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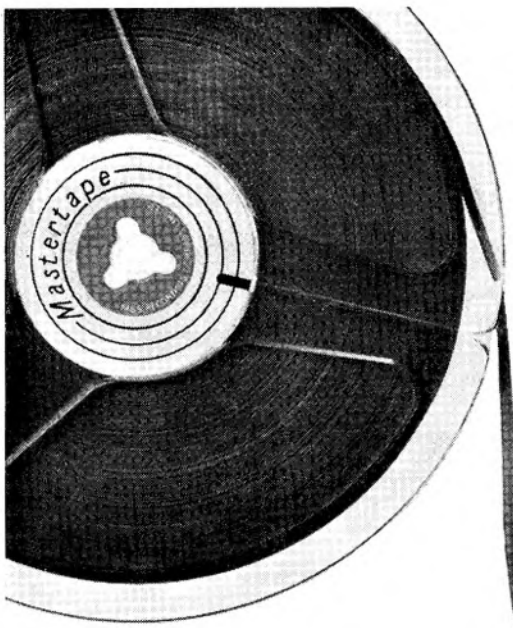

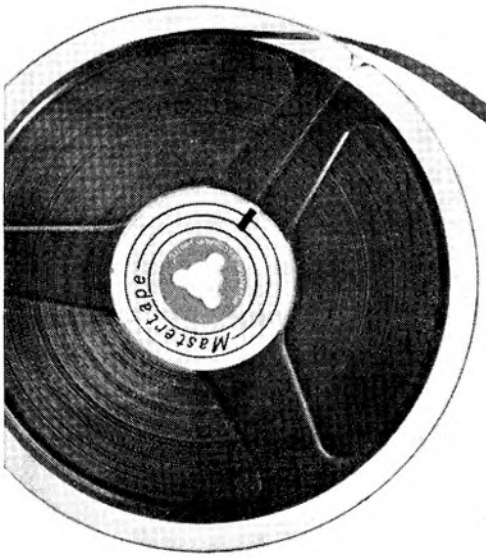

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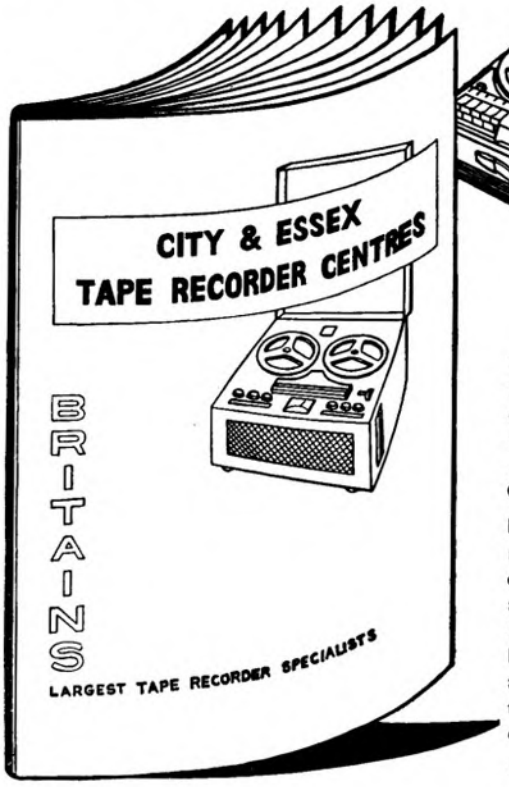

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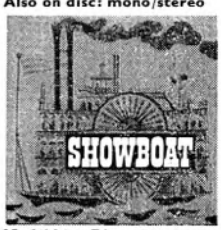

35. Ol' Man River, Bill, Make Believe, many more well-loved numbers from this famous musical memorably sung and played by full star cast.
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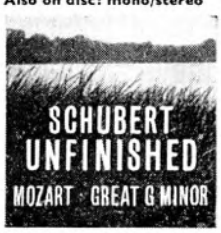

44. Leopold Ludwig and LSO combine brilliantly in an exciting 'double': two of the world's greatest symphonies receive vivid new interpretations.
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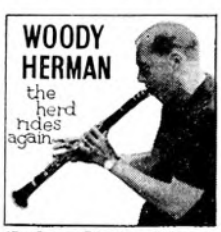

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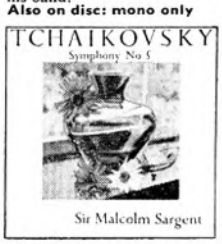

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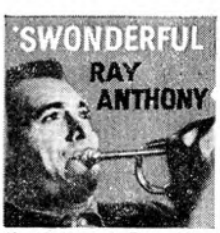

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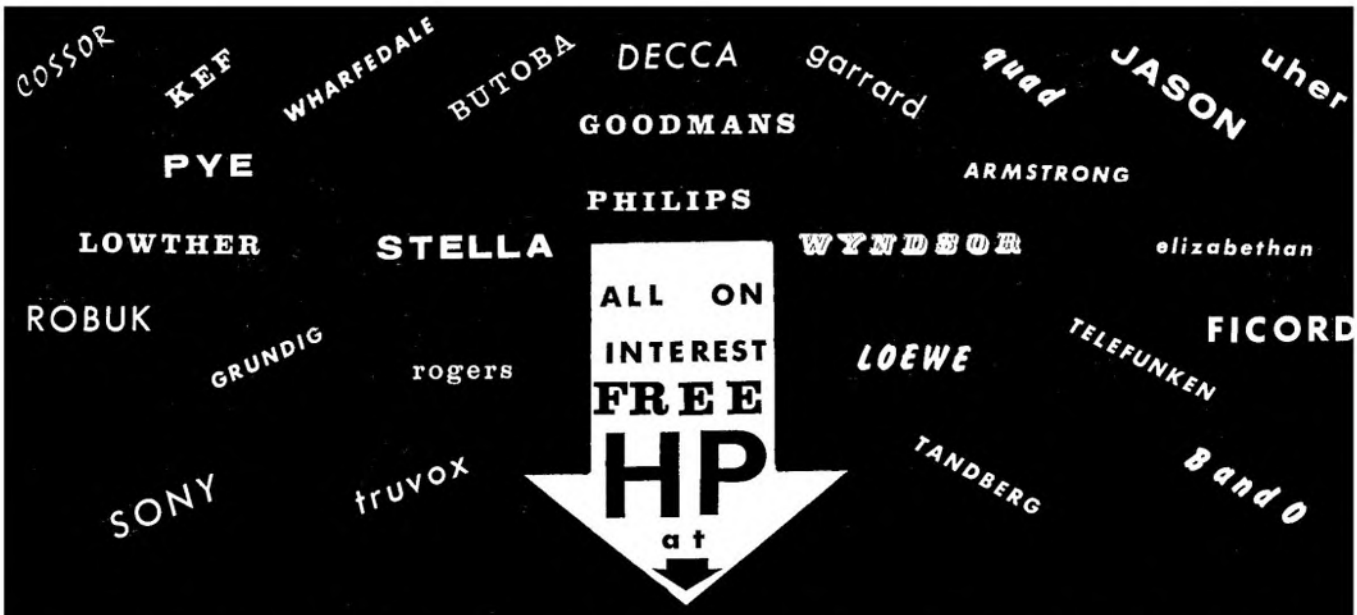

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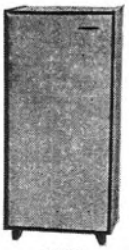

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HI-FI STEREO 6 WATT AMPLIFIER Model S-33. Attractively styled, completely self-contained. Printed circuit makes it easy to build. Only 0.3% distortion at 2½ W/chal. U/1 output, ganged controls. **Kit £13 7s. 6d. Assembled £18 18s. 0d.**

MA-5

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

SSU-1

HI-FI SPEAKER SYSTEM Model SSU-1. This kit is easily assembled. It contains speakers and balance control in its direct ducted port reflex cabinet. It is equally suitable for stereo or mono in average room. **(Legs 14/6 optional extra.) Kit £10 17s. 6d.** Available for vertical or horizontal use.

AUDIO SIGNAL GENERATOR Model AG-9U. Delivers up to 10 volts pure sine-wave (less than 0.1% distortion. 20 c/s to 20 Kc/s). Decade switch-selected frequencies from 10 to 100,000 c/s. **Kit £22 10s. 0d. Assembled £30 10s. 0d.**

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COLLARO "STUDIO" TAPE DECK. Two tracks. "Wow" and "flutter" not greater than 0.15% at 7½" p.s. Long Term Speed Stability better than 0.5%. **£17 10s. 0d.**

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

USC-1

TA-IS

TRUVOX D93

STUDIO

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

TRANSISTOR INTERCOM. Models XI-1U and XIR-1U. Ideal for office or home. Each Master operates up to five Remotes.
Master Kit £10 19s. 6d. Assembled £16 19s. 6d. Remote Kit £4 7s. 6d. Assembled £5 16s. 0d.

STEREO CONTROL UNIT Model USC-1. A deluxe stereo control unit with variable filter, switched rumble filter, printed circuit boards and many other refinements. Operates direct from tape heads. **Kit £19 10s. 0d. Assembled £26 10s.**

"OXFORD" PORTABLE RADIO Model UXR-2. Superbly styled hide case, with Golden trim and slide-rule tuning scale; this completely self-contained transistor dual-wave set performs brilliantly everywhere, even in a car. Reproduction is exceptionally good. Printed circuit. **Kit £14 18s. 0d.**

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

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GARRARD AUTO/RECORD PLAYER Model AT-6. A 4-speed stereo-mono unit with manual or fully automatic record selection; adjustable counter-balanced arm.
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GOLDRING LENCO TRANSCRIPTION RECORD PLAYER Model GL-58. Fitted with the G.60 pick-up arm and Ronette 105 mono-stereo cartridge, it has infinitely variable speed adjustment between 33⅓ and 80 r.p.m. and four fixed speeds. 3½lb. turntable to reduce rumble, "wow" and "flutter" **£20 1s. 3d.**

S-99

RSW-1

UXR-2

AT/6

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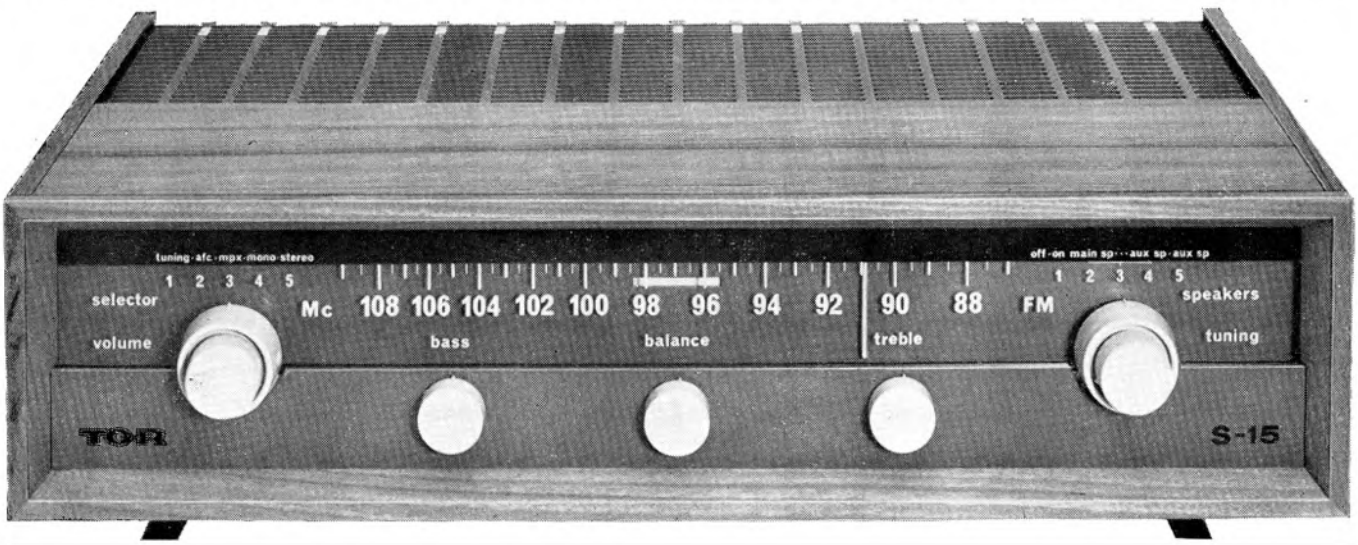
THE FINEST TUNER-AMPLIFIER ON THIS OR ANY OTHER MARKET



New from Denmark is this fully integrated FM tuner/amplifier. Before you settle for anything—*at any price*—see and hear the TO-R. Just consider these features:

- **Automatic Frequency Control** tunes and holds on any station automatically.
- **6 watts push-pull output per channel** to drive two main speakers (plus 2 more if necessary!) or 12 watts monaural.
- **Multiplex Radio Decoder** (for BBC experimental stereo broadcasts) can be supplied separately or built in as required.
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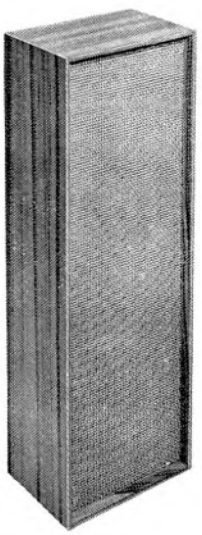
- **Contemporary finish** in teak or walnut ready for self-mounting.

S 15U mono tuner/stereo amplifier **53 gns.** *inc. tax.*
S 15Um stereo Multiplex tuner/stereo amplifier **59 gns.** *inc. tax.*

TO-R *FINE SOUND WITH SCANDINAVIAN GOOD LOOKS*



...AND SPEAKERS TO MATCH

Here is the ideal small space speaker, built long and slim for corner, floor or wall fitting. An 8" round speaker is combined with a 2" tweeter for perfect matching to the TO-R amplifier.

Dimensions: 32" x 7" x 10"

19 gns. *inc. tax*

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Trade enquiries to MEDLEY MUSICAL LTD · 134 PLUMSTEAD ROAD · LONDON · SE18

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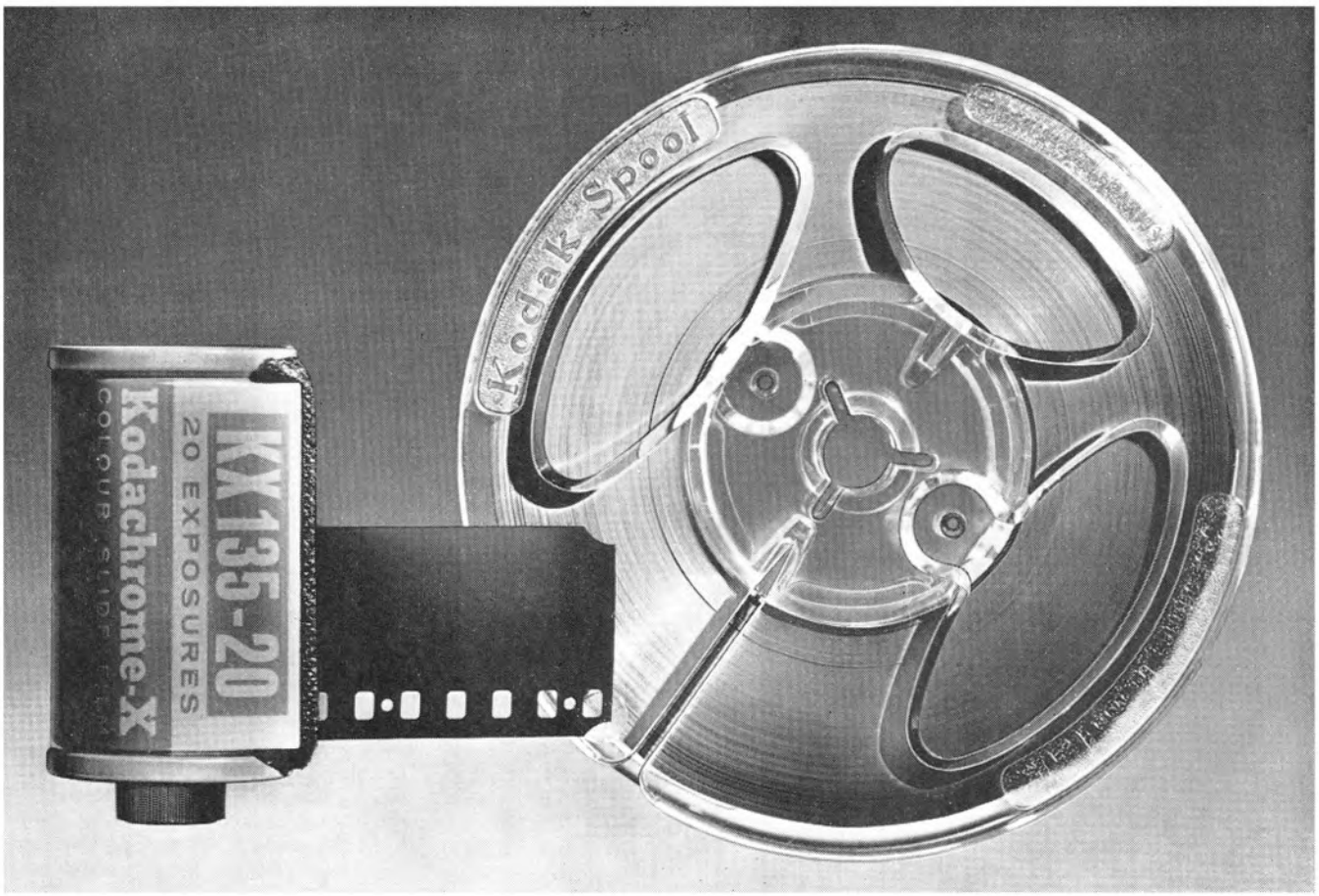

How Kodak's film-coating skills set today's highest standard in tape

Kodak know a lot about surface coating. More than any other manufacturer in the world, in fact. This isn't really surprising, because one of the reasons for the unrivalled high quality of Kodak colour films is the unique evenness of their emulsion coatings.

