PRICE

A bulk purchase of premium grade, top quality POLYESTER MAGNETIC TAPE from one of the world's foremost experts in film coating technology. With FULL LEADER stop foil, Polythene wrapping and in original manufacturer's boxes. Available in long-play base only at these BARGAIN PRICES!

	LIST PRICE	ONE	THREE	SIX
900' on 5" reel	28/-	16/6	48/-	90/-
1200' on 5¾" reel	35/-	22/6	65/-	125/-
1800' on 7" reel	50/-	28/6	84/-	160/-

Please add 2/- P. & P. for single reels. Otherwise POST FREE!

SCOTCH 3M TAPE – HALF PRICE!

Brand new, fully guaranteed, premium grade, polyester base magnetic tape, double coated for the electronic industry.

SCOTCH (150 D/C) Polyester L/P, 900' on 7" reel. **ONLY 15/6**, P. & P. 2/-.
Three reels for **45/-**, post free; six reels for **84/-**, post free. Boxed add 1/- per reel. Can be supplied on 5¾" reels at special request.

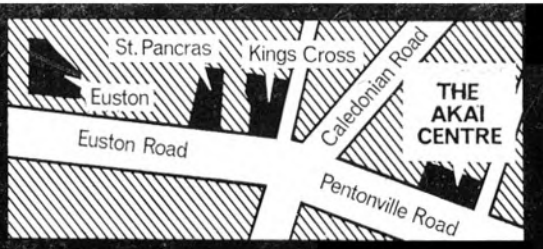
To K. J. ENTERPRISES (Dept. TR), 17 THE BRIDGE, WEALDSTONE, MIDDLESEX
Please supply your lists and goods as detailed below :

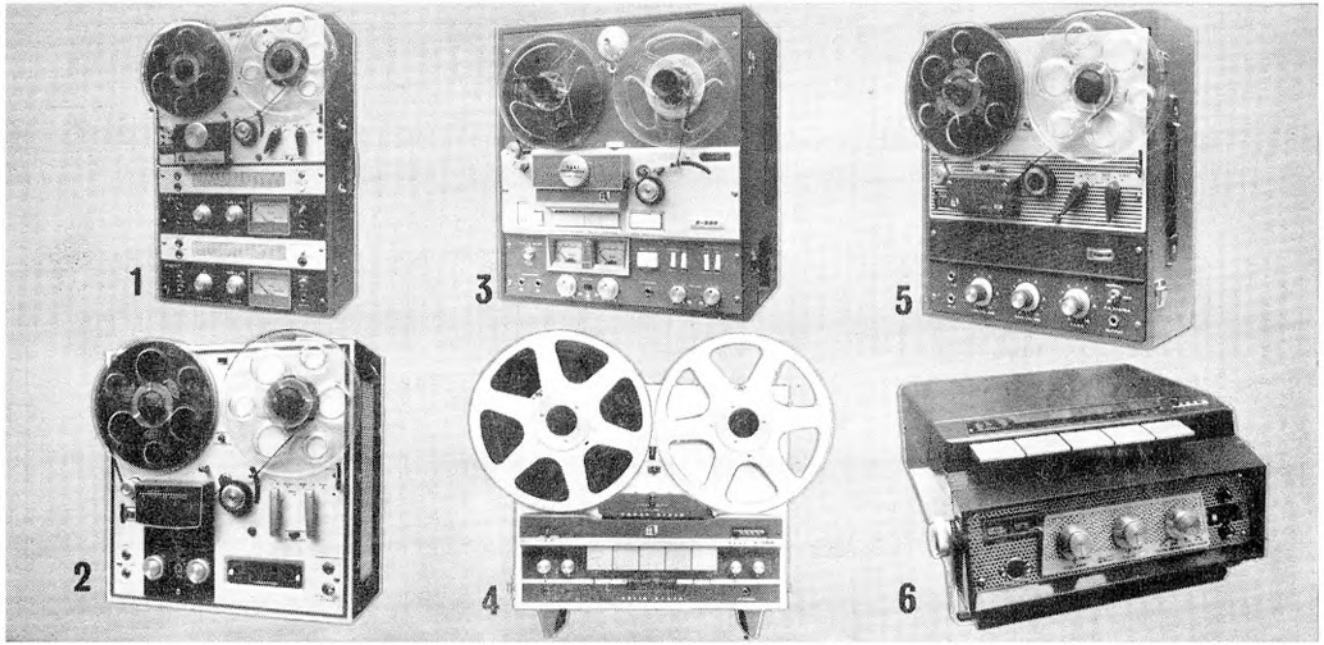
Qty	Description of Goods	Amount
	Total for post and packing	

I enclose my remittance for Total £.....
NAME.....
ADDRESS .....
(Print Please).....

August 1967

THE AKAI CENTRE





1. AKAI M8
A high quality 4-speed 4-track stereo/mono recorder with Crossfield head. Vertical or horizontal operation. 4 hours stereo recording on 1200ft. standard tape. 2 stereo fill-in speakers. Sound-on-sound. 6 watts per channel. **125 gns.**

2. AKAI 1710
A superb high quality completely self contained 3-speed 4-track stereo/mono recorder. Takes 7" tapes. Two 7" x 5" built-in hi-fi speakers, 3 watts per channel. Separate volume controls and VU meters. Extremely attractive styling with AKAI precision and superb finish. **79 gns.**

3. AKAI X355
A machine for the advanced amateur or professional, with 3 motors, 3 speeds, 4 heads (including Crossfield bias) and 30 watts per channel output. Fully solid state; push button solenoid operated controls, automatic reverse, repeat and shut-off functions. Built-in echo chamber effect. Full A.B. monitoring. Remote control facilities, etc., etc. **239 gns.**

4. AKAI X300
A studio type 3-speed 4-track stereo/mono recorder of professional quality. 20 watts per channel; Crossfield heads; 10½" reels; keyboard controls, and many other features. **185 gns.**

5. AKAI 910
A mono recorder, available in 4- or 2-track form. Clean and functional styling; 2 speeds; 3.2 watts output. Built-in P.A. system and mixing facilities. **57 gns.**

6. AKAI X4
A fully transistorised stereo/mono, battery / mains portable recorder. 4-track; 4 speeds; Crossfield heads; superb low-speed frequency response. Mains-rechargeable battery. 5in. reels. Weighs only 11.2lb. **118 gns.**

SPECIAL OFFERS!

We have a wonderful selection of BRAND NEW, SHOP SOILED AND SECONDHAND AKAI RECORDERS Showing savings of up to 50% on original list prices.

Examples :

AKAI M6 As new. One only	**69 Gns.**
AKAI 355 2 track, one only. Brand new	**169 Gns.**
AKAI X4 Brand New (Brown model)	**79 Gns.**
AKAI 1710 One only—s/soiled	**64 Gns.**
AKAI M8 New—s/soiled	**99 Gns.**
AKAI M69 As new—one only	**39 Gns.**
AKAI X300 One only—s/soiled	**169 Gns.**

HURRY WHILE STILL AVAILABLE!

EXPORT FACILITIES
To all residing overseas, visiting the U.K. or taking up residence abroad we can now offer an exclusive export facility. All AKAI equipment can be despatched overseas, free of U.K. Purchase Tax and U.K. Import Duty.

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Our expert staff all 100% AKAI enthusiasts are able not only to demonstrate these wonderful recorders but to give you expert advice and technical assistance based upon years of selling AKAI tape recorders. Remember if its AKAI you are interested in then there is only one place to go and that is "THE AKAI CENTRE".

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