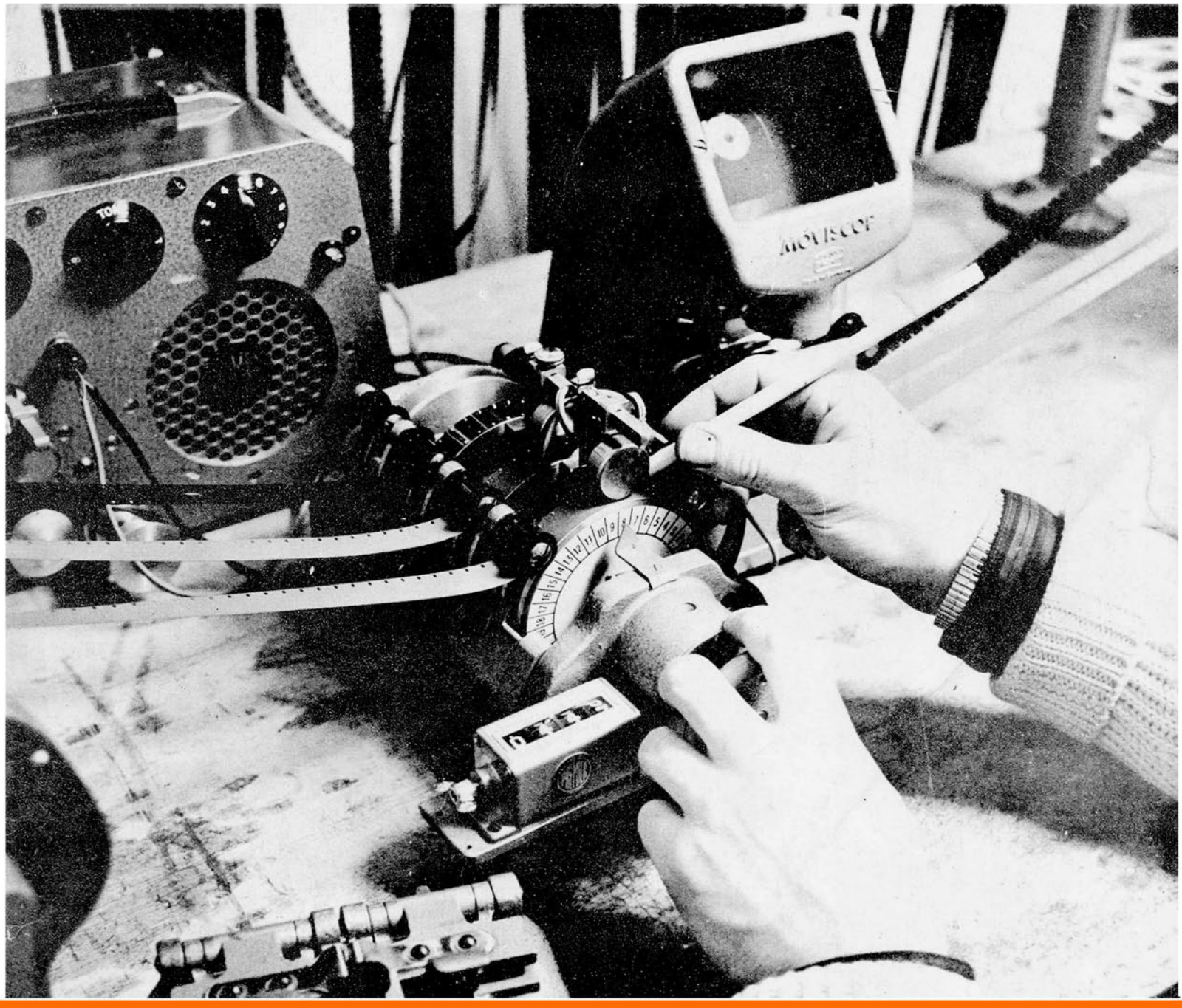
the TAPE RECORDER

PRICE 1/6

JUNE 1963
VOL. 5 No. 5

INCORPORATING "SOUND AND CINE"



AUDIO FESTIVAL REPORT

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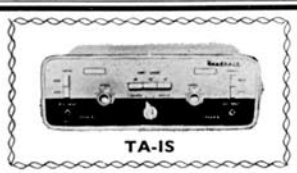
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Models TA-IM and TA-IS

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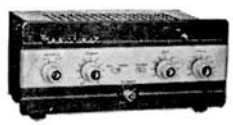
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HI-FI STEREO 6-WATT AMPLIFIER Model S-33. Attractively styled, completely self-contained. Printed circuit makes it easy to build. Only 0·3% distortion at 2½ W/chal. 20 dB N.F.B.; sensitivity 200 mV. U/L output, ganged controls. **£13.7.6**

HI-FI STEREO 18 WATT AMPLIFIER Model S-99. Within its power rating, this is the finest stereo amplifier available, regardless of price. Printed circuit board construction; ganged controls. U/L push-pull output. 0·2% distn. at 9 W/chal. **£27.19.6**


S-99


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MASTER XI-1U


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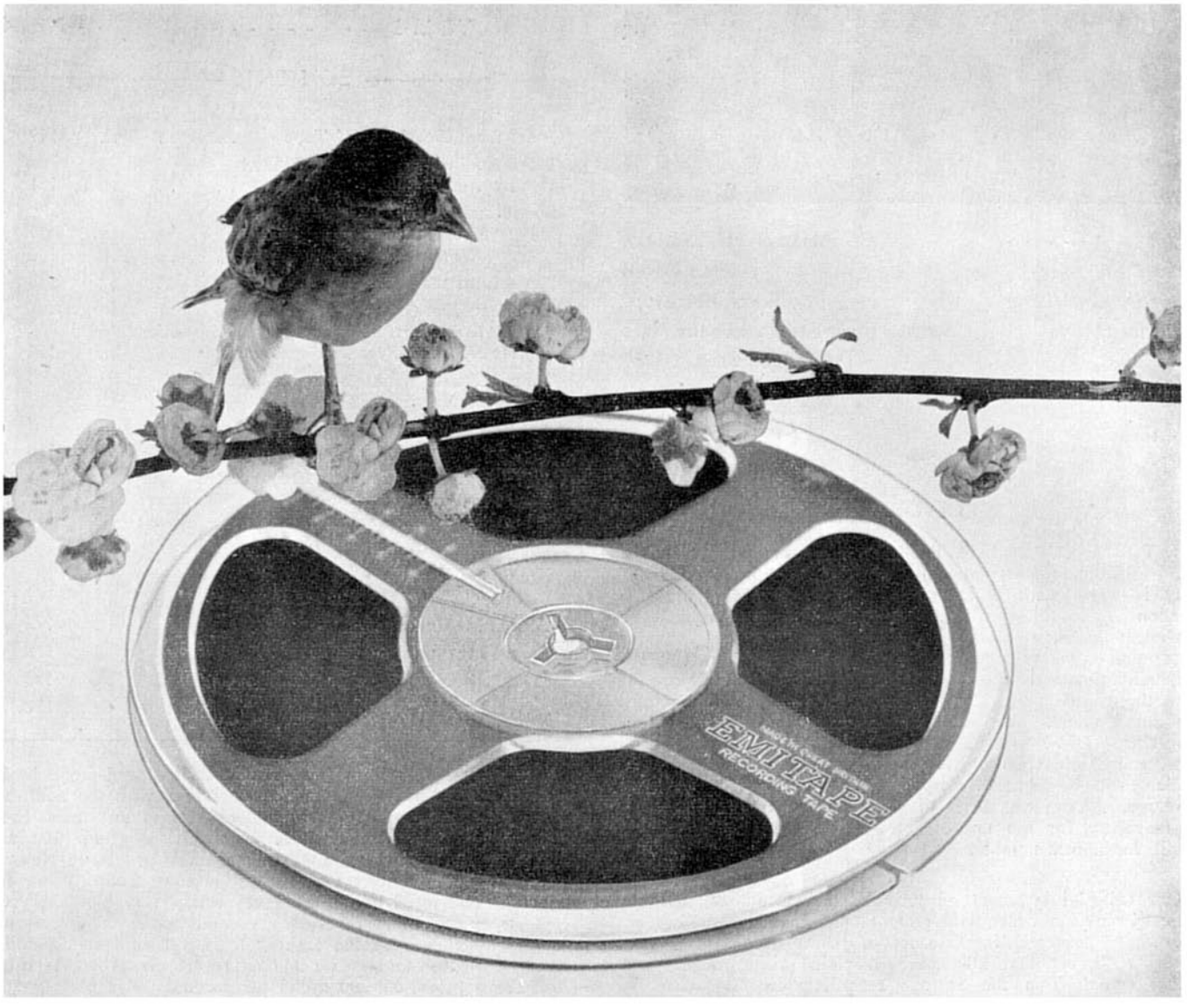

How to find summer with Emitape

This summer, don't leave your tape recorder at home gathering dust. Get another reel of Emitape. Then take it out and about, and give it a chance to hear what's going on in the world.

Children are playing outdoors. Lawnmowers are cricketing. There's birdsong, and a buzz of insects. Mix these and other effects into your own tapes, and hear how evocative they sound. Or try adding an 'on-location' sound track to a cine-film, or to a programme of colour slides.

DON'T KNOW HOW TO START? Then write in for the first of a new series of leaflets, *Tape Outdoors*. It's free! It was written specially for Emitape by John Borwick. And it tells you how to start outdoor recording. Also available—John Borwick's leaflet on *Tape Indexing*.

Get another reel of **Emitape**

Please send me your free leaflets, *Tape Outdoors* and *Tape Indexing*, by John Borwick.

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E.M.I. TAPE LIMITED, HAYES, MIDDLESEX

the TAPE RECORDER

JUNE - - - - - - - - - - - - - - - -1963

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

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CONTENTS

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EDITORIAL

TWO months ago, in this column, we wrote about tape editing and we said that we intended to return to the subject. We do so now. Readers who have been with us since our first number, and who file their back numbers, will know that we published the first of a series of articles on tape splicing and editing on page 21 of February 1959. This very fine series of articles by I. W. Jarman of the BBC was subsequently re-edited and published in booklet form (*How to splice tape*). Thousands of copies of the booklet have been sold, and if we add that readership to our regular *Tape Recorder* readership of five years ago, we know that at least 20,000 people have the professional know-how required for the job. However, even that fairly large total represents only a small fraction of the total number of tape recorder owners in these islands, and we know from countless letters and conversations that the majority of tape recorder users *do not* edit their tapes. The main reason for this is that they do not know that they should. If every tape recorder dealer had made a point of telling every customer who visited his shop during the past five years, the picture might have been a very different one today.

There is something rather shocking in deliberately slicing through a length of tape for the first time. Many readers will think twice—*and not do it*—even after this editorial urge to do so! Therefore, for those who really cannot bring themselves to the point, we recommend the purchase of a small message spool specifically for that purpose. This is not the place for a lesson on tape editing, neither is there space for it here; but if we can instil the desire to " cut and splice " in even a few thousand minds of interested readers, this short column will have done its monthly job very well.

Forgetting for the moment that tape editing is a necessary art when it comes to making good tapes—and incidentally, *saving* a lot of tape in the long run, let us just say that tape editing is an amazingly absorbing pastime in itself, with no end in view other than amusement and satisfaction. It will probably surprise many readers to learn that more interest and genuine entertainment can be found in one evening's tape editing than will normally be extracted from any month's average use of the recorder for recording and playback. This, however, is most definitely true. Further, the ability to cut, edit and splice tape will immediately show up the instrument as a far more interesting and amusing possession than the average owner has ever imagined it to be. One professional recording engineer of our aquaintance regularly entertains his friends with evening sessions of cutting and editing. His star turn is to record a broadcast talk, and then to cut out bits and put them into different places, finally turning the " talk " into a complete nightmare of what it originally was! This trick is, of course, practised every day in the serious course of editing, when a nervous speaker begins with dozens of " ums " and " ers ". Sometimes the tapes are de-ummed and de-erred altogether: and sometimes a few ums are put into place in later parts of the speech (where the speaker has gained his confidence) in order to balance it all out. One professional tape editor once saved all " ums " and " ers " that he had cut out, and then strung them together as a separate, short tape.

For the initial experiments the only necessary tools are a *Chinagraph* pencil (light coloured to show up on the shiny tape back), a pair of scissors and some proper jointing tape—*not* ordinary " sticky tape ", because the " sticky " part of it will be squeezed out by pinch wheel and capstan, and will collect dirt and clog up tape heads. Later, an editing block and a razor blade should be used. By stopping the tape and marking the spot for a cut, and then by re-jointing the cut ends temporarily, rough editing can be done very simply. Tape can be run at half speed to make the trying-out process easier. At first, whole sentences can be removed. Later, with more skill, words can be neatly sliced out and, later still, even the tail ends of odd syllables. And, even later still, a complete dubbing on to a second machine of the edited tape will begin to point the way to the useful and serious end for this art.

One spool of tape, crammed from end to end of its two or even four tracks, is virtually un-editable without a second machine. And so it is that tens of thousands of tapes lie sterile in cupboards and on machines till the interest in the recorder dies. *Three* spools of tape, with two of them recorded on one track only, mean that two can be cut and cut and cut; and the end product will be one usefully filled spool, plus two spools of most usable spliced lengths—and so on and on. We recommend readers to make " the first cut ", and to find out for themselves what a lot of value they have so far been missing. More on this score later.

COVER PICTURE

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

SUBSCRIPTION RATES

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

TAPE AT THE AUDIO FESTIVAL

THE eighth Audio Festival and Fair closed at 8 p.m. on Sunday, 21st April, 1963, after 37,600 visitors had passed through the turnstiles. This figure was lower than last year, but this must have been due to the continuous rain that fell on London on the Saturday.