Now, Kodak have applied these advanced coating skills to the manufacture of sound recording tape. The result is a tape whose magnetic oxide layer is accurate to within *millionths* of an inch. No wonder that sound recording engineers all over the world have acclaimed it as the finest tape ever made.

Play it as soon as you can. You'll be getting a higher signal-to-noise ratio than you ever thought possible, a frequency response that remains unsurpassed at all tape speeds, a remarkable freedom from drop-out and print-through, and, above all, a *total* uniformity in performance.

There's a Kodak Tape for every recorder, of course, including the world's only Quadruple Play tape, for use with battery portables (5½ hours playing time on a single 3¼″ reel!). So next time you buy tape do the sensible thing and specify Kodak Tape. It will do full justice to your equipment. And it costs no more.

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Kodak tape...the best tape in the world

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

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

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

SPECIFICATION

Power Source:	**6 unit cells (U.2.), 9 V.**
Output:	**500mW (700mW max.)**
Transistors:	**9 Transistors, 1 Thermistor, 1 Diode.**
Tape Speed:	**3¾ i.p.s., 1⅞ i.p.s.**
Frequency Response:	**100-7,000 c/s at 3¾ i.p.s., 100-4,000 c/s at 1⅞ i.p.s.**
Recording Level Indicator:	**VU meter.**
Speaker:	**3½" Permanent Dynamic Speaker.**
Dimensions:	**3¼" x 9" x 12½".**
Weight:	**5 lb. 14½ oz.**
Accessories:	**Dynamic microphone with remote control switch; 5" recording tape (600 ft.); 5" empty reel; radio cord; leather case for accessories; hand belt; splicing tape; sensing tape; plug for slide sync.; magnetic earphone.**

RQ-303

Also from NATIONAL:

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

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

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

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

**With optional mains adaptor available*


RQ-115 & RQ-116

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tape recorder

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Editorial and Advertising offices

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editorial

MUCH HAS BEEN written in this magazine, and indeed in this column, about the mythical 'ideal' recorder. The specification of such a machine could only be construed from personal opinion and individual requirement, thus our contributions can only reflect our own feelings. With this in mind, therefore, we are offering readers the chance to air *their* views on this subject. The resulting barrage of letters, for which we are hoping (!), should give some idea of the average consumer's requirements, painting a picture for the edification of interested manufacturers. We would like to hear of the features worth continuing and adding to the modern non-professional tape recorder. How many tracks? Which speeds? What spool capacity? Automatic or manual gain control? Spools (looking back to the October issue) or cartridges? And finally—what price?

Together with the picture of a generally accepted ideal, it is hoped that some interesting, original and practical facilities will be suggested; some of these will be published in the near future.

No amount of public feeling will hasten the steady evolution of *technical* quality, so there is little point in suggesting ultra-low wow and flutter figures for the ideal tape deck. One thing we *can* do, however, is discourage the present trend towards a split in the domestic class of recorder. The latest products, exhibited at the various electrical shows a few months ago, contained a high proportion of recorders designed with the 'teenager' in mind. The commercially induced 'pop' record market (for which the teenager is, rather illogically, blamed) brought with it a tide of very low quality gramophone reproducers. It is generally accepted, though grudgingly, that young people have considerably more money to spend on 'luxuries' than the family-raising adult population, but the advertising and publicity people continue to hammer out moronically the advantages of the latest "Even cheaper!" record-players.

This practice is now spreading to the tape recording field, with ultra-cheap, ultra-simple equipment being advertised in the national press. A new low-priced tape recorder market is being created unnecessarily, as most of those for whom the equipment is intended are in no way so poorly off that they cannot afford the prices of present domestic recorders. Why not, therefore, make use of technical developments to *improve quality* while retaining present price levels, rather than reduce the cost of current low standards?

For our own part, we look forward to seeing the much discussed 'add-when-you-can' recorder—basically a tape deck and record/playback mechanism, to which can be added a variety of accessory units to increase the machine's flexibility and quality. The 'add-on stereo' device and 35mm. slide adapter are forerunners (we hope) of this principle, although the idea is widely used in industry to convert and modify electronic service gear and computers. 'Plug-in echo' and 'slip-in mixing' might retail for about £4, possibly with a standard plug-and-socket fitting for any brand of add-on tape recorder (a standardisation unlikely to occur in this country); there is, indeed, no end to the possibilities of such a system. Little new thinking or technical invention will be needed by the far-seeing firm that decides to produce equipment of this type, as currently-produced tape decks and electronic circuitry are perfectly suitable basic components.

While indulging in an optimistic peep into the immediate future, we might allow ourselves the vision of a disposable paper recording tape selling at about 1s. per 1,000ft. and sufficiently robust to stand ten or twelve playings before crumbling out of existence. We realise it is not the plastic base but the oxide composition that makes tape expensive, but nevertheless there is room for much thought on the subject. The uses of such a product have yet to be imagined, but magnetically recorded advertising (which heaven forbid), or even a tape 'newspaper' on tape, might well be the outcome.

An abrupt change of subject brings us to a very sad event. Many *Tape Recorder* readers will be familiar with the name John Berridge, an occasional contributor to this paper (see his piece on *Telcan* in September) and the regular American Correspondent of our parallel magazine *Hi-Fi News*. Alas, John was killed as the result of a fall over a cliff on September 10th. A Coventry man, John emigrated to Canada some years ago and for the last year has been in the U.S.A. Forever active and full of ideas, he has been a lively trans-Atlantic wire whom we shall miss very badly. He leaves a wife and two little daughters, and we are sure that all our readers will wish to join us in sending sympathy and wishing them fortitude.

NOVEMBER 1964 . VOLUME 6 . NUMBER 10

COVER PICTURE

Talking flowers appear, at first sight, to be the subject of a recording about to be made on the latest Grundig battery portable. Observant readers will note, however, a small bird perched on the far right—doubtless making feathery remarks about the pleasing appearance of the TK6.

SUBSCRIPTION RATES

Annual subscription rates to *Tape Recorder* and its associated magazine *Hi-Fi News* are each 30s. in the U.K. and 32s. 6d. overseas (U.S.A. $4.50) from Link House Publications Ltd., Dingwall Avenue, Croydon, Surrey. These include free copies of the indexes.

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This is the Ever Ready HP2 battery, one of the revolutionary new range of High Power batteries. At current drains of 300 mA in tape-recorders the HP2 has a working life over 4 times as long as that of the standard U2. HP batteries are extending the life and so the use of many types of battery-powered equipment from toys to photo-flash in the same way. Get full details from The Ever Ready Co (GB) Ltd., Hercules Place, Holloway, London N7. Telephone: ARChway 3030

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world of tape

SPECIFICALLY STEREO

FROM our limited experience with amateur recording clubs it has become clear that stereophonic sound has a much narrower band of followers than is to be found in the hi-fi world. The old contention of stereo being one great confidence trick still exists among many otherwise fairly well informed recording enthusiasts. This may or may not be a 'sour grapes' solution to the much greater difficulties (and admittedly greater cost) experienced in recording good stereo tapes.

For the converted, however, a well-established tape correspondence organisation exists exclusively to promote and perfect stereo techniques. Members of *Stereo International* may draw on a considerable library of tapes illustrating and teaching all aspects of stereo recording and playback. The exchange of recorded messages with other members encourages creative experiments for comparison with correspondents' efforts and possible inclusion in the library. With technical and non-technical members interchanging experiences and problems, the organisation offers a pleasant method of absorbing relevant knowledge and of making lifelong friendships.

The only requirement for joining—the possession of stereo tape playback facilities or, preferably, a stereo recorder.

Stereo International Director : R. V. Huddlestone, 9 College Avenue, Melton Mowbray, Leicestershire.

GRUNDIG BOOK BREAKS SALES RECORDS

THE *Grundig Book*, written by Frederick Purves and one of a series published by *Focal Press*, has greatly exceeded sales records for books of its kind. Over 100,000 copies have been sold since the publication, now in its 10th edition, was first announced. The price is 15s. 6d.

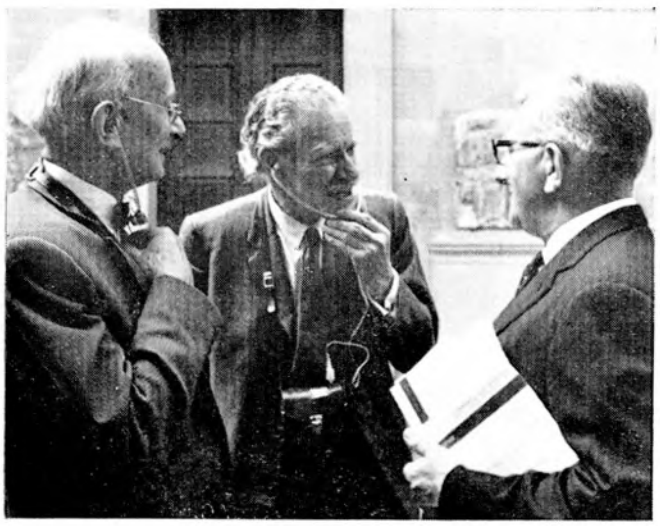
LISTEN TO THE ELGIN MARBLES

BATTERY tape recorders are now being used to provide tape lectures in the British Museum. A 45-minute commentary on the *Elgin Marbles* can be hired by visitors for 2s. 6d. Compiled from material supplied by the Greek and Roman Department, it is read by C. Gordon Glover, and is said to achieve a balance between the specialised and uninformed listener. A French version is being produced, recorded by Max Bellancourt.

Modified versions of the *Clark and Smith Minifon Attache* form the basis of the *Soundguides* system and a portable tape player is being specially developed to provide sufficient quality for reproduction of music. This will run at $1\frac{7}{8}$ i/s, whereas the Minifon operates at $\frac{15}{16}$ i/s. Rechargeable DEAC cells provide four hours playing time, with $\frac{1}{4}$in. tape magazines lasting one hour. A digit counter and battery meter are also incorporated.

It is planned to extend the service to other parts of the museum. Soundguides are also in operation at Windsor Castle and St. Paul's Cathedral.

Manufacturers : Clarke & Smith Industries Ltd., 289 High Holborn, London, W.C.1.



A 101 TAKES TO THE AIR

MINIATURE recorders have gone into use at the Rolls-Royce Flight Test Establishment at Hucknall, Nottinghamshire, replacing pen and notebook for compiling data on the behaviour of new aircraft. Like the note-book, the *Fi-Cord* 101 battery dictating machines are strapped to the test pilot's leg, from where they are connected to the radio communication network, avoiding the need for extra microphones.

Recently, a Rolls-Royce test pilot was forced to eject himself from a *Lightning* aircraft. His recorded comments on the erratic behaviour of the aircraft greatly assisted location of the fault.

In the case of serious injury to the pilot, which did not occur in this instance, such recordings would be of immense value.

AMPEX TRAVELVISION

USE of cine film to entertain passengers on long-distance air journeys is not a new idea, but the latest scheme from the *Ampex* stable is an interesting development in airborne viewing. Anything from the latest Hollywood epic to general travel information can be relayed through the *Travelvision* system. This comprises a portable video tape player (weighing 96lb.) and series of receivers, not forgetting a camera or two through which a pilot's eye view of the take-off and landing may be experienced.

To avoid annoying passengers not wishing to participate, the video sound track is played through earphones. High quality stereo music, two programmes of which are played on professional audio equipment, can be selected as an alternative to television.

THE GRAMOPHONE SUPERSEDED

H.M.S. *Ursa*, a 2,800 ton naval frigate, has been fitted with *Reditune* tape playing equipment, after heavy seas proved too much for the ship's gramophone.

With frequent poor reception of commercial radio stations, closed-circuit 'canned' music was welcomed by the crew who quickly organised a team of 'tape-jockeys' to select the day's music from a library of one hundred 90-minute endless reels.

Positioned throughout the vessel are twenty-three speakers from which music may be enjoyed without fear of interruption from a needle lurching out of its groove.

Manufacturer : Reditune Ltd., Wrencote House, High Street, Croydon.

NEXT MONTH

THE December issue of *Tape Recorder* will be on sale on November 16th. Martin York will discuss the Guarantee controversy and Part 9 of Towards Better Taping will outline equalisation of mixers. A simple face-lift for shabby recorder cabinets will be given by E. Cornwall.

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Agfa tape is specially pre-stressed for maximum tensile strength, to give you the most consistently perfect reproduction you've ever heard. If you record music you can be sure that its pitch will never vary, no matter how often the tape is played. You'd expect a tape as special as this to cost *more* than ordinary tape – but it's the same price. Agfa PE Recording Tapes (Long-play, Double-play and Triple-play) are available in shatterproof plastic cassettes (5″, 5¾″ and 7″ spools). □ Our man soon gave up trying to get the bowler on. He went back to reading his *free* copy of Magneton Illustrated, our colour magazine all about recording. We've got lots more, too. For *your* free copy write to Agfa Ltd., 27 Regent Street, London S.W.1. (REGent 8581).

Agfa tape will not stretch

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ONE MAN'S EDITING

SOME COMMON SPLICING FAULTS

BY P. D. TURNER

I HAVE chosen that title in order to make it clear that I am not an expert editor : all I know I have found out the hard way, by doing it. Possibly my experience may be of use to you ; but if, as may well be, you know more than I, bear with me—I've had lots of fun.

Some little time ago, the Editor of *Tape Recorder*, in a leading article, gave it as his opinion that nobody has truly begun to get the best out of his recorder until he has taken razor-blade in hand and cut his precious tape. Now, let us admit that the first slash calls for courage ; but the Editor was right. Recording itself is an art as much as a science. If one is recording a musical work, then the recording is right or wrong and that's that : few amateurs, I fancy, go to the lengths of the professional and record take after take until what they regard as perfection is achieved. But if one is making up a tape feature, or polishing up an interview, then editing is a necessity. One can edit after a fashion using two machines and the pause-button —and some people are very good at this. But I believe that the only real way is to cut the tape.

As no man is a judge in his own cause, there is a lot to be said for letting somebody else edit one's material. This may sound heroic ; but my wife and I get along very well doing it : she provides the material, and I edit it. Most of the material is interviews for the welfare tape *Cotswold Roundabout* which is produced monthly by the Society of which she is chairman (I know where to get my orders from, thank you) and I joint secretary. She is a much better interviewer than I, and I must say that she accepts my judgments and carve-ups with astonishingly good grace. For our purposes, items have to be quite short, and nearly always there is more material than we need. Further, there is nearly always a good deal of rather dull stuff, and a much smaller quantity of really interesting matter. Sometimes one comes upon a 'natural', and the interview goes straight through almost without editing ; but that is not common. What is interesting is the way in which what does not seem at first hearing to be very promising material ends up as a fascinating item, after the best bits have been isolated ; and quite often points can be driven home much more effectively by editing out the irrelevant.

We start by listening carefully, and deciding what, in general, to include. As the original tape will have been made on a battery machine —at present a *Telefunken M*300—we then copy the parts selected, using 7½ i/s for the copy, so as to preserve the exceptional quality which this little machine will provide. The higher speed also makes editing easier, simply because the signal takes up more tape. 15 i/s would be easier still. We then get down to the real edit. How does one go about this ?

The first requirement is a machine which will 'inch with sound'—that is, a machine which leaves the replay head in circuit while the tape is not being transported, with the tape sufficiently in contact with

(*continued on page* 399)

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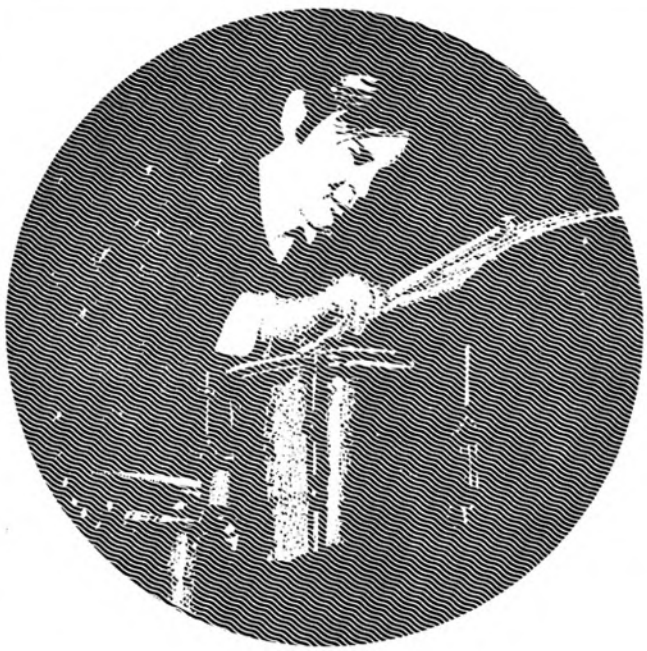
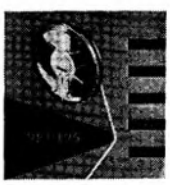
BRING YOUR RECORDINGS INTO FOCUS!



USE PHILIPS MAGNETIC TAPE

However good your tape recorder is, you need Philips Magnetic Tape to get the crisp, faithful recordings you're looking for. Available in all current sizes of standard, longplay, doubleplay and tripleplay, Philips Magnetic Tape offers you such a high standard of reproducibility that your recordings will sound better than ever. Add to this such further advantages as great sensitivity, wide frequency range, low noise level, high resistance to stretching or breakage and powerful adhesion of the magnetic coating, and you have a tape of the finest quality. What's more, to make your choice of Philips Magnetic Tape easier, each kind comes in a colour-coded pack. Choose *your* Philips Magnetic Tape today, and get the most out of your tape recorder.



