the TAPE RECORDER

PRICE 2/-

May 1963
Vol. 5 No. 4

INCORPORATING "SOUND AND CINE"

BULL FIGHTER'S PANTS CAPTURED

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The whole world of sound faithfully recorded on —

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ANNOUNCING

TWO NEW TAPE RECORDERS FROM BRENELL

£120

FOR STEREO

THE STB1

This new stereo tape recorder from Brenell contains many new features which will appeal to the discriminating amateur and professional alike. It is beautifully designed both mechanically and electrically and incorporates twin recording and twin replay pre-amplifiers, designed for use with existing high fidelity amplifying equipment. Some idea of the versatility of this new machine will be gathered from this very brief specification:—

4 speeds, 1⅞, 3¾, 7½ and 15 i.p.s.—mixing—superimposing—sound-on-sound—immediate comparison of original and recorded signals—2 edgewise meters—replay facilities for ½, 2/2, ¼ and 2/4 track pre-recorded tapes.

69 Gns.

FOR MONO

THE MARK 5 Series 2

This new machine replaces the MARK 5 and offers a number of improvements both in appearance and electrically. The cabinet is finished in dark grey with chrome trim and the deck and amplifier have light grey masks giving the whole machine a very pleasing appearance. The amplifier has been redesigned to give an improved frequency response at all speeds on both record and playback. The output remains the same at 4 watts.

Specification

4 speeds, 1⅞, 3¾, 7½ and 15 i.p.s.—3 independent motors (synchronous drive to capstan motor)—instant stop without spillage—pause control—monitoring—superimposing—up to 8¼ in. reels—fast rewind (1,200 ft. in 45 seconds).

88 Gns.

and we continue

THE MARK 5 Type M

A high-class, semi-professional machine, the Type M has earned itself an enviable reputation for quality and reliability. Its superb finish and performance will match any high fidelity equipment which is available today—just consider this brief specification:—

4 speeds, 1⅞, 3¾, 7½ and 15 i.p.s.—separate record and replay heads and amplifiers—reels up to 8¼ in. dia.—fast rewind (1,200 ft. in 45 seconds)—mixing—superimposing—recording level meter—adjustable rotary tape guide.

Brenell

GD381

All this equipment can be seen and heard at the Audio Festival and Fair.

BOOTH No. 53 DEMONSTRATION ROOM 236.

BRENELL ENGINEERING COMPANY LIMITED.

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WORLD RECORD CLUB OFFERS YOU THE CHOICE OF
ANY 3 PRE-RECORDED TAPES

31. Rimsky-Korsakov: Scheherazade. Sir Eugene Goossens conducts the LSO in a breathtaking performance of this rich and exotic masterpiece.
Also on disc: mono/stereo

32. Star cast and orchestra stage all the famous songs: Getting to Know You, Hello Young Lovers, I Whistle a Happy Tune, Shall We Dance, etc.
Also on disc: mono/stereo

53. These two suites, containing some of Bizet's most thrilling music, are given magnificent performances by the Sinfonia of London under Muir Mathieson.
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19. Look Over Your Shoulder, My Lean Baby, White Christmas, Don't Worry About Me, Melody of Love. 12 top numbers sung by the fabulous Sinatra.
Also on disc: mono only

56. All the magic of old Vienna! starring Jacqueline Delman, John Larsen. Linden Singers and Sinfonia of London conducted by John Hollingsworth.
Also on disc: mono/stereo

33. Beethoven 5th. plus Egmont. Josef Krips and LSO in a titanic interpretation which matches the tremendous power of this celebrated music.
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30. Ian Carmichael, Joyce Blair, star cast/orchestra. As Long as He Needs Me, Consider Yourself, all the hit numbers from Lionel Bart's great show.
Also on disc: mono/stereo

39. Great ballet conductor John Hollingsworth and the Sinfonia of London in a sparklingly fresh interpretation of Tchaikovsky's famous Ballet.
Also on disc: mono/stereo

20. Answer Me, Nature Boy, Ruby and the Pearl, these plus 8 more favourites sung especially for you by the unique Nat King Cole.
Also on disc: mono only

40. Superb singing by Bruna Rizzoli and Giuseppe Savio with the chorus of the Teatro Nuovo di Milano and orchestra conducted by Napoleone Annovazzi.
Also on disc: mono only

29. Me and My Shadow, Among My Souvenirs, Mean to Me, How About Me . . . the fabulous Judy Garland sings 11 of her greatest songs.
Also on disc: mono only

25. Ian Wallace, Joyce Blair and chorus. Some Enchanted Evening, I'm In Love With a Wonderful Guy, and all the unforgettable songs from this great musical.
Also on disc: mono/stereo

34. Stardust, How High the Moon, Nearness of You, 'Round Midnight, King David —eight numbers by the vibraphone genius, Lionel Hampton.
Also on disc: mono/stereo

48. Deep in My Heart, Drinking Song, Serenade—all the old favourites fresher than ever with Marion Grimaldi, Linden Singers and Orchestra.
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37. Revolutionary Study, Polonaises A and A flat, Fantaisie-Impromptu— 12 favourites in all played by the pianist of Dirk Bogarde's 'Song Without End'.
Also on disc: mono only

22. 12th St. Rag, Isle of Capri, Smile, Blue Moon, Bunny Hop Mambo, Satin Doll. 12 top numbers played in characteristic style by the Duke and his band.
Also on disc: mono only

2. Grieg Piano Concerto. Alexander Jenner in an electrifying performance with the Bavarian State Radio Orchestra conducted by Odd Gruner-Hegge.
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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.
Also on disc: mono/stereo

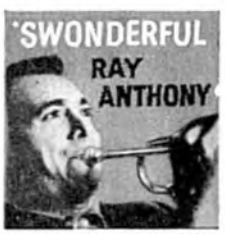
44. Leopold Ludwig and LSO combine brilliantly in an exciting 'double': two of the world's greatest symphonies receive vivid new interpretations.
Also on disc: mono/stereo

45. Crazy Rhythm, Bijou, I Cover the Waterfront, Northwest Passage, Blowin' Up a Storm, etc. The master clarinettist plays 12 numbers in great style.
Also on disc: mono/stereo

38. Hervey Alan, Ian Wallace, Marion Grimaldi and chorus sing the immortal favourites: Cobbler's Song, Robbers' Chorus, Chu Chin Chow, etc.
Also on disc: mono/stereo

14. Tchaikovsky Symphony No. 5. Sir Malcolm Sargent and LSO combine to give this famous symphony a dramatic and colourful rendering.
Also on disc: mono/stereo

43. Andy Cole, Barbara Leigh, Mike Sammes singers: High Society, Three Coins, Harry Lime, Gigi, The High and the Mighty. 11 top film hits.
Also on disc: mono/stereo

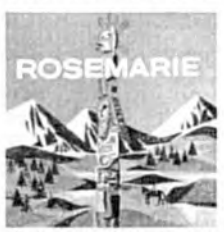


41. Night and Day, King Porter Stomp, Pennies from Heaven, Christopher Columbus, Don't Be That Way, with the top American bandleader/trumpeter.
Also on disc: mono only

42. Jericho, Swing Low, Shadrak . . . 12 of the best loved Negro Spirituals movingly sung by George Browne, Isabelle Lucas and Linden Singers.
Also on disc: mono/stereo

36. Beale Street Blues, After You've Gone, The Sheik of Araby, My Kind of Love, 12 tremendous hits by one of the world's greatest jazz trombonists.
Also on disc: mono only

49. Beethoven's Fidelio Overture, Brahms' St. Anthony Vars, Mendelssohn's Hebrides, Wagner's Siegfried Idyll. All under Britain's greatest young conductor.
Also on disc: mono/stereo



50. David Hughes, Barbara Leigh, Andy Cole and chorus sing Indian Love Call, Rose Marie, and all the other tunes from Friml's well-loved musical.
Also on disc: mono/stereo

47. Brahms Violin Concerto. Superb playing by Endre Wolf and Sinfonia of London under the baton of Anthony Collins makes this a truly memorable performance.
Also on disc: mono/stereo

46. Elizabeth Larner, Andy Cole, Peter Knight singers. Exciting 'double' featuring highlights from two famous shows by Frederick Loewe and Cole Porter.
Also on disc: mono/stereo

FOR ONLY 30′-

THE GREATEST BREAKTHROUGH SINCE TAPE RECORDING!

Here is the greatest World Record Club introductory offer ever made . . . a unique offer never before matched by any record club or company anywhere in the world!

EVERY ONE OF WORLD RECORD CLUB'S UNRIVALLED RELEASES AS 12" LPs IS NOW AVAILABLE ON 3¾ ips TAPE!

Now *you* have the opportunity to play any WRC release *on your tape recorder*. Each of these 'tape records' runs at 3¾ ips, mono, on 5" spools and can be played on either 2 or 4 track recorders. New electronic techniques of tape-to-tape transfer give these 3¾ ips WRC pre-recorded tapes a standard of reproduction unattainable previously at less than 7½ ips.

1. AN UNPARALLELED INTRODUCTORY OFFER.

Choose now, any three of the superb 3¾ ips pre-recorded tapes shown here, **for only 10/- each** and number them on the attached coupon. (if you wish, of course, you can choose 12" LPs instead. Introductory discs and tapes are both the same price.) Please send no money until *after* you have received, played and approved them. **We want you to prove to yourself, before paying, that our tapes are equal to the world's best.**

2. THE OPPORTUNITY TO BUILD A UNIQUE TAPE COLLECTION.

The WRC plan offers you an exciting and varied annual repertoire of more than 60 selected tape releases, covering classics, jazz, shows, ballet music, light music and 'pops'. Every one is a superlatively recorded 3¾ ips mono tape (or 12" LP—mono *and* stereo). Tapes are offered to you at the privilege club price of 29/- (12" LPs at 26/6) plus a small charge for post and packing—much less than you would pay elsewhere for recordings of anything like this quality. Your only obligation, as a Club member, is to agree to buy four more tapes (or 12" LPs) over the year. Beyond this, there is no subscription or membership fee.

3. A PLANNED PROGRAMME.

Every World Record Club release is hand-picked by an independent panel of Britain's top musical authorities. The Countess of Harewood, Lord Montagu of Beaulieu, Sir Arthur Bliss, Richard Attenborough, Cyril Ornadel, Ray Ellington, Leon Goossens, Malcolm Arnold, Steve Race, John Hollingsworth, Antony Hopkins—and, as special adviser on tape, Miles Henslow.

4. FREE MONTHLY MAGAZINE.

A monthly magazine, packed with fascinating musical articles, reviews, news and pictures, is issued free to all members.

5. SPECIAL CONCERT PRICE CONCESSIONS.

Many concert halls and theatres throughout the country (including the Royal Festival Hall) allow special concession rates to club members for many performances.

6. FREE BONUS TAPES.

The more you buy, the more you save! After fulfilling the minimum membership obligations, you earn *another* tape of your own choice free for every extra three you buy!

7. EXCLUSIVE EXTRA RELEASES.

In addition to the regular monthly selections, the club offers members exclusive extra tapes at the standard Club price.

World Record Club is unique—the first and greatest Record and Tape Club in Britain, with the largest show catalogue (on tape and mono/stereo disc) *in the world*. No other method of tape—or record-buying offers you so many additional benefits, so much freedom and variety of choice, with no 'high-pressure' selling. And, of course, there are no subscriptions or membership fees of any kind.

Don't miss this great opportunity. Send off the coupon today, for your 3 introductory selections for only 30/-

. . . AND IF YOU OWN A STEREO TAPE RECORDER

hear the fantastic reproduction of

STEREO 21

THE NEWEST, TRUEST SOUND ON TAPE TODAY!

Revolutionary new STEREO 21 pre-recorded tapes (7½ ips twin-track) are issued exclusively by World Record Club. But they are offered *without membership commitments of any kind.* The first list of all new STEREO 21 releases is now available. It features *30 superb stereophonic tapes* ranging from *Beethoven's Eroica* with Josef Krips conducting the LSO, to a lavish full-cast production of *Oklahoma.*

As always, WRC prices present unparalleled value—all STEREO 21 releases cost either 50/- or 60/- depending on playing time (up to 50 minutes). STEREO 21 tapes are now obtainable through leading retailers or direct by post from World Record Club. Send for full catalogue now—STEREO 21 *must be heard to be believed!*

7-DAY FREE TRIAL OFFER—*POST TODAY!*

To WORLD RECORD CLUB (Dept TRR8)
PARKBRIDGE HOUSE, RICHMOND, SURREY.

SEND NO MONEY NOW

3¾ ips pre-recorded tapes		12" LPs

Tick which you want

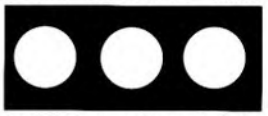
Please send me, without obligation, on 7-day free trial, the three selections indicated. (Your 3 selections must be either *all* tape or *all* disc.) If satisfied, I will pay you 30/- plus 3/- postage, packing and insurance. Only at that stage may you enrol me as a full member of World Record Club, entitled to all the benefits described. My only Obligation as a member would be to agree to purchase 4 more top quality 3¾ ips tapes over a 12-month period at the special club price of 29 - each (or 4 12" LPS at 26 6 each.) If I am not completely satisfied with my 3 selections I will return them to you within 7 days in good condition, and owe you nothing.

Signed .....

this offer applies in Gt. Britain and N. Ireland only.

MY 3-SELECTION 'PACKAGE' COMPRISES

Choice No. 1 Choice No. 2 Choice No. 3



(place tape/disc key numbers only in the circles)

Tick here if stereo 12" LPs are required where available ☐

Mr/Mrs/Miss .....
(BLOCK CAPITALS PLEASE)

ADDRESS .....

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STEREO 21 FREE BROCHURE

To WORLD RECORD CLUB (Dept TRR8)
Box 11 PARKBRIDGE HOUSE, RICHMOND, SURREY.

Please send me your free colour brochure, showing the full range of your new STEREO 21 releases.

NAME .....
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ADDRESS .....

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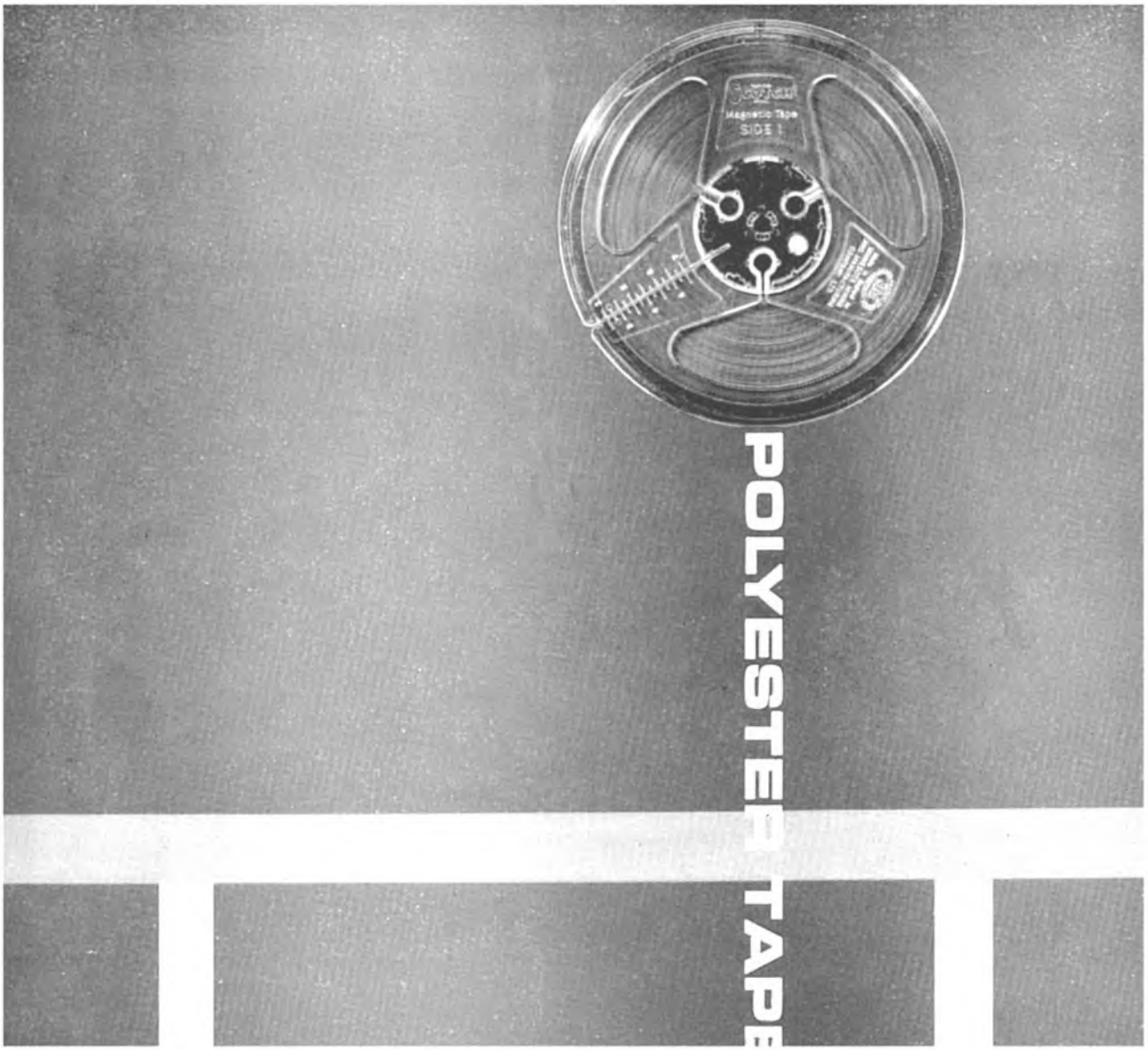

A winner for the backing

You can't lose on Polyester backed "SCOTCH" Magnetic Tape. It's the great tensile strength of Polyester that makes the going good for extra stability and lasting high-quality reproduction.

Even experts agree to that. "SCOTCH" Magnetic Tapes —sound, video, instrumentation and computer—are their first choice every time. Leading disc makers use them for cutting masters, while more than 90% of the world's taped T.V. programmes are recorded on "SCOTCH" Video Tape No. 379 with polyester backing. But "SCOTCH" Magnetic Tapes are far from reserved for experts. To professional and enthusiastic amateur alike, "SCOTCH" Polyester-backed Magnetic Tapes give everything to play for.