Altogether seventy-four manufacturers demonstrated equipment in hotel bedrooms spread over four floors of the Russell Hotel. The organisers appear to have realised that demonstration rooms last year were far too close together and it was remedied by taking extra floors. This was ideal from the visitors' and manufacturers' points of view, but it gave one the impression that there were not so many firms at the Festival. As usual the ground floor was occupied by a static display of each manufacturer's equipment. This gave visitors the opportunity of examining the piece of equipment before passing on to the demonstrations.

Live Artistes Featured

Live artistes were featured in two demonstration rooms, those of *Truvox* and *Cosmocord*. The first of these featured a harpsicord played by Mrs. Eleanor May. Stereo recordings were made using two single Reslo ribbon microphones fed into a Truvox PD 87 stereo recorder. Within seconds of the live performance finishing the recorder was brought into action showing how it had recorded this magnificent instrument. After four days at the show it could be said that not once was the Truvox room lacking an attentive audience. The Cosmocord demonstration featured disc and tape. The compere was Mr. R. Wells, who, in a very light hearted way, introduced the various items. A trio consisting of an accordion, guitar and a Spanish guitar player assisted in a "live versus recorded" test. *Acos* microphones were used throughout. The comedy was slightly overplayed and the audience appeared to be embarrassed by some of the items. Several people on leaving the room were hard to say that they had waited a year to listen to equipment being demonstrated and would have preferred a thirty-minutes' programme of a more serious nature. However, it takes all sorts. . . . !

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GEVAERT NEW STYLE TAPE BOXES
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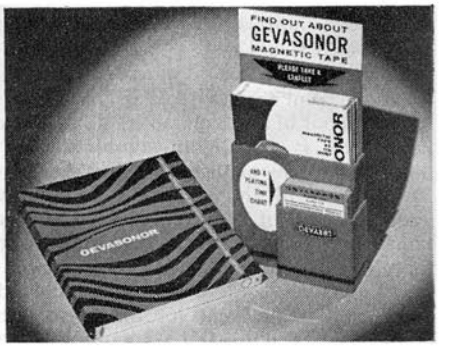

Transistorised Recorders

The slogan of the Festival "You've never heard it so good" seemed very appropriate. The quality of the equipment and the sound produced has certainly improved since last year, another point worth noting was the fact that although manufacturers of pre-amplifiers, amplifiers and tuners seem to be rather loathe to move on to transistors, tape recorder manufacturers have not wasted any time. *Philips, Grundig, Clarke and Smith, Garrard, Fi-Cord, Loewe-Opta, Siemens Norge, Butoba, Sony, Stuzzi*, not forgetting the microphone manufacturers *Lustraphone, A.K.G.* and *Grampian* all featured transistors in some of their equipment.

Tape Demonstrations

Tape manufacturers also put on some excellent shows. Agfa, with the use of a 21 in. cathode ray tube and an excellent lecturer in the shape of Mr. D. S. Cox gave an impressive demonstration of the standards that have been reached by this company. In simple language, so that every visitor could understand, it was explained what was meant by signal to noise ratio, distortion, drop-outs and print-through. These were illustrated by black-and-white images on the cathode ray tube called a "Visualiser". *M.S.S.* with a demonstration entitled "This is your Tape" gave the enthusiast the opportunity of hearing comparisons between tape manufactured in 1959 with the tape manufactured today. Three recorders were used to show how a drop-out compared on ¼- and ½-track machines at various speeds. Bias was also dealt with with the help of an illuminated board showing the effects obtained by increasing and decreasing the bias voltage. For the technical enthusiast a drop-out counter produced by *M.S.S.* was in operation in the room. B.A.S.F. featured a complete four position tape language laboratory and visitors had the opportunity of hearing what happens when this latest aid to teaching is used. For those interested in tape exchanging a booth was provided and tape supplied for messages to be sent to relatives and friends at home and abroad. The main theme of the *C.B.S.* stand was the new range of tapes produced for ¼-track heads. Mr. L. Guest gave a programme entitled "High Fidelity in Sound and Colour" in the *Gevaert* demonstration rooms. This consisted of music recorded on Gevasonor tape and colour slides on Gevacolour film.

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A.K.G. C 12A CONDENSER MICROPHONE
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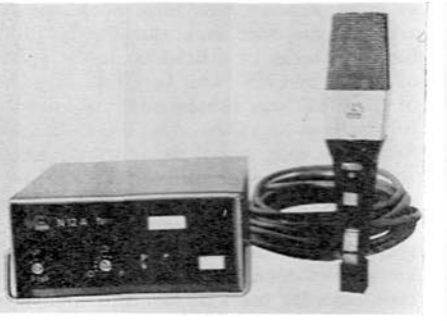

Other Manufacturers Showing Tape

Other firms showing and demonstrating tape included *E.M.I., Zonal, Irish, Scotch, Ampex* and *Sony*. With such a wealth of tape manufacturers in this country it is surprising so very little is used by individuals who appear to consider tape non-expendable and non-cuttable.

Returning to tape recorders, possibly one of the most interesting was the *E.M.I.* 311 professional recorder believed to be the first tape recorder in the world to have a head block that can be reversed to meet both American and English standard. Other recorders featured included the RE 321, TR 90 and TR 52/2. *Vortexion* with their C.B.L. stereo recorder fitted with the latest stereo deck aroused much interest as did their mixers. Turning the faders on the units gave the impression that everything was encased in oil. Judging by the comments of some

TAPE AT THE AUDIO FESTIVAL

of the visitors in this room some bank statements will go from black to red! *Brenell* with the Mark 5 Series 2 and the STB 1, two newcomers to the show, proved that as one of the first manufacturers in the tape recording field they are still very much up at the front. *Ferrograph, Tandberg* and *Revox* gave their usual impressive demonstrations. The *Grundig* room was always full of keen interested enthusiasts studying the new models produced during the past year. The TK 46 stereo and TK 41 recorders collected most attention. *Philips,* on the other hand, with virtually a complete new range of recorders since the last Festival gave visitors the opportunity of hearing some of the recordings made on transistorised machines.

Clarke and Smith with the TR 634 and TR 635 featuring the Wearite and Truvox decks respectively. Both machines use speeds of $7\frac{1}{2}$ and $3\frac{3}{4}$ i/s and are two track. 10 watt outputs allows the machines to be used in large halls and schools without the use of additional amplifiers.

Radio Controlled Microphone

A radio controlled microphone developed since last year's show was featured in the Lustraphone room. A roving reporter was sent into the park opposite the Russell Hotel and excellent results were heard at the receiving end. A reverberation unit, produced for use with tape recorders and amplifiers was demonstrated by *Grampian.* Using a Ferrograph recorder this unit, which can be remotely controlled showed the varying amounts of reverberation that can be obtained. The unit completely transistorised, operated from one 9 volt battery.

Two completely new microphones were to be seen in the *A.K.G.* room. The C 12A condenser and the D 77A Dynamic Stereo microphone. Although the price of the condenser is possibly too high for the average individual at £139, the D 77A is modestly priced at £15 10s. *Standard Telephones and Cables*

★
E.M.I.
MODEL 311
PROFESSIONAL
RECORDER
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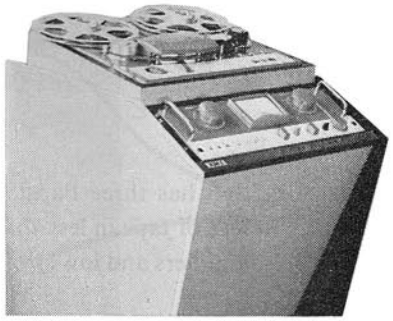
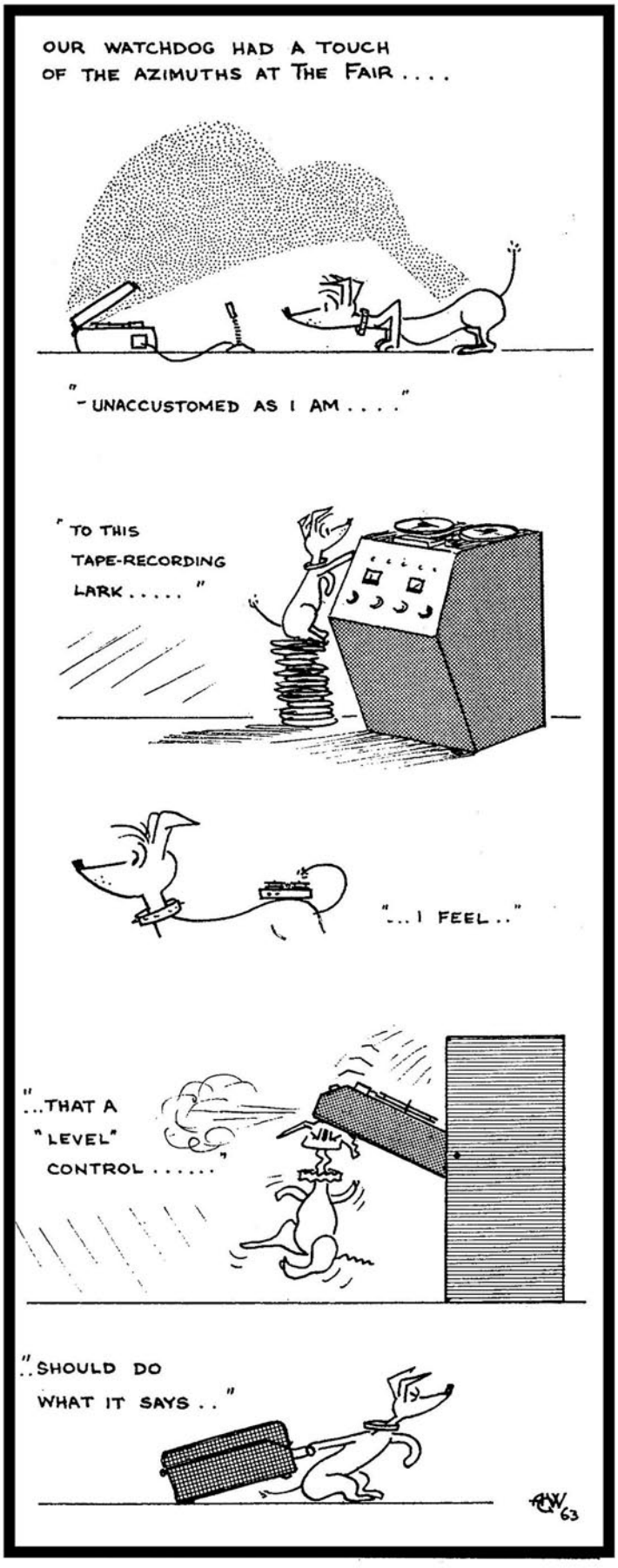


also introduced two new models in the medium price bracket—the 4113 ribbon cardioid and the 4114 moving coil priced at £11 11s. and £3 13s. respectively. Stereo dynamic headphones were also shown for the first time weighing only 10 ozs. and priced at £6 6s.

Summing Up

Summing up, the 1963 Audio Festival once again gave visitors the opportunity of making comparisons between different models on show. It also gave them the chance of meeting the designers and salesmen and even the directors of recording organisations. Searching questions were asked and frank answers given, but anyone contemplating the purchase of a recorder, microphone, mixer tape or splicer in the next few months, must, after visiting this show, have a clearer idea of what is required.



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By R. G. WOODS*

NOTES ON PERMANENT MAGNETISATION OF TAPE HEADS

IN considering the causes of remanent magnetisation of heads one must appreciate that every ferromagnetic material will display the phenomenon of "magnetic remanence", i.e. every preceding magnetic excitation will leave behind a certain magnetic bias.

The strength of the residual magnetisation will depend on the magnetic antecedents, coersive force of the material and the effective permeability of the magnetised circuit. Most recorder heads use very high permeability core material and sensitive heads which do not use rear gaps are particularly prone to high residual magnetisation.

From investigations it has been found that there are several causes which can contribute to this effect; some of these are:—

(*a*) Use of bias frequency having a rich even harmonic content (asymmetrical waveform).

(*b*) Switching surges caused by track switching or change-over from play to record, etc.

(*c*) The passage of D.C. through the head winding such as that caused by leakage current through a coupling capacitor of a transistor input stage or an incorrectly positioned diode rectifier in the modulation indicator stage.

(*d*) The passage of a D.C. magnetised tape over a play-back head.

(*e*) Incorrect dimensioning of head feed stage of an amplifier where sudden high input levels can be rectified and the use of a too high value coupling capacitor to the head feed which transfers large peak voltage impulses.

Close attention to these points can help in reducing remanent head magnetisation but may not completely avoid it and it is common practice to provide for head demagnetisation by

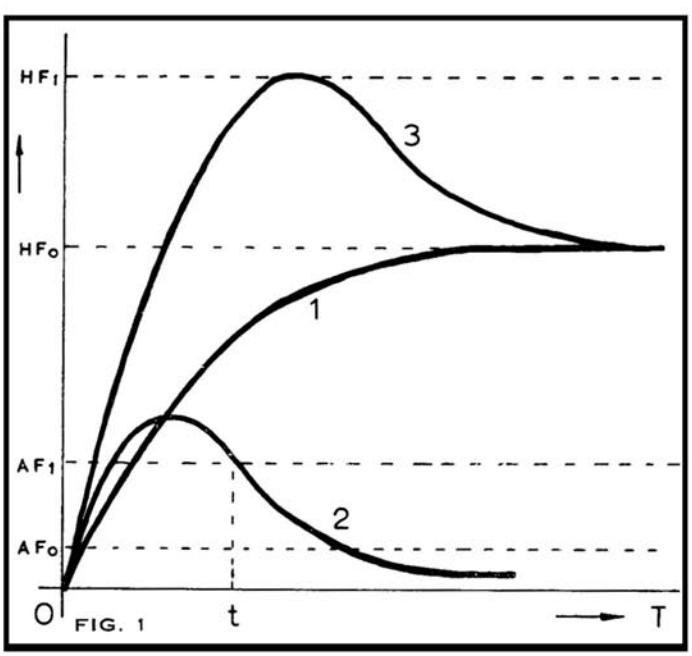

FIG. 1

having a large capacitor in the H.T. feed to the oscillator which will provide a slow decay of the bias to the record head when the record switch is turned *off* Tests have shown that this measure is not always fully effective since magnetisation may occur when the record switch is turned *On* and it can also be shown that the amount of demagnetisation provided by the set bias level is usually insufficient to demagnetise the head to a level below which its effect is not noticeable.