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

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the head for the signal to be heard while the tape is gently rocked backwards and forwards across the head. With a little practice, the exact position of a word, or even a syllable, can be judged. Not all machines allow of this ; and not all of those which are suitable from this point of view have the heads so arranged that they can easily be approached by that life-saving tool, the chinagraph pencil. Never buy a machine which will not inch with sound, unless you have another which will. In my experience, the *Wearite* deck is the easiest on which to edit ; but it can be done with many others. I use a *Revox F36* ; and as this superb machine has the reputation of not being a very good one from the editing point of view, I will pass on a tip which renders it as good as any. The reason why difficulty arises is because the pinch roller is mounted on a heavy arm, which also carries pins which hold the tape away from the heads on fast wind and while the transport is stationary, so that the tape is not in contact with the replay head. I have found that a round wooden ruler, of the kind beloved of solicitors' offices of yesterday, held against the chest and gently pushed against the back of the roller, moves the tape on to the head and leaves both hands free to manipulate the spools. Dead easy and very effective.

Having found the place, one makes a small mark on the shiny back of the tape with a chinagraph pencil—which can be had from any good stationer—and the tape is removed from the tape-path and placed in the editing-block. There are several designs of block, including some automatic ones. I prefer the simple type, such as the *EMI Editall ;* but I respect the views of those who prefer more complicated designs. Using the slanted slot, bring the mark on the tape so that the slot passes directly under it ; take a new razor-blade, slide the corner along the slot, and your first cut is made.

A word about razor-blades. Sharpness is all : as soon as a blade begins to get dull, change to another. After all, these blades were made to slice soaped hair, not to be dragged along metal, and they don't last long. Economy here is fatal : a blunt blade will give a jagged cut and make a silent splice impossible. There are some handy gadgets which turn a razor-blade into a kind of pocket-knife. I have found these very useful : they prevent cutting the fingers and allow the use of double-sided blades, which have four corners against the two of the single-sided blade. Buy the cheapest there are ; and discard frequently.

I make two marks before cutting the tape : one to mark the beginning of the section I want to cut out, and the other the end of it. All that is necessary then is to place aside the bit cut out, and join up the ends. To do this, I always use the narrow splicing-tape rather than the half-inch type. The narrow is slightly narrower than the tape itself ; and if placed accurately it cannot stick or jam the tape transport. But placing it accurately is not the easiest thing in the world—indeed, it is about the hardest part of the job for me, because when I try to do it I get what the psychiatrists call an 'intention tremor' ; in other words, my hand shakes and I dab the blessed thing all over the place. This means trimming with scissors and a whole host of potential gaffs ; but I have found the answer to that one. The ladies use some spring clips as part of the arcane alchemy they practise with their hair. You can buy a whole card of them from a good chemist for a bob or so. They are rather like the familiar crocodile clip, but much less fierce. Clip the right-hand end of your splice—or the left if a south-paw—in this clip, rest your hand on the deck, place the splice with dead accuracy in the groove of the splicer, and press down the free end. Open the clip, release the splice, and press down : it is already just where you want it. Utterly simple ; and since I found this gadget I have never had even to dust a splice with talc, even less trim it with the scissors.

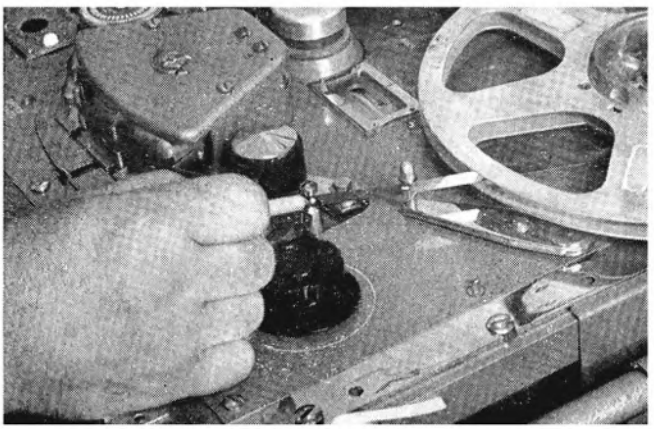
I cut myself at least a dozen splices at a time, by dabbing the end on the edge of the shelf holding the recorders, and snipping off about half an inch or slightly more with the scissors. The splices stand there, sticking out ready to be taken up and inserted in the clip.

Your join is made. You wind back the tape until the join is behind the replay head, and try it. If you have butted the two ends together accurately, and applied the jointing-tape with care, the result you hear is a silent and undetectable transition from what you did not want, to what you do. It is quite a moment.

But suppose that instead you find that after all you made the cut in the wrong place ? Such things have happened, believe you me. Not to panic : all is not lost. You do not need to make another copy and start all over again—though, since you still have the original tape, that standby is there as a last resort. The answer is to keep separate the piece of tape you have just cut out, and the right way up. My own method is to remove it and hang it over my left knee—remembering the Chinese proverb, I never stand when I can sit. One can then cut the splice by replacing in the block and aligning the cut with the slit, and re-insert the piece of tape removed ; find the right place and cut again : the double thickness of splicing-tape will do no harm.

An accurate butting-together of the cut ends is important. This may be heresy, but I have found that the real enemy is a join where the ends overlap : that *will* make a click, whereas a tiny gap between ends never does, so far as I know.

Using this method, we edit the tape, and then go through it again, timing it. Perhaps it is too long, and has to be boiled down. In any case, be ruthless : cut out everything which does not genuinely contribute to the effect you are after. Brevity is the soul of punch, if



Above : *If the playback head is inaccessible, the chinagraph mark can be made alongside a convenient guide ; the distance from head to guide enables calculation of the cutting position.* **Photo on page 397 :** *Daphne Oram, composer of musique concréte, makes full use of splicing techniques to produce the unearthly from everyday sounds. Both illustrations by courtesy of the BBC.*

not of wit. Sometimes cutting out may be an agony ; but it is worth it, and here is the point where the judgement of another is so useful. Then a final listening. You are probably pretty bored with the thing by now ; but it can usually be improved by cleaning up : cutting out the ums and ers, the "I sees", the "wells" and the "looks". Don't overdo this, or you will destroy the naturalness of speech, which is never perfect in practice. Pauses may need to be shortened ; but they may also need to be put in. I have found that this is best done with a length of tape already used, but with no signal as such on it ; one can use a length of leader-tape, but the dead silence resulting sounds artificial where the used tape does not.

After what you think is the final edit, put the thing aside at least until next day. Listen again, and if really necessary make the final changes. You may decide at some point to change the order and place something which was earlier on the original at a later point in the feature. To do this, cut out the passage, keep it carefully the right way up (the diagonally-cut ends will fit both ways up !) and identify it with one of those tacky labels on which you have previously noted the content. Attach only a slight strip, so that it can easily be peeled off without damaging the tape. If inserting musical links or sound effects, I find it best to make a copy and edit out the exact passage I need, identifying it as above and inserting where needed. I include any fade-in or -out when making the copy. The same method with any announcement at the beginning or end : these also should be copied, in order to preserve the same acoustic throughout.

Your job is done ; and you are left with a comparatively short master-tape, and a pile of cut bits. Each of these should be carefully dropped into a box after one has made sure that the edit is correct. They can then be joined together without further ado, since the ends are slanted as cut. A whisk over the bulk-eraser, and you have a useful length of tape. Splices are very strong, and do not come adrift if well made. Any recording made on the joined tape should be as silent as if it had been intact. This means that the cutting method isn't all that expensive.

(*continued on page* 418)

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PART 8—USING MIXERS

BY GORDON J. KING

TOWARDS BETTER TAPING

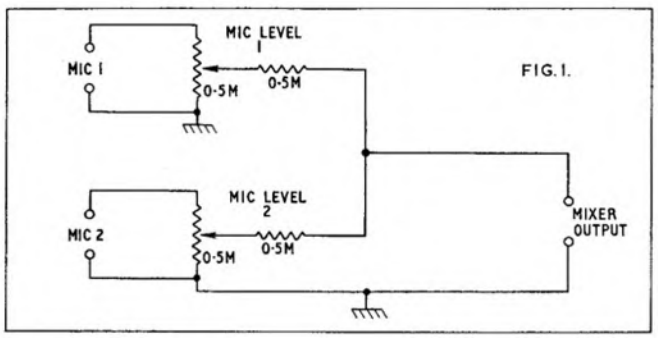

FIG. 1.

IT can prove technically embarrassing if the output signal delivered by a microphone mixer is considerably below the level from one of the microphones. This, of course, implies that the mixer has an *insertion loss*. The price that has to be paid for maintaining correct microphone and tape recorder matching and ensuring the smallest possible interaction between the fader or gain controls of each microphone channel is a signal loss or attenuation.

This attenuation occurs actually in the resistive network comprising the signal mixing circuits. A passive mixer (one without valves or transistors), therefore, must have an insertion loss. For instance, the insertion loss of the network shown in **fig. 1** lies between approximately 3dB and 6dB from either microphone input to the output. This means that even when the mixer controls are flat-out the signal level at the output (as applied to the tape recorder) is approximately half the level of the signal at either microphone (i.e., mixer microphone input socket).

This is on a two-channel circuit. When the number of channels is increased, the insertion loss also increases. It may be possible to accommodate a 6dB loss, without too much bother, if the microphone is a high-level crystal type. In that case, the circuit as shown in **fig. 1** could be adopted. This is suitable for high impedance crystal mics and for a high impedance microphone input at the recorder, although this input impedance of 0.5M or less may attenuate the low frequencies somewhat. The enthusiast can generally tell whether such an insertion loss could be tolerated by observing just how far he needs to advance the record level control on his recorder for the average type of recording that he makes. If full modulation occurs, for example, with the control just over half-way advanced, then a 6dB loss would not matter overmuch. However, if he discovers that he invariably works with this control almost fully advanced, the implication is one of lack of microphone channel sensitivity (or the use of a low-level microphone) and an extra 2-to-1 signal reduction should not be considered.

The solution, then, is to employ a mixer in which a valve or transistor amplifier boosts the signal to counteract the insertion loss of the passive network. For instance, if a small amplifier were connected to the output of the mixer in **fig. 1**, as shown in **fig. 2**, the loss could be neutralised or even turned into a gain. The latter condition would exist, of course, if the amplifier gain exceeded the network loss.

At this juncture, however, another factor crops up, and that is the very important one of signal-to-noise ratio. Whenever a small signal undergoes the process of amplification, a certain amount of unwanted 'noise signal' is also generated. Thus, in the amplified output, we have the wanted signal plus some noise signal.

Now, if the noise signal is not smaller than about one-thousandth of the level of the wanted signal it can mar the recording. The noise signal gives rise to a 'hiss' on the wanted sound, and the lower the level of the wanted sound, the more troublesome becomes the background hiss, which remains at a constant level.

If the wanted signal is a thousand times stronger than the noise signal, we have what is called a thousand-to-one (or better known as 60dB) signal/noise ratio. In practice a signal/noise ratio of this value is very good ; that is, from the amateur recording aspect.

The amateur is still doing well when he holds a 40dB (100-to-1) signal/noise ratio on reasonably low-level signals. However, when the ratio deteriorates below 40dB the end product is usually very messy.

How, then, can the enthusiast ensure that he is getting the best possible signal/noise ratio ? Well, firstly, he must make sure that he is not working always with the record level control full on to approach full modulation. Under that condition either the microphone or the microphone amplifier is faulty or low in sensitivity. Crystal microphones can suffer a reduction in output voltage after being stored in relatively high temperatures or a damp environment for any length of time, while microphone amplifiers and the first stages of tape recorders can give more noise and less gain due to reduced emission of a valve or a fault in an associated part, particularly a resistor.

Secondly, the user must endeavour to direct *all* the available microphone signal to the first amplifier stage in the microphone channel. Let us analyse this. Suppose that the microphone signal is 1,000 microvolts (one microvolt—μV—equals one-millionth of a volt) and the noise signal 10μV. Here, then, we have a 100-to-1 or 40dB signal/noise ratio, and results could be reasonable (it would be better, of course, if the microphone signal were greater and the noise signal less).

Now, suppose that the enthusiast decided to employ a passive microphone mixer of the type shown in **fig. 1.** Thus, even with a microphone gain control full on, that corresponding microphone would now deliver only 500μV to the tape recorder output. The noise signal remains the same, so the signal/noise *ratio* would have deteriorated to 50-to-1, or approximately 34dB (i.e., 6dB down on 40dB). Under this condition the background hiss could be troublesome.

Agreed, there are now two microphones instead of one, but from the signal/noise ratio aspect of an individual microphone, the number of microphones connected to a mixer is of no great consequence, for there would be little point in employing a mixer if all the microphones were to be directed to the same sound-source.

The idea, then, is either to increase the microphone signal as applied to the first amplifier in the chain or to reduce the amount of noise generated by that amplifier (or both). Also, to take steps to see that the microphone signal is not *attenuated* before it is applied to the first amplifier.

We keep referring to the *first amplifier*, with the inference that subsequent amplifiers in the chain do not count ! Actually, they are not all that important, since the noise generated by them is very small compared with the wanted signal they receive *after* the first amplifier.

From first principles, say that the first amplifier steps up the microphone signal by 100 times (i.e., 40dB gain) ; thus, the second valve will receive a signal 100 times stronger than the microphone signal. If the microphone is delivering, say, 1,000μV (1mV), then the second amplifier will receive 100mV (0.1V). If the noise generated in the

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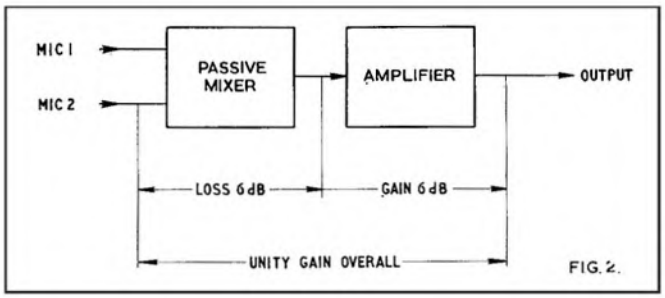

FIG. 2.

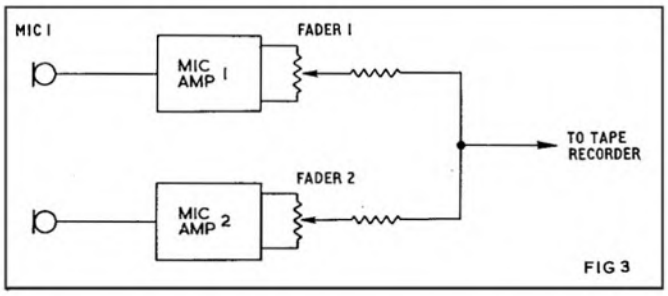

FIG 3

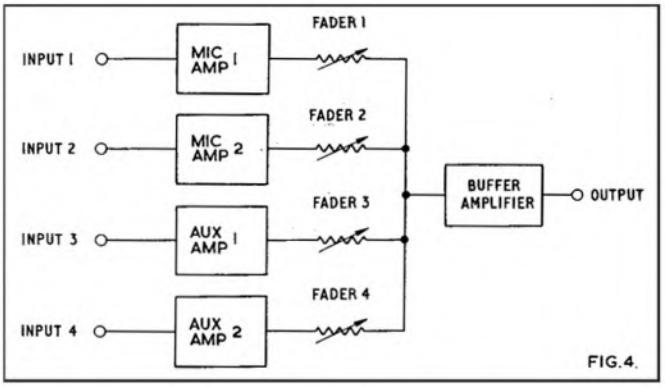

FIG. 4.

second amplifier is 10μV, as in our previous example, we now have a signal/noise ratio (at this second amplifier) of 10,000-to-1 (which is 80dB) and barely worth considering.

The most important stage so far as the overall noise is concerned is clearly that which is directly following the wanted signal source. It is here that we must concentrate most of our attention if we want to reduce the amount of hiss on our recordings.

Because of this, many microphone mixers employ an amplifier for each microphone channel. This means that each amplifier will receive the full microphone signal since there will be no attenuation between the microphone output and the amplifier input. Moreover, each microphone input circuit can be tailored for the best possible match, giving the maximum signal transference between microphone and amplifier.

The fader or gain controls for each channel can then be positioned subsequent to each microphone amplifier, as shown in **fig. 3.** This technique further assists in reducing the noise of the controls, for the controls are then working at a position of slightly lower gain,

Commercial mixers often feature more than two channels, with low and high impedance inputs and a buffer output stage for feeding to the input of the recorder. This buffer stage may be of low, medium or high impedance output, depending upon the requirements and the type of tape recorder it is to feed. The general idea is shown in **fig. 4.**

Mixers are best for amateur use if they embody their own power supply. Valve mixers may thus have a mains power unit while a transistor version would contain a suitable battery.

A typical commercial mains version is the four-channel mixer, the *Esimix Major*, by Electronic and Scientific Instruments (Worthing) Ltd. This features a modified Mullard circuit with the first triode sections of ECC83 valves acting as microphone amplifiers. The second triode section of one of the valves serves as the 'buffer amplifier', arranged in the cathode-follower mode, so enabling the mixer to be positioned at some distance from the parent recorder if need be. There are high and low impedance inputs. The high impedance sensitivity of the unit is 100 times (40dB) and the frequency range from about 5 c/s to 35 Kc/s.

A useful transistor version for the enthusiast is the Grampian three-channel mixer using transistors. This has as standard, two low-level 600 ohm inputs and one auxiliary high-level input at 1 megohm, but other combinations can be ordered as required.

The output is at 600 ohms, this coming from a buffer amplifier using a pair of transistors after the faders. Each input channel has its own transistor amplifier. The use of a low-noise semi-conductor (Mullard AC107) and careful matching ensure the best signal/noise ratio. A special feature of this mixer is the tone control system, employing bass and treble controls.

Transistor mixers with internal batteries facilitate mobile and semi-portable applications, and the lack of mains power to the low-level input stages goes a long way towards reducing hum problems.