Trade Mark Scotch Magnetic Tape

POLYESTER RANGE: NO. 102 STANDARD PLAY. 150 EXTRA PLAY. 200 DOUBLE PLAY

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the TAPE RECORDER

MAY - - - - - - - - - - - - - - - - 1963

VOL. 5 - - - - - - - - - - - - - - - - No. 4

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★

EDITORIAL

EDITORIALLY speaking, this month is usually a period of frustration for us; and this year the editorial month of May is worse than usual, with the Easter holidays and the London Audio Show falling at exactly the wrong time. The net result is that we cannot report at all on the Show until our June number, because this May issue has to go to press before the holiday—and therefore before the doors of the Show open—even though the magazine will not reach our distributors until the month's end. The same factors operate against our other magazine, " Hi-Fi News ", and we publish this short explanation now, sooner than later, because we know that most of our readers will be equally disappointed with this lack of news coverage. All we can do is to offer our sincere apologies, and to make up for the unavoidable delay by giving really full details in the next number.

* * *

Our editorial comment on tape recorder standards, and our comparison of recorder with gramophone, have already brought us quite a heavy mail. One reader points out that we were wrong to imply that all has been plain sailing in the disc world (apart from the various recording speeds, which we mentioned), because some records even started at the inside and worked outwards! We *did* appreciate these exceptions as we wrote, but we did not dig into details because the point we wished to make was that (from the date of the standardised flat record) to all intents and purposes all records could be played on a " standard " type of gramophone, whereas the many prevailing differences in tapes, spools and trackery make it impossible for any existing tape recorder to cope with the lot. It will doubtless be several years, yet, before standardisation makes it possible for a weeding out process to begin; but we certainly hope that this overdue shake-up will soon take place, so that manufacturers in all sections of the industry can concentrate on a minimum number of products and units. When this very desirable state of affairs is reached, we should not only see better tape recorders, but cheaper ones of better overall performance; and there should most certainly be a great improvement in after-sales service, too.

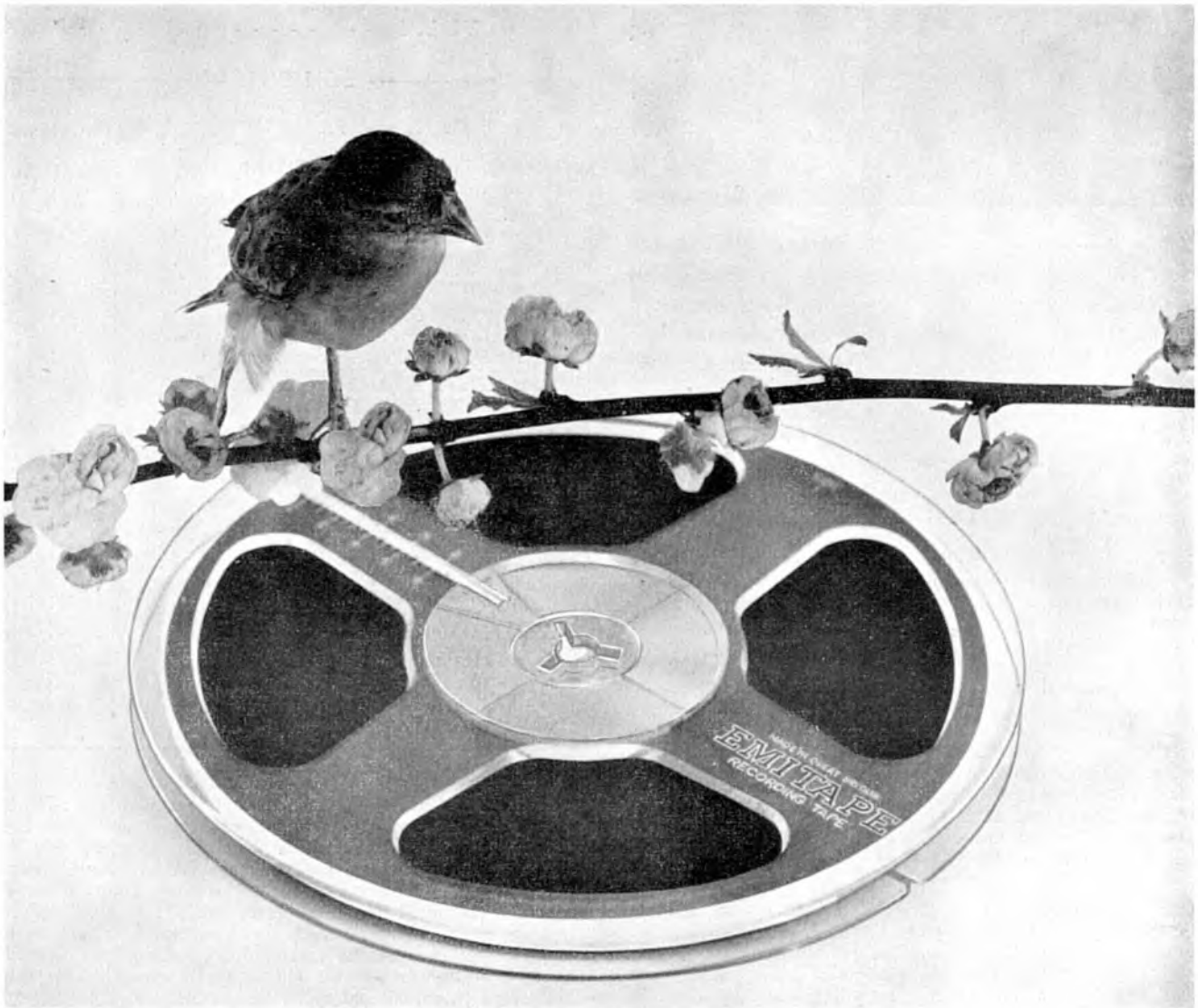
* * *

The world of tape recorder users—though it embraces very many sub-divisions—can be divided basically into two sections. The first, and by very much the largest section, is made up of users who regard the tape recorder as a modern home utility in the amusement field. The second is confined to those who look upon a recorder as a unit in the chain of the equipment which is necessary for the finest possible reproduction of sound—the true hi-fi enthusiast. This section is also divided neatly into two camps. Some plump for the so-called semi-professional machine: others buy high quality decks and, with the addition of a tape pre-amplifier, use the electronics of their hi-fi equipment to do the rest. It is to this latter group that we repeat the brief editorial announcement, made in " Hi-Fi News " this month, about a stereo tape recently received from a reader in America. The speed used for the recording is 15 i/s. The pre-amplifier is something relatively new, but which may well be the target standard of the future. It is a " solid state " fully transistorised unit and, so we understand, of almost flat response from about 1 to 1,000,000 cycles per second! (A laboratory test has apparently found it to be only 6 dB down at 2,000,000 cycles per second.) The 15 i/s speed is, we realise, far too extravagant with tape to be used by many people, but with the standard " good quality " speed of 7½ i/s the overall quality is still remarkable.

The two worlds of " tape " and " hi-fi " come closer and closer together as decks and pre-amplifiers are improved. Given top quality equipment, and its intelligent use, it takes the very sharpest pairs of ears to detect the difference between tape and disc at its best. Newcomers to either the hi-fi or the tape field will do well to think ahead, towards the day when stereo broadcasts by the *multiplex* system arrive, and to plan their chains of equipment accordingly. Here, at least, we have one department in which there is standardisation—½-track recording at 7½ i/s. With this arrangement everything is set for really good average quality, and with editing completely under control and requiring only a pair of scissors (or razor blade) and some splicing tape.

SUBSCRIPTION RATES

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



How to find summer with Emitape

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

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

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

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

NAME .....

ADDRESS .....

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.....

Get another reel of **Emitape**

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

NEWS FROM THE WORLD OF TAPE

South Africa Orders EMI Test Tapes

BROADCAST organisations and professional recording studios throughout the world make frequent checks on the performance of their tape recorders by playing back test tapes, which comprise a sequence of pure tones over a very wide range of frequencies recorded at pre-determined intervals. Such test tapes are recorded at the Hayes plant of EMI Electronics Ltd., using magnetic tape which has been carefully selected for uniformity along its entire length.

Tones from a special generator and their related pre-recorded announcements, which give an audio indication of the tone to be played back, are recorded on magnetic tape using a specially modified and calibrated EMI studio tape recorder. All known corrections are made to allow for the differences between the replay head used during production and the head of a standard studio tape recorder.

The test tapes, of 0.25 in. width, are made to international specifications. They are wound on 7 in. spools, and packed in containers made of mild steel to minimise the effect of any magnetic fields—from loudspeakers, microphones or even magnetised screwdrivers—which may come near the tapes.

* * *

Philips Organise Show

IN the absence of the traditional annual Radio Show this year, the *Philips* group of companies (*Philips, Cossor, Stella* and *Peto Scott*) will be holding a show of their own at the Fairfield Halls, Croydon, from August 26th to September 4th. The full range of radio, television and tape recording equipment will be shown, in addition to domestic appliances.

* * *

A.P.A.E. Exhibition

THE Association of Public Address Engineers held its annual exhibition and general meeting on March 6th and 7th at the King's Hotel, Harrow-on-the-Hill. Over 3,000 visitors attended the exhibition and more than 90 members and guests sat down to the annual dinner in the assembly room of the hotel. This was the first occasion on which the static exhibits were augmented by demonstrations of equipment, and it was also the first time that the event had lasted for two days.

* * *

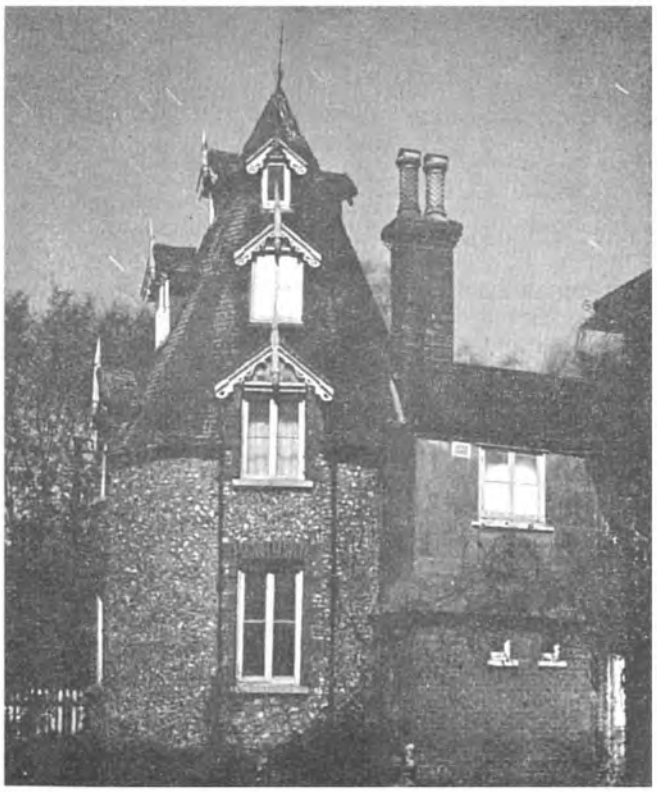
Paris Sound Festival

THE "Festival International du Son" took place from March 7th to 12th in Paris at the Palais D'Orsay. This event is about the nearest Continental equivalent to our own Audio Festival and Fair and has a similar hotel setting; there are several important differences, however. Firstly, it is not confined, even nominally, to hi-fi, but covers record players, stereo radiograms and tape recorders. Two sets of technical standards were applied at the show to determine which category equipment came in.

Secondly, live performances of major musical works are given by the RTF during the show, thus providing a standard against which the reproduced sound can be judged. This is normal practice at the French event and helps to bring home to visitors that hi-fi is a means and not an end.

A number of British amplifier and speaker manufacturers were represented, though tariffs and marketing arrangements brought the prices of British equipment up towards the generally higher levels which prevail in France.

One marked difference from our London Show concerned the degree of crowding— or undercrowding by our standards! Due to the longer run of six days there was generally much less of a crush, and it was not usually necessary to queue for admission to demonstrations.



The home of electronic music. Miss Daphne Oram, authority on musique concrête, has set up her studio in a converted oasthouse on the Kent countryside, and recently received a grant from the Gulbenkian Trust which will enable further research to be made in this subject.

* * *

Philips Lighting at London Son et Lumiere

LIGHTING and sound effects for the Tower of London Son et Lumiere show which opens to the public on 28th May, will be by Philips Sound and Light Bureau. The company's equipment will be installed by H. J. Cash & Co. Ltd., electrical engineers, Westminster.

For highest quality equipment

Heathkit
DAYSTROM

at lowest possible prices

HI-FI FM TUNER, Model FM-4U

Available in two units which for your convenience are sold separately: Tuning unit (FMT-4U—£2 15s. 0d. incl. P.T.), despatched wired and tested, and I.F. amplifier (FMA-4U—£12 6s.). Printed circuit for I.F. amplifier and ratio detector. Built-in power supply; 7 valves. Tuning range 88-108 Mc/s. (Illustrated bottom right.) Total price **£15.1.0**

HI-FI AM/FM TUNER, Model AFM-1

Also available in two units as above: Tuning heart (AFM-TI—£4 13s. 6d. incl. P.T.) and I.F. amplifier (AFM-A1—£20 13s.). Printed circuit board; 8 valves; consecutive FM limiting and ratio detector. Tuning range FM: 88-108 Mc/s; AM: 16-50, 200-550, 900-2,000m. Switched wide and narrow AM bandwidth. Built-in power supply. Total price. **£25.6.6**

TO ALL MUSIC LOVERS AND HI-FI ENTHUSIASTS

Our wide range does not permit adequate coverage here of all models. A FREE CATALOGUE and full specifications of any particular model will be gladly sent on request without obligation on your part. ASSEMBLED MODELS NOW AVAILABLE, PRICES ON REQUEST.

All prices include free delivery in U.K. Deferred terms available on orders over £10.

Tape Recording and Replay Hi-Fi Amplifiers Models TA-IM (Mono) and TA-IS (Stereo)

For use with most tape decks. Thermometer type recording indicators, press-button speed compensation and input selection, 3-position bias level and printed circuit construction.

TA-IM	£19.2.6
TA-IM and Collaro "STUDIO"	£30.10.0
TA-IM and Truvox D83 ...	£47.2.6
TA-IM and TRUVOX D84 ...	£45.5.0
TA-IS (illustration Centre) ...	£24.10.0
TA-IS and Collaro "STUDIO"	£35.14.0
TA-IS and Truvox D83 ...	£52.6.0
TA-IS and TRUVOX D84 ...	£50.9.6

A WHOLE RANGE OF PACKAGED DEALS (INCLUDING "CONNOISSEUR CRAFTSMAN" TURNTABLE and DECCA flss PICK-UP) NOW AVAILABLE TO SAVE YOU FURTHER MONEY.

HI-FI EQUIPMENT CABINETS

THE "MALVERN"

A range of over a dozen equipment cabinets is now available to meet the differing needs of enthusiasts. Designed for maximum operating convenience or for where room space is an overriding consideration, this range includes kits accurately machined for ease of assembly and "left in the white" for finish to personal taste, ready assembled cabinets or assembled and fully finished cabinets, and has at least one model to meet your requirements. Why not send for full details? Prices from **£6.19.6** to **£29.8.0.**

"COTSWOLD" HI-FI FREE SUSPENSION SPEAKER SYSTEM

This is an acoustically designed enclosure 26 in. × 23 in. × 14½ in. housing a 12 in. bass speaker with 2 in. sreech coil, elliptical middle speaker, together with a pressure unit to cover the full frequency range of 30-20,000 c/s. Capable of doing justice to the finest programme source, its polar distribution makes it ideal for really Hi-Fi Stereo. Delivered complete with speakers, cross-over unit, level control. Tygan grille cloth, etc. All parts precut and drilled for ease of assembly and left "in the white" veneered for finish to personal taste.

COTSWOLD

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S-99

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By RALPH WEST

MORE AUDIO POWER TO YOUR ELBOW!

MOST professional tape recorders, and some others, are designed to accept line input signals (600Ω in most countries). For those not familiar with such things, this scheme, whereby all connecting cables handle relatively low voltages but relatively large signal currents is to reduce hum trouble with long connections. Signal lines may run all over a very large building like a broadcast station or suite of recording studios, and miles overhead or underground in the P.O. system. By standardising thus and standardising the peak signal power used, any piece of apparatus can be connected anywhere to any other piece of apparatus—well, nearly!

Some audio generators provide an output suitable for 600Ω line use, but many do not. The writer has an old and faithful Advance H1 generator which only provides an output suitable for feeding into very high impedance devices, such as ordinary audio amplifiers, i.e. straight into the grid of a valve, or maybe via a volume control of value between 100,000Ω and 1MΩ.

Distortion

The problem in this particular instance was to find a signal of 2.0 volts at 1,000 c/s to feed into a 600Ω line input to set up a tape recorder 0 VU on its meter. Well, 1.897 volts to be precise! The signal had to be reasonably free from distortion. Using the H1 direct, it was possible to get 2.0V into this low impedance by turning its output control to something like 15 volts on its scale. The distortion, seen later on an oscilloscope, was shocking and explained why the various value voltmeters would not agree, and why the subsequent adjustments had proved incorrect!

One possibility considered was the use of a matching transformer with a step-down ratio of say 10:1. With a maximum output of 22V available this would become 2.2V providing the load applied to it was not too low. A 10:1 would make the 600Ω line impedance "look" like 600 × 10^2 ohms i.e. 60KΩ. This value of load should be all right and not produce appreciable distortion in the H1 amplifier stage. This solution was not pursued as there was no suitable transformer to hand and one good enough to use over the whole audio range would not be cheap. Instead a simple cathode follower stage was added.