Details are now given for a simple circuit modification which can be arranged to overcome these defects.

In this circuit the demagnetisation of the record head is effected when switching *On* to record by arranging that bias

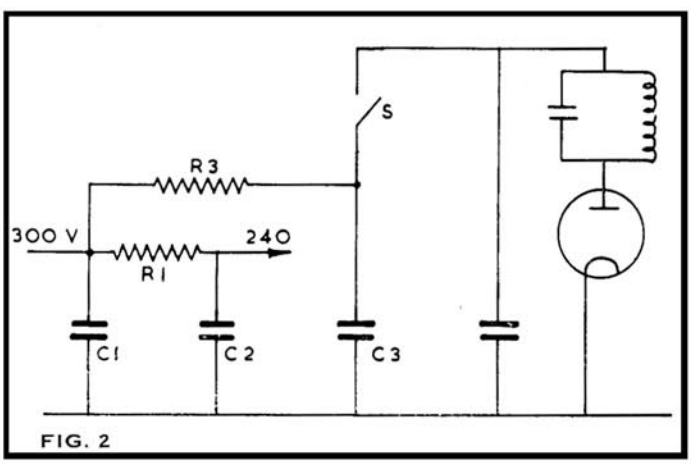

FIG. 2

level is momentarily increased to a much higher value over a time period longer than that of any "switch on" magnetising impulse. Operation of the circuit can best be explained from **fig. 1.**

Normal Operating Bias Level

The normal operating bias level of the oscillation is shown as curve 1 where it is seen to rise gradually from switching *On* at T=O to a steady value HFo. Now the maximum operating AF current to the record head is represented by a level AFo. From experiments it is found that the maximum permissible D.C. impulse level (that will not magnetise the head with the given bias level) is shown as AF1.

If on switching *On* an impulse (curve 2) is generated which exceeds the maximum permitted level (AF1), magnetisation of the head will occur, but if the circuit is arranged so that there is a temporary *increase* in bias level (curve 3) the duration of which is longer than the D.C. impulse (say up to it) then the D.C. impulse will be harmless.

A Simple Circuit

A simple circuit is shown in **fig. 2** which performs this function. The components C1. C2, and R1 are the normal HT supply filter arrangements where an elevated HT of approximately 300 volts is available at C1 from the rectifier. This high voltage is applied via a resistor R3 to a storage capacitor (50-100μ FD) C3. When the switch contact *S* is closed for recording operation, the oscillator receives the full increased HT for a time period dependent on the time constant of the circuit after which the voltage falls due to the passage of current through the resistor R3 to the normal operating level of the oscillator which corresponds to the predetermined bias level.

This circuit is given for its simplicity but quite obviously other arrangements can be used to give the same effect.

* *Miniflux Electronics Ltd.*

TAPE RECORDER SERVICE

No. 18 FERGUSON FTD3 AND FTD4

By H. W. HELLYER

Ferguson 3202 *Four-track Recorder*

IT was a bold venture by Thorn Electrical Industries, in mid-1962, to bring out, in quick succession, two versions of a British-designed tape deck in their medium priced tape recorders.

Bold, because this was by no means the most affluent period in the trade, and because the existing models which used the popular B.S.R. deck (the 441 and 445) were quite competitive. Indeed, most of the machines on the popular front were based upon one of the principal three—B.S.R. TD2, Collaro "Studio" and Garrard Magazine deck. We cannot assess the economic result of this venture, and can only wish their enterprise the luck it deserves. We can, however, take a look at the special problems of servicing that may arise, and point out the individual features of the Ferguson decks that are worthy of attention.

Two Track Machine

The FTD3 is a single-speed, two-track deck, which was first fitted to the Ferguson 3200 tape recorder. With a 3¾ i/s speed, spool size of 5¾ in., and a Rewind time of 2½ minutes in either direction, this single-motor deck is built to meet standard requirements. There were several features incorporated to give it that little extra which will appeal to the enthusiast: an EM87, fast-rise recording level indicator; digital tape position indicator with a reset button, and a "decay" switch setting that comes into action during rewind or "off" to help reduce the effect of head magnetisation. There are also inching and pause facilities and a very easy form of piano key control.

For the benefit of owners who wish to know more about their machine than is published in the sales brochures, we might add the following specifications. Wow and flutter: better than 0.2 per cent. *rms*. R/P head impedance, 500 mH, (D.C. resistance 300 ohms); Erase head impedance 0.5 mH (D.C. resistance 1.7 ohms); Bias frequency, 55 kc/s. Frequency response 60-10,000 c/s ±3 dB. Bias voltage is 25 volts, measured across the head with a valve voltmeter, and the erase voltage is 40 volts, measured in a similar manner. The signal-to-noise ratio is better than 40 dB, input sensitivity: microphone, 1.5 mV into 10 Mohms; radio, 1.5 mV into 22 Kohms; pickup, 75 mV into 1 Mohm. Output levels are: radio, 500 mV at 22 Kohms; ext. 1/s, 3 watts into 3 ohms.

The principal mechanical features are shown in **fig. 1.** To forestall criticism, I should again point out that the drawings in this series of articles are prepared from my workshop notes and are not precision layout diagrams. What they lose in exactitude, I hope they gain in presenting the basic information necessary to underline these service notes.

Spring Tension

It can be seen that this is a lever-operated deck, and a number of springs are incorporated for positive engagement and lever return. It is important that these springs are correctly tensioned and that levers are free to move properly. There are two main strictures: levers should not bind at pivot points, especially where circlips are used for holding in place; and over-enthusiastic lubrication should be avoided. Excess of grease and oil on moving parts is one of the bugbears that the service engineer comes to expect. It picks up dirt and ultimately causes an aggravation of the very fault it was first applied to prevent! The only parts requiring occasional—very sparing—lubrication are the spool bearings, intermediate wheel bearings and the upper bearing of the flywheel. A clean, dry, polished surface is the best finish for other moving parts.

The deck is easily removed. Control knobs pull off, as does the moulded cover protecting the heads, then the four screws securing the top cover can be released and the cover lifts from its location in the grommets set in the top plate of the mechanism. There are two screws securing the socket panel cover and the voltage selector "window" and two screws at each side of the top plate. Remove these, and the whole assembly can be lifted clear. The loudspeaker can be disconnected, if required, by pulling off the tags. No soldering is needed—but

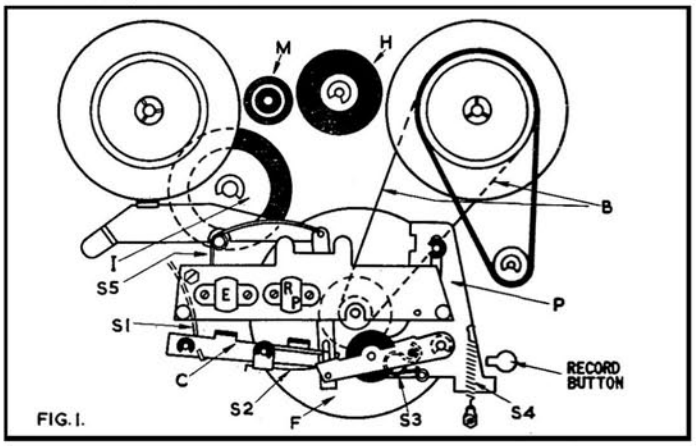

FIG. 1.

there is one point worth mentioning, which applies to all decks. When servicing, always reconnect the loudspeaker, either by removing it and joining the original wires, or by fitting an extension lead. This gives protection to the output stage, which should never be allowed to operate unloaded. Switching transients, etc., can do immense harm to an output transformer, and output valves, like technical writers, dislike hollering into a void.

Alternative Motors

The printed circuit board comes away from the base of the mechanism if it is required to get at the components, but if this has been disturbed, take great care with the location of the switch bracket. With the board in position, the switch lever arm should just touch the baseplate. The method of adjustment is to slacken off the two screws in the plate near the front edge, and adjust the board itself until this condition is achieved. The fixing holes are slotted to allow for this adjustment. Finally, retighten the two screws.

Note that there have been alternative motors fitted. On some early models, the motor had a 0.7 in. lamination stack. Later models had a 1 in. stack and these were connected to the 225 volt tapping instead of directly across the transformer primary. A larger clutch pad was also fitted on these later models, and some had an adjustment screw in the latch plate, which will be described later, when we come to the two-speed version.

On the single-speed machine, the intermediate wheel *I*, in **fig. 1**, is brought into contact with motor pulley and flywheel, to give primary drive. The diagram does not show a third dimension, but the relative depth of these parts is evident as soon as the deck is inspected.

The idler is mounted on a plate, with lever movement pivoting

TAPE RECORDER SERVICE

No. 18 FERGUSON FTD3 AND FTD4

By H. W. HELLYER

it into place and a spring, located beneath the right hand spool carrier, which supplies tension to the upper corner of this plate. A clutch belt *B* drives the right-hand take-up pulley from the flywheel *F*. If take-up is erratic or sluggish, check that this belt is correctly positioned, especially on the small pulley section of the flywheel.

Pressure Pad Assembly

There are four other important springs, denoted on **fig. 1** as *S*1-5. When the Record/Play key is depressed, the operating plate *P* moves forward against the tension of spring *S*4. The pinch wheel is carried in to engage the flywheel capstan and pressure is regulated by the movement of the plate and bracket, aided by *S*3. If this spring relaxes (a similar fault to the operating arm spring on the BSR tape deck), the pinch pressure may be inconstant, leading to wow. Usually, this spring has a reverse effect if damaged; the return action to neutral when the Stop Key is depressed becomes sluggish. But note that the pressure pad assembly is interconnected, and the lift-off spring *S*2 can impose too great a pressure on the pinch wheel bracket if the pressure arm bracket is binding. Engagement of the pressure bracket *C* is aided by *S*1.

The pause brake is coupled to the operating bracket by *S*5, sufficient braking power being applied by a single pad to the left-hand spool carrier, the lower end of the bracket holding off pinch wheel and pressure pad assembly while the key is held. These "wire" springs are especially vulnerable, and no attempt should be made to regulate the various pressures by bending them. Hardened steel cannot be reformed without annealing and re-tempering, so a spring that has to be bent is invariably weakened. Tension springs are a different proposition: they

★

FERGUSON MODEL 3200 SINGLE SPEED TWO TRACK RECORDER

★

can be stretched slightly by opening the pitch of the turns, but an increase in tension is best effected by cutting a small portion from the end of the coil spring and then adjusting by slight expansion. Obviously, care must then be taken that too much is not lopped off.

Latch Plate Mechanism

The next important part of the mechanics is the latch plate beneath the operating keys. This has a locking action when any key is depressed, and is neutralised by depression of the Stop Key. Two springs assist this double action. Referring to **fig. 2,** these are *S*1, the brake link spring, and *S*2, which provides the upward pressure. If the keys do not lock into position when

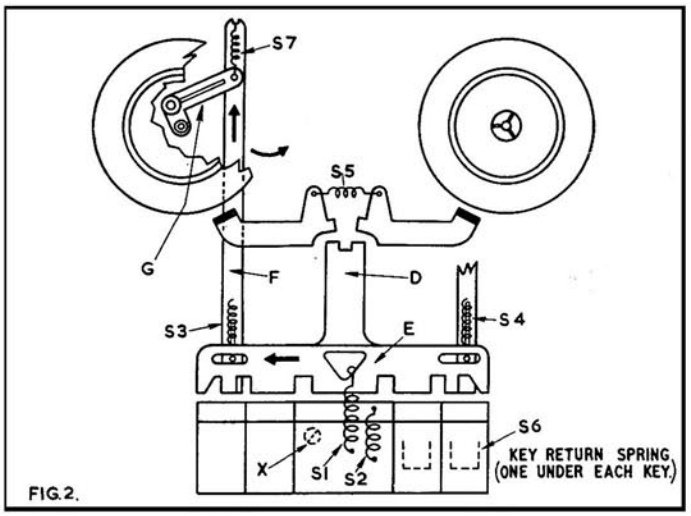

FIG.2.

depressed, the latter spring may be at fault. But note that the pressure of this plate can be adjusted on the four-track deck and also on some later production runs of the two-track. A screw will be found (dotted *X* in **fig. 2**) and should be adjusted until the plate clears the bottom edge of the control keys by 0.02 in. If the brake link spring *S*1 is dislodged, the latch plate action will be impaired.

Braking Arrangements

Also shown in **fig. 2** is the braking arrangement, and the fast wind spooling links. The brake arms are pivoted, and held off the spool carriers by the forward position of the arm *D*, against the tension of spring *S*5, which acts to assist engagement when this preventative pressure is removed by depression of the Stop Key. The spring *S*1 helps to hold the arm *D* away, and the interlock plate *E* has slots through which the pillars of the brake plate *D* are fitted. This interlock plate slides sideways during Rewind and should be checked if spillage is reported when the brakes are applied at the end of fast winding.

Direct engagement of the left-hand spool carrier with the motor pulley is effected during Rewind by the movement of the spooling link *F* in the direction showed arrowed. It can be seen that this movement pulls the angle arm *G* upward with the aid of *S*7, and *S*3 provides clean return action. *S*4 is the matching spring on the right-hand link, with the rest of the assembly omitted from the drawing for ease of presentation. The action, however, is similar, with the difference that the right-hand spool carrier engages drive wheel *H* (see **fig. 1**), which in turn engages the motor pulley to give the appropriate direction of rotation.