Nevertheless, there are conditions where hum could be troublesome due to the formation of a hum loop. For example, such a loop could develop in a system where two or more pieces of equipment are connected to a 'mains earth'. The mixer may be receiving signals from, say, a radio tuner, which itself is 'earthed' and delivering them from its output to a tape recorder, which is separately earthed. Hum could develop under this condition. The solution would be to remove the earth connection from *one* piece of equipment. The equipment, which should remain earthed, can be determined by experiment, eventually de-earthing the piece which reduces the hum most.

The question of matching often arises when a mixer is introduced. Past articles in this series have dealt with the factors of impedance, signal levels and matching, and it is not intended to revive the subjects again here. Nevertheless, one or two extra words of practical assistance may be welcome.

Always read carefully the instruction details as issued by the maker of the equipment, and endeavour to translate the input sensitivity of each channel to the signal that it is proposed to apply to it. This should be a reasonably close match, as also should the partnering impedances.

An input sensitivity of, say, 500mV (a mV—millivolt—is one-thousandth of a volt, 0.001V) across 1 megohm would be nowhere near suitable for a crystal microphone, for instance. Although a microphone of this type has a high impedance, it may only produce a few microvolts and thus fail to provide sufficient signal to drive the recorder. However, these parameters make the input suitable for accepting the signal from a high-level crystal pickup.

There is another factor to have in mind when considering crystal microphone or pickup inputs, and that is there will be a progressive loss in bass response when the input impedance is much less than about 1 megohm. Crystal devices favour the highest possible impedance across them, which is one reason why the *Esimix* unit referred to above uses 10 megohm resistors in the grid circuits of the amplifier valves. Crystal microphones can be connected to high impedance circuits without loss of bass response ; thus, for lack of bass when using a crystal microphone or pickup, examine the impedance characteristics of the unit to which it is connected.

Low impedance microphones and pickups are not quite so frequency-sensitive in this way, but it is still important to ensure the best possible impedance match. If a low impedance microphone (20-30 ohms) be connected across 600 ohms, the main trouble will be an unnecessary fall in overall sensitivity, due to the absence of a transformer designed to raise the impedance to 600 ohms. There would be a drop of about 14dB of gain, and as this would impair the signal/noise ratio, trouble with hiss from the mixer input stage may result. A transformer with a voltage step-up of 5 : 1 (14dB) will give an impedance transformation of this factor squared (25), thus matching 24 ohms to 600 ohms.

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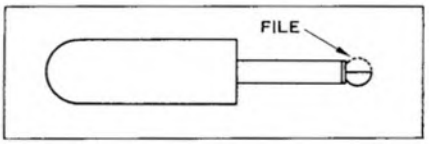
our readers write . . .

. . . about recording from the Beolit 609



From : J. Farley, 61 Orangefield Avenue, Belfast, 5.

DEAR SIR, You may care to publish the following modification made to a *Beolit* 609 FM portable radio :

To get a high quality output, file a jack plug as illustrated and plug into the GRAM socket. Twist the plug until a connection is made and then mark the plug appropriately.

Yours faithfully.

. . . about after-sales service

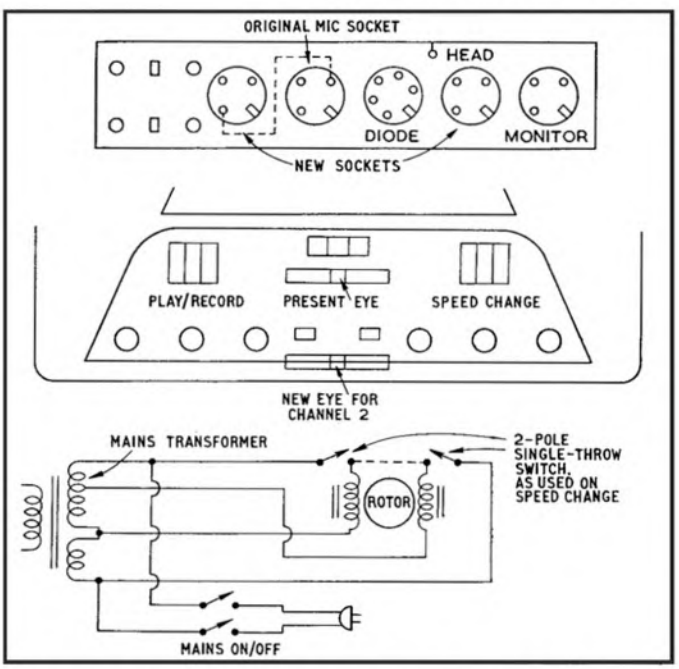
From J. Fitzpatrick, 259 Maidstone Road, Rainham, Gillingham, Kent.

DEAR SIR, In your October 1962 issue, you published a letter from Mr. Herkes proclaiming the good after-sales service he received from Messrs. Reps Tape Recorders Ltd. of South Acton, London. I would be grateful if you would be so kind as to publish how I have benefited through their after-sales service.

My Reps R10 tape recorder, after nearly three years hard usage, developed a minor fault and, while at their works for repair, it was stolen. They informed me of this and said they would write again on the matter. But without any further notice, within four weeks they replaced my recorder. *That* is after-sales service which should be recorded by all your readers.

Yours faithfully.

. . . about the EL 3536 again



We apologise for the omission of the above illustration from Readers' Letters in the October issue. This was due to pressure on space. The drawing should clarify the Philips EL3536 modifications outlined by Mr. Bishop.

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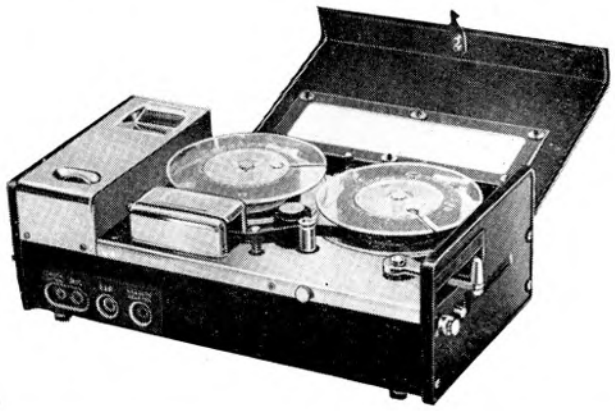
field trials

OF BATTERY PORTABLES



NUMBER FIVE — OLYMPUS PENCORDER — BY DAVID KIRK

THE initial reaction of those present in the room when the *Pencorder* was unpacked was one of enthusiasm towards the sturdy finish of the recorder mingled with slight dismay at the strong smell of the cow-hide case ! This odour, however, quickly lost its pungency in the days that followed.

At a time when most designers appear keen to destroy the 'complicated' appearance and atmosphere of the tape recorder, it is pleasing to find a battery portable lacking unnecessary and easily damaged plastic peripheries and studs.

The cowhide case disguises the fairly small size of the recorder as it incorporates a large accessory compartment. This will hold about ten carefully stacked 3in. spools as well as the accessories provided. The latter are made up of the following : A moving-coil microphone with battery on/off switch, connecting lead with crocodile clips, earpiece, and three 3¼in. spools. A reel of virgin acetate tape and a demonstration recording were found on two of these spools.

All input and output connections are of the miniature jack type, save that of the remote battery switch, which uses a sub-miniature jack mounted on the microphone plug.

Mechanical operation is a little involved and is controlled by metal switches on the right-hand side of the recorder. FAST REWIND, RECORD and PLAYBACK are operated by a single arm, below which is a small record interlock. FORWARD WIND is accomplished by pushing a separate arm which remains in position until the RECORD/PLAYBACK/REWIND control is placed at STOP.

Record and playback gain are regulated by a single graduated control. A VU-meter is also fitted to give some idea of correct modulation level. On playback this indicates battery condition.

A removable capstan sleeve allows alteration of speed for 3¾ and 1⅞ i/s. No allowance is made for the adjustment of frequency correction to suit the different speeds.

The Japanese may produce good recorders on occasion, but much of their tape—certainly that supplied with the average domestic battery recorder—is of atrocious quality. Indeed, one importer of such equipment admitted that he replaced the tape on Japanese recorders before re-sale, with superior Western brands. It was not, therefore, entirely surprising that the Pencorder became troublesome when recordings were made with the tape supplied. Severe flutter was apparent on both music and voice at 3¾ i/s. This was traced to the sharp angle through which the tape passed between feed spool and heads. The acetate tape wrinkled visibly and shuddered off and against the corner guide as it moved towards the head gap.

Double-play PVC tape entirely overcame this trouble and, in common with a brand of triple-play, greatly improved the performance.

One other slight trouble experienced in the period required to discover the recorder's 'habits' occurred when a certain 3¼in. spool was used on the Pencorder. This spool happened to be a tight fit on the hubs and could not be made to sit flat on the spool base. Being of slightly greater than average vertical height, due to its construction from thick plastic, the odd fiftieth of an inch thus added here-and-there caused the top of the spool to scrape against the closed lid. The spool in question is restricted to one well-known brand but it would be advisable to watch out for this trouble when experimenting with new spool types for the first time. Cine and all other spools I could lay my hands on fitted perfectly.

Having recently moved close to the sea, it seemed a good idea to test the Pencorder's abilities on general sounds of the coast. The splash of waves against breakwater reproduces very disappointingly on most inexpensive domestic recorders. Often, what little sound is picked up by the microphone is lost, due to the nature of the sound, in a background of tape hiss and motor noise. But a recording made on this machine proved to be of startlingly good quality when replayed from a mains recorder straight into a pair of *Paraline* speakers. The recording, made at 3¾ i/s, reproduced every splash and gurgle and was almost entirely free from hiss. Electrical interference from the motor was non-existent and speed fluctuation quite inaudible. This same recording, played through the Pencorder's 4in. internal speaker at the time it was made, showed nothing particularly remarkable in quality, and the built-in speaker can therefore be described as for monitoring purposes only.

Other effects, including a speed-boat starting up and a large tug-boat chugging past a pier, were instantly recognisable on playback. The tug-boat, particularly, was presented with all its bass component and seemed to be chugging through the room.

Still using thin tape, several sequences of piano 'music' (my abilities on this instrument normally arouse even more degrading remarks than do my occasional *musique concrete* experiments !) were recorded in a serious attempt to assess wow. This was present only to a very minor degree and it was interesting to note that deliberate shaking, twisting, turning upside-down, and swinging had little effect on the speed stability. This has its advantages, of course, when tapes have to be made in a moving vehicle or while walking.

Removing the 3¾ i/s sleeve from the capstan and storing it on a spindle included for that purpose, the quality was assessed at 1⅞ i/s. As serious recording would not be attempted at anything other than the fastest speed—especially with such a spare tape capacity—the quality at 1⅞ i/s obviously needs only to perform the duty of reproducing recognisable speech. The Pencorder does its job quite well as a general-purpose dictaphone at this speed, and the provision of an on/off switch on the microphone is useful for this purpose. It cannot be too strongly stressed, however, that 'remote-control' of this simple and inexpensive kind can and *will* cause extensive damage to the tape transport system : idlers will become deformed if kept under compression whilst stationary. This applies not only to battery, but to mains equipment.

In closing (for the benefit of those who just read the summary) I would recommend this addition of a recorder to the *Olympus Pen* range of cameras, as an ideal battery machine for the not-so-rich enthusiast. Tapes recorded on this, and replayed on a good mains machine, do justice to the resulting improvement in playback quality. This, coupled with long battery-life, an excellent microphone, and the small size, makes the Pencorder very good value at £34 14s.

MANUFACTURER'S SPECIFICATION

Tape Speeds : 3¾ and 1⅞ i/s. **Spool Capacity:** 3¼ins. **Battery Complement :** Six 1.5V cells. **Battery Life :** 12 hours. **Frequency Range :** 200 c/s to 5 Kc/s. **Signal-to-Noise :** 35dB. **Output Power :** 200 mW. **Loudspeaker :** 4in. elliptical. **Level Indicator :** VU-meter. **Dimensions :** 5¼ × 9⅝ × 3¼in. **Miscellaneous :** Remote on/off switch on microphone. Fast wind and rewind. **Accessories :** Cow-hide case (£3 3s.). **Price** (including microphone, earphone, tape and recording lead) : £35 14s. **Distributor : Pullin Optical Co. Ltd., Ellis House, Aintree Road, Perivale, Greenford, Middlesex.**

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THIS month the first circuit to be shown is for those who, in spite of the diatribe at the end of last month's article, still prefer to use the VU-meter to measure recording modulation. The signal level at the monitor point is about a tenth of that at the output, so that to drive a reasonable meter movement some amplification is needed. **Fig. 1** shows a suitable circuit, and there are two variations on this. If any general purpose type of meter is chosen, then the diode bridge **(a)** is used. A series resistor and parallel capacitor are used in an attempt to improve the meter characteristics a little. However, it is possible to buy a proper meter designed for use and calibrated as a VU-meter, and this has quite well defined characteristics which are correct when fed from a 600 ohm line ; for this **(b)** should be used.

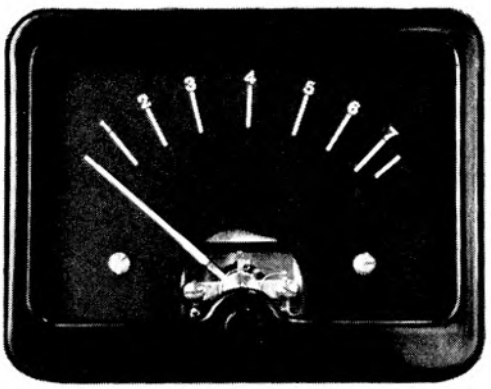
The signal is amplified by a single transistor Tr1 and passed to an emitter follower stage (Tr2) which provides no voltage gain but gives a low output impedance ; this can be calculated as the input source-impedance divided by the current gain, β, of this stage. The source-resistance is R3, 5.6K, only, since the collector impedance of a transistor is high, and an OC 83 has a minimum β of 50. Thus the maximum output impedance of the stage is 112 ohms. In the case **(b)** for a commercial VU this is padded to as near 600 ohms as it is possible to reach in one resistor. For the other circuit a four-diode full-wave bridge is used to rectify the signal on to a 25 μF capacitor (C4). In theory this should be charged in about 12 mS, or much the same time as the PPM circuit described last month. However, this demands a peak current greater than Tr2 can supply so that this figure is nowhere near reached ; in any case the meter would not respond at anything approaching the correct speed. The decay time is also controlled by C4 and R7 to about half a second time constant. The meter is a 100 μA model and one of the 50 μA types available for £1 is very adaptable to this purpose. The output transistor must have a small heat sink of the flag type to keep the junction temperature to safe limits, for all temperature ranges.

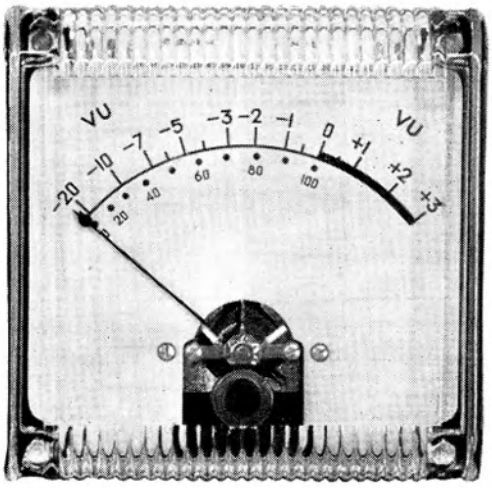
The specification for a proper VU-meter such as is used in **fig. 1b** is given in the Bell System Technical Journal for January 1940, and states that the meter shall incorporate a full-wave rectifier so that the complete unit can be plugged easily across a line for measurement. If a signal of 1 Kc/s of a level which in the continuous steady state would read to the 100 mark, is suddenly applied to the input terminals, the pointer should read 99 in 0.3 seconds, and have an overshoot of not more than 1.5%. This should be compared with the PPM which, because of its rise-time of 2.5 mS, will reach 99% in 0.012 seconds ! The input impedance of the VU is 3.9 K, and the frequency response is within 0.5dB from 25 c/s to 16 Kc/s. The frontal appearance of the two meters is shown in the photographs (PPM by courtesy of *Ernest Turner Ltd.*) ; the final choice of the system will rest with the builder, but if possible try to see the two systems in use, and better still on a side by side comparison.

Fig. 2 shows the flashing circuit which drives a red panel light on the mixer to indicate some sort of a fault condition. For example, if a recording is started when the tape-to-studio key is depressed, a sound picked up by the microphones in the recording room will be played back into this room a fraction of a second later when the tape passes the playback head. This in its turn will be picked up and recorded and so a permanent echo is recorded on the tape, and if the loop gain is greater than unity the echo will build up until it overloads the tape. The lamp is linked to the tape key so that a compulsive visual indication is provided to at least lessen the likelihood of this happening. On the prototype this facility was used for the oscillator circuit, tape-to-studio, and talkback circuits, although it can be used for any other circuit if necessary provided that a separate switch is available for each function. Some of the lever switches had no spare ways left after the signal switching was done, so that for these a small microswitch was arranged under the operating bar of the lever.

The circuit used for the flasher is a multivibrator type, also known as the Eccles-Jordan circuit after the designers who built the original using valves. Square-waves are produced at the collectors of the transistors, and since a square-wave is very rich in harmonics this circuit is used in electronic organs ; filtering and recombining will produce the many tone colours required in such instruments. The operation of the circuit can be described simply as follows, assuming for the moment that Tr2 and 3 are taken as a single transistor.