Cathode Follower

The cathode follower is a most useful device and **fig. 1** shows a typical circuit. It has a number of very interesting properties: *A*. Its input impedance is very high, so it may be added on

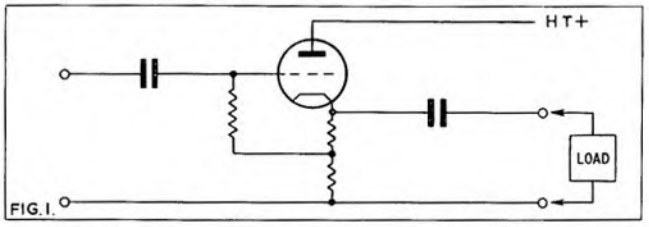


FIG. 1.

to all sorts of circuits without upsetting them. *B*. Its output impedance is very low, even below 100Ω, with a suitable choice of valve. This is perhaps its most useful property as long leads can be run from it with much less fear of introducing hum or losing the high frequencies in a long screened lead as with high impedance circuits. It is also possible to use a wide range of loads without altering the output voltage—provided such loads are not too low. With suitable loads the output voltage is approximately 9/10 of the input voltage and the distortion introduced is negligibly small, distortionless, in fact, to all practical intents. It will also handle quite large signals—many times greater than its bias value. It is like a super step-down transformer in many ways, one that steps down impedance without stepping down the volts as well.

It should not be used with loads as low as its output impedance, otherwise it can only handle small signals without distortion—about as large as its bias in fact.

Considered Satisfactory

In this instance, used with a line terminated by 600Ω the load is a bit low, so the maximum output without distortion was only 6-8 volts rms. This was more than enough so the design was considered satisfactory.

Fig. 2 shows the detailed design. Almost any old valve can be used if it is only going to be used for fairly large outputs—the writer found several Z77 (and CV138) valves in an old TV

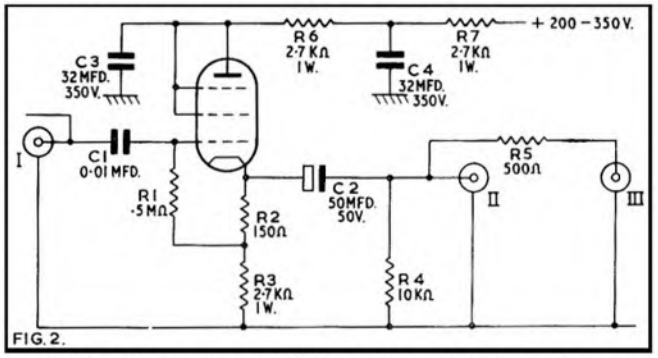


FIG. 2.

receiver! If, however, it is likely to be used with small outputs (the H1 generators will go down to 0.1 mV) and thus may be followed by considerable amplification, a little more care is necessary. A valve with low enough noise and microphony will have to be chosen and even then used on a resilient mount. An EF86 would be excellent. The rather elaborate anode circuit smoothing shown was also found necessary for the same reason. In order not to upset the working voltage of the H1 generator, the HT connection was made direct to the cathode of the rectifier, not the smoothed HT line. In order to maintain the output down to 15 c/s (should it ever be needed), the output capacitor had to be large and a 50 mfd, 50v bias capacitor was used with a 10KΩ resister to earth, to keep it polarised. Measurement at the new socket II showed the output impedance to be around 100 ohm so a third output socket was added with a 500 ohm series resister. This provided a 600 ohm output, i.e. its output voltage when loaded with 600 ohm falls to half its open circuit value.

Housing the Extra Components

There was plenty of empty space inside the Advance H1 generator to house these extra components without interfering with the existing circuit in any way. The output from the original socket is unchanged because the cathode follower input impedance, as already pointed out, is very high. The modification has soon proved its worth and is passed on as a useful idea because it could be added on to most audio generators that only provide a high impedance output.

by Richard Golding

SOUND AND CINE

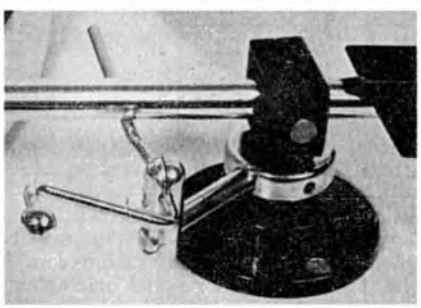
PART FIVE—PLACING SOUND EFFECTS

A PROJECTION aided dubbing session where effects are to be placed in sync on separate tape may be carried out quite satisfactorily, at one final run through, single handed.

Taking our basic equipment as: (1) an 8 mm silent projector, (2) a sound coupler, (3) a tape recorder, and (4) a record player with its own amplifier, we can devise a system whereby a half-dozen effects can be placed (fairly spaced out of course) over the length of a film, from one single disc, to cue. Or, a larger number of effects from any number of discs. With this as a basis we can then go on adding whatever equipment is available or necessary for the compilation of more complicated tracks or even for the preparation of a 16 mm transfer to optical sound. The success of the system, of course, relying on the accuracy of the cue marks on both disc (and/or tape) and film.

Transfer to Disc

In the first place we will consider that you have made up your own effects (see Sound and Cine January issue) and that these are stored on tape ready for dubbing. As there is only one tape recorder available and this must be used to carry the film sound track you will need to splice up a special tape where these sound effects are joined together in the order that they appear in the film, and to have this tape transferred to a 78 r.p.m. acetate disc. Each effect should be separated by at least two feet of leader so that spaces may be made on the



★

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disc between each effect. The cost of the transfer need not be high for there are many small professional studios offering this service, and indeed, you may purchase from Stagesounds of London a single sided 10 in. disc with six of their own effects made up to your order for only 24s.

The physical side of the recording session may be made as easy as possible by setting up all the equipment on one table and the layout of this will depend on whether or not the coupler is built-in to the projector. All controls should be easily accessible so that should a mistake occur instantaneous stopping of all units can be effected. A small screen such as the *Noriscoper* will aid daylight viewing and will allow the addition of a working light over the record player. The sound effects disc should be marked with a grease pencil at each entry. Where the use of several discs is required these should be marked up and arranged in the order that they appear in the film. The use of several discs, however, may mean that a straight final run through will be out of the question and that the session must stop and start every time a new disc is needed.

Disc Entry

The method of disc entry is most important and the normal marketed locating device such as the *Microlift* or *Hi-Jack* control unit does not really allow the precise location of spot effects to the cued visual where the start of the sound must match the first visual frame of the effect within a fraction of a second. Naturally, installation of a precision groove locater such as the BBC RP2/1 is out of the question, but we can improvise to achieve a like result. The RP2/1 is equipped with a quick start device and instead of lowering the pick-up into a selected groove which is first determined by listening on

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headphones, the pick-up stylus remains in the groove whilst the disc is suspended above the turntable which is revolving. On cue, a lever is thrown which lifts the turntable to meet the disc and an accurate speed is achieved within one quarter of a revolution.

With our system, the disc is placed on the stationary turntable, the record player motor is switched off, the amplifier is switched on but with the volume control turned down. The stylus is left resting on the disc in contact at a point in the groove of just over half a revolution from the start of the effect. The actual distance will be found by trial and error and should be marked with a grease pencil. This is to correspond with the warming-up time of the motor as it gets to speed. Each effect should be marked in this manner so that as soon as the effect is transferred the motor can be stopped and the stylus taken quickly to the next entry point.

Cueing the Film

The next stage is to give the film cue marks. There is no set standard to be followed for professional studios rarely need to use this method, relying on footages counters for narration entry and sprocketed synchronisers for dubbing effects. Where cost is to be kept down, however, in the small industrial film unit, the producer will introduce his own system of marking up for post synching and rather than mark the film with a grease

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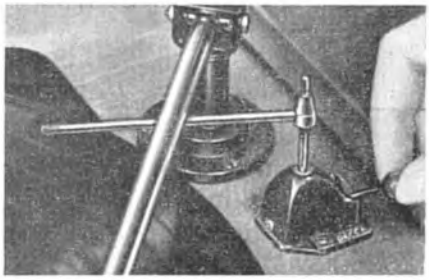
pencil he will punch holes through the relevant frames. Pencil is not used because repeated projection and the handling in subsequent editing may remove the mark. As we do not wish to damage our copy in this way, which in most cases will be the only one we have, the *Chinagraph* should be used as this

marks a good thick mark and can be taken off with not too much trouble afterwards. The film base should be used at all times.

The first two frames of the visual effect should be marked with a cross on each as, even with the comparatively slow speed of 16 f/s, one cross will flash by much too quickly. To prepare us for this cue the two or three seconds prior to the crosses should contain a warning signal. The easiest way to do this is to draw a zig-zag line of about four strokes over the length of the two or three seconds of film. On 8 mm film running at 16 f/s this will be about seven inches long and should present no problem. Somewhere along this zig-zag line two more frame crosses should be drawn as an additional cue to correspond with the distance the stylus must travel during its warm-up speed. This may be within 8-12 frames of the actual effect cue. Each effect must be marked and, theoretically, once one warning cue has been worked out in frames this should hold good for all the others.

Tape and film are now given start marks (of course if the master tape already contains some sound and the effects are to be superimposed or placed on a companion track this will have already been done). The stylus is in contact with the first pencil mark (warm-up cue), the record player motor is off and the amplifier is on but with the volume turned down. Immediately the FX zig-zag starts to show up you will have about two seconds to get ready. As the warm-up crosses flash up the motor must be switched on followed by the immediate fading up of the sound to the predetermined level (which should be clearly marked on the volume control). As the second two crosses show up you should hear, over your monitoring headphones, the sound of the effect hitting the visual

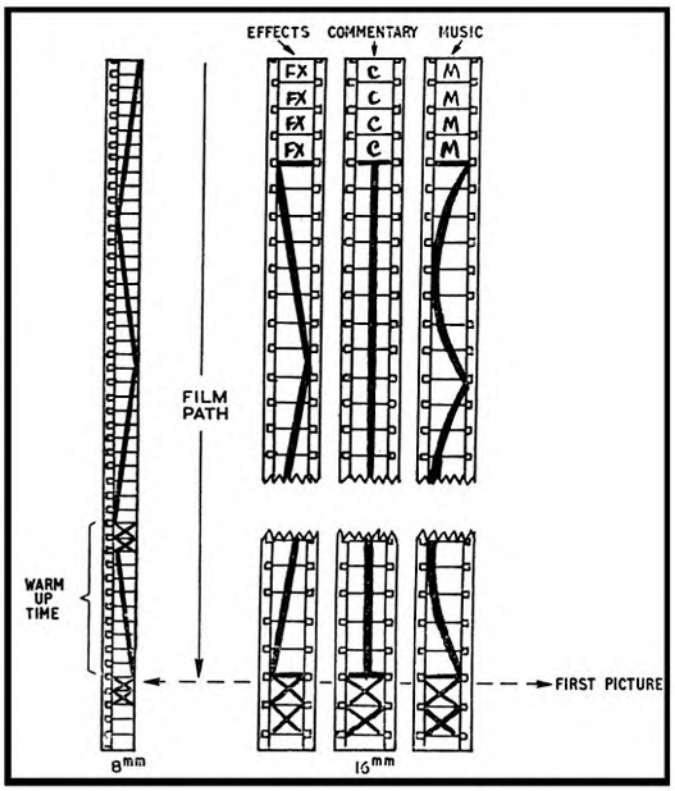


effect in perfect sync. As soon as the effect is over the sound is faded out and the motor stopped. The stylus is now adjusted to the exact position needed for the next entry. It is quite reasonable to suppose that no passage of the film is so overloaded with sound effects that you will not have enough time to proceed in this fashion without losing your place. If, however, two effects do occur so close together that natural progression is impossible then you will have to stop the projection for a moment or two to prepare the next entry. This last little problem may be avoided somewhat by including the two effects on the original effects tape as one entry. The timing of the gap between the effects on the tape must be perfect and should be measured physically against the number of frames rather than timed with a stop watch.

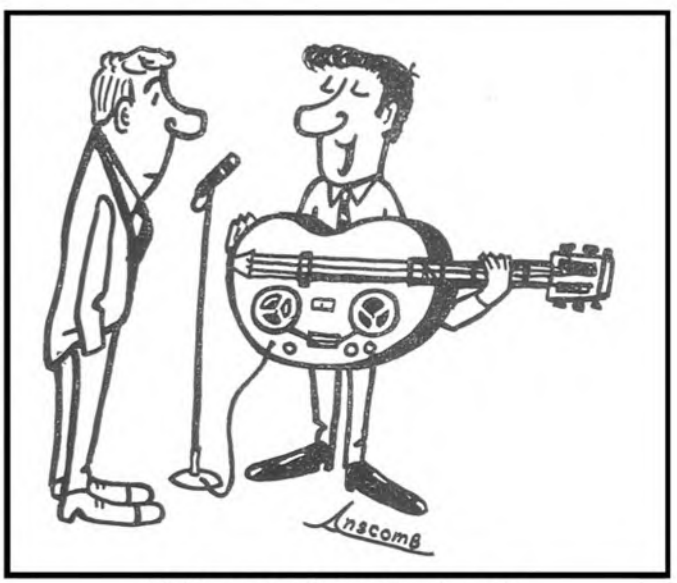
Extra Equipment

Marking cue lines and crosses on film and marking up the discs are essential but the warming-up cue mark is not always necessary and depends on the actual equipment in use. Where extra equipment permits the use of another tape recorder a background loop may be running continuously (a wind effect for example) and may be brought in and out at will whenever required. With transistorised tape recorders the warm-up time may be so slight that it may be possible to drop the effect straight in but, again, this depends on the actual model in use.

Where extra equipment is being used during a complicated session and Music, Commentary and FX are being dubbed the warning signal lines should be of different type to avoid any confusion among the various operators. I am not suggesting that the following pattern should be adopted as standard but it is a clear one and has worked successfully on many involved



dubbing sessions and I pass it on. The effects signal is a drawn zig-zag, the commentary is indicated by a straight line down the centre of the film and the music is shown by a series of curves with a peak, say, at every half-second. The warning signal should be prefaced by four frames of code letters—FX, C or M. Overlapping of any of the three can be worked out if desired. Parts of this system can be taken and developed for 8 mm and 16 mm magnetic stripe recording and in preparation of a track for transfer to optical sound. In the case of the latter the transfer Laboratory should be consulted before making up the final track. Readers proposing involved sessions with four-track recorders will find that methods detailed in the March issue of Sound and Cine will be of great value when combined with the cue-mark system outlined in this article.



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NEWS FROM THE CLUBS

MEMBERS of the **Ayr and District Tape Recording Club** had a special meeting on Saturday, March 23rd, when they were guests of British Overseas Airways Corporation at Prestwick Airport. The group met outside the hotel building at 9.30 a.m. on Saturday morning and spent a most enjoyable day recording the activities and comments of the personnel. Recordings were made of flights arriving and taking off and of passengers embarking and disembarking. Many hundreds of feet of tape were used and when this has been edited, the club hopes to use extracts of this for their hospitals programme. B.O.A.C. will also receive a copy and will use it at their training school to give trainee employees an idea of the flow of work the airline handles. Live interviews were recorded with section heads and with Mr. Pusey, the manager at Prestwick Airport.

* * *

THE last two meetings of the **Whitstable and District Tape Recording Club** have featured a tape slide show from Rhodesia and a demonstration of stereophonic headphone listening. Following a request for assistance from the Faversham Society in the compilation of a programme to be entitled "Faversham in Sound", the club readily accepted, and work will soon be started on the many and varied sounds needed. These will include interviews with local residents, and sounds of the main industries of the town, i.e. the shipyard, brewery, canning factory, engineering works etc. All these will eventually be edited into two or three half-hour feature tapes for the society's archives.

* * *

ONE of the meetings of the **South Devon Tape Recording Club** during the past month was a programme entitled "Excursion in Stereo," given by the chairman, Gordon Furneaux. He described some experiments he had carried out and explained the various microphone positions used in the various recordings. These included a cabaret put on for a local Blind Home, a multi-track recording of a guitar and various sound effects.

Member Larry Seeny recorded an interview with Miss Helen Dart at Paignton, for the club magazine tape "Audio-View." Miss Dart was the oldest person to be interviewed on tape. She is 108 years old.

* * *

PLANS to encourage "do-it-yourself" in tape recording were detailed at **North London Tape and Hi-Fi Club's** annual general meeting in December.

More lectures by members themselves, more practical on-the-spot recording and more emphasis on building equipment were the main features of the club's programme for 1963, said committee member John Wilson, presiding in place of chairman Sinclair Scott who was fog-bound at his home in Cuffley, Middlesex.

On top of these activities, in April the club would have to fill a classroom for three days at Cheshunt (Herts.) Hobbies Exhibition. He added that individual members would be asked to swot up on such subjects as tape, heads, amplifiers and speakers and lecture to the rest of the club at meetings. Thanks for this idea must go to the Walthamstow club, the originators.

Sinclair Scott (centre) chairman of the North London Tape and Hi-Fi Club watches as secretary Richard Collinson receives the trophy he won for the club's "Tape of the Year" from the Mayor of Enfield Alderman E. Hendrick.

Recalling the past year, secretary Richard Collinson said membership had nearly doubled—to 26. Attendance at meetings averaged at 16.

* * *

THE **Glasgow Tape Recording Club** has been making steady progress during the past few months, particularly since moving into our new premises at 91 North Hanover Street, where the members have every facility for making and listening to recordings. The Sound Magazine for the Blind has now been circulating for almost two years and has a growing audience. Among recent contributors were Jimmy Shand and Joyce Grenfell.

* * *

ON March 30th, Ernest Morris, chairman, and Peter Turner, joint hon. secretary of the **Cotswold Tape Recording Society (Cheltenham)** attended the rally of tape and cine clubs organised by the Northampton club. This was an ambitious event, consisting of a trade exhibition, open to the public, and items covering a wide range of audio and cine subjects, occupying two halls for the greater part of the day.

In the course of the rally, a meeting was held to inaugurate a new association of Midland tape clubs, which will assist and coordinate the work of the various societies within a generous area described as the Midlands.