Important Differences

FTD4. The four-track deck has several important differences, but is basically similar to the foregoing. Most important, of course, is the speed change assembly for the additional slow speed of $1\frac{7}{8}$ i/s. There is a bracket and a cam, with two more springs; one for the lift arm that changes the level of the idler wheel, and the other from the secondary arm on which the idler rides to the primary pivot point. If speed changing is not in order, check that the ramp has full movement and that this latter spring is not relaxed.

Other differences are the additional braking arrangements, with two solenoids. One is for the facility of remote control pause, the circuit of which is shown in **fig. 3,** and the other is the main braking solenoid. The solenoids are powered by a 32.5 volt negative and depend on the discharge of the 450 microfarad electrolytic capacitors for the high starting current. The "Holding" current is then supplied via the series resistors. Action is initiated by short-circuiting the series circuit; in the case of the Stop solenoid, by the metal foil of the tape leader; the Pause solenoid is operated by remote switch *S*1. Note the safety device of the series switch *S*2. The purpose of this is to avoid inadvertent action of the Pause mechanism while switching the machine between functions (when switching from Record/

(*Continued on page* 198)

TAPE RECORDER SERVICE—(continued)

Play to any other function, particularly). The circuit is rather more complicated than as shown, having an auxiliary socket position and continuation through the microphone plug and socket. Setting of the solenoids is done with the R/P switch depressed.

The Stop solenoid link screw is adjusted until the latch plate just trips to release the key, provided that the setting of the latch plate—as described earlier—is correct. The Pause solenoid, energised, should have correct braking pressure and should allow a clearance of between 0.01 and 0.015 in. between the pinch wheel and capstan.

Note that the pressure pad assembly also differs on this deck, having a rocker pad and direct linkage to the pressure bracket.

Different Heads

Some models, bearing the suffix *M*, had other differences. Alternative heads were fitted. It is important, if carrying out subsequent modifications to bring machines up to date, to check that there is a clearance of 0.09 in. between the head face and screen, and that the erase head is level with the edge of the mounting plate.

An alternative oscillator coil, with a white spot, may be fitted. In this case, three capacitors may be changed in value to 50 pf. These are the 220 pf across the head input (erase), the 220 pf

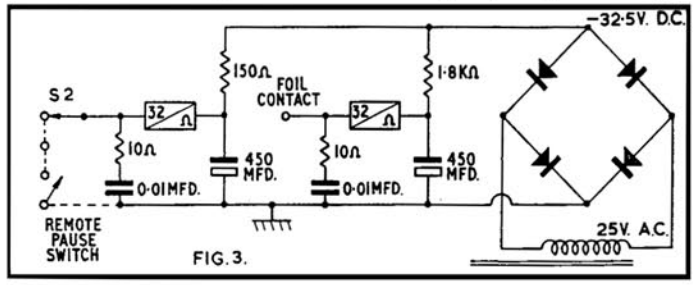

FIG. 3.

from the oscillator coil to the head switch and the superimpose bypass, normally 100 pf, which shunts the oscillator coil to chassis, and which is beneath the switch.

Once more, lack of space prevents our going into the electronics of the two principal machines that employ these decks, but a final note should be made about Hum.

Humdinger Fitted

A humdinger (200,000 ohms, wirewound preset resistor) is fitted across the heater winding of the transformer, with the tapping taken to chassis. This should not be disturbed, normally, but if valves are changed, some regulation may be necessary to reduce hum pickup. First, remove the tape spools, switch to Record and turn the tone control to minimum, gain to maximum. The chassis should be electrostatically screened (do not disturb the input stage screening). Connect a sensitive valve-voltmeter between the junction of the 0.05 mfd (0.02 mfd in earlier models) connecting to pin 9 of the ECL86 and the 0.04 mfd that joins it and chassis. Short out the 1 megohm resistor to the tapping on the oscillator coil to stop oscillations. Connect a dummy input of 1,000 pf between pins 4 and 5 of the microphone plug. Adjust for minimum reading on the meter. Approximately 50 mV should be expected.

Important Note

As with all electronic tests on tape recorders, remember to allow the machine to warm up for at least ten minutes before making any adjustments.

SOUND AND CINE

STUDIO FILM CRAFT FOR ACTORS

By RICHARD GOLDING

The photograph on the right shows one of the leading students at the Television and Film Craft school taking part in an "Emergency Ward 10" type setting.

IT is fashionable to make comparisons between the various international film technique schools, to compare the merits, say, of the Centro Sperimentale in Rome with the Polish school at Lodz, and to lament the lack of similar establishments in our own country. It is the lot, also, of some of our film intellectuals to campaign unceasingly for the setting-up of a national, State subsidised, film school here where the curriculum would follow that of Lodz with its five faculties: Direction, Camerawork, Theory and Criticism, Production Organisation, and Acting. This course, at Lodz, lasts four years and costs the State £100,000 a year to run and if each student were to pay his own fees, board and lodging, and filmstock costs he would need over £3,000 to cover him for the four years. There is no doubt that the Polish Film School is a great success and that the present high prestige that the Polish feature film enjoys is due in part to the high quality of these young technician graduates who have been accepted readily by the industry. We must remember, however, when we make these comparisons that Poland had no studios, no equipment and practically no technicians at the end of World War II and virtually had to start from nothing.

A.C.T.T. System of Grading

With the British film industry we have a different situation entirely. The main studios have been running continuously for a great number of years, there is no shortage of quality technicians, the A.C.T.T. system of grading seems to work to satisfaction and there are dozens of training schemes all along the line. Some Polytechnics run film technique classes as an extension to their still-photography courses, there is the London School of Film Technique with a full-time six months' practical Cinema course and then there are the Television training schools.

What we do not have, and this seems to me to be important, is some sort of intensive training school for actors. Some drama schools do dabble but there seems to be precious little specialisation and we are faced with a situation where, in a country where Film and Television now predominate, we have a large number of actors emerging who know everything about movement under the proscenium arch but nothing about movement in front of a camera.

Spare-time Hobby

This sort of situation is not only frustrating for the actor but also for the film casting director when placing new talent. One such casting director, Ronald Curtis of Merton Park Film Studios, has sought for a number of years some way out of this problem. As a professional with thirty years' experience in feature films and all kinds of documentaries he knows only too well what the young, inexperienced actor is up against when he applies for his first film part and just how much a completely new technique is required when acting for the film.

To help both himself in his casting problems and the young actor, too, Ronald Curtis began teaching film acting technique in his spare time as a hobby in Max Rivers' rehearsal rooms. The experience was most rewarding but not complete enough for there was a lack of suitable equipment and adequate space for permanent set building. Late last year, however, he decided that the only way to back theory with extensive practical work was to set up his own professional filmcraft school.

The Auricon Sound-on-Film Studio Model 16 mm Camera

In November 1962, he found a suitable suite of rooms at Laystall Street and there he started his Television and Film Craft School. He decided that the course should revolve around one practical asset—a filmed record of the student's progress—a talking example of what the actor's capabilities really were. With this film in his possession, an actor, desiring a specific part, could simply show the casting director how he shaped in certain roles, how his voice sounded and how he moved in the limited space. A living testimonial of his ability. The obvious choice in equipment was a film camera that could shoot lip-sync dialogue and the first buy was the new Auricon Sound-on-Film camera. This 16 mm recording camera is fitted with a magnetic head for recording on pre-striped film inside the camera. The complete outfit consists of camera, headset, microphone, amplifier and a constant speed motor. Six-hundred feet magazines are used giving a run of 16½ minutes at 24 f.p.s. The 10-1 Angenieux Zoom lens with 12 mm to 120 mm was chosen to complement the camera by reason of its versatility. Other equipment included a Vortexion tape recorder and Film Industries microphone for use in rehearsals and commentary training, a full range of lights and a variety of flats, staging and other useful properties.

Fencing Instruction

Ronald Curtis himself was the obvious choice for the school director and chief lecturer but he needed experienced personnel to back him up. Tony, his son, who also works for Merton Park Film Studios offered his assistance as art director, a field he is experienced in having served his apprenticeship with one of the leading architects, Mr. A. J. Northcliff. The actor, Tony Wall, was appointed to take charge of commentary reading, Voice-Over tuition and all sound matters. Jack Craig, a well-known make-up man, was brought in and the lecturing team was completed by Ian Mackay as fencing master. Fencing plays a large part in the instruction of correct movement and is not taught primarily for those who are required for swordplay.

(*Continued on page* 201)

STELLA SUPREME!

NEW 4-SPEED, 4-TRACK STELLAPHONE GIVES 34 HOURS' RECORD/PLAYBACK WITH SUPERB SOUND QUALITY

Meet the great new Stellaphone – Model ST 459! This – the most magnificent tape recorder in the whole Stella range – is a truly impressive instrument that features no less than four international tape-speeds: 15/16″/sec., $1\frac{7}{8}$″/sec., $3\frac{3}{4}$″/sec., and $7\frac{1}{2}$″/sec. In conjunction with the latest 4-track recording technique, the ST 459 can therefore achieve no less than 34 hours' playback with a 7″ reel of DP tape.

4 SPEED

4 TRACK

34 HOURS

Other notable advantages include: Unsurpassed sound quality at all tape speeds from 5″ x 7″ elliptical speaker • Fully labelled controls for easy operation • Unusually 'clean' and tidy deck layout • A transistorised amplifier cuts the weight of the complete recorder to only 26 lbs • No warming-up time required • Stereo socket giving, with additional equipment, facilities for duo-play, multiplay, and stereo replay • Wooden cabinet covered in washable two-tone PVC cloth • Supplied complete with sensitive moving coil microphone, reel of 7″ long-play tape, and an empty take-up spool

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62 GNS

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The Curriculum

The course was split up into twelve evening sessions of two hours each lasting over six weeks and took the following pattern:

Lesson 1. Script reading. Camera lecture. Studio procedure. Interviewing with tape recorder. Fact finding and corrections.

Lesson 2. Film and Television make-up. Recap on first lesson using Studio "Know How" sheets. Continue make-up lesson.

Lesson 3. Camera positioning. Rehearsal of given scripts. Layout of scenes. Run through for recording of Commercials. Questions.

Lesson 4. Continue lesson three with artistes word perfect. Rehearsal of acting scene and Commercials. Questions and Talks.

Lesson 5. Timing dialogue for acting scene. Acting Commercials and recording scene. Speech correction and use of words.

Lesson 6. Continuation of the fifth lesson.

Lesson 7. Fencing. It is essential that in all film and TV work the Artiste obtain a rhythm of movement with a preconceived idea to co-ordinate the action to dialogue. This lesson is important and a vital part of television film training. It includes certain exercises designed for grace and deportment. The Artiste is taught the fundamental principles of fencing under a skilled instructor. Dress required: black tights, blouse or sweater, white plimsoles and a right-hand leather glove. The lesson is repeated each Monday until the end of the course.

Lesson 8. Completion of make-up lesson. (Artistes now make themselves up.) Mistakes rectified. Continuation of film acting lesson.

Lesson 9. Continuation of Commercials and television lesson.

Lesson 10. Continuation of film acting lesson. Recap on Studio "Know How". Continue acting lesson. Recap on all previous work.

Lesson 11. Movement. Voice recording (Commentaries and Commentators).

Lesson 12. Final recording of memorised commentary and commercials. Complete run through of scenes previously timed and played. Movement—fencing. Questions. Advice and talks regarding Agencies.

The actual production of the film examples takes place on a Saturday or Sunday preceding the last lesson. Students are notified of the time and of what wardrobe to wear. They must be prepared to spend all day at the studios.

Quite obviously, everything is not detailed in the curriculum, for instance, a vital part of Voice-Over is the post-synching to film loops. The school places special emphasis on this training as dubbing to picture is a very difficult process and actors experienced in this technique are in short supply.

The Films

There are three kinds of films produced and of these the most important is the Actor's film. In this he chooses his various roles, portraying, for instance, a gangster in one scene, a comic Frenchman in the next and a Television Commercial announcer in the last. This is the small composite film, lasting perhaps five minutes, which is to help the Artiste sell himself. The second type of film is designed for the Model or Film Employment Agency and can contain up to ten characters. Each character plays a scripted part of his own in a scene of not less than one minute's duration. The third type of film is designed to help the smaller agent and is primarily a parade of his available talent. Agents find these of infinitely more value than the normal selection of stills when sending off information to their clients.

The evening I was there in the studio the atmosphere was quite exciting for one of the actors was tuning into his part as a tough, vicious drug addict who was giving his girl friend some strong-armed treatment. Later I found that this actor was really a professional film stunt man whose ambition was centred on higher things than acrobatics. While I was there, watching, I sat at a most authentic looking bar in the corner. It was dry, of course, for it had been constructed as a set but it had the most fabulous collection of bottles that it just about gave me the thirstiest evening of my life. It had been left as a permanent fixture because it looked so good. And there at the bar I had the opportunity of discussing the course with an actor. "For me," he said, "the most vital part of the whole business is the example film one receives at the end of it all. It is a valuable record of my progress but, more than that, I now have visible and immediate evidence of what I can do. I can, if needed, even send the film off to New York if there is a part going which I think I can fill and all that it will cost me is the postage. Of course, in the first place, there is the expense of the course and the filmstock but this is only a fraction of what I would normally spend for a year's supply of good still pictures."