Take the moment immediately after Tr1 has switched off and Tr2/3 have just switched on. The collector of Tr2 and 3 has just moved from the supply voltage, -6V (corresponding to no current in the lamp) to almost zero volts (full current through the bulb). This swing in voltage was passed directly through C2 on to the base of Tr1 which is thus





A STUDIO QUALITY MIXER

PART 6 - THE LAST FEW CIRCUITS

BY D. P. ROBINSON

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cut off. C2 then attempts to charge up to -6V, through R2, and after a while passes through zero volts on its way. At this point Tr1 starts to conduct, and the voltage at the collector drops from -6V towards earth. This drop is passed instantaneously through C1, since it is an AC waveform, to the base of Tr2/3, tending to turn this pair off. The voltage at these collectors will rise and this rise is passed through C2 to Tr1 and so turns this transistor on further. This is positive feedback, and the circuit snaps from one state to the other. C1 then charges up slowly towards the supply voltage via R3 and the process is repeated. The output is a square-wave, and the two time-constants C1/R3 and C2/R2 are chosen to give a rapid flash from the bulb, which is a 6V 40mA Post Office type.

Two transistors are used in the compound arrangement to produce, in effect, one with a very high current-gain so that the bulb can be driven to the maximum brightness without unduly loading the circuit. The average current taken by the circuit is 23mA, whereas if only two transistors were used in this configuration instead of the three the current demanded would be 40mA. The resistor R5 is used together with the zener diode ZD1 to produce a relatively stable supply of 6V from the main -24V rail, and the other resistor R4 is added across the

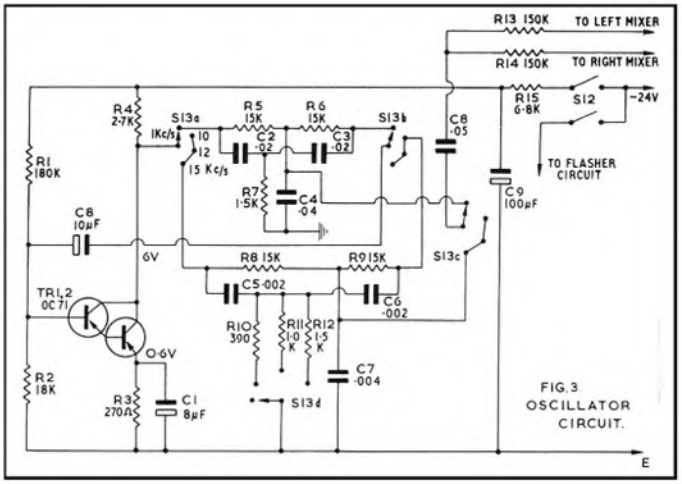

FIG. 3 OSCILLATOR CIRCUIT.

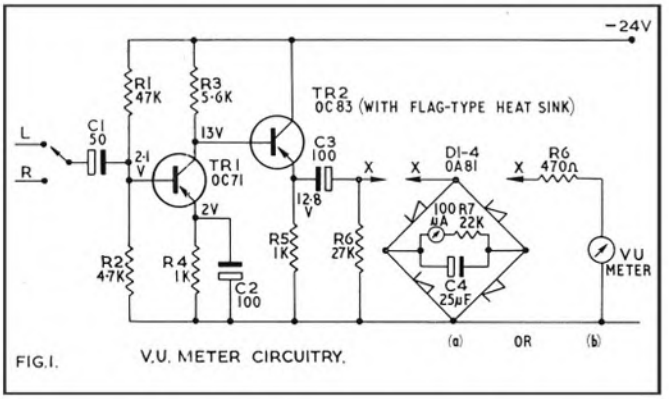

FIG. 1. V.U. METER CIRCUITRY.

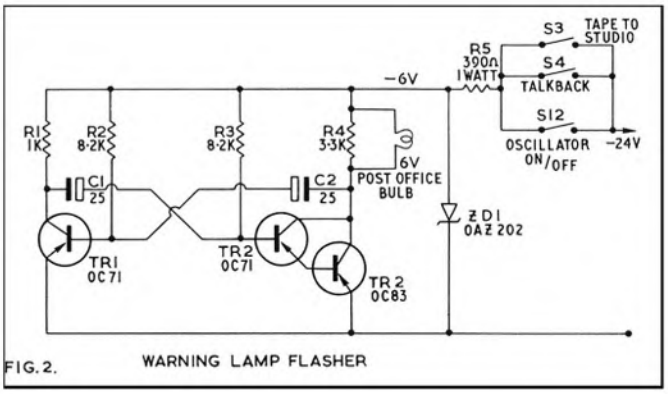

FIG. 2. WARNING LAMP FLASHER

bulb so that if the bulb fails the flashing circuit will still operate and there is no possibility of any damage occurring from back-biasing of the transistors. This is a very simple circuit to build and can be adapted for many other uses, one of which could be to replace the mechanical flasher in a car. It was added to a very early mixer of somewhat similar type mainly as a gimmick, but very soon proved its worth in the field and became very useful. It is only too easy to forget the recorder is still switched to the studio when the next take is attempted!

The prototype mixer used another very useful circuit, a built-in oscillator **(fig. 3)** which gave spot frequencies for checking the tape recorder and also for recording a short burst of 1 Kc/s tone at peak level or at some other known level at the start of all major recordings. When a dubbing or re-recording is made from a master recording, for example when records are to be made, all the other apparatus can have the peak level settings adjusted to this pilot tone. Once this is done, there is no further need to touch any of the controls and so the dubbing can be done without supervision, which reduces the manpower required.

The oscillator is a two-transistor design, with feedback from collector to base which passes through a twin-T network to reverse the phase so that the total phase shift is 360°. The feedback is thus positive and the circuit oscillates. So that the shifting network is not unduly loaded by the amplifier stage, a compound-pair is used, as in the flasher circuit. In the network, R7 controls the frequency of the oscillation and the range is about 50%, so that two networks are used to cover the range required. One is centred on 1 Kc/s, and R7 can be adjusted until the frequency is exactly correct ; the other is tuned to 10, 12, and 15 Kc/s, with R12, 11 and 10 controlling these frequencies. These latter are for checking that the equalisation of the recorder is set up correctly, and that the playback head is aligned with the record head. The output is set at a constant level using the PPM in the mixer (the oscillator output is not constant since it is essentially a simple circuit), and still using the PPM the tape output can be measured. No extra equipment is required so that this is a very simple operation to perform.

The oscillator output is taken from the network at a point where it is

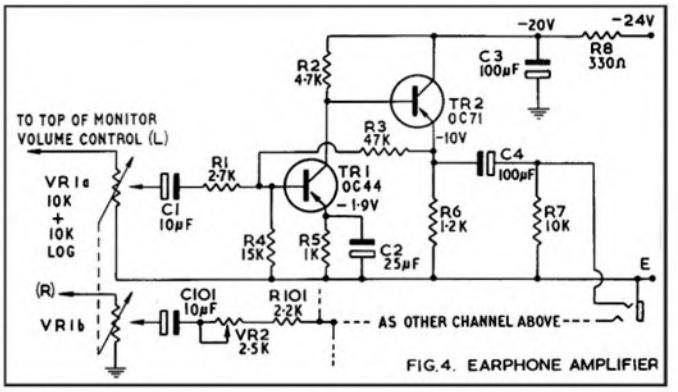

FIG. 4. EARPHONE AMPLIFIER

relatively low in harmonics, and is fed to both the left and right mixing busbars. The supply voltage is derived via R15/C9 from the main supply, and a separate pole in the switch is used to operate the flasher circuit to make quite certain that the device is not left in an operating condition for longer than is strictly necessary.

There are sometimes recording situations where it is not possible to set up all the equipment and monitor loudspeakers in a room separate from the performers, and for monitoringin these situations an ear phone socket was provided. While earphones are certainly no substitute for good quality speakers, it is a case of something being better than nothing. 'Blind' recordings have a habit of going wrong ! A quick survey of the high quality earphones available shows that there are two main types in general use. One is a 15-ohm-per-earpiece version, which is intended as a substitute for the main speakers, and while being much more sensitive than the speakers still requires a fairly large signal. The other types are smaller and lighter to wear, and are in the order of 500-ohms each, requiring a very small power indeed to drive them to full output.

(continued overleaf)

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How clean is Clean ?

When comparing tape recorders special note should be taken of "Signal-to-noise Ratio" i.e.:—the noise level on a tape which has been erased by the recorder's oscillator, compared with the signal from the tape when fully modulated. This is expressed in decibels (d.b.).

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with a recorded signal output of 1 volt :—

— 40 d.b. =	10	millivolts of noise
— 45 d.b. =	5.6	" " "
— 50 d.b. =	3.2	" " "
— 55 d.b. =	1.8	" " "

"The reproduction remains CLEAN even by immediate comparison with the original, and this, to my mind, is infinitely preferable to another octave or two of frequency "with whiskers on". (A. Tutchings reviewing Tandberg Series 6).

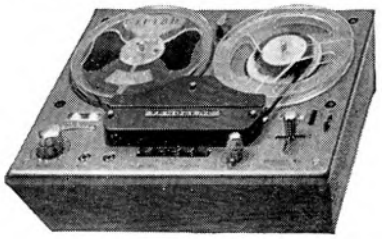

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Fig. 4 shows an amplifier designed to feed to one of the latter type, and in particular the *AKG K50* earphones. In the manufacturers' technical data these are listed as 400-ohms per earpiece, and as requiring a normal input level of 250mV, although the maximum that can be applied to the units without serious distortion is 6V. The amplifier shown will produce 2V at full drive which gives an uncomfortably loud sound, and it will be recognized as being very similar in design to the output amplifiers used in the main part of the mixer. The volume control VR1 is ganged for the two channels, and is fed from the top or 'hot' end of the monitor volume control which is in the recessed panel on the front of the mixer, so that the two controls are independent. The gain of the right channel can be varied by ±6dB over the left channel to adjust the balance between the two earphones should the two earpieces have different sensitivities. This is achieved with VR2 ; both these two potentiometers are mounted on the fader rack in the central portion.

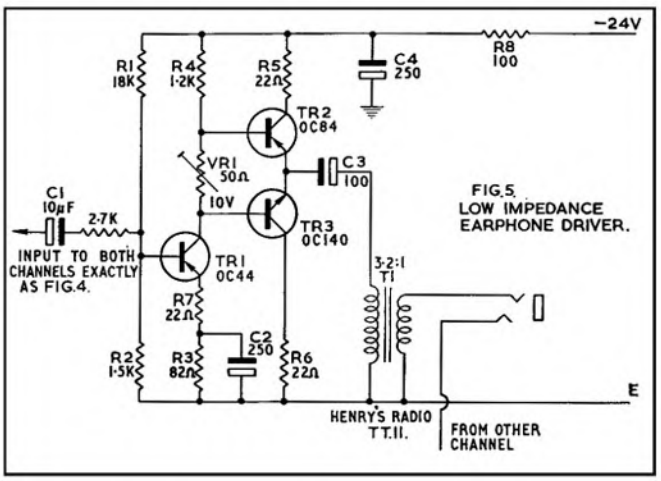

FIG.5. LOW IMPEDANCE EARPHONE DRIVER.

For those who have low impedance earphones, the circuit of **fig. 5** is more suitable. By using an output transformer the matching impedance for 15-ohm earphones is achieved, and more power can be delivered to the load. The AKG 'phones need typically 2.5mW, while low impedance 'phones need 60mW for the same intensity at the ear. The first circuit, while possessing a low output impedance, will not drive into a 15-ohm load. The final circuit adopted is very similar to that used as the drive amplifier in the peak-programme-meter circuit described last month, with one amplifying stage followed by a push-pull complimentary-symmetry stage, but biased into Class A condition.

There is one variable resistor in the circuit to adjust this biasing, by providing a small potential between the bases so that in the absence of an input signal the output transistors are conducting slightly. If no resistor is included, there will be bad crossover distortion in this stage. The circuit is arranged so that there is a minimum resistance on the first switch on ; after the DC potentials have been checked, VR1 is increased until the current taken by the whole circuit is 15mA.

This circuit gives a good quality sound to the earphones, but not as good as the previous circuits ; to provide a top quality signal to low impedance earphones requires a conventional power amplifier, which will probably demand more current than the small power supply in the mixer will supply. The 'phones are only used at the unfortunate times when it is not possible to use the best system of a separate room for equipment and artists.

With the two earphone amplifiers the last building block has been described, and at this point the guiding principle behind the mixer could be repeated. Each block is entirely self-contained, and is so able to stand by itself with an unchanged performance ; any amplifier may be taken and used in similar applications elsewhere. Next month we will start by answering some of the questions brought up in readers' letters, and the series will be concluded with a few hints on setting up the equipment for stereo recordings.

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HOW WE MADE THE FLETCHING FESTIVAL TAPE

BY R. W. GRIFFIN

TO celebrate the 700th anniversary of the Battle of Lewes, fought on 14th May, 1264, and to commemorate the visit of Lord Simon de Montford with his knights and his army to the little village of Fletching on the eve of the battle, it was decided to hold a Festival. It was to take the form of a *Son et Lumiere* display, but with the addition of live characters, and was to be presented in the village church where Simon spent some hours in vigil and prayer, and where some of his knights were buried after the battle.

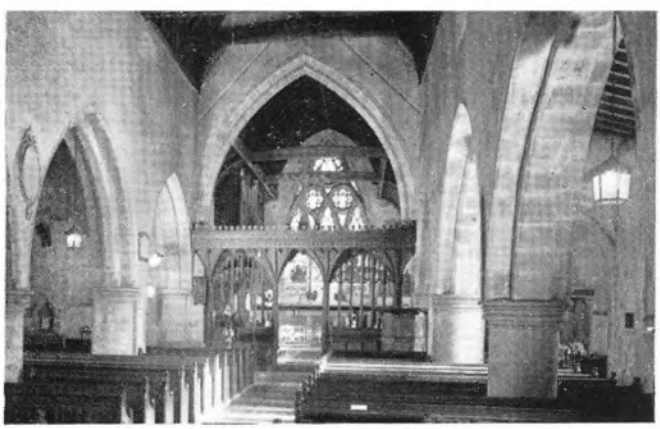
The narration for the whole performance was recorded on *Tape A* by Richard Ainley, whose fine voice contributed much to the success of the occasion. The production team consisting of the Vicar of Fletching, the County Drama Adviser of East Sussex, a Lighting Director, a General Manager and myself, met and discussed the plan early in March. Various pieces of music were suggested for the different episodes, leaving the writer to choose the particular passages to be included. A wide variety of sounds and noises was also required, ranging from footsteps and horses walking, trotting and galloping, to birdsong, bells, bows-and-arrows, battle sounds and grave-digging.

During the next three weeks, *Tapes B* and *C* were built up, the former consisting of all the music selections in their correct order, with convenient short gaps between each item, the latter comprising a similar collection of all the sounds, some of which had to be pre-mixed, such as galloping horses with shouting and the swish of arrows superimposed. Each tape was carefully cued for the start and end of each episode. The whole thing was then put together by four members of the Lewes Tape Recording Club, using four recorders and a three-channel mixer.

It says much for the skill of the operators and the excellence of their varied equipment that no technical hitches arose. The fact that it took some five or six hours to complete, is a measure of the care taken in the production. Many times the action was stopped, the result played back and a decision taken either to proceed further or to re-record the previous passage in an endeavour to achieve perfection.

Tape A, the narrative, was transmitted from a *Vortexion* via the mixer, which on this channel, had no fade control, the level being pre-set by the playback volume control on the Vortexion and not altered throughout the session. Tape B was handled by a *Grundig TK 8303D*, whilst Tape C was played back by a *Sound* 555. These two channels, of course, had the necessary volume fade controls. In all cases the signal was taken from the external loudspeaker sockets at low impedance in order to minimise hum. The output from the mixer

(*continued overleaf*)



Top : *Photo by courtesy of "Sussex Express and County Herald".*
Above : *The church interior.*

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was fed into a *Ferrograph 4A* owned and operated by the Chairman of the Lewes Club.

The resulting tape was heard the following day by the Producer, the Vicar and various others interested in the final production, and as a result several amendments were agreed. The opening music was not entirely suitable and in any case was too long. There were several gaps of silence which had to be cut, one or two clicks to be removed and, in one case of a musical item, an excess of bass was noticed. The writer then spent several weeks putting these modifications in hand, re-recording passages where necessary and where no multiple-mixing was involved, splicing the new sections in place of the offending pieces, cutting the silences and resplicing—and in one case *increasing* a silent sequence some three seconds by splicing in a 2ft. length of erased tape.

Rehearsals in the church with the performers began on May 2nd, and the public performances were given on May 13th, 14th and 15th, the tape being played on the writer's Ferrograph 4A, the output being fed into a 25W amplifier supplying a pair of loudspeakers located out of sight over the chancel screen and a third speaker mounted over the main entrance door.

The narrative commenced in darkness by Simon's remark that he last visited Fletching on the 13th May, 1264, when he camped there with his army. He tells the assembled villagers of his intention to enter the church to pray for God's help and guidance. At this point his horse is heard being led off and his own footsteps approach the door. As the latch clicks and the hinges creak, the door opens and a spotlight falls on Simon as he enters in full armour. He makes his way up the nave in silence, admiring the building which, in 1264, had been completed only thirty years previously.

SOLEMN BACKGROUND

Following his prayer, with a quiet background of solemn music, the Bishop of Worcester appears, to read a letter from King Henry III calling on Simon to surrender and abandon his rebellious campaign. Simon rejects this idea and kneels again in prayer whilst monks holding lighted candles parade round the church to the accompaniment of Gregorian Plain Song. Day breaks with music and birds' chorus and Simon rides out to see his men fall in before their march to battle. He tells them they are going to battle in the name of fair government and the honour of God and His church. The men cheer and start to march off with their wagons, horses and equipment, singing a 13th-century marching song. Before Simon departs, however, he invests five of his warriors with the Order of Knighthood, standing on the chancel steps. At this point a disturbance is heard outside and an alleged spy is brought in, who, however, proves to be the wife of one of the knights disguised as a boy, having escaped from the captivity of the king at Tonbridge.

The narrator then describes the strategy and course of the battle, with coloured spotlights to illustrate the dispositions of the armies. Finally, there is a solemn procession back into the church where the bodies of the fallen knights are buried, with tolling bells, solemn music and monks chanting. Simon concludes with a brief plea for remembrance of his fight for freedom, followed by a blessing by the Bishop.