On April 1st a visit was received from Mr. M. L. Gayford, B.Sc., A.M.I.E.E., chief engineer of the acoustics division of the world-famous British firm of Standard Telephones and Cables. Mr. Gayford's subject was microphones—on which he is a world authority. He began with a lecture on the different types of microphones: crystal, moving-coil, ribbon and condenser—with a glance into the future at the development of the transistor microphone. The way in which these different instruments work, and the main problems associated with each type, were discussed lucidly, with the aid of diagrams. Many questions were provoked by the lecture; and after the interval several microphones manufactured, virtually by hand, by the firm of S.T.C. were demonstrated, with the aid of a Ferrograph tape recorder and Daystrom loudspeaker system. It was thus possible to compare immediately the recorded signal with the natural sound. Of particular interest was a noise-cancelling microphone, which Mr. Gayford addressed quietly, while members applauded and shuffled all round him to simulate the noise of a crowd. The recording, when played back, allowed Mr. Gayford's remarks to be clearly heard despite the background hubbub. To compare, a normal dynamic microphone was used in the same way, when the commentary was completely lost in the noise.

TAPE RECORDER SERVICE

No. 17 PHILIPS, STELLA AND COSSOR

By H. W. HELLYER

Cossor CR 1603

SEVERAL months ago, the servicing details of some Philips tape recorders were sketchily dealt with in these pages (May and June 1962). Since then, although a number of new models have been released, under the parent company's mark as well as in the Stella and Cossor range, it has not been possible to dwell at any length on the special features of these machines.

Specifications for the Philips *Starmaker* and the Stella 456 have appeared in reviews by my well-informed colleague, A. Tutchings, but there has been practically no discussion of what has become a talking point among engineers—the present trend in Philips tape recorder design. I shall return to the 456 review later, but would first like to pass on the gist of an excellent letter that was recently received from the Technical Commercial Department of Messrs. Philips in reply to a query the author was making before writing this article.

Recent Developments

Discussing recent development, the Philips spokesman said: "Probably the most important . . . is the introduction of transistors into mains operated tape recorders. This started with the EL3514, where a single transistor was introduced. This was in the input stage to give the high gain required for small microphone and head signals without the inherent problem, with valves, of hum due to the heater supply".

Readers may recall that the EL3514, christened the *Starmaker* and widely publicised, was a single-speed (3¾ i/s), mains-operated portable, using an AC107 transistor in the input stage, from a 500 ohm impedance moving-coil microphone, feeding an ECC83, with EL95 output, DM71 magic eye and a Selenium rectifier for the h.t. supply. It was particularly notable for its large (7 in.) loudspeaker, made possible by the upright styling which followed the EL3585 and Stella 470 breakaway from conventional "boxiness". Some of the mechanical details applicable to service work were described in my June 1962 article of this series (pages 203, 204), and a review of the model was published on pages 263, 264 of the subsequent issue. Mr. Tutchings was particularly pleased with the utter simplicity of the control system and the cleanness of the sound, although the output power is, admittedly, only 1½ watts. As it is a 4-track machine, taking spools up to 5 in. diameter without the plastic lid (4 in. maximum if enclosed), thus giving up to four hours recording with double-play tape, which retailed when it was first brought out in early 1962 for 27 guineas, readers who have the opportunity of picking one up on the second-hand market may be agreeably surprised.

A Logical Step

From a transistorised input stage to a fully transistorised main machine is a logical step—if we remember that the advantage of semi-conductors is not limited to a reduction in size and weight and power consumption. Other factors to be considered are: (1) improved reliability, (2) reduction of heat, (3) reduction of hum, and (4) elimination of warm-up time.

The last point is important for many applications, where it is desirable that a tape recorder shall function as soon as it is switched on. To enable full advantage of this, the control system was designed for rapid switching between functions, and the "press-press" type of button and key control which can be operated with one hand as the machine is being carried, was borrowed from the truly portable models and modified in a very interesting way for the Stella 456 and its equivalent Cossor 1603 tape recorders.

But before going into more detail of these representative "popular" models, let us follow the Philips trend to the later machines, the EL3549 and EL3534. These two machines also include the low speed of 15/16 i/s, for speech recording. The latter machine was introduced at the Radio Show last year and the former first marketed last December. The 3549 is designated a hi-fi machine, and is a successor to the EL3542. The addition of the low speed makes this a four-track, four-speed machine, with a frequency response from 60-16,000 c/s ±3 dB at 7½ i/s, giving 2½ watts from a 5 x 7 in. elliptical loudspeaker. A stereo socket is provided for the connection of a pre-amplifier, the EL3787, which is to be introduced at the Audio Fair (still in the organising stage as these lines are being written).

The other machine that has been mentioned, the EL3534, is a fully stereophonic tape recorder, with the "Multiplay" facility. This enables a recording made on one track to be fed back to a second track and mixed with a separate input, with full monitoring provision. This mixed recording can then be replayed to the first track, mixed with a new input, and so on, enabling a synchronised multiple recording to be built up.

Parallel Track Facility

The parallel track facility, taking the place of conventional superimposition (which so often amounts to no more than a disconnection of erase head circuits), is steadily becoming a regular feature. In the later Philips models, the lower track of the R/P head is brought out to a "Stereo Replay" socket, to form a right-hand channel for stereo replay, and with the monitoring of the first track available, it is possible to play back synchronised signals and obtain a *Duoplay* facility.

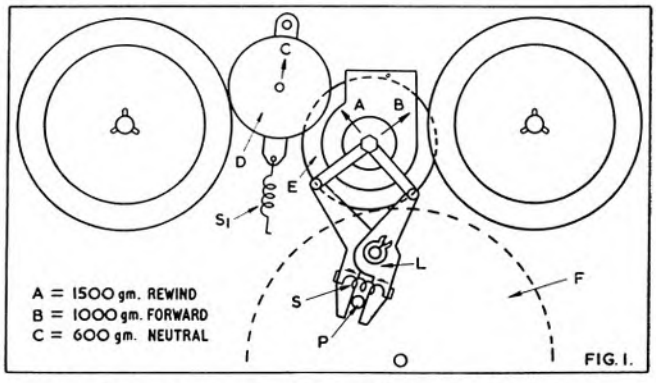


FIG. 1.

That many of these facilities should also be incorporated in the "popular" range is a good selling point for this manufacturer. The new "Family de-luxe" model, which also makes its first appearance at the Audio Fair, will sell for only 42 gns. and yet has these modern features, and, with the addition of the pre-amplifier, can be built up to a high quality stereo installation.

From the servicing point of view, these new machines are much easier to "get around". The deck layout has been cleaned up and, despite the retention of the "rod-operation" the rather flimsy slide switches that so many tape recorders and tran-

TAPE RECORDER SERVICE

By H. W. HELLYER

sistorised portable radios are employing, and the "swivel-stop" switch cam enabling "push-button" operation, a service engineer's job should be considerably eased. The EL3534 and 3549 models have hinged printed circuit panels for accessibility to both sides of the printed circuit, which is one small consideraton more manufacturers would do well to emulate.

It is notable, too, that Philips are standardising their plugs and sockets, in accordance with the recommendations of the B.R.E.M.A. and A.M.G., and have limited their connectors to those conforming with the Continental *and* British (recommended) standards. These are the 2-pole 4 mm socket for external loudspeaker connection, the 5-pole flat I.E.C. for gramophone input and the 5-pole round D.I.N. sockets. In fact, going one step further, they have duplicated the I.E.C. socket with a D.I.N. connected in parallel on some machines—what more could one ask in the way of conformity?

*

STELLA MODEL ST 456 FOUR-TRACK RECORDER

*

Stella 456 and Cossor 1603

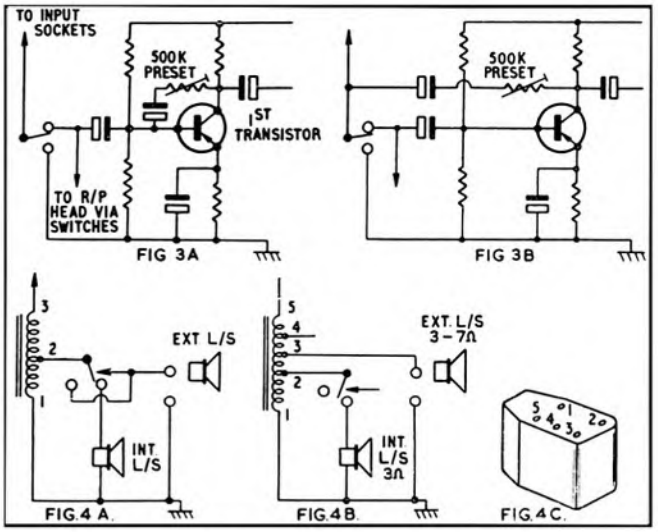
From the general to the particular. Regular readers will have noted from Mr. Tutching's review of this model (*Stella ST*456, *page* 307, *August* 1962, *Tape Recorder*) that it has several special features. One of these was the "ingenious device", as our reviewer called it, of the right-hand control knob. This lever operates the forward and reverse fast wind when the whole knob is swivelled in the appropriate direction, and Record/Playback when the central tab is depressed. A catch-lock system releases the latter action when the tab is pressed again.

The point about this control is the effective way it is mounted, making it extremely difficult to remove. This is the only knob which has to be removed for dismantling, the top half of the plastic casing being secured with four screws, and the lower half, which can be taken off independently for servicing, held by the screws in the rubber feet. To ease off the transport knob, turn it to the neutral position, hold the machine firmly with the left hand, grip the flat sides of the lower section at the section nearest the edge of the machine and pull steadily upwards. When reassembling, make sure that the spring blade of the tab section seats over the flange of the R/P lever and push the transport knob firmly downwards until the transverse spring clicks into place.

Main Operating Lever

Beneath this knob will be seen the main operating lever. The R/P action pivots this lever, engaging the pressure roller assembly, releasing the brakes and engaging the secondary idler wheel with the flywheel and right-hand turntable friction coupling.

The fast wind and rewind action is rather different. **Fig. 1** shows the layout of the main items, with the pin *P* actuating the double swivel which engages the drive wheel *E* with either the right-hand turntable or the small intermediate drive wheel *D*. The important parts here are the two springs, *S* and *S*1. The former holds the two sections of the swivel lever in tension, and the latter applies tension to the rewind drive wheel which is engaged by a separate section of the drive roller *E*. Actual pressures are shown on the drawing at *A*, *B* and *C*.



Tape Guides

An important part of the operation of this deck is the adjustment of tape guide and turntable heights. The right-hand turntable is adjustable by fitting spacer washers above or below the mounting plate, to allow the tape to run centrally between spool flanges when the tape guides are adjusted as shown in **fig. 2** for 13.5 mm spacing. Note that some machines were supplied with non-adjustable tape guides, and these are taken as a datum for all other adjustments. It is wise, when making head and turntable adjustments, to begin by setting the tape guides absolutely accurately.

The next move is to check that the tape runs correctly past the capstan—do this *before* making head adjustment. Alteration is effected by moving the complete mounting plate on which the capstan top bearing is fixed. This is held by three screws, which should be slackened only enough to allow the plate to be moved until the tape runs past correctly.

Head Adjustment

The head adjustment should be made with the aid of a test tape, recorded with a constant 6 Kc/s tone. The head is mounted on the three-screw plate, with the forward screw *S* adjusting the height, and screws *Q* and *R* rocking the head for correct azimuth. Final adjustment should be made with screw *Q* so that there is maximum playback of the appropriate track, with the pin *P* adjusted for minimum difference between tracks.

The erase head should be set so that the upper core *C* protrudes 0.1 mm above the edge of the tape and is parallel to it. The erase head also has a three-screw mounting. Adjustment should be made for no attenuation of parallel tracks—this procedure has been dealt with in detail on previous occasions and need not occupy us here.

Drive Assemblies

Note that alternative flywheel and friction drive assemblies have been fitted to different machines in the same range. The principle is somewhat different to normal clutch action, but is very effective, having a negligible "drag" and a very low possibility of induced wow and flutter. Much more can be attributed to incorrect setting of the pressure assembly, which should have a 1,500 gm. compression of the roller to capstan

(*Continued on page* 158)

TAPE RECORDER SERVICE—(continued)

and a 60 gm., plus or minus 6 gm., tension of the plate in front of the pressure assembly, and also the capstan top bearing mounting, adjustment for which has been detailed.

Brakes should have a 1 mm clearance between brake shoes and turntable when the R.P. function is selected. This can be adjusted by bending the bracket slightly. Note that the return action of the brake engagement plate is spring-assisted. Check for binding at the lower edge of this plate.

Track Selection

The track selection is by slide switch, which is mounted on a bracket held by a screw with a small amount of possible play. Check this in case of erratic action. It is worth noting at this stage that the top cover can foul the track switch slider if the small latex pads behind the tape guides are dislodged. (I am indebted to reader A. Baylis, of Horfield, Bristol, for this piece of advice.)

Other variations in production are noted in **figs. 3** and **4**, which show, respectively, the input stage circuit and the alternative arrangement. **Fig. 3a** gives the original circuit, with the 500,000 ohm preset resistor set for an output of 1.9 mV at the test point (on socket panel) with a 1 Kc/s signal of 11 mV applied between chassis and contacts *s* or *q* (second or fourth) of the five pin socket. **Fig. 3b** gives an alternative circuit for increased playback sensitivity, and in this case the preset may be replaced by a 470 k fixed resistor.

The alternative loudspeaker arrangement makes use of a tapped output transformer, to allow a 3 to 7 ohm external loudspeaker to be used. **Fig. 4a** shows the original circuit, **fig. 4b** the revised, and the inset gives the connections to the output transformer.

Moving Coil Meter

As a final practical point, take care when dismantling and re-assembling, that the recording level meter is not damaged. The movement is quite delicate, and, in conjunction with the calibrated gain control, is capable of giving very accurate indications (for what is, after all, a "family" tape recorder, not a professional machine). But this is a moving coil meter, and the connections to it are fine, and easily disturbed, so care must be exercised. Make sure the spring wire is correctly clipped over the meter flange before screwing down the top cover, and the wires are not trapped between the vertical plate and the edge of the deck.

Electrical adjustments have been omitted from this article, deliberately. It is seldom necessary to alter settings of bias, boost coil, recording level indication or response levels on these printed circuit transistorised machines, unless major repairs have been carried out. One very important point requires to be noted, however. If a 456 is purchased new, please check the voltage setting on the carousel. The mains transformer is formed from the motor stack, and plugging in to 240 V. mains with the voltage tapping of the machine set to 110 V. will result in a burnout. I have had three of these returned to my workshop already with this fault—due to lack of inspection by the salesman who unpacked the machine and plugged it in without checking this fundamental point! It may be an insult to the readers of this magazine to mention such a thing—but small omissions can be expensive, so I feel sure I shall be forgiven.

. . . . tape recorder workbench

No. 46 VALVES OR TRANSISTORS

by A. Bartlett Still

THERE may well be a number of you who will recall that a few months ago I described an Audio Valve Millivoltmeter, and followed this up, a couple of issues afterwards, with a transistorised Audio Oscillator.

At about the same time I received a card from a reader in Richmond, Surrey, posing the following, very reasonable question: "Could you kindly tell me if there would be any advantage, in cost, stability, or freedom from false readings due to internal hum, in transistorising the millivoltmeter you described in Workbench Nos. 39-40?"

Stability

On balance I incline to the view that the short answer is that there would not be any advantage. A transistorised unit would presumably operate from batteries and be smaller, but I am not altogether sure that such a piece of test gear needs to be independent of the mains and portable. The same might be said of an Oscillator, but to a lesser degree. However, in respect of the other factors specifically mentioned in the question, one can be more precise. Doubtless the same degree of stability could be achieved with transistors, as with valves, but the circuit would be considerably more complex in my humble opinion, and, as a result, cost would turn out to be a distinct disadvantage.

Admittedly, there is unlikely to be any internal hum arising in such an amplifier, but there need not be much in a valve amplifier, certainly I have always found it impossible, on the prototype, to discern *any* meter movement that could be put down to internal hum. Occasionally, when metering a 50 c/s signal, or thereabouts, it is possible to detect some "beat frequency" effect, but this can happen on quite expensive devices!

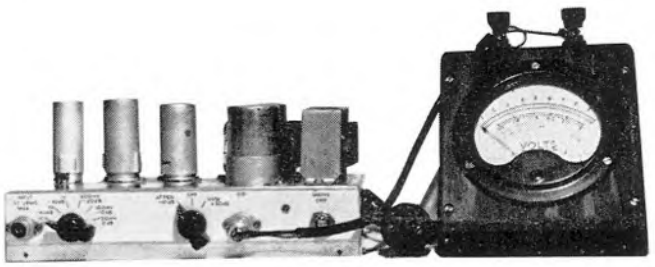
Cost

No, I am fairly convinced that, unless stability, and as a result, accuracy, were to be in doubt, the cost would be prohibitive, and without any other really worth-while advantage.

It is probably rather trite to say that you get the sort or quality of tape recorder that you pay for, but it is nevertheless true, despite what some of the advertisements say. The cheaper models must be lacking somewhere; if it is in gadgets, all well and good, because the machine may basically be sound. Indeed, I fancy there are a number of such machines around, because I get a number of letters, and have devoted a few articles, to adding one or two of the more useful gadgets. But what happens when, so to speak, you have bought the lot for fourpence? One thing that is noticeable is that there is no reserve in performance. The amplifier is being asked to function with an absolute minimum of valves, for reasons of economy, and with the cheapest of components. As a result I have heard of cases where performance has fallen off noticeably once the first flush of youth is past. In one instance results were improved by a new valve, although the "old" one had only done about a hundred hours, and, what is more, then did long service in another machine. I have always considered myself a pretty down-to-earth sort of chap, and nobody has to tell me that not all of us can afford the best. All the more important then, that we should spend our money wisely.

"Class A" Conditions

In the instance I have just cited, the valve in question would, fairly obviously, have passed as "O.K." on a normal valve tester, as indeed it was. There is, however, one application, common to most machines of whatever price, where a valve will test as all right although it has ceased to be up to standard. Most



valves operate under conditions known as "Class A", where the anode current deviation, under signal conditions, from the static level, is not very great. The valve used as a bias oscillator, however, works under conditions that tend towards "Class C". This means that the standing current is much lower, it may even be zero, and so, to produce the power required, the "Peak-to-mean" ratio is higher. The cathode of the valve must therefore be capable of emitting a high burst of current every cycle, if the desired output is to be maintained.