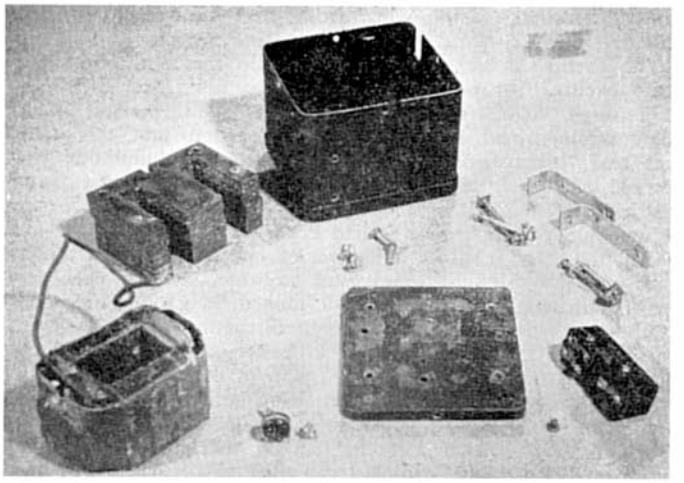
More Than a Commercial Effort

I left with a most agreeable feeling for the whole enterprise for it seems that Ronald Curtis regards this as much more than a commercial effort (the initial outlay on equipment is going to take a long time to be recovered in any case). In fact his last words were: "It's no fun working with anyone who hasn't got it!" I applaud his attitude for it seems that he, at least, is taking a step in the right direction. The address: Television and Film Craft Ltd., 10 Laystall Street, E.C.1.

BULK ERASING— WHAT, WHY, HOW

BY JOHN BERRIDGE

The increasing popularity of the degausser has put it well up on the list of required accessories. Here is an explanation of its function and details on building a simple one.



The bits and pieces necessary to assemble a simple but effective bulk eraser. Not shown is a length of mains cord and appropriate plug, plus the remaining parts of the transformer which were not used.

THE disadvantages inherent in erasing a tape to the blank state using the erase head built into the recorder are many and arguable, but the main one is the impractical length of time involved. For this reason more than any other, bulk erasers of one sort or another are becoming regarded as an essential accessory to the serious recordist. The pros and cons of both methods will be presented later in this article, and since recorder erasure has been well covered over the years in many articles, I will not touch on it here.

The What

One important aspect of magnetic tape erasure is frequently overlooked. There is no simple way to demagnetise the applied magnetisation *directly*. You cannot simply remove the magnetic signal (an inaccurate phrase I realise, but not ambiguous) in the same sense that you can wipe chalk marks off a blackboard. To continue the analogy, it can only be done by filling in the total surface of the blackboard with chalk, so that any markings there previously lose their identity in a sea of white, then wiping off the whole blackboard until all the chalk is removed. In other words, tape can only be erased by the roundabout process of first magnetising it so that all oxide particles are at the same level of magnetisation and then removing this one level of magnetism.

One practical aspect of this lies in trying to determine at exactly what level to magnetise the tape. Rather than try to estimate what field strength was achieved by the strongest recorded signal voltage, it is far easier simply to apply a signal which will magnetise any tape to the saturation point. We simply apply a strong voltage to saturate the tape completely.

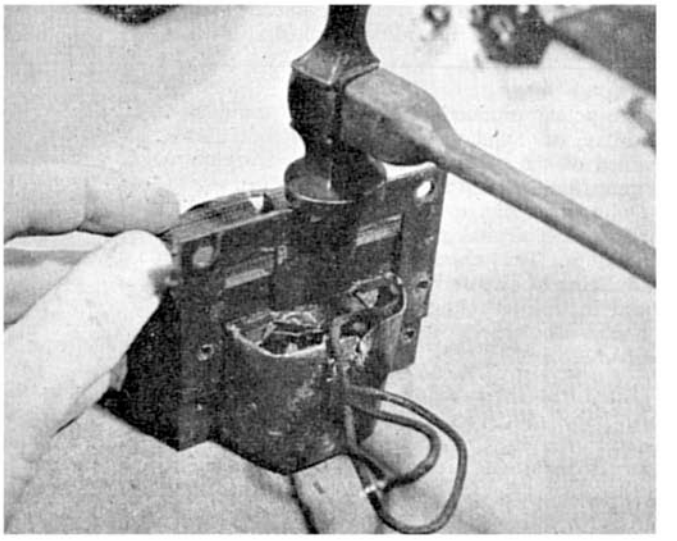
Logically this would seem to be sufficient (and some recorders in the past achieved this state by using a permanent magnet against the tape), since there would be no variation in field strength along a length of this tape, and thus no voltage *variations* across a playback head and no audio information. There will, however, still be a strong steady voltage produced across the head by the motion of a magnetic field past it (the whole principle of tape playback). In practice this reproduces as a pronounced hiss. Furthermore, such a tape will only record a signal voltage of one polarity, that which tends to magnetise the tape in the opposite polarity to its existing saturated state. Any voltage which tends to assist the existing magnetism will not be recorded since the tape is already saturated. To imply the remainder of the logic, such a tape will record only every alternate half-cycle of signal voltage, a state of affairs leading to extreme distortion. Thus, complete demagnetisation of the tape is also necessary.

The Why

Achieving the initial saturation is no problem, it can be done with a permanent magnet or a strong D.C. electro-magnet. Let us examine what happens, however, when we use an A.C. electromagnet. We also assume a voltage strong enough to produce a saturable field.

At the peak of the first half-cycle of voltage, the field will saturate the tape in one polarity, at the second peak it will be saturated in the reverse polarity. Successive half-cycles keep reversing the polarity, each time saturating the tape. The first requirement of erasure is answered every half-cycle. Halfway between the two extremes of saturation is a state of zero magnetisation and if we could arrange to turn off the electromagnet at the precise moment that the magnetisation has been brought to zero, we would then have a completely demagnetised tape. Quite obviously, this is a practical impossibility, but this continual cycling of magnetisation can be viewed from another aspect.

As the oxide particles cycle from saturation in one polarity to saturation in the other and back, the average level of magnetism over a long period is zero. Once the tape has been saturated and all previous magnetic signals obliterated, this average level of zero will hold true for any field strength right down to zero over a long period. This is the crux of the bulk erasing process. If the field from the electromagnet, which keeps magnetising the tape to saturation, can be reduced to zero slowly enough then the level of magnetisation will end up at zero and the tape becomes completely demagnetised, and the erasure process is complete. Slowly enough means at such a rate that there is relatively little difference, no more than a few per cent., between the amplitudes of successive peaks of field strength (and therefore of applied voltage). For example, if there is a 5 per



All the E laminations are replaced in the former facing in the same direction, with the last few tapped in gently to avoid cutting through the insulation. Tapping on a flat surface will also line up the bolt holes.

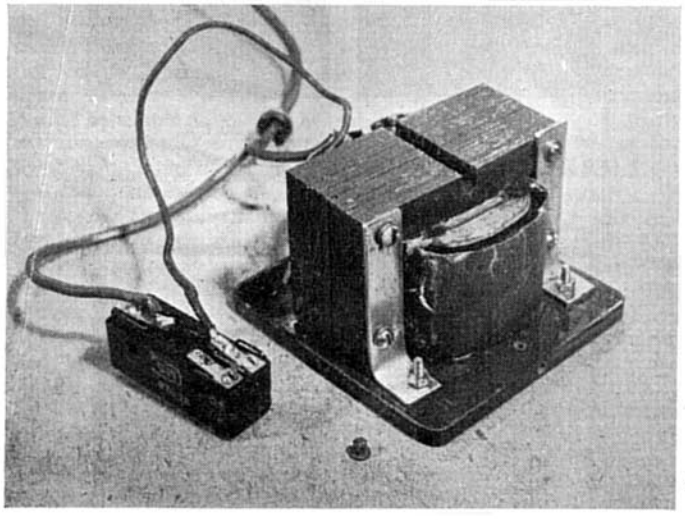
BULK ERASING— WHAT, WHY, HOW

cent. drop in amplitude between peaks then zero will be reached in 20 cycles. Let us say then that we can accomplish erasure in no less than 25 cycles (just for convenience). If the applied voltage is a 50 Kc/s sine-wave then the whole erasure can take place in $\frac{1}{2}$ millisecond. Tape can be pulled past an erasure head at playback speed quite easily and still have the individual oxide particles leaving the proximity of the erase field at a slow enough rate to pass through 25 cycles or more. However, I have already pointed out that playback erasing is a tedious method so turn instead to a much larger electromagnet fed from 50 c/s mains.

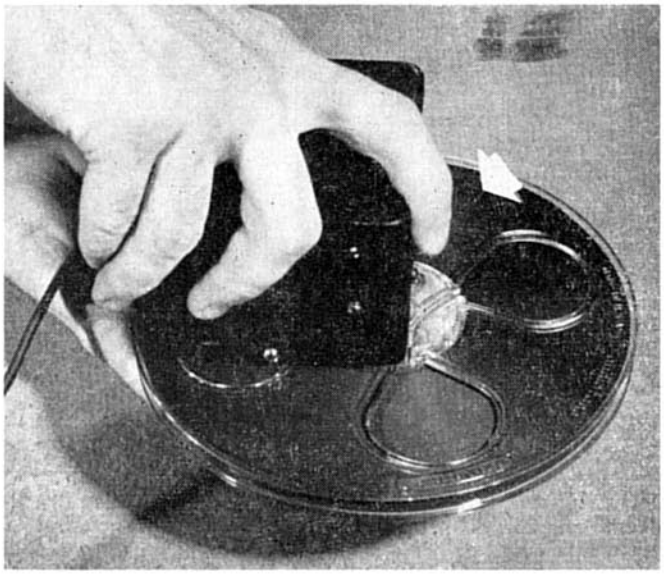
A good-sized coil will put out a heavy enough field to erase even a large reel of tape in very short order simply by passing the coil close to all parts of the tape. Reducing the field can be accomplished in one of two ways. The obvious is by using a Variac (variable-voltage transformer) to decrease the applied voltage to zero. Obvious and practical, but expensive and, as it happens, unnecessary. Since magnetic field strength varies inversely as the square of the distance from source, then the field can be reduced to zero by the simple expedient of removing the tape slowly from the coil. I will outline the handling of a bulk eraser in a coming paragraph.

The How

Bulk erasers are expensive to buy mainly because originally only professional outfits used them and they were therefore specially designed to do the job as efficiently as possible. This has produced a bottleneck since this very price system has prevented the average amateur from considering them (which would have increased the market and brought the price down). Bulk erasers are very cheap to build, however, and here is how.



Simple brackets are made and the coil mounted face down. The leads from the primary winding (all others are cut back) are wired in series with a push-button switch and the A.C. lead. The small stud in the foreground protrudes through the metal case.



In use the eraser is held in contact with the reel which is rotated underneath it to ensure complete erasure of the tape. The position of the stud for the push-button switch is shown by the arrow, under the tip of the index finger.

The quickest and cheapest way to get hold of a 230 volt A.C. electromagnet is to convert any old mains transformer. Why? Well, both an electromagnet and a transformer are designed to produce a strong magnetic field, the difference being that a transformer keeps it within the bounds of a closed core so that it will induce a voltage in any secondary windings. Open out the core and ignore the secondary windings altogether and the field gets radiated off the open poles of the core quite nicely, turning the transformer into a nice usable electromagnet. It will not be as efficient as a properly designed coil but it does very well for the job of erasing.

Since the secondary windings are not needed, then a power transformer which has been junked because of burned-out secondaries can be resurrected to serve as a bulk eraser coil. Almost every service shop in existence has replaced a bad mains transformer at some time in its history and these can often be obtained for a few pence. And this is one of the very few instances when a cheap component is much better than an expensive one. Good transformers have electrostatic shields, grounded cores and use potting techniques which often solidify the whole thing into one lump. This is excellent as a transformer but this one has to be pulled apart, so pick one of the cheap ones that falls apart just by looking at it. It does the job just as well.

Remove Unwanted Leads

Start by breaking the transformer down into its component parts. Covers and terminal boards (if any) are usually held on by long bolts which pass through holes drilled in the laminations. The bolts will be needed later so be careful not to damage them unduly. Make absolutely sure which are the leads to the 230 volt primary winding and cut off all others, right down to the coil former, they will not be used and could be a nuisance. The best way to remove the laminations is to use a small hammer and old screwdriver to tap the first few out from the coil former (taking care not to damage the former or any windings). Once the first few are free, the rest should be loose enough to be pulled out by hand. This is usually a little messy since nearly all transformers have been dipped in either wax or shellac, so an old newspaper is recommended. The laminations take two shapes, E's and I's and they are usually inserted so that each E (or group of E's) is put in the opposite way to its neighbour.

(*Continued on page* 205)

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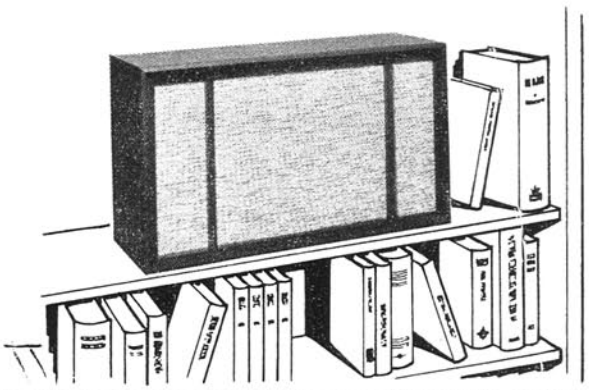
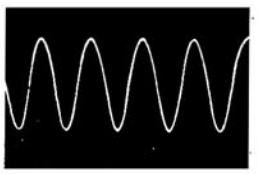
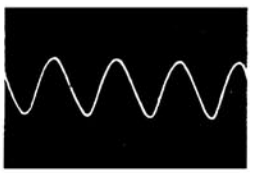


The clean low-frequency performance is clearly illustrated by the wave form oscillograms taken with an input power of 3 watts.



50 c/s



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BULK ERASING — *Continued*

The three legs of each E are bridged by an I forming a closed loop through and around the coil former. At this stage you should now have all the windings, still on the former with all but the primary leads cut off, two stacks of laminations, securing bolts, nuts and washer, and a random collection of covers, bits of wire and such. Out of this you retain the coil, the securing bolts and so on, and the E laminations. Everything else goes in the dustbin.

The E's now go back into the coil former but this time all facing in the same direction (the last few can be tapped in gently and carefully with the hammer). Some more judicious tapping on a hard, flat surface will even up the laminations like a pack of cards and also line up the bolt holes. You now have a perfectly good electromagnet which, when connected to the mains, will radiate nicely off the three pole pieces.