Some of the recorded noises presented problems. The sound of grave-digging superimposed on the chanting monks was finally produced by plunging a scoop into a wooden box half filled with rice, to give a most realistic sound of a spade in gravel. The battle noises, to a background of part of Stravinsky's *Rite of Spring* music, were made by two people clashing carving knives together, whilst rushing round a room shouting and kicking furniture and anything else handy ! On top of all this was then superimposed the noises of a boys' school canteen about to serve lunch ; the effect was terrific !

The whole production was a great success, the local paper commenting that "the narrative and sound are unfaultable, with the choice of music complementing the action. Monks chanting against the backcloth of a village church, swords clashing and mingling with the dying cries of man and horse, Simon's voice lowered in prayer asking for guidance—all these myriad sounds came through with remarkable clarity."

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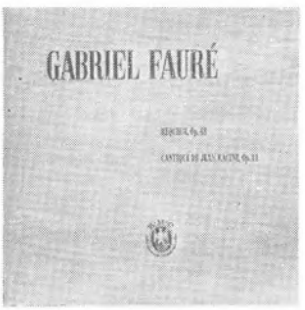
tape reviews

BEETHOVEN SYMPHONIES. No. 4 in B flat Major. No. 5 in C Minor. Vienna Symphony Orchestra conducted by Heinrich Hollreiser. **Recotape RML 504.** 3¾ i/s mono, twin-track. 50s.

THE Beethoven symphonies must surely be the most widely loved in all the concert repertoire. They certainly must be the most widely recorded. It is perhaps their very familiarity that make the performances recorded here seem work-a-day and lacking in any extra vitality. Certain factors in the quality of the recording itself also mar the performance and it is often difficult to decide whether it is this or the actual playing that gives the drowsy, Sunday-afternoon atmosphere to the music.

Perhaps one of Beethoven's more characteristic musical habits is his use of the *sforzando*, that sudden dynamic accent on a note or chord that gives the music added drama and impetus. On this tape there is so much recorded echo, and the lower strings and tympani are so prominent, that these sforzandi smudge over into subsequent passage work. This is more noticeable in the last movement of the fourth symphony. How some of those emphasised chords hang around ! In the first movement of the same work a counter melody played on the lower strings is almost obliterated by reverberation.

The performance of the fifth symphony suffers less from this particular defect (although it is still noticeable), but the balance of the instruments is such that the flute disappears completely except in its more exposed passages. Again, one is too aware of the lower strings and tympani and a muddy atmosphere pervades. These are faults, I fear, that would show up on all replay machines, small or large. **G.G.**



REQUIEM, Op. 48 and CANTIQUE DE JEAN RACINE, Op. 11, Gabriel Faure, Bernard Kruysen (baritone), Denis Thilliez (boy-soprano), Chanoine Henri Carol (organ), Philippe Caillard Choir, Orchestra of the Monte Carlo Opera conducted by Louis Fremaux, **World Record Club TCM 51,** 3¾ i/s mono twin-track, 29s.

THE music we refer to in general as 'classical' has its roots in church music. At the time of Palestrina almost all extended musical compositions were written for church services and the *Requiem Mass* is one of these. The actual form of the mass has changed little since that time, though, of course, each composer subsequently writing a requiem mass has used his own style and technique. Verdi's Requiem Mass, for example, is a highly dramatic work that is mainly operatic in its style.

Fauré is a composer not usually associated with the larger scale choral and orchestral works. His output consists mainly of chamber and instrumental compositions and songs. In fact his Requiem Mass could almost be described as a chamber mass, since it was originally scored for harmonium and string quartet with choir and only two solo voices. It is a quiet and reflective work, written on the occasion of his father's death. The voice parts are straightforward and mainly chordal in texture, some of the melodies being very beautiful.

In the performance recorded here, an organ replaces the harmonium and a theatre orchestra plays the instrumental parts (in a later edition Fauré extended the scoring to include church organ and small orchestra). The choir with the baritone and boy soprano soloists give a simple and sincere account of the work, though here and there faults of intonation occur in the boy's singing. I myself felt that there could have been more contrast in mood between the different sections of the mass. For example the majestic "Hosanna" of the *Sanctus* seemed mild in retrospect when listening to the sad and beautiful *Agnus Dei*.

The recording is restricted in frequency range and there is a hard tonal quality in the louder passages. The review copy was marred in a number of places by drop-out, sufficiently so to be distracting. Fauré's Requiem Mass deserves, in fact needs, a much better presentation than this.—**G.G.**

NEW ORLEANS DIXIELAND JAZZ. Played by the Rosie McHargue Dixielanders. Bugle Call Rag. When the Saints Come Marching In. Muskrat Ramble. Synthetic Blues. St. James Infirmary Blues. Sweet Sue. Ballin' the Jack. Billboard. **Recotape RML 230.** 3¾ i/s mono. 30s.

HERE we have a mystery. Who are the musicians concealed behind such extraordinarily unlikely names as Rosie McHargue, and for what purpose are they so disguised? This recording has, in fact, been issued in Britain already on a *Gala* LP (*Dixieland USA*); the personnel were then given as Arvell Shaw (bass), Pee Wee Russell (clarinet), Buck Clayton (trumpet), Vic Dickenson (trombone), Bud Freeman (tenor), Jo Jones (drums) and Lou Carter (piano). As for the reason why such renowned jazzmen should be concealed in this way, the reader's guess will probably be as good as mine.

The first three numbers, *Bugle Call Rag*, *When the Saints . . .* and *Muskrat Ramble*, are given the usual Dixieland routine at a fairly fast tempo with plenty of good breaks and solos, but the best part of this tape carries the slower numbers: *Synthetic Blues*, *St James Infirmary* and *Ballin' the Jack*. Under the influence of the three ex-Basie men, Clayton, Dickenson and Jones, the music takes a turn towards Mainstream, with some outstanding solos by Clayton and Dickenson.

Lou Carter deserves special mention for some very interesting piano playing; his name does not appear in Leonard Feather's *Jazz Encyclopedia*, so even after the identity of the rest of Rosie McHargue's group is established we are left with one obscure unknown.

The quality of the recording on this tape is not of a very high standard—there is a general muzziness and lack of clarity, as well as some drop-out.—**T.F.**

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TAPE RECORDER SERVICE

NO. 35 — FI-CORD 1A AND 202

BY H. W. HELLYER

SINCE *Fi-Cord International* made their lamented decision to pull the shrouds over the Model 1A and enter the fierce competition for a more 'popular' market with the 202, we have received a succession of complaints. Most of these, paraphrased, say: "Why isn't the 202 like the 1A ?", which is rather akin to comparing your sprightly young niece with your trustworthy maiden aunt. They just have different virtues, that's all.

The 1A made its mark as a very versatile portable—in the true sense of the word. It has seen service in all parts ofthe world, in the tropical jungles, the sand of several deserts, the salt of many seas, and even in the rarefied air of the upper stratosphere, storing the words of a legion of reporters. Its users formed a devoted clique, long before the days of the popular portable, and even the BBC forsook its staunch (if rather solid) EMI machine for several memorable assignments.

HAD ITS FAULTS

It had its faults, many of the original ones ironed out long ago. Among these were the fiddly plug and sockets and the motor noise. The first could be eliminated by replacing by a more reliable fitting: indeed, a modification was made, I think at the BBC's request, in 1962, using the German PREH socket for microphone connection. Douglas Fisher, in an interesting article in the April 1963 issue of *Tape Recorder*, advocated replacement by a *Bulgin* jackplug, which loses the microphone switching facility, but makes a much stronger job. As he was using a *Grampian DP4* with his 1A, this was no loss.

In the same article, he describes modifications which made the machine more rugged, if a little less portable, and the device of supplying motor and amplifier by different batteries to overcome the motor noise problem.

For the sake of readers who have had the opportunity of picking up one of these machines on the secondhand market, the following brief notes on adjustments and servicing are offered. No doubt, the devotees will be able to add their personal modifications, and we should like to hear about them.

Two speeds are used on the 1A, $1\frac{7}{8}$ and $7\frac{1}{2}$ i/s. The latter gives a frequency response of 50 c/s-12 Kc/s $\pm$ 3dB, but a battery life of less than two hours, and of course a fairly restricted running time as the spools are only $3\frac{1}{4}$in. diameter. The batteries are of the accumulator type, rechargeable, indeed the Fi-Cord charger is a standard item, giving a recharge of all four cells simultaneously in ten hours, and is adaptable to work from a 12V car battery. As a matter of interest, the 202 has a 12V eliminator pack, which will be described later, and which may help solve some of the problems of readers frustrated by the battery supply problem on many other machines.

The other speed of $1\frac{7}{8}$ i/s is used for speech only, giving much longer recording time per spool and a battery life of over three hours. This battery life depends very greatly on the lengths of the periods of use, as any portable user will know. The speed change is effected by a fork action, moving the drive belt to the slow pulley. The toggle action should be checked, and it is necessary to make sure the arm is free of the panel. It may be necessary to bend the fork slightly if the machine has aged and the belt lost some tension, but avoid bending this too near the motor.

SETTING THE GOVERNOR

As to exact speed, the setting of the motor governor is very important. There is a 3.5V, 35mA indicator lamp which flickers when the speed is irregular and should shine brightly when the brush is lifted from the governor. The governor is adjusted by a 14 BA screw (needing a watchmaker's screwdriver) which is turned anti-clockwise to increase the basic speed. If the correct speed is not obtained, even when this screw is clear of the spring, and knowing that the batteries are up to standard, it will be necessary to turn in the contact screw, remembering to relock it, and adjust again. The end contact face should be tangential to the motor shaft and pressure must be correct.

Mechanical loading, which often causes speed variations on battery portable machines, can be checked by measurement of battery consumption. With the total battery voltage greater than 7V the total current should be 130 to 160mA. This can rise to 180mA during $7\frac{1}{2}$ i/s play. If the current is too great, check that the flywheel assembly and main drive are not imposing too much load. To isolate the cause, remove tape and all except the main belt, release the pressure disc and note that the current increase is not more than 15mA. Check the coil spring and link between the pressure bar and the knurled disc,

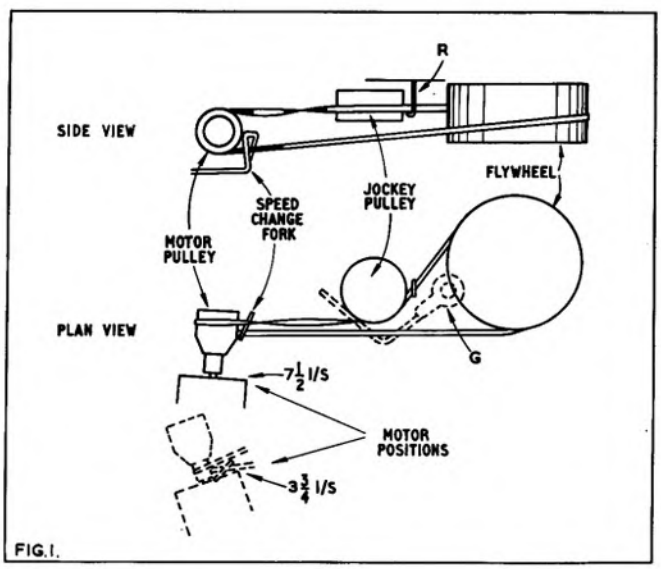

FIG. 1.

which should be slack when disengaged. A screw threaded through a spring allows pressure adjustment.

Next, refit the take-up belt, and note that the current does not exceed a 10mA increase. If more, take a look at the spindle and the belt itself. With the take-up spool held, current increase should not exceed another 30mA. Add the belt from motor pulley to counter-shaft and note that the current rises no more than 5mA, then add the slow pulley to counter-shaft belt and note that increase is less than 10mA. Finally, load the tape, move the pressure indicator arm to impose and

(*continued on page* 413)

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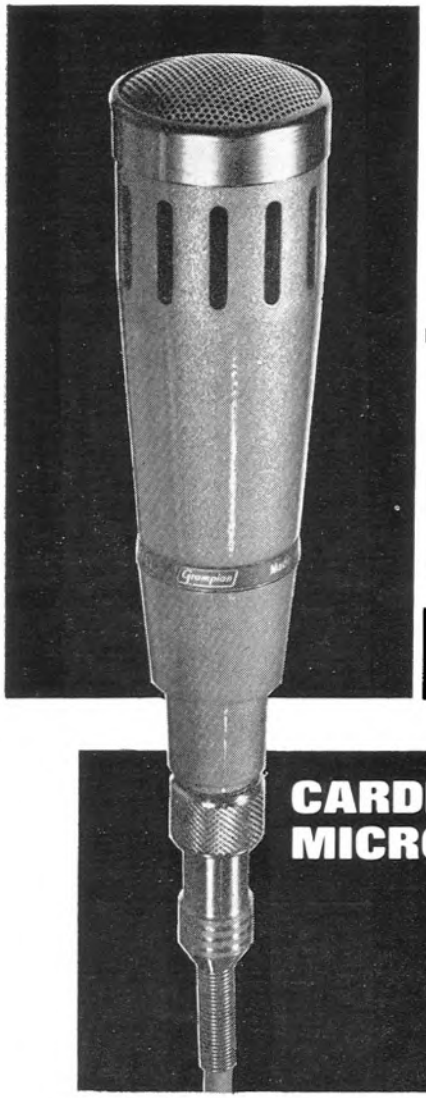

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release pressure and note that current change is not more than 5 to 7mA.

The azimuth adjustment is not conventional. A clamp bracket is fitted, and packing between the head and the holder is adjusted. The top edge of the tape runs below the red moulding of the erase head (note that the bottom of the erase head pole piece is lower than the record/play head gap).

When the machine is switched to RECORD, a reading of 33 to 40V RMS across the erase head should be measured. The brightness of the DM70 is a good indication that the oscillator is functioning normally. Bias frequency is 60 Kc/s. The amplifier is easily checked with a direct line recording, and a good indication of efficiency is a series of voltage tests. Space precludes details, which would require publication of the complete circuit, but these tests can be tried by readers who require them.

The *Ficord* 202 is a quite different machine : heavier, bigger, with some extra facilities, and using seven separate mercury cells in place of the accumulators. It has a number of special features, some of which affect the servicing procedure and are worthy of close attention.

The speeds are $7\frac{1}{2}$ and $3\frac{3}{4}$ i/s. As before, the transfer of a belt from larger to smaller step on a motor pulley reduces the speed, but in addition a microswitch, actuated by the speed slide switch, inserts a 12-ohm resistor in series with the motor supply at the slower speed. **Fig. 1** shows the belt run, and illustrates not only the correct 'twist' in the belt, but also the belt guard **G**, and the reverse guard **R** through which the belt is threaded. The first acts as a barrier between the main belt and the counter-belt and helps keep the belt on the jockey pulley. The jockey pulley should run very freely on its cone bearings, and there must not be any end thrust on the cones. The bearing screw at one end is adjusted for a very small end float ; extra friction wastes battery power. When the tape switch is horizontal and fast forward not engaged, extra battery current (motor) will be drawn. **Fig. 1** shows both the side view and the plan view, with the motor position at both speeds.

POSITIONING THE DRIVE BELT

The twist in the belt is between jockey pulley and motor pulley, amounting to a total of a quarter revolution. The twist should not be allowed to occur in the other leg of the belt, between jockey pulley and flywheel. The angle of the motor pulley affects the drive. Two screws are accessible after removing the feed spool. To do this, slacken the grub screw in the lower part of the drum and withdraw spool carrier and spindle from above. Slacken both the screws near the spool carrier boss and move in their slots for correct run of belt in the $7\frac{1}{2}$ i/s position. Near the counter reset wheel are two more screws, which are used for final setting of the limit cam, which gives the actual position of the belt on the pulley. After making this adjustment, run the machine in all functions and change speed to ensure that the belt 'throw' is correct. Over-adjustment may cause the belt to ride off completely. Perhaps it is wise at this point to stress that none of these adjustments should be made unless absolutely necessary ; the temptation to 'improve matters' by fiddling can be fatal on this machine.

Braking is simple, being an edge friction on the spool carrier at each side. A brake arm with the friction pads fixed is loosely pivoted on a pin, which acts from below. Adjustment is for precedence on the feed spool, for normal running, and the right-hand spool when rewind is taking place. Spring action is employed to hold the brake on, and the spring is attached to the pin, which is also employed as a switch actuator by an insulated disc mounted on it. The switch brings in the light circuit, giving warning when the brakes are released.

The clutch action can be rather complicated, and again, susceptible to maladjustment. A belt from the flywheel drives an auxiliary pulley assembly, which is mounted on a cam plate, with a hairpin spring action. The legs of this hairpin are dissimilar. The bent leg must be clear of the pin when the switch is clockwise and should give sufficient thrust when the switch is turned anti-clockwise to give correct rewind. The straight leg gives just enough pressure for clutch drive on take-up. Note that a current increase is evident when the right-hand spool carrier is retarded : between 18 and 25mA is given as nomal by the makers. The intermediate idler drives the feed spool for PLAY only. On the selection of FAST WIND, another pulley comes into action, spring aided, to drive the take-up spool directly from the flywheel. It is essential, for good battery life, that these movements are completely free and that plates do not rub on adjacent flat planes.

THREE DISTINCT ACTIONS

When RECORD or PLAY are engaged, by the actionof the 'Tape' control, there are three distinct actions. First, the brakes are removed, then the pressure pad assembly is engaged simultaneously with the clutch action, and finally the pressure roller engages with an 8oz. pressure. Spring action balances the pressure of both this and the pad assembly, which has an inward pressure of an ounce or so. To check these pressures, hold the feed spool and note a current rise of 40mA, release and then hold off the pressure arm assembly, noting a 5mA change. These tests are done at $7\frac{1}{2}$ i/s.