Test by Substitution

A normal valve tester check will determine that the emission of the valve is O.K. for the more usual applications, but it is unlikely to make stringent enough demands on the cathode to be a real test for a bias oscillator valve. This I have confirmed in practice. When it is considered that some tape recorders are rather "touchy" in respect of their bias setting, it is probably as well to consider "test by substitution" as the only way to produce the right answer.

I hope that my comments this month will have answered a few of the questions that I know have been puzzling some of my readers. If you have a question, of general interest please, that requires rather broader treatment than can be given in the "Readers' Problems" column, then drop me a line.

Readers' Problems

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

Track Standards

Dear Sir:—I have recently converted my tape deck from ½ to ¼ track operation and would be grateful if you could supply me with details of the accepted standard for order of track recording. My machine plays from left to right and the heads are made to employ the two centre ¼ tracks.

In order to align the heads correctly I should like to obtain a suitable test tape. Could you please advise me of a supplier of such an item.—*Yours faithfully,* **D.R.S., Harlow.**

The standard for four-track recording may be explained as follows: With the oxide surface of the tape held away from you the top track (track 1) should play with the tape moving from left to right. The next track will play from right to left the one below that from left to right while the bottom track plays from right to left. It will be seen that a head with two gaps, spaced by a track width, should be set to play the outer and opposite inner tracks. Reversal of the tape will then play the remaining two.

For head alignment a frequency test tape is required, for 7½ i/s the E.M.I. TBT1 is suitable, for 3¾ i/s a tape is marketed by Saga. These tapes are available through any dealer handling tape records.

* * *

Mechanical Noise

Dear Sir:—I have a Telefunken 85 T Stereo, which has had about 2,500 hours' use in the 16 months which I have had the machine. Recently, however, I have been experiencing horrible noises. The noises are purely mechanical, one emanating from the motor in the form of a whistle, the other being a knocking noise coming from the take up spool drive. I have thoroughly cleaned all drive pulleys and belts with a slight reduction of the second noise as a result. However, both noises are still clearly picked up when I am recording via the microphone, which stands about six feet away from the recorder.

Your advice on how to eliminate these noises would be greatly appreciated as I have been receiving complaints from some of my friends with whom I exchange tapes about the background noise being recorded.—*Yours faithfully,* **A.G.B., Salisbury, Southern Rhodesia.**

From here it is gratifying to note that the Tape Recorder Service articles have a following overseas. In fact, part of your trouble, noisy reproduction of your tapes on the Telefunken 85 T, may be due to your local climatic conditions. Bearings tend to dry out more quickly than normal, and 2,500 hours' use indicates it is time for re-lubrication. Pay particular attention to the upper bearing of the flywheel, and the lower motor bearing.

The second noise, a knock in the take-up mechanism, may be due to a malformed belt, but could also be caused by the stretch lever pressing against the right-hand side of the assembly plate—this can be checked with the top cover removed. Note also, that there is a locknutted adjustment on the capstan lever arm (idler) to ensure the correct slipping momentum. This is 240 to 360 grammes, which is checked by fitting a spring balance to a piece of string wound round the hub of an empty 7-in. spool and noting a pull of between 3 and 4 ounces (80 to 120 grammes) when the machine is switched to playback. It may be necessary to bend the stretch spring plate and the backing plate, but note that there should be a clearance of a couple of millimetres between these when in the playback position.

Check that the motor mounting is correct, and that the motor pulley runs centrally, with the motor belt in the middle position on pulley and turntable idlers. Check that the rubber shock absorbers have not hardened on the motor mounting.

Finally, ensure that the screening flap around the head housing is correctly positioned—this can cause pick-up of motor noise (even when normal), as can a microphonic EF86 *valve.*

* * *

Increasing the Output

Dear Sir:—About 10 months ago I purchased a Robuk RK 3 tape recorder. The rated output is 2.5 watts and I would like to increase this to about 4-5 watts.

Secondly the frequency response at 3¾ i/s is 60-7 Kc/s and 1⅞ 60-3.5 Kc/s, this appears to be lower than most machines. Is there any way of increasing the frequency response? This machine also has a very heavy tendency to bass emphasis, even with tone control set to full treble which in doing so, causes an annoying hiss. Can this be overcome?—*Yours faithfully,* **A.J.C., Brighton.**

As you say, the output of your Robuk RK3 is specified at 2.5 watts. The best way of increasing this to 4-5 watts is to feed the playback signal through a power amplifier and external loudspeaker. There is a high impedance output from the third stage, suitable to feed a 5-10 watt amplifier with all the power you would need. I would not recommend adding stages to the RK3 as it stands. In the first place, the EZ80 delivers only 90 mA maximum HT current. An EZ81 would be needed to give sufficient HT for an additional push-pull output stage, which is what you would need. But although the EZ81 will give up to 160 mA, it should have a higher input voltage and takes a higher heater current. This would mean that the existing mains transformer would be inadequate for the extra load an EZ81 and, say, a pair of EL84 valves would impose. While going to such lengths in the modification as to change the whole power pack—and adding an output stage—with the attendant hum, heating and feedback difficulties, it might be as well to take advantage of the existing amplifier output feed.

As regards frequency response: this is limited to some extent by the head. You could fit a head with wider playback response, but not having undertaken this modification to the Robuk, I am reluctant to advise on circuit alterations to allow for the new head. I would mention, however, that the specifications are quite modest, and 60-7,000 cps ± 3 dB is probably bettered in performance. You would notice greatly improved results by feeding an external loudspeaker—or amplifier plus speaker—and I would advise this before making any response modifications.

The tone control on this machine is a simple shunt-fed 5 kpf and 1-meg potentiometer from the anode of the third stage, and as such is really only a top-cut. If you added an amplifier and kept the tone control at full treble, the tone should be quite wide in its range. Hiss at full treble may indicate your head needs demagnetising.

P.S.:—I regret I am unable to supply circuits, but suggest you try the makers.

* * *

Bass Reproduction

Dear Sir:—Some months ago I purchased a Harting Tape Deck, fitted with Amplifier, etc., but have been unable to trace the cause of "rough" reproduction in the bass notes, and it gives a very pronounced bass resonance. Investigation shows this to occur during the recording process, as recordings from

other decks do not replay too badly. The Record/replay Head is only slightly worn which I think you will agree, is unlikely to affect bass response, and of course, valves have been replaced, electrolytics, etc., checked. Unfortunately I have been unable to get a circuit diagram of this equipment and although some of the circuitry seems straightforward, there are some pre-set resistors and small rectifiers included, the functions of which are not apparent.

Can you please suggest the likely cause of this trouble?—*Yours faithfully,* **R.A.H., Worcester.**

The difficulty you are experiencing with pronounced bass resonance is not, I surmise, peculiar to the Harting Deck. "Rough" reproduction of bass notes—if it is only being originated during recording—is most likely caused by incorrect biasing. In particular, the amplitude of the bias voltage has a bearing on your problem.

Please check that a tape recorded on your machine plays back in a similar "rough" fashion on another, good machine. Check also that recordings from your machine at medium level play back through another machine also at medium level and do not have to be replayed at full volume. (This would prove whether head wear had made it necessary for an increased modulation level during record, with consequent distortion that would not be noticed during medium level playback.) Check also that erasure is complete and background noise absent when recording with no input on a clean tape. If there is a strong hiss, suspect incorrect bias frequency—which would also result in incorrect amplitude, affecting the bass. The pre-sets you mentioned may be the relevant adjustments, but the crystal diodes are probably in the modulation level indicator circuit, and can be temporarily disconnected for test purposes if this is so.

* * *

Telephone Effects

Dear Sir:—I have visited several recording studios and they have a facility on the control desk for turning normal speech into "far end of telephone" sound at the flick of a switch.

I am using a *high* impedance ribbon microphone and crystal types as well. I also have a G.P.O. telephone handset with insert. Is there any way that I can switch to the "telephone talk" sound using the above microphones?—*Yours faithfully,* **J.H., London.**

The typical sound of speech received by telephone line is due to the restricted frequency response of the system. If, therefore, we could restrict the frequency response of one of your microphones in a similar manner the results should be such as you require.

Compared with normal standards we require severe restriction on bass response and, to a slightly lesser extent, on treble. The easiest way to achieve the bass cut is to use a crystal microphone feeding into a low impedance. This can be accomplished by connecting a resistor directly across the microphone input socket. A suitable value must be found by experiment, but I would suggest 100 *Kohms for a start. A lower value might tend to decrease the entire signal too much.*

In order to restrict the treble response, a capacitor should be connected in parallel with the resistor to shunt the high frequencies. Its value will depend to a large extent upon the value finally chosen for the resistor, but may well be about .005 mfd.

Should it be successful, the resistor and condenser combination can be switched across the microphone line as required. I will not pretend that this will give you results as good as studio equipment, but I doubt whether you would wish to spend the money involved in more exact frequency response shaping.

* * *

Slow-Running Recorder

Dear Sir:—I have had my Regentone R.T.50 recorder for three or four years and it has given surprisingly good service. Recently, however, it has developed the fault of requiring at least half an hour's play before the correct speed is reached. Can you suggest a remedy for this?—*Yours faithfully,* **A.G.H., Fife.**

*As you probably know, this machine uses the Motek K*10 *tape deck. Some details of this were given in the article which appeared on pages* 117 *and* 119 *of the April number of this magazine. Unfortunately, limitations of space prevent a fully comprehensive description of a deck, and the particular parts that are probably causing your fault were not shown in the diagrams on page* 119. *But if you refer to paragraph* 3 *of this page, dealing with the speed change mechanism, you will probably be able to ally it to the following notes and solve your problem.*

The idler that drives the flywheel, and hence the capstan, is mounted on a forked bracket, which slides on a fixed peg, and is held in engagement by the spring X of Fig. 1. *Relaxation of this spring is one possibility, as is the binding of the bracket. Check tension and clean and lubricate with a light grease.*

If you remove the top cover, you will see the slide mechanism that is attached to the pinch wheel bearing bracket, secured with a 4BA nut (usually a Simmonds type) with washers above and below, which slide forward when the Play button is pressed. (The Record button has a similar basic action.) A popular fault is this assembly developing excessive friction, and the cure again is to clean and lubricate. I should try this first if I were you—just remove the top plate and paint over this slide with methylated spirit, after removing any dust that may be present, then grease very lightly, operating the press keys a number of times. If necessary, slacken off the nut, but do not remove altogether unless you want the fiddling job of re-assembly afterwards! Incidentally, this assembly is easily identified by the guide pin that protrudes up from it.

* * *

Radio Microphones

Dear Sir:—Although quite satisfied with my mains supplied tape recorder, I have always been aware of the advantages of complete portability. But the main trouble with the battery portable tape recorder is its very limited playing time and, in some cases, the fact that the recorded tapes cannot be played back on other tape recorders.

I believe, however, that all this can be overcome by purchasing a portable transmitter which, in conjunction with an FM receiver, could transmit messages over a radius of miles, have them "picked up" by the FM receiver and fed into the input on the mains supplied tape recorder. By using a time switch the tape recorder could be switched on and off at the required times or better still, a friend could operate the recorder and the receiver, seeing that the message was not being over-recorded. Would this be practical or not? *Yours faithfully,* **K.S., Stockport.**

You can obtain portable transmitters, of course, either one specially designed for radio amateurs or an ex-W.D. "Walkie-Talkie" etc. Operating at very low power indeed, you can transmit and be recorded over distances of a mile or so without difficulty. In professional broadcasting, and television, for example, miniature "radio microphones" are frequently worn—visibly or invisibly—to allow singers or interviewers complete freedom from trailing wires etc. Even the TV floor manager will often be equipped with one of these vest pocket transmitter/receivers to keep him in touch with the producer.

*Before making plans to use this idea for amateur recording, however, it is absolutely essential to find out the G.P.O. regulations on obtaining a licence to operate transmitting equipment. Where operation on the amateur wavebands is contemplated, we would urge you to write first to the Radio Society of Great Britain, New Ruskin House, Little Russell Street, London, W.C.*1.

WHEN IS A DROP-OUT NOT A DROP-OUT?

PART ONE WHAT IS A DROP-OUT? By GRAHAM BALMAIN

THE question posed in the main title is much wider than of mere terminology, although it does seem wise to sort that out first. A drop-out is the audible catch in the flow of sound, not the physical irregularity which produces it; the effect, in fact, not the cause. The nodule shown in the photographs (**fig. 1**) is *not* of itself a drop-out, but it might very well cause one under suitable conditions. For the moment, things like this are nodules, lumps, spots, pimples or whatever. It dates from several years ago, by the way; today's pimples hardly show their noses above the coating surface, which just shows that molehills can be made out of mountains.

A host of other things also may cause drop-outs: actual or magnetic holes in the tape coating (very rare); tape with crinkled or ragged edges, or with a curl, or with stiffness beyond the power of the deck to control; airborne dust and fluff, including even cigarette smoke particles (*that'll make 'em give it up!*); particles scraped from the tape itself during its passage across the deck; mechanical damage to or distortion of the tape by the deck or certain modes of vibration of the latter; or anything else which holds the tape away from the record/playback head from time to time.

The transport mechanism has a much greater effect than is generally realised. A perfect one will allow only drop-outs genuinely due to tape faults to appear—they can be counted and located in exact repetition if the same length of tape is played several times—while a poor one may add many others which

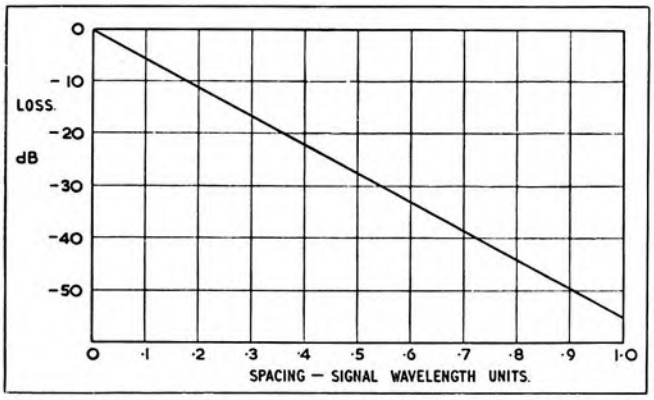


Fig. 2: *Effect of Head-Tape separation. The horizontal scale can be read directly (full-scale = 1 thousandth of an inch) for a signal wavelength of 1 thou', e.g. 7.5 Kc/s at 7½ i/s, 3.75 Kc/s at 3¾ i/s, 1.875 Kc/s at 1⅞ i/s, etc.; or with full-scale of half this for twice these frequencies and similarly for other wavelengths in inverse proportion.*

cannot necessarily be reproduced either in number or position. The latter are genuine enough as they occur, but their several causes, being transient, can only be accepted with statistical resignation rather than be defined with certainty.

Spacing Losses

The exact process of drop-out follows directly from one of the natural laws of magnetic recording and reproduction: the strength of a signal recorded on a tape or reproduced from it falls pro rata by some 55 dB for every wavelength of separation between the head and the tape (**fig. 2**). For a 10 Kc/s signal recorded or reproduced at 3¾ i/s, for instance, the wavelength is 0.375 of a thousandth of an inch and a complete head-tape separation of this amount would result in the full 55 dB loss. At 1 Kc/s the loss for the same spacing would be 5.5 dB. A more homely loss of 6 dB at the higher frequency needs a separation of only 40 millionths of an inch—$\frac{1}{25}$ of the thickness of a cigarette paper or about the size of common airborne dust particles. And this is only for the one process; the losses may be doubled for the complete record/playback sequence.

So we can say immediately that the general severity of drop-outs will be increased by lowering the tape speed, since this decreases the wavelengths involved in a given frequency range. Two other working conditions also have an influence. Firstly, an increase in the a.c. bias applied during recording has the effect of reducing the severity of individual drop-outs and thus reducing the number of drop-outs exceeding a certain level (**fig. 3**). This is due to the increased bias causing the signal to penetrate further below the coating surface; the mean head-signal spacing is increased and a given additional separation has less effect. A greater bias also causes some loss of h.f. registration, of course, because of this greater penetration.

Effect of Track Width

Secondly, the wider the track recorded on the tape and/or scanned during playback, the less severe will drop-outs be. This would not be true if the tape were quite rigid, since then any foreign particle, however narrow, could hold the whole tape width away from the head. However, as the tape is both flexible and elastic to an extent depending mainly on the type and thickness of the base material, separation effects are more or less localised around the irregularity. The nodule in **fig. 1a** is near the edge of the tape, which may or may not help; only about one-third of the recorded track shown in **fig. 1b** is seriously affected. This track is about 25 thou' wide and is recorded with alternating saturating data pulses of about 7.5 thou' wavelength, e.g. 1 Kc/s at 7½ i/s. A quarter-track as now used —about 40 thou' wide—would be carried to the edge of the tape and the effect of this nodule would obviously be much more serious, especially since the much lower modulation level in audio recording would also increase it.

The effect of tape stiffness is shown more clearly in **fig. 4.** The wavelength here is half and the magnification about twice that in **fig. 1**. I must emphasise again that these are old photographs of old nodules on old tapes, used because it is difficult to get clear photographs of the much finer colloid patterns which are necessary to show up present-day blemishes. For modern conditions imagine that **fig. 5** was taken with a magnification about ten times that of **fig. 1**.

Types of Drop-out

I have managed to get this far without giving any very definite answer to the question: What is drop-out? but I fear an attempt can be delayed no longer. Well, it all depends on what you mean by the word, as a certain professor used to say. We have to decide two things before we can say what a drop-out is: one is the minimum time in which we can notice that information is absent; the other is the minimum degree of absence, so to speak, which we can detect. The answers may vary greatly according to the system we are using.

In data recording, one method is to use patterns of pulses recorded on the tape according to a pre-arranged code to represent data. If one or more of the pulses is missing from the pattern reproduced in the playback channels at any instant, then obviously the information given at that moment will be incorrect. Whether a pulse is effectively missing or not depends on the discrimination capabilities of the playback arrangements: one system might

(*Continued on page* 165)

WHEN IS A DROP-OUT NOT A DROP-OUT?