Installing the Transformer

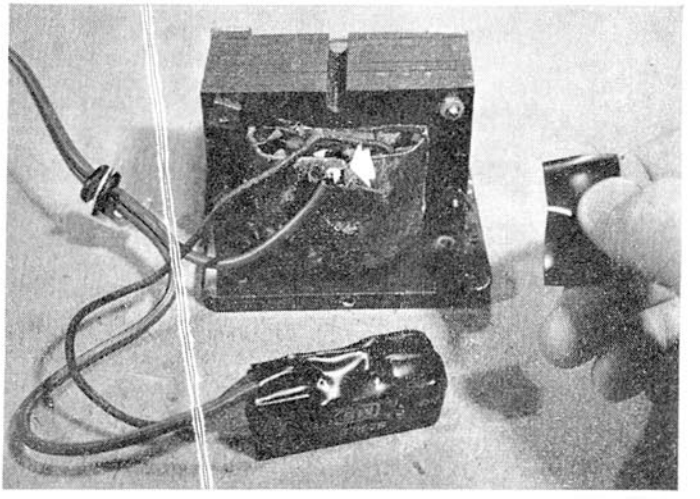
The remainder of the work consists of fabricating (or buying) some brackets with which to mount the coil, and then installing it in a suitable enclosure together with associated wire and an on/off switch (and pilot light if you want to be really fancy). The original covers or brackets could have been used for mounting but were thrown away because they would have acted as a bridge across the pole pieces of the laminations. If any of the original hardware can be used for mounting without this happening, then fabricating brackets will be unnecessary. The ones used by the author were simply bent with a pair of pliers out of strips of alloy, but Meccano brackets would be twice as handy.

The case used here happened to be the right size and came off an old Government-surplus timer mechanism. Its biggest asset was that the base was a sheet of quarter-inch thick phenolic. The coil was mounted on it with the pole pieces facing down and this then became the face of the finished eraser. The phenolic protected the pole pieces without shielding the field radiated from them, and any similar protective face over your own eraser must be plastic. A metal face acts as a shield and destroys the effectiveness of the coil as an eraser. The timer cover on the author's unit was a one-piece metal case, black wrinkle finished and this saved a lot of extra effort, but if you cannot locate anything similar then a light wooden enclosure can be made up in very short order and given a couple of coats of varnish.

Switching

The on/off switch in the unit shown was a microswitch which happened to be part of the original timer. It was connected in series with the coil leads as shown and an A.C. lead which was fed through a grommeted hole in the side of the case. The switch itself was mounted inside the metal case in such a fashion that a small red plastic stud (found in the scrap box) could be used as a push-button to press down on the actuating pin. The whole layout happened to fit into the case so neatly that when the assembled unit is picked up as shown in the final photograph, this push-button comes very conveniently under the tip of the index finger.

Apart from its availability, however, the microswitch was used for a better reason. Not only will it handle 230 volt A.C. without trouble, it is also spring loaded. Now a coil made up in the fashion described here will overheat if left on for more than a couple of minutes. Transformers are not designed to be operated with open cores and unloaded secondaries, and power and losses which are normally absorbed by the load get dissipated in heat. If such a coil were left switched on inadvertently for an hour or so it could easily get hot enough to catch fire. A spring-loaded switch eliminates this possibility, and if you make up your own eraser in the hand-held fashion I have shown here, then it is a good idea to plan the layout (and use a suitable switch type) so that you can operate the switch and hold the eraser with one hand. You may not be lucky enough to come up with the arrangement that I was able to, so planning the layout is a problem that will have to be solved by each individual.



All electrical joints are covered with tape to avoid possible shorts. As shown by the arrow, this particular transformer was rejected because of a short primary lead. The mains lead was soldered to the short length of wire left exposed and the joint was taped down to the outside surface of the insulation.

Such an eraser can, of course, be arranged to sit face up on a table top (with rubber feet on the underside to protect the surface of the table), thus leaving both hands free to handle switches and reels of tape. This is a matter of personal preference (switch placement would not be critical in the face-up version), it makes no difference to the operation of the eraser.

Using a bulk eraser requires a certain explanation. Since the field between the pole-pieces will be strongest in one plane, then tape oriented in one direction will be erased far more efficiently than tape at right-angles to it. The result would be partial erasure of all the tape with the unerased portion coming up every half-revolution of the reel. To avoid this the reel of tape should be rotated across the face of the eraser while it is switched on.

Furthermore, switching the eraser on or off while in contact with the tape will impose a heavy transient on the tape which will be difficult, if not impossible, to remove. It shows up as a regular thumping on any subsequent recordings. As already shown, erasure takes place when the tape is withdrawn slowly from contact (or proximity) with the eraser. Establish a procedure of turning on the eraser, bringing it and the reel together and rotating the reel a few times then, still rotating the reel, separate them slowly for three feet or more before turning off the eraser.

Even such a simple degausser as this should reduce the residual noise level of the tape to a level much lower than can be achieved by even a good erase head. In fact, bulk erasing brand-new tape can lower its noise level to a measurable extent. Bulk erasure, or degaussing if you prefer the word, should be a standard procedure for the serious tape fan.

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No. 47 MIXER UNITS

by A. Bartlett Still

THERE is one subject that continually excites interest amongst readers—Mixer Units. This is, after all, understandable in view of the usefulness of a mixer unit as soon as anything more than a completely straightforward recording is required. There are a few commercially designed and built units available, but requirements vary so widely that no maker can ever really hope to sell the sort of quantities that a low price requires.

This sort of accessory would seem to be an ideal subject for this column, and I have, in fact, devoted space to mixer units on a couple of previous occasions at least. However, that does not preclude me from having another look, and putting forward what I hope are some fresh ideas on how you can build the sort of unit that *you* will find useful, in spite of the fact that your ideas on the number and type of channels, etc. may be shared by few others. Nevertheless, certain fundamentals exist, and these may be used to establish a number of "building bricks", any of which can be put together to produce the desired combination.

Outputs

Let us consider the output first. The output impedance should be low, so that we can use a useful length of cable between the unit and the tape recorder, without having to worry too much about the effectiveness of the cable screening. The signal voltage available has obviously got to be suitable for the recorder in question—in most cases a level of about 10 mV should be ideal, with a minimum of about 2 mV. To obtain the low output impedance necessary an emitter follower stage is required, representing one of our building bricks as shown in **fig. 1.**

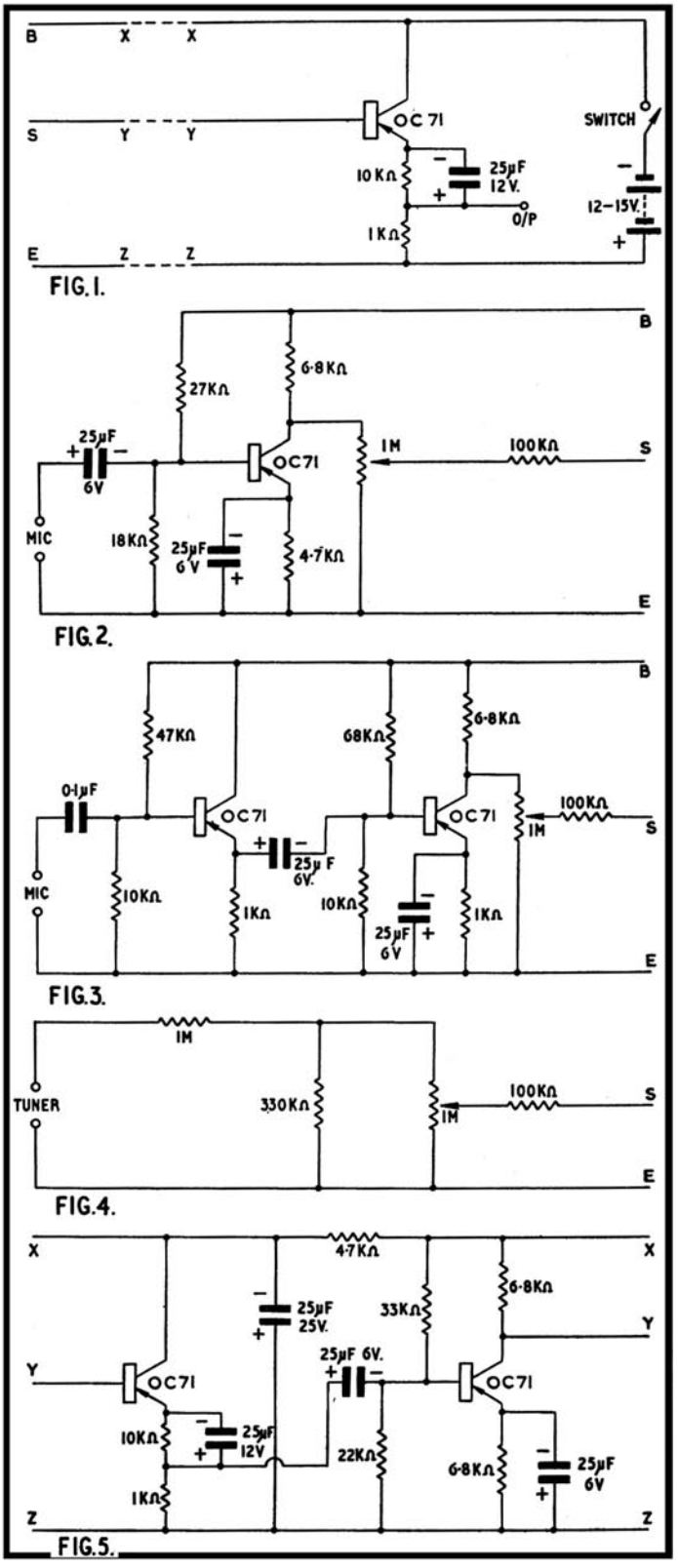
For microphone channels, input amplifiers will be required. If moving coil or ribbon microphones of low impedance are used the input amplifier brick will be as in **fig. 2.** In this instance we are able to make use of the low input impedance of a transistor amplifier to match the microphone. With crystal microphones, however, a high input impedance is required if the frequency response is to be satisfactory and so the arrangement in **fig. 3** is suggested.

Inputs

Where inputs require to be taken from higher level signal sources, such as a radio tuner, no amplifier is required. All that is needed is the level control and isolation resistor, as in **fig. 4.**

Any of these various units may be connected to the output unit, the three lines B, S, and E interconnecting. Under these conditions the signal applied to the tape recorder from, say, a moving coil microphone would be about the same as that microphone directly connected via an input transformer. There should, however, be the absence of hum that can be associated with such transformers. If more signal is required, or greater sensitivity of the microphone is needed, additional amplification must be applied. This would take the form of the circuit shown in **fig. 5,** connected at X,X—Y,Y—Z,Z in **fig. 1.** It will be noted that an additional emitter follower stage has been included, this is to allow the mixing to be done at a higher impedance, and permit the use of more standard values of gain control potentiometer.

It will, perhaps, be noted that I have given some different component values, notably resistances, in circuits that are virtually performing a similar function. They do not, in practice, need to differ. I am not able, however, to check performance over a wide enough range of actual transistors to accommodate the sort of variations that can occur. Resistance values that are suitable for one transistor may tend to be noisy with another, though this is not so likely if a reputable make (such as the Mullard OC71) is used. Should you experience transistor hiss, I hope the variations I have offered will allow you to obtain the best operating conditions.



EQUIPMENT REVIEWED

★

STELLA
ST 459
FOUR-TRACK
FOUR-SPEED
RECORDER

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Manufacturer's Specification: Operates on the four track system. **All transistor:** no warming up time required. **Four speeds:** $\frac{15}{16}$, $1\frac{7}{8}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ i/s. Adjustable to mains voltages of 110, 127, 200-250 v, A.C. 50 c/s. (Can be adapted for 60 c/s by dealer.) The recorder is provided with a "stereo" output socket for the reproduction of pre-recorded stereo tapes, providing that a suitable preamplifier is connected to this socket. Also for "duo-play" and "multiplay" purposes. Mixing of microphone with Radio/Gramophone inputs. Can be used as an amplifier for microphone or record player. Suitable for long-play and double-play tape on 3 to 7 inch reels. **Maximum playing time:** 4 times 8 hrs. **Monitoring facilities:** during recording by means of headphone or via the built-in loudspeaker. **Tape pause button.** Connection for foot switch. **Meter type modulation level indicator. Record safety interlock. Frequency range** at a speed of $\frac{15}{16}$ i/s: 60-4,500 c/s, $1\frac{7}{8}$ i/s: 60-10,000 c/s, $3\frac{3}{4}$ i/s: 60-13,000 c/s, $7\frac{1}{2}$ i/s: 60-16,000 c/s, all plus or minus 3 dB. Built in 2.5 watt amplifier. **Automatic stopping:** at the end of the tape when in the record, playback, fast wind or fast rewind position. **Rapid winding in both directions:** 1,800 ft. of tape in 180 seconds. **Power consumption:** Approx. 55 Watt. **Signal to noise ratio:** better than 40 dB. **Three inputs:** diode 0.02 meg., 3 mv, record player 0.5 meg., 150 mV, microphone 1,000 ohms, 1 mv. **Four outputs:** diode 0.02 meg., 1 v. **Loudspeaker:** 3-7 ohms, 2.5 W, headphones 1,500 ohms, 200 mv, stereo c. 300 ohms-c. 0.4 mv at 1 Kc/s. **Dimension:** 17 in. by $15\frac{1}{2}$ in. by $8\frac{1}{4}$ in. **Weight:** 28 lbs. **Tropicalised. Price:** £65 2s. **Manufactured by Stella Radio and Television Co. Ltd., Astra House, 121-3 Shaftesbury Avenue, London, W.C.2.**

THIS machine, like the Philips Stereo recorder reviewed last month, illustrates a trend in Continental design away from valves towards transistors, even in mains operated units. The advantages are many: no heater hum problems, instant operation, low operating voltages, smaller power unit, cooler running, light weight, etc., etc. The usual objections put forward by technical purists of higher distortion, particularly in class B output stages, have been overcome by using a class A single ended output stage—a steady current drain is no snag in a mains machine—and by plentiful use of negative feedback at appropriate points in the circuit. Hidden virtues, not yet appreciated by most engineers, are the low working impedance of all transistor circuits leading to the use of low impedance heads, microphones, gain controls, etc., with consequent elimination of most electrostatic hum and screening problems.