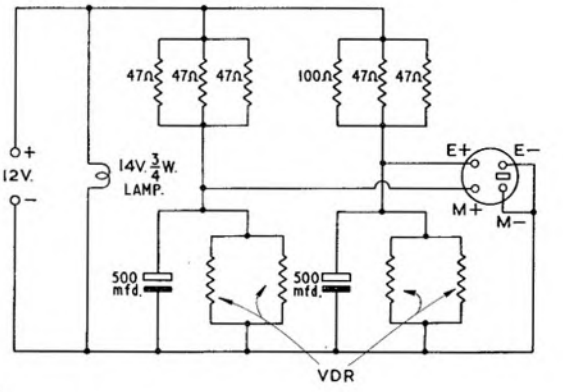

FIG. 2.

There is not sufficient space to go into electrical details, but the automatic volume control circuit is worthy of mention—if only because it causes irate howls from music lovers when everything comes out *mezzo-forte*. This operates when the volume control is turned fully anti-clockwise. On speech, it can be a useful asset. Meter indication is used for modulation level, and also to indicate battery state, but this indication is not meant to be a registration, and must be set according to the user's experience.

CONVERTOR CIRCUITRY

The final point, as promised, is a note on the power packs. The AC pack is fairly conventional, conforming to the modern style of using a transistor regulator in conjunction with a Zener diode. There are considerable variations in current during use (as before, details can be given) and as a Class B output stage is used the variations occur also during changes in amplifier drive. This is self-compensating when batteries are used, because of their low impedance. Coupling an eliminator brings the problem into prominence, and good regulation is important. Messrs. Fi-Cord seem to have got over this problem very well.

The DC pack is illustrated in **fig. 2.** From a 12V source, such as a car battery, the supply is taken directly to the tape recorder input, with filter circuits across the supply, which include voltage dependent resistors to give adequate regulation. Such a circuit is easily adapted for similar machines. Note that the negative line is direct, whereas the positive line is fed via the filter networks, there being separate supplies for motor and amplifier.

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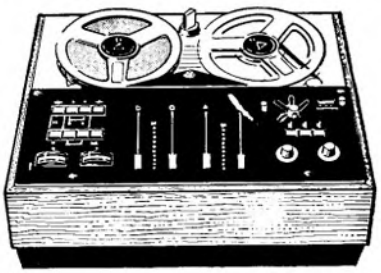

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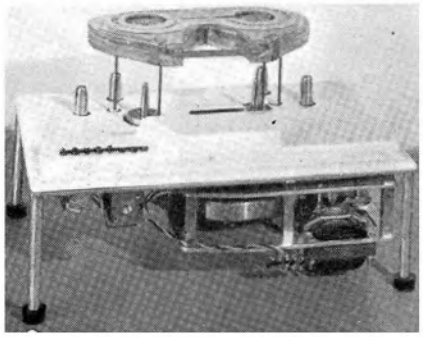

SOUND COVERAGE AUTOMATIC TAPE DECK

DESIGNED for industrial applications and use in language laboratories and telephone answering systems, a tape deck has been produced by *Sound Coverage*. Solenoid controls operate the pinch wheel carriage and brakes, making the deck, which takes standard *Garrard* magazines, suitable for fully remote control. *Tape Deck Type SCD/AG* operates at 1⅞ i/s and incorporates ¼-track *Marriott X* medium impedance playback heads. Wow and flutter totals ±2% and the retail price with one head is £27 12s.; with two playback heads—£28 12s.

Manufacturer: Sound Coverage Ltd., 7-9 Kew Green, Richmond, Surrey.

GLOBAL BULK ERASER AND MIXERS

A METAL version of the *Mk.* 1 Bulk Eraser has been introduced by *Global Products*. Claimed to reduce background noise level below 6 dB, it can be used to erase tape and de-magnetise heads. Price is £2 10s. 3d. including postage and packing. A heavy duty eraser is also available at £5 2s.

Three passive (non-powered) mixers have been added to the range of accessories, including sound-effects tapes and a splicing block marketed by Global. All are fitted with standard jack sockets. Two-way, three-way and four-way versions, priced respectively at £2 3s. 8d., £2 18s. 4d. and £3 14s. 2d. are available. **Manufacturer: Global Products, 13 Stanley Street, Rothwell, Northants.**

WYNDSOR SABRE II RECORDER

LATEST recorder to be announced by *Wyndsor* is the *Sabre II*. Supplied with crystal microphone and recording leads, the new machine is based on the *BSR Monardeck* and runs at 3¾ i/s, ¼-track. Continental DIN plugs are fitted to the control panel which uses original styling. Superimposition facilities are offered. Frequency response is claimed as 50c/s to 12Kc/s ±3dB, with a signal-to-noise ratio of 45dB.

Cabinet dimensions are 15 x 13¾ x 7in. with finish in charcoal grey PVC material. A 7 x 4in. elliptical speaker is fitted, and storage space is provided at the rear of the cabinet for microphone and accessories. Two inputs are provided: microphone—2mV at 1 Meg; radio—250mV at 1 Meg. Loudspeaker output is 2.5W at 3 ohms, with a 500mV 1 Meg. output provided for external amplifier. The Sabre II is priced at £24 3s.

Manufacturer: Wyndsor Recording Co. Ltd., Wyndsor Works, 2 Bellevue Road, Friern Barnet, London, N.11.

A NEW GRAMPIAN

LATEST addition to the *Grampian* microphone range is the moving-coil *GC*1. Incorporating a cardioid pick-up pattern, it is suitable for studio and outdoor use and has an effective frequency range from 40 c/s to 12 Kc/s. Output level for the low-impedance (25 ohm *GC*1/*L*) model is -86dB, ref. IV/dyne/cm² at 1 Kc/s, and the price is £14. Three other impedances are available, selling for £15: the 200 ohm *GC*1/*X*, 600 ohm *GC*1/*M* and 50K *GC*1/*H*. A swivel holder is included for connection to table and floor mountings.

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Maximum spool capacity is 5¾in. and scanning is on two tracks at 3¾ i/s. Claimed frequency range and speed fluctuation figures are 80 c/s—12 Kc/s and 0.6% peak-to-peak, respectively. 40dB signal-to-noise ratio is also quoted.

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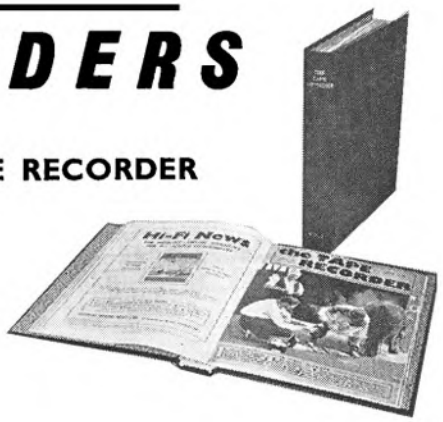

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PHILIPS EL3300 CARTRIDGE RECORDER

Manufacturer's Specification : Supply voltage : 7.5V. **Current consumption :** approx. 100 mA at 7.5V. **Tape speed:** 1⅞ i/s. **Wow and flutter :** less than 1% peak-to-peak. Twin track system. **Cartridge :** loaded with 300ft. triple-play tape. **Tape width :** 0.15in. **Track width :** 0.59in. **Fast forward and rewind :** approx. 70 seconds for complete cartridge. **Output power :** 250 mW. **Frequency range :** 120 c/s—6 Kc/s. **Signal-to-noise ratio :** better than 45 dB. **Transistors :** 1 AC126, 4 AC125, 1 2AC128. AC bias and erase—oscillator frequency approx. 35 Kc/s. **Permissible temperatures :** 41-113°F or 5-45°C. **One combined socket for :** microphone, radio and gram (pins 1 and 4 parallel), 0.3 mV at 2K. **Output :** external amplifier (pins 3 and 5 parallel), 0.5V 20K. Common earth and screening—pin **2. One combined socket for :** power supply unit (pin 1 positive, pin **3** negative), headphones (pins 2 and 4) 200mV output. 1.5K. Remote stop/start (pins 1 and 5). **Dimensions :** 7¾ × 4½ × 2½in. **Weight with batteries :** 3lb. **Price :** £26 5s. **Manufacturer : Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.2.**

THIS technical review should be read in conjunction with the field trial of the same machine which appeared in the August issue, and for those of you who would also like to compare it with the predecessor of its bigger brother the *EL*3586, the *Stella* 470 review appeared in March 1962.

The use of tape of a non-standard width in a magazine or cassette prevented the use of my standard test tapes to measure absolute recorded levels and playback response independent of recording characteristic, so that the complete recorder had to be treated as a 'black box' and the measurements limited to input-output voltages and sound levels.

WOW AND FLUTTER

A 3 Kc/s tone was recorded, via the input lead provided, at a level well below overload as indicated by the red sector of the recording level meter. This was replayed via the same lead into my wow and flutter bridge which measures small deviations from a constant frequency and. records them on a paper chart to give the 'fluttergrams' of **fig. 1.** The fluctuations are comfortably within the 1% peak-to-peak limits specified by the manufacturer (I have marked the 1% limits on the top trace). The integrated RMS reading of the combined wow and flutter remained fairly steady at 0.25%.

It will be seen that the speed changes are a combination of 50 c/s flutter from the 3,000 rpm motor and a 6 c/s wow at capstan frequency. Wow and flutter of this magnitude are completely indetectable on speech, sound effects and most types of pop music which will be the staple diet of this little machine.

Next a single tone of 500 c/s was recorded at various levels to determine the overload characteristics of the recorder. The waveform was quite clean up to the top of the green sector of the record level meter. At the centre of the red sector the wave form was just perceptibly distorted (estimated 5% 3rd harmonic), and above the red sector it was obviously distorted.

NOISE LEVEL

Peak signal was erased with the gain control at zero and the combined tape and transistor noise measured. The ratio was 100 : 1 or 40 dB. Examination of the noise wave form showed a heavy low frequency component, which is characteristic of certain kinds of transistor noise, together with a low level hiss from tape transistors and motor. Weighting the noise measurement to match the ear's characteristic at low levels gave a reading of better than 50 dB.

The combined record replay response of **fig. 2** was obtained by recording tones covering the range 40 c/s to 10 Kc/s at a level 12 dB below overload. Response is level ± 3 dB from 100 c/s to 6 Kc/s and falls off sharply beyond these limits.

The electrical response, signal/noise ratio and wow and flutter were thus very satisfactory for a tape speed of only 1⅞ i/s, and it now only

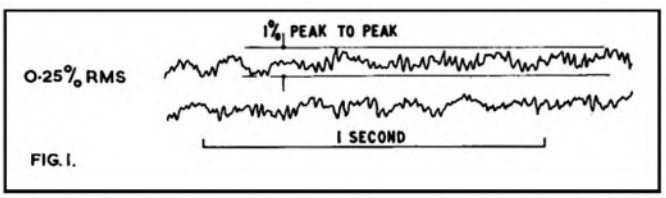

FIG. 1.

remained to measure the acoustic responses to evaluate the effect of the speaker cabinet and microphone on the overall performance.

OVERALL RESPONSE

One-third octave bands of filtered white-noise were recorded and the sound level measured on the speaker axis at a distance of one foot. Listening tests had given the impression of slight boxiness and coloration with the lid closed so this test was repeated with the lid removed

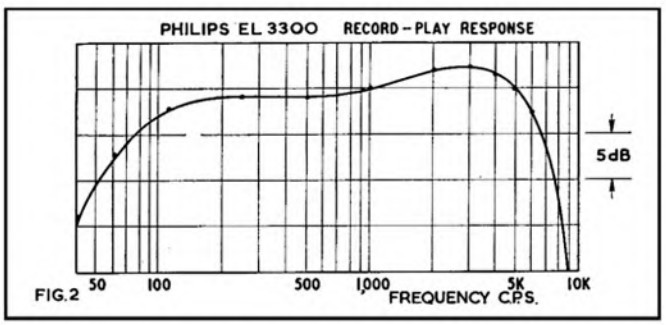

FIG. 2

to give the dotted curve of **fig. 3.** The acoustic response is limited to the range 400 c/s to 5 Kc/s which is not very surprising when one considers the size of the loudspeaker and cabinet.

Finally, the microphone was measured in a white-noise sound field to give the response shown in **fig. 4.** It will be seen that the slight rise

(continued overleaf)

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in response at 1,500 c/s complements the dip in the recorder's acoustic response to give a very level, though limited, response over the voice frequency range.

COMMENT

To summarise, this is a compact, lightweight, extremely portable recorder with an acoustic response adequate for checking the quality

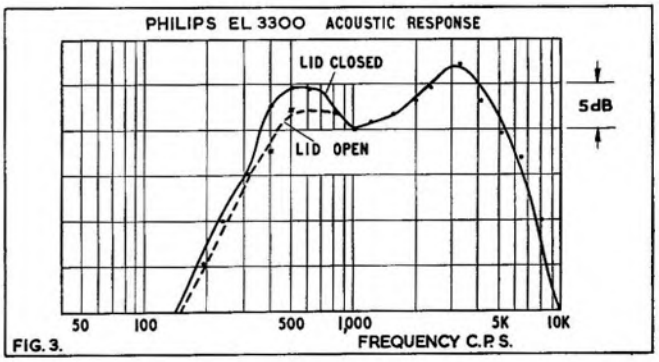

FIG. 3.

and content of recordings in the field, but the excellent electrical response makes it worthwhile to play the recorded signal through a wider range amplifier or speaker, or to re-record on to the static home recorder for editing or incorporating into other recordings. In other

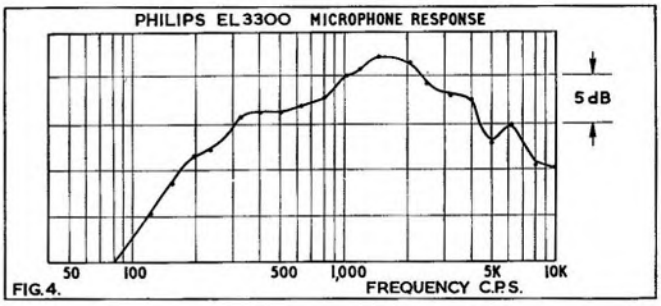

FIG. 4.

words, like most portable recorders, it is the number two recorder so essential to the real sound recording enthusiast who wants to widen his horizons and do a little more than record radio programmes and short announcements. **A. Tutchings.**

Finally, a few don'ts. Don't use tape recorded on more than one track, as you will inevitably cut through them all: make sure the tape you are going to use has nothing on it you want to preserve, and either bulk-erase or pass it through the recorder to clean it. This obviates odd snatches of other recordings turning up in the wrong place. Don't drop the odds and ends of tape round your feet: you will step on them and ruin them. Don't use scissors or razor-blades which have been near a magnet—such as the one in a loudspeaker unit. Above all, don't hurry: editing takes time if it is to be done well. And don't forget that the chinagraph pencil, that admirable creature, has the ideal consistency for adhering to your replay head: clean the head thoroughly after each editing session, so that you won't get faulty recordings the next time you use the machine. This is particularly important if your record- and replay-heads are combined, less important if they are separate, though you may get a very dull replay if you leave blobs of waxy material sticking to the head-face.

So, assemble your gear handily around you, settle comfortably in your chair; and the best of luck to you.

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THE ACOS MICROPHONE RANGE

Manufacturer's Specification : Low-price, general-purpose microphones. **Mic. 60** (crystal) : £2 2s. **Mic. 60** (ceramic) : £2 7s. **Mic. 55** (dynamic) : £2 15s **Mic. 39** (dynamic) : £7 10s. **Manufacturer : Cosmocord Ltd., Eleanor Cross Road, Waltham Cross, Hertfordshire.**

COSMOCORD, who manufacture *Acos* electro-acoustic devices, are rightly proud of their range of low-priced microphones, and they have provided us with the four basic types of transducer : crystal, ceramic, magnetic and dynamic which, in various types of cases, make up their range of microphones. They have also provided their own frequency response curves and sensitivity figures for each of the units sent for review with the request that we run independent tests and measurements on completely different test equipment. I must admit that the test procedure and equipment could not be *more* different.

They have used several thousand pounds worth of *Bruel & Kjaer* test gear, which plots a continuous response over the entire audio spectrum with every tiny peak or dip shown in detail ; an anechoic chamber was used to reduce the effect of sound reflections from the room boundaries.

My tests were done in an open laboratory using a White Noise test tape which carries twenty-five one-third octave bands of filtered white noise covering the range 40 c/s to 10 Kc/s. The sound level from the test loudspeaker was adjusted on each band to give a constant output from a carefully calibrated reference microphone so that the sound intensity at this point in space was maintained at a virtually constant level. The microphone under test was placed in close proximity to the reference microphone and its output measured on each test band. Thus my responses will be slightly smoothed, as each point on my graphs represents the integrated reading over a bandwidth of one-third of an octave rather than that at a discrete frequency. Nevertheless there is very good agreement between the two methods of test when allowance is made for the two-to-one difference in the vertical dB scale. (Each big division on my graphs represents 5dB, and each of the big divisions on the Acos graphs is 10dB). There are some differences in bass response on the magnetic and dynamic microphones which can be explained by differences in distance from the sound source. I will deal with these as we come to them.

I have plotted my sensitivity figures directly in voltage output for constant sound pressure of one μbar, rather than in dBs below 1V/dyne/cm² which means exactly the same thing. To save a lot of mental acrobatics, or slide rule manipulation, I can assure readers that the sensitivity figures also show good agreement.