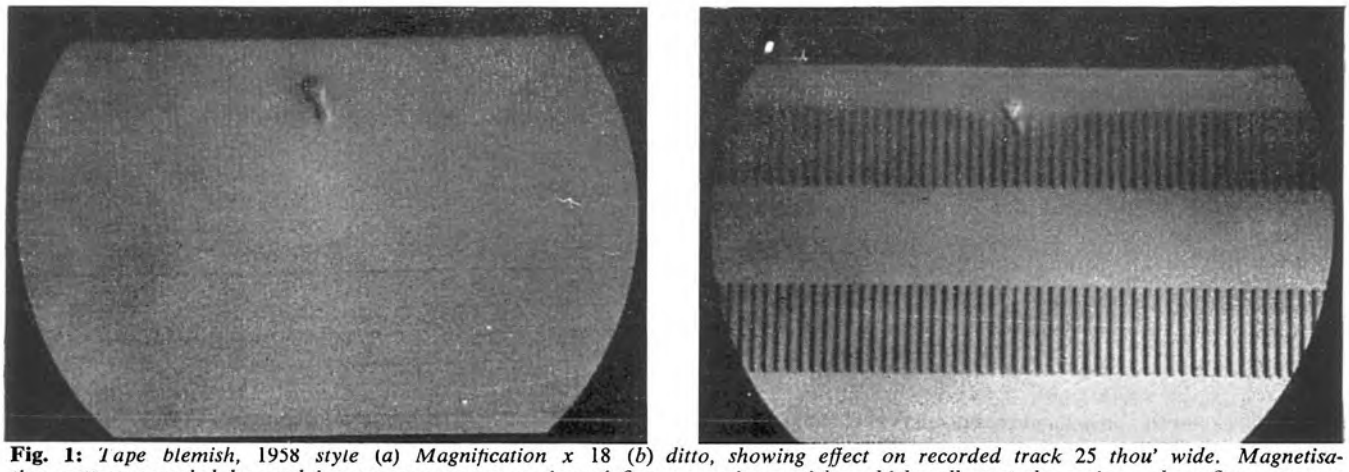


Fig. 1: *Tape blemish, 1958 style (a) Magnification x 18 (b) ditto, showing effect on recorded track 25 thou' wide. Magnetisation pattern revealed by applying an aqueous suspension of fine magnetite particles which collect at the regions where flux enters or leaves the coating surface. Effective size of blemish about 18 x 6 x 2 thou' high.*

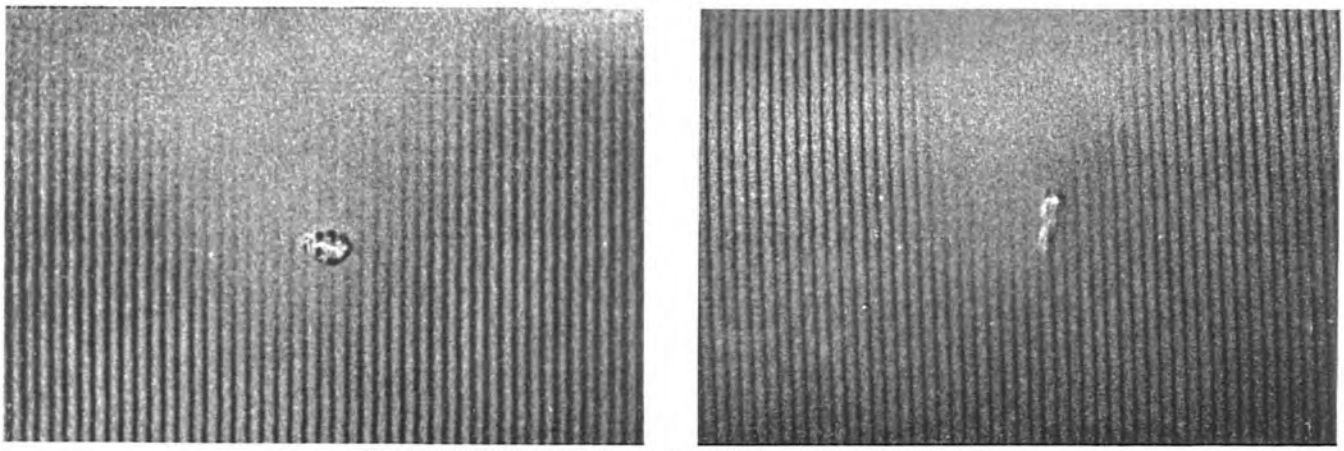


Fig. 4: *Two more nodules on old, stiff tape. Magnification x 40.*

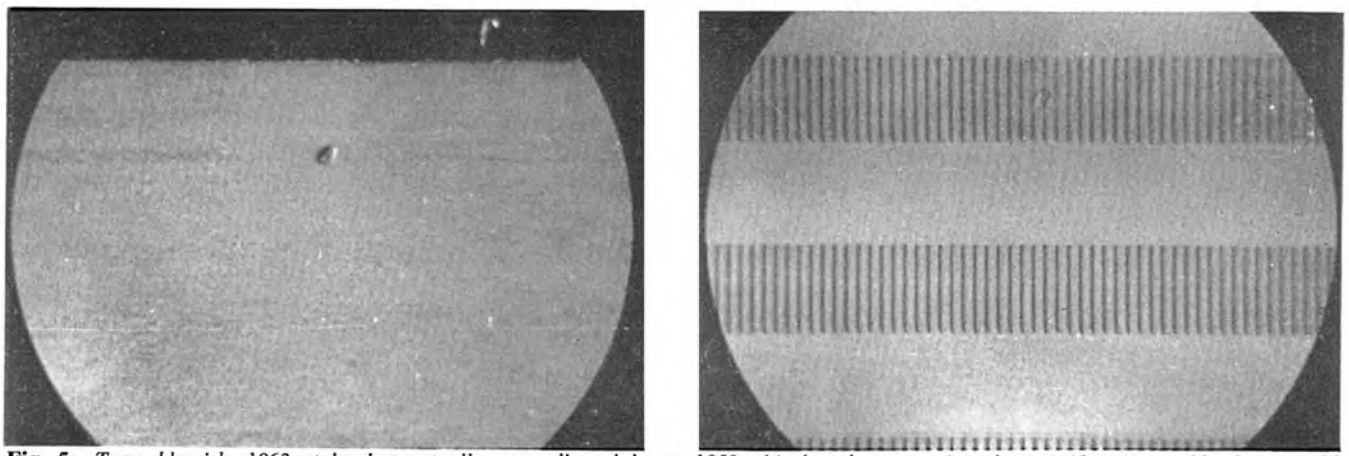


Fig. 5: *Tape blemish, 1963 style, but actually a small nodule on 1958 thin-based tape. Actual magnification x 18, but would represent present conditions at magnifications of 100-200. Actual size of blemish about 5 thou' diameter x 1 thou' high, about ten times the average modern pimple.*

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WHEN IS A DROP-OUT NOT A DROP-OUT ?—*cont.*

fail to recognise a pulse which had been attenuated by more than 2 dB; another might recover pulses attenuated by 12 dB or more. The first system—a very poor one—would miss perhaps four pulses from the track in **fig. 1b**; the second would register them all. (In this method of recording there does not *have* to be a pulse at every suitable point on the tape, of course, so the nodule might not cause drop-outs because there might be no pulses there to suffer attenuation.) Thus our minimum time unit is one pulse-length and the minimum degree of detectable attenuation is the maximum which the playback channel can tolerate. A drop-out here is simply a lost pulse.

Audible Effects

The position in audio recording is far less simple, and we know far less about it than we do in data recording. Instead of the electronic discriminators followed by meters, counters or whatever that we have in the data system, the only criterion of whether a signal is all there or not is our own personal hearing and judgment, which may vary widely from person to person, from moment to moment and from mood to mood. This does not help the manufacturer at all; he obviously cannot retain a large panel of assorted listeners to tell him whether his

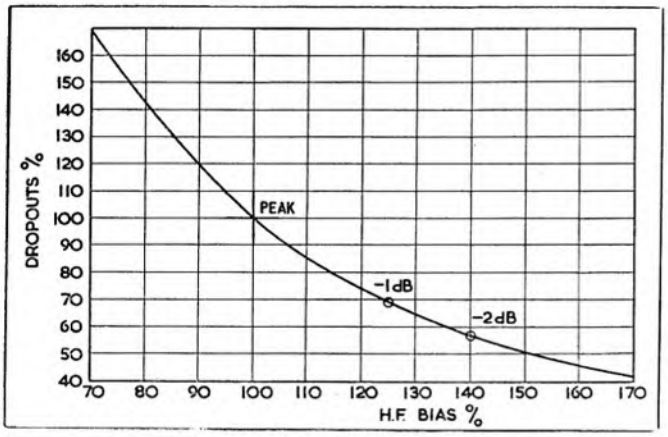

Fig. 3: *Typical influence of H.F. Bias on Drop-outs, normalised to give percentage relationship. Read as follows: assuming one had* 100 *drop-outs of a given size when* 100 *units of bias were used, then increasing the bias to* 140 *units, say, would reduce the number of drop-outs of that size on the same length of tape to about* 57. 100% *bias is that which results in maximum output of a mid-frequency signal,* 125% *bias results in* 1 *dB drop, etc. Most of the cheaper domestic recorders work at about* 100% *bias, the better ones up to* 140%.

efforts at reducing tape or machine faults to insignificance are successful or not. Nevertheless, he must have some means of knowing, and preferably one which is not given to fatigue, moodiness, carelessness, inattention or to changing its mind on a second hearing.

This is not to say that human reactions can be eliminated altogether from the process. Properly-organised listening tests must be carried out at least once in order to establish some idea of what constitutes a significant drop-out. We can, in various ways, demonstrate the presence of many output irregularities which are not audible to anyone present at the time and many more which are audible to some but not to others, so there are obviously threshold conditions which have to be investigated and classified. But such tests have generally involved only a handful of engineers and other more or less experienced colleagues, which is not a sound basis for investigating the effects of drop-outs (or anything else, for that matter) on the interested public.

Remember that this will include everyone from the buyer of £5 tape recorders to the very experienced and highly critical professional sound engineer. One would expect to have to aim at the standards set by the latter, but the former must also be included in case he is sensitive to something which escapes the professional. It could happen; for instance, one investigation into the subjective effects of wow and flutter revealed that female listeners as a whole were considerably more sensitive to it than were males, although ladies, bless them, rarely take a critical interest in sound reproduction (as we mean it here).

Drop-out Tests

As far as I know, no such investigation (nor even a more limited one) has been published even if it has been carried out, so we have no definite data to work from when we try to design a drop-out tester. However, we must have such testers and one supposes that listening tests performed by handfuls of engineers here and there are better than none. I propose now to examine one or two methods of detecting and measuring drop-outs in the hope that what they are will become clearer as we go along.

The first essential in the objective measurement of drop-outs is a steady signal of some kind. The exact waveform is not too important although the sinusoidal waveform which characterises a pure tone has a slight advantage over, say, a square waveform because its flux changes are distributed more evenly along the tape. This is really only significant in the detection of very small irregularities, however.

Comparisons

Using a pure tone immediately increases aural sensitivity to drop-outs. One could fairly say, I think, that if a person can detect no drop-outs in a recording of a steady tone of suitable frequency (say 3-5 Kc/s) then he would hear none in any normal programme material recorded on the same machine and tape. This is not a particularly good test because we do not know *how* much more sensitive it is than listening for drop-outs in programme material. One does not normally listen to steady pure tones, and a system improved to allow that, drop-out free, might well be prohibitively costly. And, anyway, what kind of programme should we compare it with? Solemn organ music is obviously more sensitive to drop-outs than is dance music, and this again more than speech, in which the sound level changes extremely rapidly. It is still all too dependent on circumstances to be useful.

Next Month

Next month we shall look at some better methods of detecting and measuring drop-outs.

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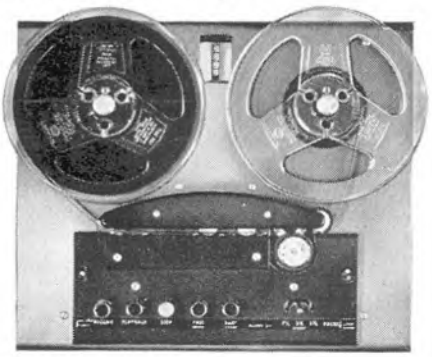

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By G. A. CLOUD

CONSTRUCT A STROBOSCOPE DISC

THERE are times when the experimentalist requires a simple stroboscope for controlling the speed of rotation of some piece of apparatus, such as a cine projector, tape recorder (especially the Gram-deck), etc. The first problem that arises is how to set about constructing the stroboscope disc.

Before describing the method of drawing, it may be advisable briefly to consider the principles of a stroboscope. If a pulsating light source (i.e., one that flashes on and off at a fixed number of times per second) is made to illuminate a disc on which a number of radial spokes have been drawn, it will be found that when the disc is rotated at a certain speed (revolutions per second), the spokes appear to be stationary. If the disc is made to rotate a little faster then the spokes will appear slowly to rotate in the same direction as the rotating disc, but if the disc is made to rotate a little slower, then the spokes will appear to rotate in the opposite direction.

Considering the Conditions

The reason for this is as follows. Let us first consider the condition when the spokes appear to be stationary on the revolving disc. At the moment when the pulsating illumination is *on* we see spoke "A" (see **fig. 1**), then the light goes out for a brief moment during which time spoke "A" has moved to position "C" and spoke "B" has moved to position "A", so that when the light next is *on* no change of position appears to have taken place and therefore the spokes appear to be stationary. When the disc is rotating slightly faster, then each spoke appears slightly ahead of the position occupied by the last spoke and thus the impression is given of the spokes slowly rotating. Conversely when the disc is rotated slightly slower the spokes do not catch up to the position occupied by the previous spoke and consequently the impression is created that the spokes are rotating in the opposite direction.

This method enables one to set the speed of rotation of a wheel, cog or shaft to a high degree of accuracy. It does, of course, depend upon two things—the accurate timing of the flashing light source and the number of spokes on the stroboscope disc.

The Light Source to Use

The cheapest form of light source is one run off the ordinary domestic mains, which in Britain is 50 cycles per second, but in some other countries it is either 60 or 100 cycles per second. Although an ordinary low wattage tungsten lamp can be used it is not as good as a neon lamp which can be bought for a few shillings. The neon lamp takes about 5 watts and has the advantage that it goes out for a moment at the end of each half-cycle of the mains, whereas the tungsten filament hardly has time to cool down to darkness before another half-cycle from the mains re-heats it up to give off light again. In the case of the neon lamp it goes out as soon as the voltage falls below about 80 volts and will not re-light until the voltage is again 80 volts.

To Calculate the Number of Spokes Required

The formula for calculating the number of spokes required is as follows:

$$N = \frac{120 \times F}{R}$$

Where: N = Number of spokes
F = Cycles per second of the mains supply
R = Revs. per minute of the disc

Example:
50 cycle mains
Speed of disc to be 78 r.p.m.
Find number of spokes required

$$N = \frac{120 \times 50}{78} = 76.92 \text{ (for all practical purposes—77)}$$

Therefore, a disc having 77 spokes will appear stationary when it is rotating at 78 r.p.m. under a neon lamp on a 50 cycle mains. Had the mains been 60 cycles then 92 spokes would have been needed not 77 for a speed of 78 r.p.m.

Drawing the Stroboscope Disc

In practice it is found that it is easier to watch the behaviour of the stroboscope disc if the spokes and spaces are of equal width (see **fig. 2**). If 77 black spokes are required the 77 white

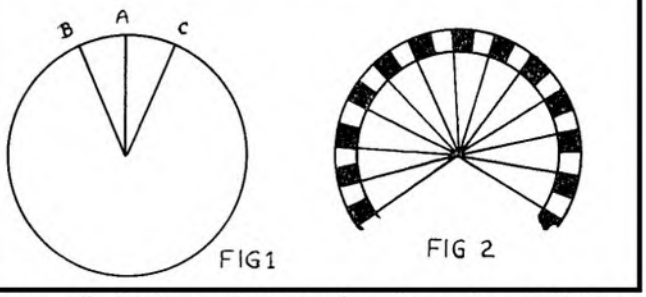

FIG 1

FIG 2

spaces will also be required, therefore the number of divisions required around the circle will be *twice the number of calculated spokes* (e.g. 77 x 2 = 154).

If 154 divisions are required then the angle between each division will be $\frac{360^\circ}{154} = 2.337^\circ$. This now presents a new problem as it is necessary to draw a circle and mark off intervals of 2.337° which is impossible with a protractor. Fortunately there is a method used by engineers for dividing a circle into a given number of divisions.

The formula is:

$$P = D \text{ Sine } \frac{180^\circ}{N}$$

Where: P = Chordal pitch (see **fig. 3**). D = Diameter of circle.
N = Number of divisions.

Fig. 3 shows the chordal pitch, which is the straight line distance between any two marks on the circle.

Example

Suppose we want a stroboscope disc 5 in. in diameter for use on a 50 cycle mains to run at 78 r.p.m. We have already calculated the number of spokes required (77). Our problem is to divide the circle into 154 parts.

We know D = 5 in. N = 154, we have to find P.

$$P = 5 \text{ Sine } \frac{180^\circ}{154}$$

$$= 5 \text{ Sine } 1.168^\circ$$

At this point we must look up the value of 1.168° in a set of Sine tables, but before we can do that we have to convert the decimal part into minutes of an arc (′). We therefore multiply

(*continued on page* 169)

the decimal part only by 60 (because there are 60′ in 1°). We therefore multiply the .168° by 60 and get 10.08′; if we ignore the decimal part, we have now found that 1.168° is the same as 1° 10′ and find the Sine of that angle is .02036. Then P = 5 x .02036, P = .1018 in.

If we now set a pair of compasses so that the distance from the point to the pen line is .1018 in. we can divide off the 5 in. circle. If we cannot set our compasses to the above accuracy then the alternative method, which the writer prefers, is to use the formula in a different way. First we choose the shortest chord that we can measure with reasonable accuracy, for example ½ in., and then calculate what diameter of circle is required.

Example: P = ½ in., N = 154. Find D.

$$\tfrac{1}{2} = D \text{ Sine } \frac{180°}{154}$$

$$\therefore \tfrac{1}{2} = D \text{ Sine } 1.168°$$

$$\therefore \tfrac{1}{2} = D \times .02036$$

$$\therefore D = \frac{0.5}{.02036}$$

$$\therefore D = 24.508 \text{ in.}$$

Therefore, we require a circle having a diameter of 24.508 in. Even if we use 24.5 (24½) the error will not be serious. If the finished drawing is too big for use it can be copied photographically to the required size, or the division lines may be drawn right through the centre and a smaller disc cut out from the middle.