Externally, this recorder has been given a "new look" by fitting edge operated electronic controls and tab tape motion controls together with a modern functional layout and cabinet design.

All input and output sockets are at the rear of the machine, and the two core screened connecting cable is fitted with a

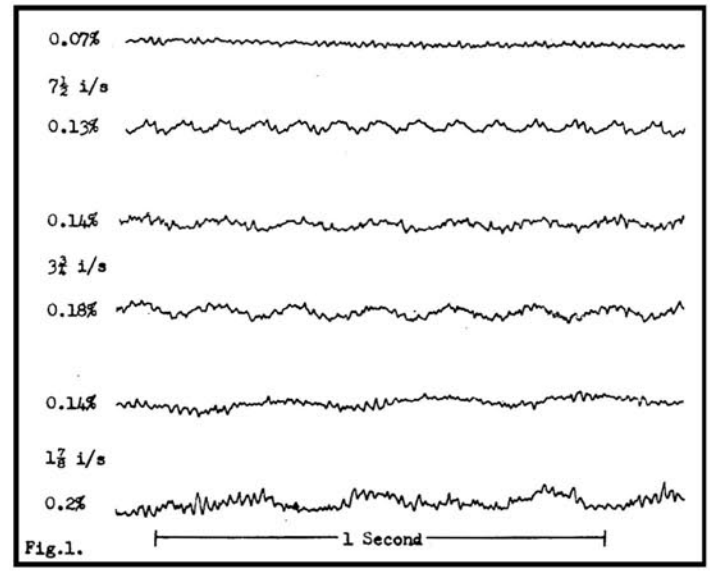

Fig.1.

D.I.N. plug at one end (to plug into the 'diode' input-output socket) and three loose cores at the other to simplify connection to most British auxiliary equipment.

Wow and Flutter

Fig. 1 shows "fluttergrams" for three of the four speeds provided by this recorder. It will be seen that the main speed variation is at capstan rotational frequency: 10 c/s at $7\frac{1}{2}$ i/s, falling to 5, $2\frac{1}{2}$ and $1\frac{1}{4}$ c/s at $3\frac{3}{4}$, $1\frac{7}{8}$ and $\frac{15}{16}$ i/s. Although audible on a sustained pure tone the speed fluctuations were never objectionable on music recordings. The average *rms* combined wow and flutter reading was 0.1% at $7\frac{1}{2}$ i/s with high and low limits of 0.07% and 0.13% due to cancelling and adding of the recorded and playback frequency fluctuations. At the lower speeds, sustained cancellation did not seem to occur, and the average *rms* readings were 0.15% at $3\frac{3}{4}$ and $1\frac{7}{8}$ i/s, and 0.2% at $\frac{15}{16}$ i/s.

Due to intermodulation between the 3 Kc/s test tone and tape noise, it proved impossible to obtain a meaningful fluttergram for the lowest tape speed of $\frac{15}{16}$ i/s. With the wavelength of the test tone comparable with the head gap width perhaps this is not so very surprising!

Play Only Tests

Test tapes with known surface induction characteristics were played at all speeds and the resultant responses showed that

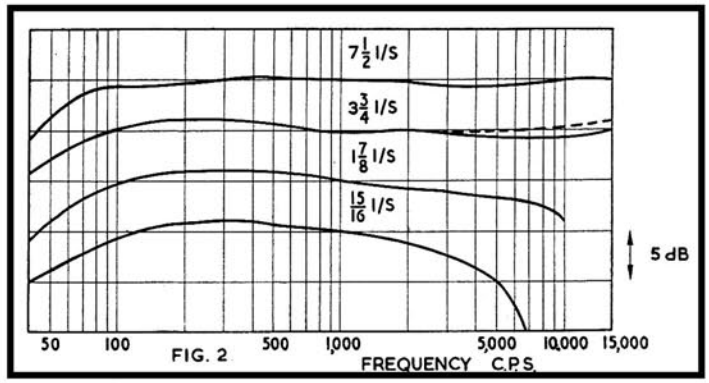

FIG. 2

playback equalisation was matched to N.A.R.T.B. time constants of 50, 100, 200 and 400 microseconds at tape speeds of $7\frac{1}{2}$, $3\frac{3}{4}$, $1\frac{7}{8}$ and $\frac{15}{16}$ i/s respectively.

System noise, with no tape running, was 44 dB below test tape level, or, assuming that full peak recording level of 12 dB above test tape level could be recorded, 56 dB below peak recording level. This underlines the very low hiss and hum level obtainable with modern low noise transistors.

Recording Tests

A 500 c/s tone was recorded at various readings on the meter type record level indicator and it was found that test tape level was recorded at a little less than $\frac{1}{4}$ scale, and that peak recording level (12 dB above test tape level) was recorded with the needle just entering the red sector of the scale. Waveform distortion was negligible at this level and full scale meter deflection gave a level 14 dB above test tape with just perceptible distortion (approx. 5%). Tape erased and biased on the machine showed a noise level 42 dB below test tape level and 54 dB below peak recording level.

Frequency runs were recorded at 6 dB below test tape level to give the responses shown in **fig. 2.** Top and bottom tracks were compared at $3\frac{3}{4}$ i/s. Dotted curve is for bottom track.

Practical recording tests showed that it was very easy to over record by allowing the meter to kick around mid scale as suggested in the instruction book. The resulting distortion and intermodulation was not objectionable and might well go unnoticed on casual listening on the recorder's internal speaker. I only spotted it when I fed the recording to a wide range external speaker and later confirmed it by C.R.O. comparison with a known properly recorded tape.

Recordings made with the meter kicking over the lower half of the scale, with only the very loudest signals reaching the red sector, sounded appreciably cleaner even on the internal loudspeaker.

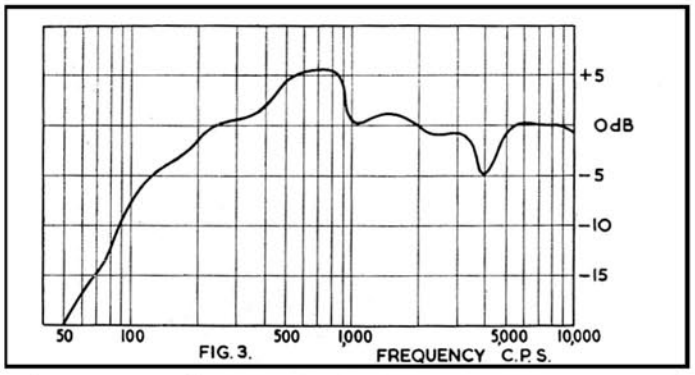

FIG. 3.

Voice recordings sounded slightly heavy on the built-in speaker, indicating a peak in the mid low frequency response. This was later confirmed by the standard acoustic tests.

Acoustic Tests

As the playback response was matched to the N.A.B. equalisation it was not possible to use a standard white noise test tape which is recorded to the C.C.I.R. characteristic. Instead twenty $\frac{1}{3}$ octave bands of filtered white noise were recorded on the machine and the sound output on the axis of the internal loudspeaker measured on playback. The resultant overall recorder-loudspeaker response is shown in **fig. 3.** The "bump" at 600 to 700 c/s explains the slight speech coloration mentioned above.

Microphone Tests

The EL3782/03 microphone supplied with this recorder is a moving coil cardioid microphone, and this particular model showed a fairly constant back to front ratio of about 10 dB with little change in polar response with frequency.

A switched marked + and − is fitted on the back of this microphone. Tests showed that it operated an electrical bass cut filter, which presumably was to be used on close speech to cancel the bass rise which occurs when a cardioid microphone is used in a spherical wave front. Practical tests showed this to be so, and free air tests using the white noise measurement technique produced the responses shown in **fig. 4.**

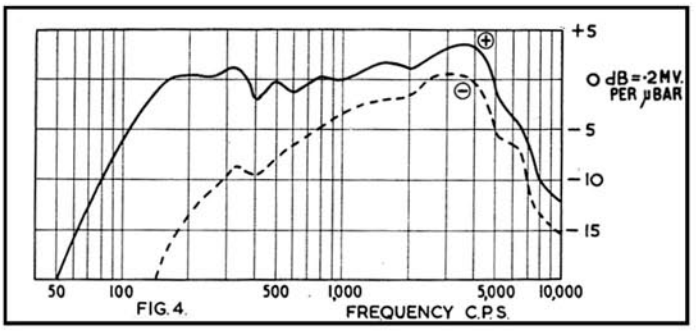

FIG. 4.

Circuit Notes

From time to time, whenever a circuit is supplied with review equipment, I propose to devote a short paragraph to interesting circuit tricks or details. The novel feature of this recorder is the three transistor power amplifier. An orthodox amplifier stage feeds an emitter follower driver which feeds the base of the large power transistor from a 47 ohm emitter load. The internal speaker is fed from a primary tap on the output transformer, and a separate secondary feeds the external speaker socket and also provides negative feedback voltage to the base of the input transistor.

Comment

An excellent recorder in every way. It handles well. All the controls are in the right position and operate smoothly and sweetly. The light weight and rather large cabinet combine the advantages of portability with a reasonable speaker enclosure providing better than usual bass response.

The meter type record level indicator must be used carefully (see Recording Tests) to avoid over recording. The electronic mixing circuits together with the facility of playing two separately recorded tracks simultaneously make this one of the most flexible recorders I have handled and I recommend it to the absolute beginner and advanced amateur alike. **A. Tutchings.**

Manufacturer's comment. Your reviewer has stated under the heading Recording Tests, "Practical recording tests showed that it was very easy to over record by allowing the meter to kick around mid-scale as suggested in the instruction book". Page nine of the operating instructions states: "The level should be so adjusted that at the loudest passages the pointer of the indicator does not quite reach the red segment". This we feel lines up with the findings outlined in the next paragraph.

* * *

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Manufacturer's Specification. Power supply: A.C. 40-60 c/s 110-220 v, 6 v car battery, 12 v using series resistance LR412, 5 U2 torch cells, 5 DEAC rechargeable cells type RS3.5. **Recording procedure:** double track international standard. **Tape speed:** $3\frac{3}{4}$ i/s. **Frequency response at radio output:** 50-10,000 c/s. **Dynamic range:** 46 dB or better. **Maximum reel diameter:** $4\frac{1}{2}$ in.

(*Continued on page* 211)

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EQUIPMENT REVIEWED — *continued*

Maximum playing time: 2 times 60 min., using triple play tape. **Output power:** 1 watt with 7.5 v H.T. **Erase and bias:** H.F. current of 55 Kc/s. **Signal level indicator:** meter. **Tape position indicator:** digital reel revolution counter with resetting knob. **Built-in loudspeaker:** PM dynamic with 3 by 6 in. oval cone. **Output socket:** 5 ohms. 7 transistors 3 diodes 1 selenium rectifier. **Dimensions:** 15½ in. by 9¼ in. by 4½ in. **Weight:** 8.8 lbs. **Price:** £49 7s. **Distributors: Highgate Acoustics, 71-73 Portland Street, London, W.1.**

THIS is a new and improved version of the machine reviewed a little over a year ago (May '62). At first sight the appearance is identical, but closer examination shows that a meter type record level indicator has been fitted instead of the magic eye and internally a more complex motor control circuit is used to give improved speed stability and even lower motor noise. I must admit that after a surfeit of multi track, multi speed, multi output recorders it was a pleasant treat to get back to a simple little single speed, single output, single track (at a time) machine!

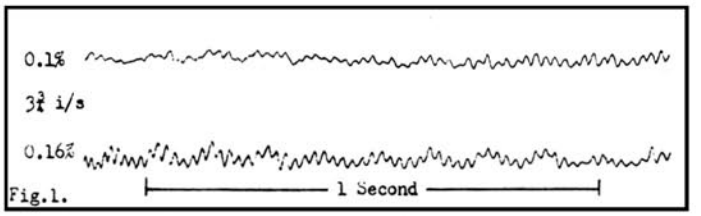

Fig. 1.

Admittedly there seems to be a wide choice of power sources, but this ultimately boils down to mains or battery. Stowage for the mains lead is provided within the recorder case, and changeover to battery operation is obtained by plugging the two pin mains plug into an internal socket inside the recorder. For this reason an adaptor should be used if mains sockets are not suitable for this plug, otherwise it may prove difficult to change to battery operation if the plug is changed.

Speed Wow and Flutter

The mean tape speed was carefully measured on both mains and battery and found to be within 1% of the nominal speed of 3¾ i/s. Short term speed variations are shown in the fluttergrams of **fig. 1.** There is a very slight trace of 10 c/s capstan wow and a low level 50 c/s ripple from the 3,000 rpm motor. With maximum and minimum *rms* readings of 0.1% and 0.16% the tape transport can be said to be eminently satisfactory, particularly for a portable machine of this size and weight.

Speed changes due to normal handling are completely negligible and the machine has to be shaken quite roughly to produce any audible speed change. It is also completely insensitive to attitude; it can be used flat, upright or upside down with not the slightest change of tape speed.