MIC. 60 CRYSTAL

This is a stick microphone using a crystal element which gives a healthy output of 2mV into an impedance of 5 Meg. The use of a lower input impedance will cut the bass response to a certain extent and should not be lower than 1 Meg. for reasonable frequency balance. The response is smooth and level at low and middle frequencies with a rounded peak at 3 Kc/s continuing at a slightly higher level up to 10 Kc/s. The slight rise at 3 Kc/s gives 'presence' to voice reproduction without exaggerating sibilant response. The level response at extreme

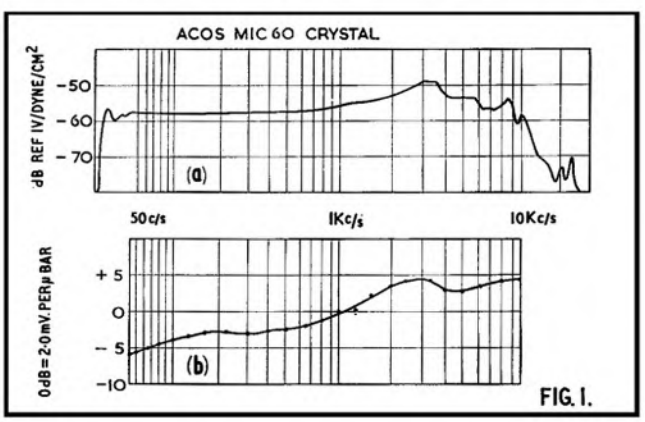

FIG. 1.

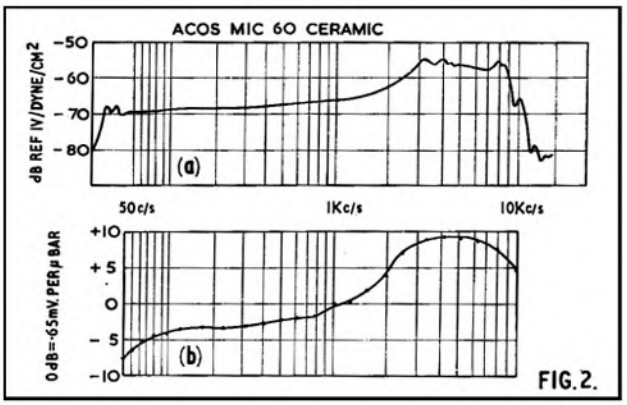

FIG. 2.

high frequencies adds a little 'wetness' and naturalness to voice or sound effects when reproduced on wide range equipment. Acos response is shown in **fig. 1A** and my response at **fig. 1B.**

MIC. 60 CERAMIC

The responses are shown in **figs. 2A** and **2B.** Sensitivity is lower, due to the use of the ceramic element at 0.6mV, and the response shows a 10dB rise at high frequencies. Care must be taken, when using this microphone for tape recording, to avoid overmodulation at high frequencies leading to what is known as 'sibilant splash'. At low tape speeds it is safer to kick the record level indicator to approximately half the peak indicated level to avoid this effect.

MIC. 55 MAGNETIC

This is a rocking-armature microphone with an impedance of about 2K. It is designed to work with transistor circuits with an input impedance of about 2K, accordingly the microphone was loaded with a shunt resistor of this value for these tests. The sensitivity of 0.2mV may seem low to readers not used to transistor circuits, but, having regard to the lowerworking impedance, it is a good average output for this type of microphone. **Figs. 3A** and **3B** show the measured responses. Agreement at high frequencies is excellent as is the response down to 300c/s, but below this frequency the measurements differ : the Acos response is 30dB down at 100 c/s and my curve is only 15dB down at 100 c/s. It would seem likely that a little sound may be

(*continued on page* 421)

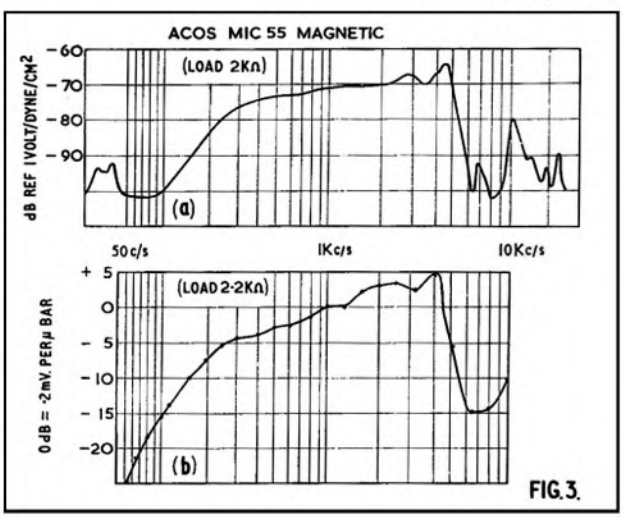

FIG. 3.

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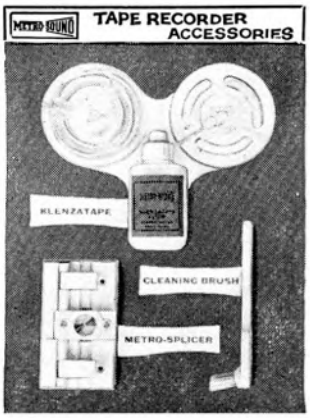

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reaching the back of the diaphragm at low frequencies due to slight flexing of the case so that it can no longer be considered a true pressure transducer at very low frequencies. Thus, like a ribbon microphone, the low frequency response will vary with the proximity of the sound-source. My tests were made at a distance of only 1ft. from the sound-source so that the wave-front is spherical, leading to the well-known 'close talking' effect. Whatever the reason, my response does seem to correspond to subjective impressions on medium close speech, and as the response is slightly better on my tests, Acos are unlikely to quibble !

MIC. 39 DYNAMIC

Figs. 4A and **4B.** Once again agreement is good at high frequencies but there is again a discrepancy at 100 c/s, but in the other direction this time ; the Acos measurements being *higher* than mine. I think this can be explained by the method of acoustic correction used in this microphone at low frequencies : a hole is provided near the cable inlet at the opposite end (of the stick type case) to the insert to provide a phase difference in the sound pressure on either side of the diaphragm, which acts to boost the output at low frequencies. The effect will be greatest when the sound pressure on the diaphragm and correction tube inlet are similar, i.e., plane wave-front or long distance from sound-source (Acos test conditions). My method of test results in the front end of the microphone being in a more intense sound field than the rear end where the correction hole is situated and so little correction is obtained, so that once again my method of test corresponds to fairly close speech conditions.

The fall in response above 4 Kc/s is quite noticeable on direct comparison with the wider range crystal microphone, but it does sound extremely good if a little top lift is applied in the amplifier.

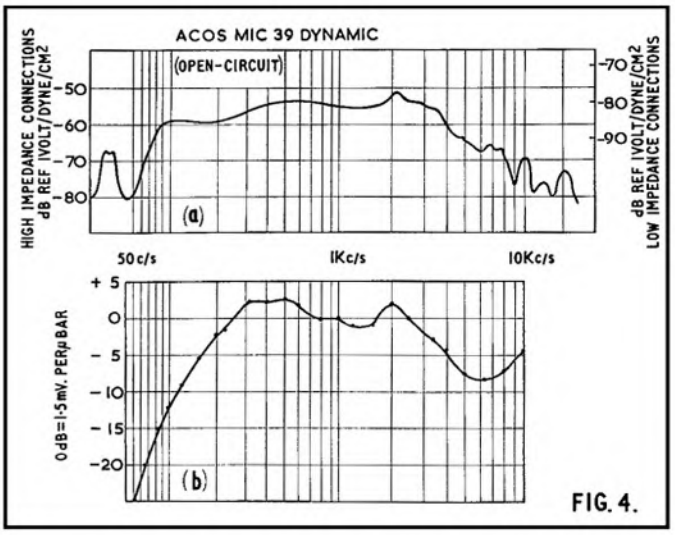

FIG. 4.

The *Mic* 60 (stick) and *Mic* 55 (lapel) cases can each be fitted with crystal, ceramic or magnetic inserts so that **figs. 1, 2** and **3** cover the whole family of units using these inserts. The *Mic* 39 *Dynamic* uses a West German insert and is only available in a black stick case.

I have no hesitation in recommending these microphones to tape recorder manufacturers and experimenters alike. Many an old recorder with an edgy, peaky microphone can be given a face-lift by fitting one of these new units.

I was particularly impressed by the *Mic* 55 magnetic lapel microphone : it offers good quality sound pickup under difficult conditions, and is unobtrusive and ideally suited to portable recorder applications. Its impedance is sufficiently low for really extended lead length with little trouble from hum or top loss, and it has a performance out of all proportion to its small dimensions and low price.—**A. Tutchings.**

READERS' PROBLEMS

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

MATCHING THE TW/PA4

Dear Sir, I have a small problem, the solution of which evades me. I own a Wearite Series 5 Tape Deck fitted with a third head for monitoring and playback purposes and for which I have built the TW/PA4 in two separate sections for convenience of layout. Switching is effected from the deck by means of sealed relays to reduce the number of knobs. The results are excellent but I wish to be in a position to use AKG low impedance headphones for monitoring during recording. The playback section of the TW/PA4 uses two EF86s rather than the EF86/ECC83 configuration and feeds into a Quad 22 pre-amplifier.

I wish to be able to incorporate a change-over switch so that I can compare the 'live' and recorded signals. This, as I see it, will need a cathode-follower to feed the headphone transformer. However the output impedances from the TW/PA4 and the Quad 22 pre-amp are quite different. I presume that I shall need two quite separate cathode-follower circuits. However I would prefer not to use valves and am wondering whether you could suggest a pair of transistor circuits for my requirements. Failing that I would settle for a pair of valve circuits.

Yours faithfully, **P.H., West Chiltington.**

It is not necessary to add transistorised buffer circuits to either the TW/PA4 or the Quad control unit to employ AKG low impedance headphones for monitoring. All that is needed in each case is a switched line transformer for coupling. Although the output from the TW/PA4 is nominally at low impedance, as you will be aware, it is intended to match into an impedance of at least 10K, *being capacitor-coupled from a cathode follower. In the same way the Quad* 22 *uses a medium to high outlet, though with a different loading. In your case it should only be necessary to fit a reversed line transformer (matching microphone at low impedance into* 10K+ *input) to match the* 10K+ *input of each output into the* 30 *ohms of the AKG. A single-pole double-throw switch can then be employed as a selector. Even better would be a three-way switch, to leave a neutral position for setting-up.*

'SCREAMING SPOOLS'

Dear Sir, Could you please assist me in finding the cause of a 'screaming' sound emitted by my *Cossor* 1602 when set at play ? Is the clutch tight or could the offender be a bent spool ?

Yours faithfully, **B.C., Gidea Park.**

The screaming noise that you are experiencing can be caused by several small things. You can eliminate some causes visually : the bent spool, the offset guide, the spool height can all be seen when the machine is observed at the right level. More likely is a hardened clutch felt, which can be softened by removing and washing in soapy water, drying slowly and fluffing out before re-fitting ; an operation that needs some care. Another possibility is a drying out of the plastic washers beneath the spool bearing, which should be lightly greased. If they are worn to the point of irregularity by being run dry, they will need replacement. You can make temporary replacements from any plastic sheeting, and again, remember to grease before re-assembly and ensure that spool height is correct for clutch operation.

(*continued on page* 423)

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A 'PULSING' SERIES 5

Dear Sir, Tape Recorder Service, covering the *Ferrograph Series* 4 in January 1963, states that "the makers recommend that the 205V tapping on the tag panel be used for the 3¾/7½ i/s version and the 245V tapping for the higher speed version and also for the supply to the take up motors". It then goes on to mention 'hunting'.

Will the above be applicable to my query, I wonder? The machine is a little noisy at 3¾ compared to 7½ i/s on playback. The noise is heard with the volume control in the off position and I would call it a 'pulsing' sound, not audible even with the ear close at 7½ i/s. The same sound is there at both 3¾ and 7½ i/s on play with the pause control in action.

Thanking you in anticipation. I would add that your article was not understood very much and I would not attempt to do any repairs myself. But your reply may give me a lead on the query and whether you think the sound should be there at 3¾ i/s.

Yours faithfully, **D.J.S., Tiverton.**

The sound you are hearing on your Ferrograph Series 5 machine is unlikely to be 'hunting', which is a quite distinctive but temporary effect. This is caused by the motor being mechanically sluggish and trying to pull into synchronous step with the energising mains frequency. If you hear the noise mainly on 3¾ i/s and with the amplifier off, and pause control in action, the trouble probably lies with the neoprene idler which couples the rotation of the motor capstan to the flywheel. If you do not intend to undertake repairs yourself, you should approach a tape recorder expert. But please give this machine a fair trial; this is the sort of fault that can show itself after long idleness and which may wear off after a period of use.

RECORDING BIAS

Dear Sir, I have a *Leak Point-One* control-unit and amplifier, also a *Studio* tape deck. The pre-amp has record and replay jack sockets but I understand that a tape head must be biased to avoid distortion.

Can I apply bias to the tape head and use my existing equipment, or must I build a complete pre-amp incorporating bias?

Yours faithfully, **R.J.F., Ealing.**

A tape head must be biased with an oscillatory signal in the supersonic range to avoid distortion when actually recording. This same signal-source, which must be built into the tape unit, also provides a suitable current for the erase head.

For simple replay, of course, no such bias is needed, and the head signal can be applied direct to a pre-amplifier with suitable correction.

PIANO ACOUSTICS

Dear Sir, I am having an extra room built on to the rear of my house for use as a teaching studio. It will also be used for the practising of musical instruments and for recording piano, solo voice and speech. The size of the room will be 10 x 9ft. with a height of 8ft. and will be built in cavity brickwork, a solid concrete floor and a felted-board roof. Three of the walls are exterior ones and there will also be an external door and medium sized window included.

What would be the best way of insulating and lining the interior walls and ceiling in order to prevent as much sound as possible escaping, and also to ensure a satisfactory musical sound both for listening and recording? (The walls will not be plastered.)

In order to produce an attractive decoration scheme internally, what materials and finishes do you recommend? What is the most suitable flooring for this type of room? Would a double door and double glazing be necessary? Have you any further comments?

Yours faithfully, **M.S., Ickenham.**

You have set yourself quite a big problem. This is a very small room in which to attempt piano recording and you would be very lucky if it sounds anything other than like a piano in a small room. As far as keeping the noise out of the rest of the house, this is not such a difficult problem. The door leading to the rest of the house should be really heavy and solid and should fit really well. Otherwise you may well have to think of double doors.

Now it is easy to cover the walls with acoustic tiles, or something to prevent a bathroom like hardness of tone, but such treatment will do nothing for the bass. That will be reflected and produce booming and areas where certain bass notes are extraordinarily weak. If the

(continued overleaf)

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walls have been made of wood—not very much thicker than a shed—then the flimsy walls would prevent reflection of bass notes and an acceptable sound might be obtained in such a small room. It will, of course, be heard clearly outside the room !

With this scheme we still envisage a good solid brick wall on the side joining on to the house, of course. Lining the walls with wooden panels spaced 1in. or more away will help the bass end a little, but would be much more effective in a larger room. The ceiling ought to be left fairly flexible, and it is always advantageous to have, if possible, walls, ceilings and floors not parallel to each other.

It is not possible to be very sanguine about any real success with such a small room. It will be all right for recording speech, and with sufficient acoustic tile to make it quite dead, would be all right for unaccompanied singing, but you will not be able to achieve anything approaching natural surroundings.

'RIDGING' AND RESPONSE

Dear Sir, I should be grateful for your advice on the following points :

(1) I own a Philips *EL*3534 Stereo recorder which has a frequency range of 50 c/s to 18 Kc/s. If I acquire in addition a portable recorder for outside work with, say, a frequency range to only 8 Kc/s, will it reproduce the much higher frequency range of the larger machine ?

(2) Tapes wound and re-wound on the EL3534 quickly lose their smooth and tightly rolled appearance which they have when new. The tapes ridge very badly when being re-wound and I fancy that this is due to nothing more than the rather flimsy spools which are supplied with most tapes. These spools tend to distort very slightly, however flat they are put on to the recorder. Is this ridging of any consequence in causing damage to tapes ?

Yours faithfully, **K.E.K., BFPO 10.**

The quoted frequency response of a tape recorder is meaningless without further specification, such as 'level to within $\pm$ X dB'. Even more explicit is the published response curve which shows that the fall-off at both upper and lower ends of a frequency scale is not abrupt. Therefore replaying a tape recorded on a machine with restricted range on a machine with a wider range may give reproduction of frequencies beyond the former range. These frequencies may not, however, be in accordance with the replay curve, and may thus show as distortion. The effect of the wider response may thus be to reveal distortion that the narrower response concealed. This often happens in practice, unfortunately.

The tape 'ridging' you notice, under most conditions, is caused by uneven spools. It has little effect on playing conditions, as the tape guides correct the discrepancy. Storage can be a problem though, and edge curl can result. This would be noticeable on tracks one and four as these are at the edge of the tape.

A LOW-IMPEDANCE MIXER

Dear Sir, I have fitted a stereo replay head to my *Vortexion WVA* recorder, playing through tape head transformers into a pair of Avantic amplifiers.

With this extra facility I wish to re-record back on to the original tape via a mixing unit. In the *Tape Recorder* of November 1961 you gave details of just such a mixer.

My problem is that the Vortexion has only low impedance microphone inputs. Could I connect a further input socket across the secondary of the microphone transformer into which I could feed the output of the mixer ? If this is practicable, could you supply me with a modified mixer circuit to match the impedance of the new input ?

I have approached Vortexion on this subject, who tell me the reflected impedance of the transformer secondary is 150K.

Yours faithfully, **C.R.B., Aylesbury.**

Your problem, matching the output of a passive mixer such as that shown on page 477 *of the November* 1961 *issue, into the low impedance microphone socket of a Vortexion WVA is resolved by using a step-down transformer at the output of the mixer. This will, in fact, considerably increase its versatility and there is quite sufficient gain in the rig you describe (pair of Avantic amplifiers) to load the Vortexion.*

An alternative would be to construct a transistorised mixer unit, applying the medium impedance output to a point after the microphone transformer secondary. This would mean adding switching to the tape recorder, however, and you may prefer not to interfere with the circuitry.

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continued on page 426

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