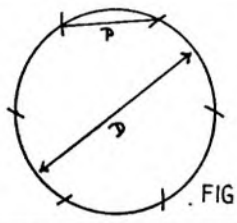

FIG 3

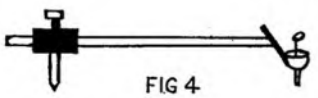
FIG 4

Drawing Materials to Use

It is essential to use good quality white paper and black waterproof indian drawing ink, so that the maximum contrast is obtained with solid black lines. The method of drawing large circles need not present any problem if a beam compass is used or constructed. The writer has found that a "UNO" pen No. 0 is much easier to use as it holds more ink than an ordinary adjustable ruling pen and also gives a good even line. The writer constructed his own beam compass, which consisted of a "UNO" pen No. 0 attached at one end of a bar and a sliding piece that carried a point, which could be clamped in any position along the bar (see **fig. 4**).

From these notes it should be possible to construct stroboscopes to indicate a wide range of rotational speeds, and which will prove of great use in many aspects of experimental tape recorder work.

our readers write . . .

. . . about Peak Programme Meters

From:—Graham Balmain, Slough.

Dear Sir:—A number of readers have contacted me asking for further details of the transistorised peak-programme meter circuit which I mentioned in the January *Tape Recorder* (described in BBC Engineering Monograph No. 26, August 1959) or of any others which might be available now.

The latest BBC monograph, No. 46 of February 1963, contains details of two more circuits. One, giving full BBC accuracy, uses 8 transistors, 9 semiconductor diodes and two transformers (both essential). The other, a simpler circuit with slightly reduced accuracy under some programme conditions, uses 2 transistors and 7 diodes with an optional input transformer; this should be entirely satisfactory for most domestic applications. BBC Monographs are obtainable at 5s. each from BBC Publications, 35 Marylebone High Street, London, W.1.

Several readers have also asked about firms who are prepared to make up units according to my descriptions or to the BBC circuits. Mr. J. C. Latham of Deimos, Ltd., 8 Corwell Lane, Hillingdon, Middlesex, says he is prepared to construct such units by arrangement.

I would like to thank readers for their interest in this series, and for their kind and often very helpful comments.

Yours sincerely.

* * *

. . . about a reader's problem

From: Elizabethan (Tape Recorders) Ltd., in reply to the A.H.S. problem on page 125 of the April issue.

Dear Sir:—We write regarding your recent letter published in the April edition of *The Tape Recorder* magazine. We are sorry to learn that you are having difficulties with your Elizabethan L.Z.29 tape recorder.

Having read the published reply to your letter we think that this is a little misleading. In our experience with this model we have never found any serious error in the head height, and we think it inadvisable to attempt to alter the position of the heads unless it can be established quite definitely that this is in fact the cause of the trouble. We are inclined to doubt this, and we think it far more likely that insufficient erase current is flowing through the erase feed capacitor shown on the enclosed circuit diagram as C.13/2.2kpf.

We have pleasure in enclosing herewith a capacitor which we suggest will improve the erase current and in all probability will overcome your difficulties. The component is situated under the head cover and can be removed and replaced without dismantling the tape recorder. We advise you to take great care when applying the soldering iron to the capacitor, and to the head, as excessive heat could damage these components.

If you have further difficulties please do not hesitate to write direct to us for we wish it to be known that we are always pleased to supply such information direct to the owner of any of our products. *Yours faithfully.*

* * *

. . . about Service

From:—M. F. Woodward, 48 Corder Road, Ipswich.

Dear Sir:—Both in this and your sister journal we have read independent views of manufacturers and equipment in the hi-fi world. I wonder if I may add my voice to this and recommend Shirley Laboratories and Planet Projects.

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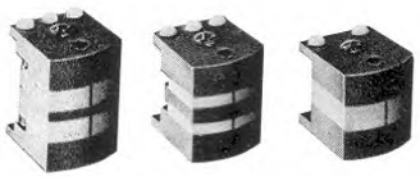
TAPE, RECORDERS & ACCESSORIES

FIRST DETAILS OF NEW PRODUCTS

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



★

NEW MINIFLUX ERASE HEADS

★

A NEW range of low-loss Ferrite cored erase heads for ¼ in. tape is announced by Miniflux Electronics Ltd. The new range which all use the double gap system, supersede the earlier types as standard components. The professional three field types will now be available only by special order. The new types cover ½-track mono, ½-track stereo and ¼-track stereo systems. A new type designated LF 60 is now included for use as an oscillator coil with a transistor bias oscillator circuit.

All the new types show improved characteristics against the earlier types and the standardisation has resulted in a lowering of prices. Full technical data sheets and circuits are available direct from **Miniflux Electronics Ltd., 8 Hale Lane, London, N.W.7.**

* * *

★

SONY TC 801 MAINS-BATTERY PORTABLE

★

A MAINS and battery recorder weighing only 13 lb. has been introduced into this country by Sony of Japan. It will be known as the Sony TC 801. Nine transistors are used in the circuit and the machine is operated by press button controls. Two speeds are provided, 3¾ and 1⅞ i/s, and half-track heads are fitted complying with international standards. A recording level/battery indicator meter allows the batteries to be checked at any time. The recorder is suitable for office dictation and field use. A microphone with "hold" button allows the operator to control the machine although it may be some distance away and a back spacer is also featured. The machine is supplied complete with all accessories for £93 9s. **The Distributors are: Tellux Ltd., Avenue Works, Gallows Corner, Colchester Road, Romford, Essex.**

* * *

Brenell Mark 5 Series 2 Recorder

THE Mk. 5 Series 2 tape recorder is a successor to the Brenell Mk. 5 machine. It incorporates a 4-speed 3-motor tape deck fitted with a double gap ferrite erase head and a narrow gap Record/Playback head around which a new amplifier has been designed.

Two models are available—one with a meter to register the recording level price £77 14s., or with the latest type of magic eye in lieu of the meter £72 9s. **Manufacturers: Brenell Engineering Co. Ltd., 1a Doughty Street, London, W.C.1.**

Brenell STB1 Stereo Recorder

THE Brenell STB1 is a 4-speed (15, 7½, 3¾ and 1⅞ i/s) mono/stereo tape recorder with additional playback heads and playback pre-amplifiers. It has been designed for use with external high fidelity stereo installations. Although supplied in a strong wooden case for portability, the STB1 may be easily removed from the cabinet for fitting into a permanent installation. (The unit is mounted on a special frame which enables it to be removed in its entirety.) Monaural recordings may be made upon both tracks and either or both tracks monitored and a comparison of the recordings made against the original signal.

Stereophonic recordings may be made from microphones, records and radio—again with monitoring of the tape if desired. An additional playback head of the 2/4 (quarter-track) is fitted to increase the versatility of this machine—i.e., to enable pre-recorded mono and stereo quarter-track tapes to be replayed in addition to half-track types.

Two models are available: the STB1/5/2 suitable for tape spools of 8¼ in. diameter, price £120, and the STB1/510/2 suitable for tape spools of 10½ in. diameter, price £140. **Manufacturers: Brenell Engineering Co. Ltd., 1a Doughty Street, London, W.C.1.**

EQUIPMENT REVIEWED

★

PHILIPS
MODEL EL 3534
FOUR-TRACK
FOUR-SPEED
STEREO
RECORDER

★

Manufacturer's Specification. Suitable for both stereo and mono recording and playback. Operates on the four-track system. All transistor: no warming-up time required. Facilities for making "Multiplay" recordings. Can be used as a stereo or mono amplifier for microphone or record player. Adjustable to mains voltages of 110, 127, 200-250 A.C. 50 c/s (can be adapted for 60 c/s). **Four speeds.** Suitable for long-play and double-play tape on 3 to 7 inch reels. **Playing time:** 2 times 8 hr. for stereo recordings, 4 times 8 hr. for mono recordings. Mixing of microphone with radio or gramophone inputs. Monitoring facilities during recording by means of stereo headphones or built-in loudspeaker. Special stereo microphone. Tape pause button. Connection for foot switch. Balance control for obtaining the best stereo balance during playback. Meter type modulation level indicator. Record safety interlock. **Frequency range** at a speed of 15/16 i/s: 60-4,500 c/s. $1\frac{7}{8}$ i/s: 60-10,000 c/s. $3\frac{3}{4}$ i/s: 60-16,000 c/s. $7\frac{1}{2}$ i/s: 60-16,000 c/s. **Two built-in 3 watt amplifiers.** Automatic stopping at the end of the tape when in the record play back, fast wind or fast rewind position. **Rapid winding in both directions:** 1,800 ft. of tape in 180 seconds. **Power consumption:** approx. 60 watts. **Signal to noise ratio:** better than 40 dB. **Three inputs:** diode 20 K at 3 mV. Record player 500 K at 150 mV. Microphone 1K at 1 mV. **Three outputs:** diode 20 K at 1 v. **Loudspeaker:** 3-7 ohms at 3 watts. **Headphones:** 1.5 K at 200 mV. **Dimensions:** 17 x $15\frac{1}{2}$ x $10\frac{1}{2}$ in. **Weight:** 36 lb. Tropicalised. Price £96 12s. **Manufactured by Philips Electrical Ltd., Century House, Shaftesbury Avenue, London, W.C.2.**

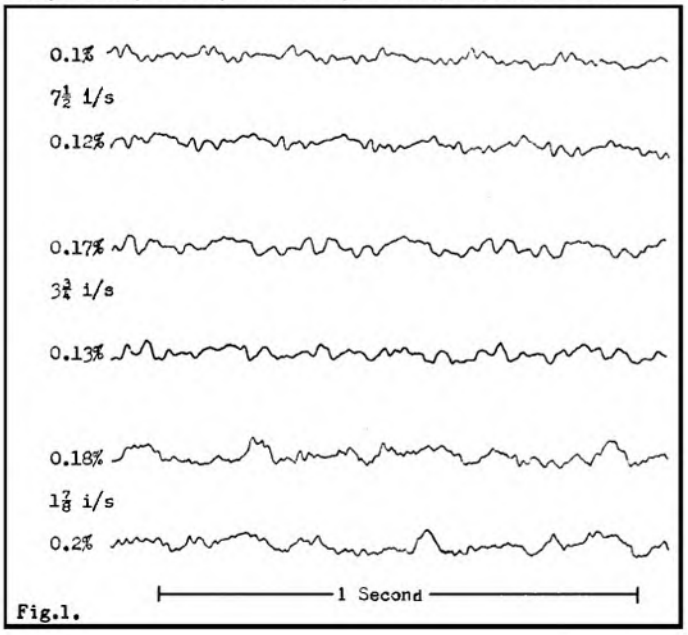


Fig.1.

THE above simply written and concise specification is typical of the rest of the Operating Instructions booklet which is well illustrated with photographs and line drawings and gives every possible variant in the setting up and use of this recorder from the tyro's first microphone recording to full stereo recording or complex "multiplay" recordings.

Connecting leads for standard Continental D.I.N. radio and radiogram sockets are provided, but accessory leads fitted with plugs or loose cores can be ordered from the dealer or manufacturer for connecting to other equipment. Two speakers are provided, one on the front of the recorder case and the other in the detachable lid with a 20 ft. cable and two pin connecting plug.

The stereo microphone consists of two monodirectional dynamic microphones mounted at a fixed angle of 90 degrees within an acoustically transparent case which can be mounted on a floor stand or on the table base provided.

Although mains operated, all amplifiers are transistorised so that there is no warming up time; the machine is ready to operate from the instant it is switched on. The elimination of heavy mains transformers makes the recorder pleasantly light in weight for such a complex piece of equipment. When I saw

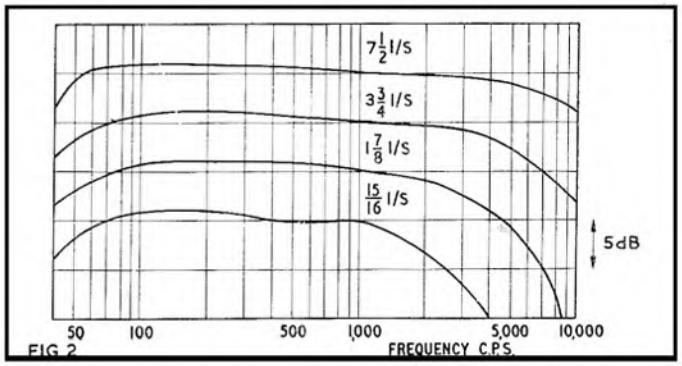


FIG 2

the size of the recorder I tensed my muscles for the usual 50 lb. weight as I lifted it from its packing, and nearly fell over backwards as its mere 36 lb. became airborne.

Wow and Flutter

A 3 Kc/s tone was recorded at all speeds and these recordings were played back through a frequency sensitive network to convert the frequency deviations due to short-term speed fluctuations into amplitude variations which were fed to a pen recorder to give the "fluttergrams" shown in **fig. 1.** At the same time the rms value of the fluctuation was measured to give the rms percentage figures shown against each trace. It proved impossible to get a meaningful reading at the lowest speed of 15/16 i/s as the reproduced 3 Kc/s signal was well down in tape noise. The other traces, however, show almost exactly the same waveform progressively expanded as the tape speed is reduced. This indicates that the slight speed disturbance is a direct function of the capstan rotation frequency of 6 c/s at $7\frac{1}{2}$ i/s, 3 c/s at $3\frac{3}{4}$ i/s and $1\frac{1}{2}$ c/s at $1\frac{7}{8}$ i/s. The higher frequency flutter looks like a bearing effect as it is so firmly tied to the capstan rotation, but it could equally well be an idler wheel vibration or wobble.

Playback Tests

C.C.I.R. test tapes were played at all speeds and showed a 6 dB step at mid frequency which indicates that N.A.R.T.B. playback equalisation is used in this recorder. The recording time constants should thus be 50, 100, 200, and 400 microseconds for the tape speeds of $7\frac{1}{2}$, $3\frac{3}{4}$, $1\frac{7}{8}$ and 15/16 i/s respectively.

Signal Noise Ratio

Test tape level was recorded with the level meter reading about ¼ scale. Normal peak recording level of plus 12 dB above test tape level was obtained with the needle just entering the red sector, and full-scale deflection of the meter recorded a level 14 dB above test tape level. Waveform distortion was just perceptible at this level. System noise and hum, with no tape running, was 36 dB below test tape level, and the noise from tape erased and biassed on the machine was 34 dB below test tape level or 48 dB below full scale meter recording level.

Record Replay Responses

Oscillator tones were fed into the radio input and recorded at all speeds and the playback levels measured at the high

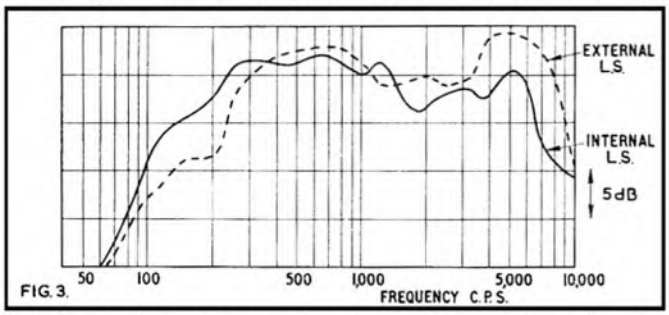


FIG. 3.

impedance diode output with a low capacity valve voltmeter. The recorded levels were kept 6 dB below test tape level to avoid tape overload at high frequencies with the N.A.R.T.B. recording characteristic.

Fig. 2 shows the resultant response curves. The roll off in high note response indicates that the bias is set at optimum, or even above optimum, to give highest output and lowest distortion. This is confirmed by the high peak recording level reported earlier. As mentioned in other reviews, I would prefer the bias to be too high rather than too low, and I am not unduly disturbed by the gentle fall in high note response as this is compensated to some extent by peaks in the high note responses of the loudspeakers and microphone supplied with this recorder. The bass response is smooth at all speeds and unmarred by head contour effects.

Acoustic Responses

Fig. 3 shows the overall acoustic response obtained by feeding one third octave bands of filtered white noise into the radio input and measuring the sound level radiated from the stereo

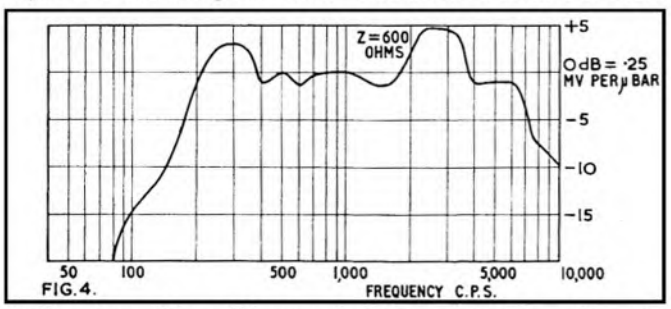


FIG. 4.

loudspeakers. The solid curve is for the internal speaker and the dotted curve is for the external lid speaker. These responses were taken at a tape speed of 7½ i/s so as to measure mainly the response of the speakers and enclosures.

Fig. 4 shows the measured response of the lower No. 2 microphone which is the one used for mono recording. The polar response changes somewhat with frequency with a rear minimum at high frequencies and a couple of side minima at lower frequencies (i.e. cardioid response at high frequencies, figure of eight response at low frequencies). I notice that diffuser baffles have been fitted to each microphone to broaden the high note polar response and so give a more even stereo coverage in this important part of the spectrum. The change in polar response at lower frequencies does not appear to affect the direct stereo pick up, but it must have some slight effect on the room coloration or hall reverberation when compared with perfect unidirectional microphones.

The cut in extreme low note response below 200 c/s will also be obvious on wide-range reproducers, but it fits in with the speaker responses shown in **fig. 3** and we must remember that this is, after all, a home stereo recording system and not a semi-professional outfit costing several thousand pounds.