Playback Tests

The top curve of **fig. 2** shows the response at the line output of a C.C.I.R. 200 microsecond test tape. System noise with no tape running was 33 dB below test tape level on battery and

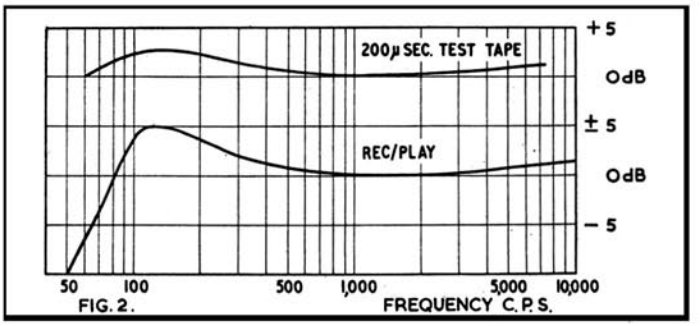

FIG. 2.

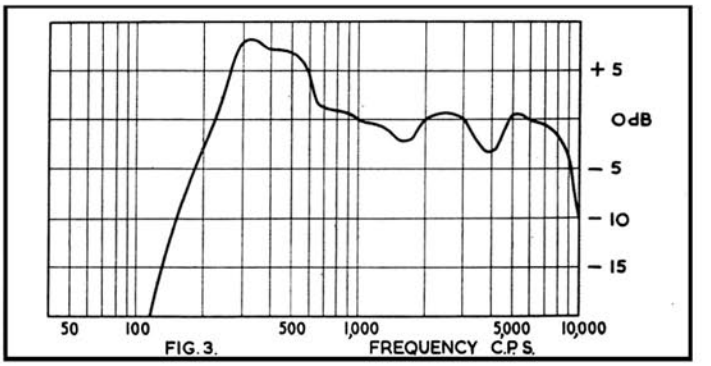

FIG. 3.

26 dB below test tape level on mains operation. Most of the latter reading was due to mains hum which was completely inaudible due to the low note cut off in the internal speaker.

Recording Tests

A 500 c/s tone was recorded at various record level meter readings and it was found that test tape level was obtained at about ¼ scale reading. Bringing the needle up to the start of the red sector recorded a level 8 dB above test tape, and full scale deflection recorded at 12 dB above test tape level. Waveform distortion was just perceptible at full deflection. Recordings with the meter kicking about half scale gave satisfactory recording level by C.R.O. comparison with tapes known to be properly recorded.

The record-play frequency response was obtained by feeding oscillator test tones to the radio input lead and measuring the radio line output voltage at each frequency with a valve voltmeter; this response is shown by the lower curve of **fig. 2.**

Acoustic Responses

One third octave bands of filtered white noise were recorded and the sound level of each band measured on replay on the axis of the built-in loudspeaker. The overall response of **fig. 3** shows that there is a bass cut due to the very small speaker enclosure with a mid bass rise between 300 and 500 c/s. The high note response is sensibly flat to 8 Kc/s.

The frequency response of the LDM12 moving coil microphone supplied with this recorder was measured in a white noise sound field and is shown by **fig. 4.** It is reasonably level from 250 c/s to 10 Kc/s. Polar response is non-directional at low and middle frequencies with some focusing of high frequencies on the axis. It will be seen from **fig. 4** that the measured impedance of this microphone was 10 K which is high for use with a transistor recorder.

Microphone Tests

I gather from the instruction book that a microphone is not included in the quoted price of the recorder, but that a fairly wide choice of Loewe-Opta microphones are available for use with this recorder. My advice is to try them all if possible and choose the one best suited to your needs. This one is certainly not the best choice for this recorder. Acoustically radiated noise from the motor picks up on this microphone even when it is placed well away from the recorder to the full extent of the lead. Even close talking to the microphone does not lose it, and the speech quality has a peculiar hollow quality which is not explained by any of the acoustic tests shown above. It seems to be a transient effect due to undamped resonances in the microphone, speaker, or both. **Fig. 4** is the open circuit response and so I repeated the tests with a 2K loading resistance to simulate the loading effect of the transistor input impedance but the frequency response was not significantly different.

Radio quality was excellent, and a number of other high quality microphones were tried with excellent quality and practically no motor noise.

(*Continued on page* 213)

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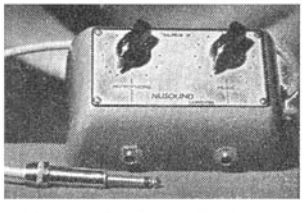

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EQUIPMENT REVIEWED — *continued*

Circuit Notes

Electrical motor noise is often produced if the motor governer contacts are allowed to make and break part of the motor circuit directly. It has been standard practice in most German portable

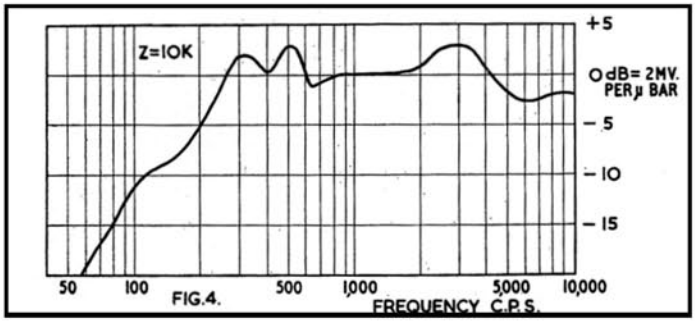

FIG.4.

recorders to use a transistor to control the motor speed, with the governer intermittently breaking the very much smaller base current of the control transistor. The motor control circuit in this recorder uses a second transistor as a high frequency oscillator with a diode rectifier to provide a D.C. bias for the control transistor. The governer contacts short out part of the oscillator winding so that both the frequency and the strength of the oscillator is varied; this in turn alters the D.C. bias on the control transistor which alters the motor speed. There is no actual make and break of the motor current and therefore no radiated electrical noise.

The motor speed control is also smoother and more accurate.

Comment

A lovely little recorder with no vices of its own, but it must be mated with a suitable microphone to show its full capabilities.

A. Tutchings

* * *

The drawing shown below should have appeared on page 157 of the May issue. It shows the tape guide layout of the Stella ST 456 recorder. We apologise to readers for any inconvenience caused.

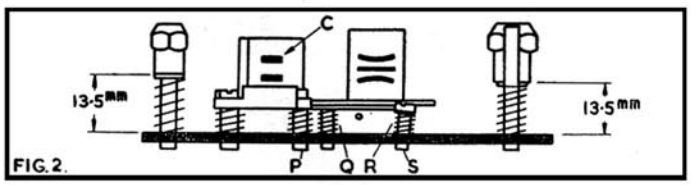

FIG.2.

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,, TK.8 ...	... 63/–
,, TK.14 & 18 & 23 ...	59/6
,, TK.20 ...	... 52/–
,, TK.24 ...	... 55/–
,, TK.25 ...	... 55/–
,, TK.30 ...	... 60/–
,, TK.35 ...	... 63/–
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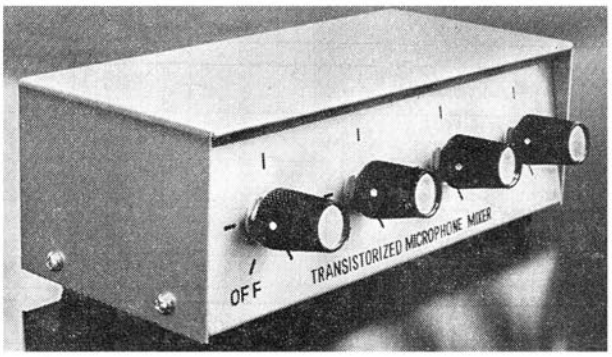

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. . . about good average quality

From:—K. W. Hart, 2 The Greenway, Rickmansworth, Herts.

Dear Sir:—I could not agree more with your Editorial (May, 1963) that with ½-track recording at 7½ i/s "everying is set for really good average quality", but I would query that word "average" in the light of personal experience.

I have one of the new Swiss Revox F36 stereo machines and use this permanently hooked up to my stereo hi-fi system and I can say most definitely that this new recorder will not give just "average" quality but quality as high as I can feed to it. My hi-fi system permits immediate comparison between original and taped signals—"monitoring"—and it is impossible to tell the difference between them at 7½ i/s. I have had the response of the recorder measured and it is flat between 40 c/s and 15 Kc/s, within 1 dB—and this on both channels. At 3¾ i/s the response is smooth up to 12 Kc/s and is the best I've heard on any machine at this speed.

I have no commercial axe to grind for Revox as I have no connection with them other than that of a customer, but I do like to grind the axe of quality in tape recording. My Revox—need I say?—is the two-track version and I should like to mention that I have been fortunate enough over the last few months to have had practical first-hand use of the best and latest stereo recorders, four-track and two-track versions. Though I realise the Editor has closed the controversy about two- and four-track recording, may I make a comment based solely on first-hand experience? It is that having lived with the best two- and four-track machines—all those costing over £100 each—I have found that I *prefer to listen* to two-track reproduction. All the machines of the top grade, whether two- or four-track, will produce a good facsimile of an original signal, but the two-track machines do it with what I can only call "less mechanical intrusion". They are kinder to tape—and to one's ears. Feeding in white noise to these machines proves the point. On the two-track machines, the Revox most notably, it comes out smooth, but on the four-track machines it comes out with a lumpy, rougher quality. But the final and conclusive point is simple: lengthy comparative listening tests prove it's easier and more satisfying to listen to two-track reproduction—it remains genuinely in the category of 'hi-fi". *Yours sincerely.*

* * *

. . . about a telephone effect

From:—I. A. Easton, 40 Buchanan Drive, Rutherglen, Lanarkhire.

Dear Sir:—With reference to the Reader's Problem entitled 'Telephone Effects" by J.H., of London, which appeared on page 161 of the May issue, I should like to point out that Telefunken make a microphone with the addition of a Telephone Effect switch. This switch is fitted to the D14 model and controls the frequencies picked up. *Yours faithfully.*

CLASSIFIED ADVERTISEMENTS

Advertisements for this section **must be pre-paid** and accompanied by a postal order, money order, or cheque. The rate is 6d. per word with a minimum charge of 7/6d. Box numbers may be used for an extra charge of 1/6d. The trade rate is 9d. per word, plus 2s. for a box number, conditions on application. **Send replies to box numbers, c/o "The Tape Recorder", 99 Mortimer Street, London, W.1.**

No responsibility will be accepted by the editor, the publishers, or the printers of The Tape Recorder for the quality of any goods offered, bought or exchanged through the medium of these columns, or for any failure in payment, etc., though the greatest care will be taken to ensure that only bona fide advertisements are accepted.

All advertisements for the July issue must arrive not later than June 4th.

LEGAL

£90 Reward. Stolen 11th/12th April from East Ham. Quantity of tape recorders including Simon SP5 Serial No. 00248. Subject to usual conditions. Apply: Turnpenney & Co., 141 Fenchurch Street, London, E.C.3.

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Easysplice Tape Splicer makes accurate splicing easy—guaranteed 5s. 6d. Scotch Boy splicing tape 3s., P. & P. 6d. Easysplice, 30 Lawrence, Ealing.

Tape Recorder, Vol. 1. Mint condition, semi-bound with index, £2 inc. post pack.—Box No. (London) 310.

Grundig 4-channel Electronic Mixer Unit (type GMU 3). Unused. Cost 16 guineas. Any offers.—Box No. (London) 311.

Truvox ¼-track Stereo Tape Deck PD 86 for sale. Surplus to requirements. Brand new, unopened, purchased 1963, £35. S.P., York House, Huddersfield.

Ferrograph Series Four, fitted FR7 monitoring head. Mint condition, still under guarantee. Cost over £90. Including Mullard four-channel mixer, cost £10. Accept £70 the two. Owner going stereo.—G. F. Goshawk, 11a Lark Crescent, Hartford, Huntingdon.

Grundig TK12 track reversal, excellent condition, any test, £20. —62 Beacontree Avenue, E.17. Larkswood 3792.

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E.M.I. TR50A professional tape recorder, 15/7½ i/s overhauled and modified by E.M.I. for dual-track operation. Two sets full-track tape heads included. £90 o.n.o. Revox C36 (Mono) recently serviced by Concessionaires, £80 o.n.o. Two STC type 4021 microphones, £12 each. All subject, unsold. —White, 56 Manor Wood Road, Purley, Surrey. UPLands 4093.

Revox 2-track Stereo £87 under guarantee. Shure M7D £5; B20 Stereodyne £4 10s. Pamphonic 1002 amp plus preamp 25W £20. Pamphonic 1004 10W amp/preamp £11. Pamphonic Senior Victor L/S £19 owner going abroad. Box No. (London) 312.

Vortexion WVA Tape Recorder, Ribbon microphone, very little used £60. Box No. (London) 313.

Wearite series 5 A/N deck, as new, only 2 months old £30 cost £44. McLachlan, 16 High Street, Albrighton, Nr. Wolverhampton.

Uher 4000 transistor portable four speeds, cardioid microphone, leather case. Nine months old, scarcely used. Cost £107, accept 75 gns. Graigen, 9 Kings Avenue, Carshalton Beeches, Surrey, Wallington 1487.

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Ferrograph 5A/N, 422 and 424, Revox F36, etc., always in stock.—City and Essex Tape Recorder Centres (see page 219).

Tape and gram equipment repairs/mods.—Harding Electronics, 120A Mora Road, Cricklewood, N.W.2.

(*Continued on page* 218)

CLASSIFIED ADVERTISEMENTS — *continued*

£10,000 worth of Hi-Fi equipment and Tape Recorder accessories. Due to purchase of wholesaler's entire stock we can offer hundreds of bargains in pickups, cartridges, styli, motors, etc., at greatly reduced prices. Send 3d. stamp for comprehensive lists. Lee Electronics Ltd., 400 Edgware Road, London, W.2.

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Recorder need Repairing? Then let City and Essex Tape Recorder Centres do it for you expertly and economically (see page 219).

Cinesmith Depolariser demagnetizes your record/playback heads in situ. Use occasionally for better recordings without hiss and with background silent as the grave no matter how often played. From your dealer or Cinesmith Products, Regent Street, Barnsley. £2 5s. Write for leaflet.

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