Comment

I like this outfit very much indeed. It does its job cleanly and unobtrusively. The controls have that *right* feel about them and are in exactly the right place for easy and instinctive operation. If I had to make any suggestions for improvement they would be to alter the tone control to give a lift at high frequencies rather than a cut, and a modification to the microphone to make the mono No. 2 microphone the upper one. For mono speech recording the microphone will often be held in the hand and at present the No. 2 (lower) microphone unit tends to be masked by the hand and the response modified by local reflections while the unused No. 1 microphone is "out in the open" and in an ideal position for mono use.

Apart from these very minor criticisms I give this recorder full marks and thoroughly recommend it for mono or stereo home recording or the reproduction of pre-recorded tapes.

A. Tutchings.

* * *

★

UHER "4004" TWO-TRACK FOUR-SPEED BATTERY PORTABLE STEREO RECORDER

★

Manufacturer's Specification: Recording sense: 4 tracks to International standards. **Tape speeds:** 15/16 i/s, 1⅞ i/s, 3¾ i/s and 7½ i/s. **Reel size:** up to 5 in. **Playing time:** 16 hr. at 15/16 i/s, 8 hr. at 1⅞ i/s, 4 hr. at 3¾ i/s and 2 hr. at 7½ i/s (5 in. reel double-play tape). **Frequency response:** 50-4,500 c/s at 15/16 i/s, 50-9,000 c/s at 1⅞ i/s, 50-16,000 c/s at 3¾ i/s and 50-20,000 c/s at 7½ i/s. **Signal to noise ratio:** 50 dB. **Dynamic range:** 55 dB. **Wow and flutter:** ±0.2% at 7½ i/s. **Harmonic distortion:** 5% max. measured across high impedance line output. **Inputs:** Mic. 0.1 mV at approx. 1 K. Radio, 1 mV at 20K. Phono, 50 mV at 1 Meg. **Outputs:** 1.6 v at 4 ohms, 1.2 v at 15 K. **Consumption:** 430 mA max. at start 7½ i/s. **Power supplies:** 4 flashlight cells (1.5 v U2), or "Dryfit" storage battery, a Model 880 mains operated power unit or an automobile adaptor cable (Model 662 for 6 and 12 v; model 663 for 24 v.) **Transistor complement:** 2-TF65 (low noise type), 2-TF65 violet, 6-TF65 green or yellow, 2-TF65 red, TF6611, 2-AC117 (matched pair), AC117, AC153. **Dimensions:** 10½ x 8½ x 3¼ in. **Weight:** (less batteries or power unit) approx. 7 lb. **Price, recorder only:** £115 10s. Dryfit battery and mains power unit £16 16s. Mono microphone £10 7s. 3d. Stereo microphone type 626, £19 19s. **Distributors: Bosch Ltd., 205 Great Portland Street, London, W.1.**

WHEN my wife came into my laboratory and saw this little recorder surrounded by relatively enormous test equipment she said "poor little thing—why don't you leave it alone?" But she need not have worried, this "quart in a pint pot" is well able to look after itself and outperforms many larger and heavier machines.

I reviewed the two-track mono version the "4000 Report" in

(*Continued on page* 175)

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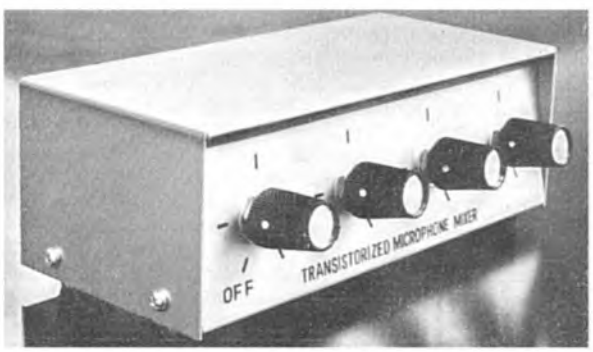

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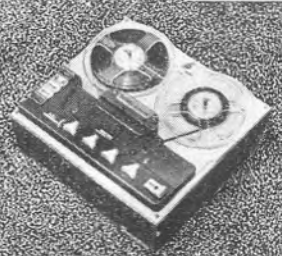

starts where the specification leaves off

the September '62 issue, but my report was rather clouded by bias and motor governor faults. I am glad to say that the present unit is free of any such troubles and that the performance on both mono and stereo is excellent without any concession to the amazing fact that here is a complete stereophonic recording system weighing under ten pounds and contained in a case not much bigger than a good-sized book.

Speed Wow and Flutter

The four tape speeds were first checked on a standard frequency tape and found to be within 1% of the nominal speeds. This is important where recordings made on this ultra portable equipment may have to be played on static semi professional machines. Wow and flutter were exceedingly low at the two highest speeds with only the slightest trace of capstan wow at 10 and 5 c/s at 7½ and 3¾ i/s respectively. With total rms wow and flutter well under 0.1% these speeds would cope with the most exacting music recordings.

At 1⅞ and 15/16 i/s the capstan wow of 2½ and 1¼ c/s is audible on a sustained tone, but completely undetectable on speech or "pop" music which is all these speeds would be used for anyway. **Fig. 1** shows the pen recordings from an F.M. discriminator circuit fed with a recorded 3 Kc/s tone at each speed. The percentage figures are R.M.S. total integrated wow and flutter measured through a circuit with a response 3 dB down at 200 c/s and cutting sharply above 300 c/s.

Playback Tests

C.C.I.R. test tapes were played at all speeds to obtain data on the complementary recording characteristics which must be known to choose the correct playback equalisation if the recorded tapes are to be played on other equipment. The responses from the C.C.I.R. test tapes all showed a mid frequency step of about 6 dB, which indicates that N.A.R.T.B. recording characteristics of 50, 100, 200 and 400 microseconds have been adopted. System noise (motor and transistor) was 39 dB below test tape level with no tape running.

Plus 12 dB above test tape level was recorded at all speeds with

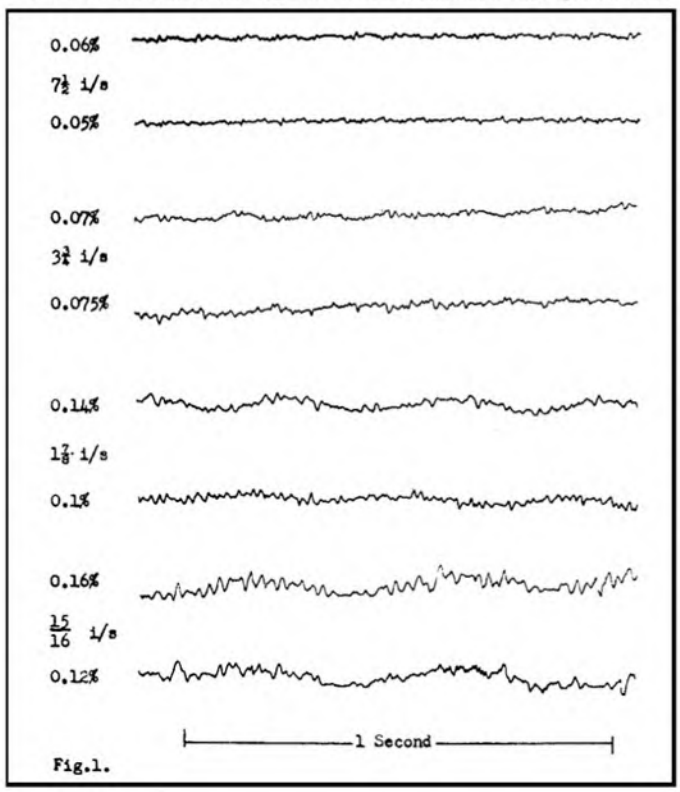

Fig.1.

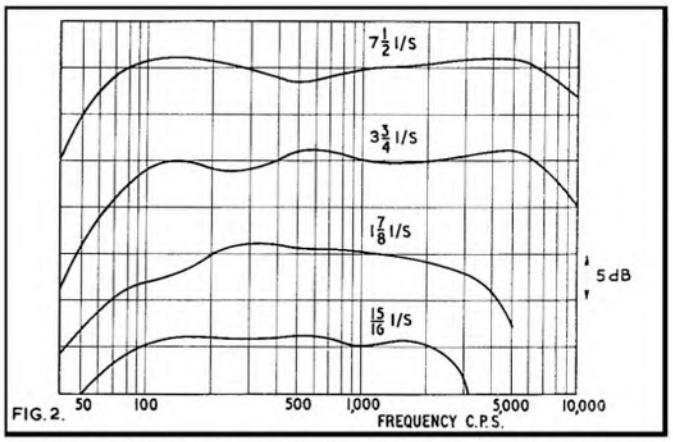

FIG. 2.

the record level meter needle just entering the red segment of the scale. Recorded waveform distortion was still low at full scale deflection which corresponded to a level 14 dB above test tape level. The frequency responses of **fig. 2** were taken at 6 dB below test tape level to avoid overload at high frequencies due to the severe high note pre-emphasis used in N.A.R.T.B. recording. The slight curtailment of extreme high note response would seem to show that the bias had been set at optimum at the highest speed for the highest recorded level and the lowest possible distortion. Regular readers know my feelings on this matter very well by now—I much prefer a clean distortion-free recording with a slight roll off at extreme high frequencies to a muddy intermodulated super wide range frequency response.

It is a sad fact that you cannot have both at medium tape speeds and, on a multi-speed machine such as this, a compromise bias must be chosen to suit the ultimate use of the machine. Engineers pull one way for low distortion, and advertising copy writers the other for the widest possible response regardless! I think optimum bias for the higher speeds is the correct choice for a machine of this calibre.

Signal Noise Ratio

As mentioned earlier, system noise with no tape running was 39 dB below test tape level. Bulk erased tape noise is 38 dB below test tape level, and tape erased and biased on the recorder is 36 dB below test tape level. Peak recording level with about 3% tape distortion is plus 12 dB and at 5% distortion plus 14 dB. Thus the ratio between a signal recorded at full scale meter deflection and noise from tape erased on the machine is 50 dB.

This wide dynamic range, together with the gentle overload characteristic limited mainly by the tape, is ideal for a portable unit where close monitoring of the recorded level is often not possible.

Acoustic Response

One third octave bands of filtered white noise were recorded at 7½ i/s and the sound level from the internal speaker measured on replay. **Fig. 3** shows the overall acoustic response. The bass cut below 250 c/s is inevitable in a box of this size, but the response above 250 c/s is level within plus or minus 5 dB out to 10 Kc/s. The 500 c/s boxiness found in the earlier machine seems to have been reduced to a manageable level and speech and music quality is adequate for checking recorded quality in the field.

For judging stereo balance an outlet for stereo headphones is provided; these 'phones are in circuit during both record and play.

Microphone

The Uher stereo dynamic microphone Type 626 has been specially designed for use with the Uher 4002 and 4004 stereo recorders.

Two dynamic capsules are mounted coaxially one above the other and the upper one is movable and can be rotated to any desired angle relative to the lower one. Normally the axes are set to 90 degrees, but, for special conditions, the angle can be varied to suit the stereo recording set up. Alternatively the top unit may be unplugged altogether and remounted in the second

(*Continued on page* 177)

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handle provided so that it can be used as a single mono microphone or as one of a spaced pair together with its headless twin.

The top unit, mounted on the mono stand, was tested for response and directional discrimination and the results are shown in **fig. 4.** The free air frequency response is level within plus or minus 5 dB over the range 100 to 10,000 c/s. The polar response is a true cardioid at all frequencies above 1 Kc/s, but degenerates

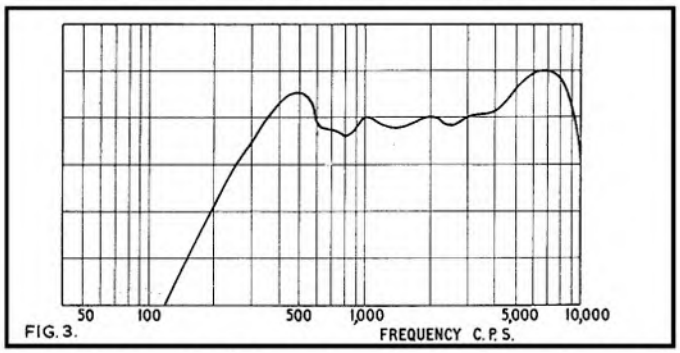

FIG. 3.

into semi-figure of eight response at lower frequencies. I find it difficult to envisage quite what effect this will have on stereo recording, but, as only the front to back ratio is affected, I imagine that the room effect or reverberation may be a bit heavy under certain conditions.

Comment

A most interesting machine to review technically and a superb bit of engineering and transistor circuitry—but I cannot help asking myself what kind of person or organisation would use it. It seems to me to fall between two stools—too light and flimsy for the true professional—and too expensive for all but the really well heeled amateur. True one could sit in the

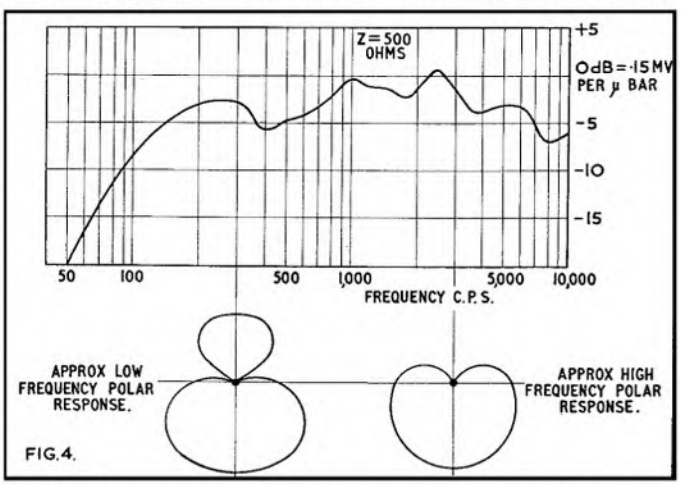

FIG. 4.

middle of a concert hall and record useable stereo recordings, where mono recordings would be lost in reverberation. One could go out into the world and record traffic and express trains rushing by. But inevitably such recordings would fall far short of those organised by a professional unit with multi microphones and a van load of recording equipment, and interest might quickly fade.

But that is not my problem—it does the job it sets out to do extremely well—how you use it is up to you! **A. Tutchings**

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The next edition is due for publication mid May. There are still a few copies of the 1962 edition in stock.

HI-FI FOR BEGINNERS . . .

This work is thoroughly recommended to every enthusiast; it has been acclaimed from all sides as being the ideal book for everyone who has just started or is about to start their hobby. Those whose particular interest lies in tape will find that Chapter 7 alone will make this book worthwhile. **Price 8s 3d post paid.**

STEREO FOR BEGINNERS . . .

For those who are confused or not wholly converted by Stereo reproduction this book gives all the answers. The author, B. J. Webb, explains in clear language what Stereo is and how best to obtain it, whether from disc, tape or radio. Advice and guidance on the purchase, installation and maintenance of suitable equipment; a six-page glossary, many illustrations and special drawings are included. **AVAILABLE SHORTLY. Price 8s 3d post paid**

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This book gives you all the necessary information for building your own Hi-Fi cabinet. Subjects covered include designing, timber, marking out, tools, materials, joints and finishes. The many photographs and diagrams help to make this book indispensable not only for Hi-Fi applications but also for general cabinet work encountered in the home. It is written by the well-known expert, Wheater Smith, whose recent articles in Hi-Fi News have created considerable interest. ". . . *highly recommended.*" **Price 8s 3d post paid.**

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HERE THERE AND EVERYWHERE

Grundig Appoint Lady Consultant

TAPE recorder and radio enthusiasts who go into radio departments of stores and shops in the north of England may have their technical queries answered by a young and attractive blonde Bachelor of Science. Helen Jacqueline McNeil, 23, of Crossland Road, Kirby, Liverpool is a graduate in electronics and engineering of Liverpool University. She has joined the staff of Grundig (Great Britain) Ltd., and will be a travelling consultant and demonstrator in 13 counties in northern England and Wales.

* * *

Saga Buys Associated

ON March 12th, the whole of the undertaking and goodwill of Associated Recordings Ltd., was purchased by Saga Records Ltd. Also purchased by Saga and its parent Company (Art and Sound Ltd., jointly with Allied Records) were the trademarks, stocks and all other physical assets.

Total records involved in the transaction were over 400,000, the largest number of any label being Eros of which almost 40,000 went to Saga. All are sold, with the exception of a few stereos, but the pressing rights have been acquired and most numbers will be reissued as soon as possible, though there will inevitably be an out-of-stock period.

* * *

Wyndsor Gold Medal

FOR several years now the Wyndsor Gold Medal has been awarded in various competitions and for the past three years it has figured as one of the major prizes in the Malta Amateur Cine Circle.

News has just been received in London that this year the prizes were presented at a gala guest night to commemorate the Circle's tenth anniversary at the Hotel Phoenicia. At this function the Wyndsor Gold Medal was presented to Albert Gauci by His Excellency, Sir Maurice Dorman, the Governor, for his film "Sombra Y Sol".

* * *

Saja Spares

MR. C. BRADDOCK, director of The Tape Recorder Centre (Blackpool), 266 Waterloo Road, Blackpool, Lancs, has informed us that his service department now has a comprehensive stock of spare parts for the Saja range of recorders.

* * *

New Aveley Premises

NEW premises for *Aveley Electric Ltd.* were officially opened on Tuesday April 2nd at South Ockenden, Essex. This was the first stage, and occupies 15,000 sq. ft. on a site of 1.2 acres. Fully automatic all-electric heating, with appropriate thermal insulation and filtered-air conditioning, ensure good conditions for the expansion of sales and service in precision measuring instruments.

The building also houses the Application Engineering and Development Section and permanent showrooms for the Instruments and Components Divisions. Lecture/demonstration facilities for staff training and customers are also featured. The company's old premises are now occupied by the manufacturing subsidiary *Avel Products Ltd.*

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

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

All advertisements for the June issue must arrive not later than May 3rd.

FOR SALE

Pre-recorded tapes. Unique complete catalogue listing all makes, mono, stereo. 7½ and 3¾ i/s including World Record Club tapes. Call for free copy or send 1s. mailing fee. Dept. T.R.3 Teletape Ltd., 33 Edgware Road, W.2. PAD 1942.

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Full building instructions for the remarkable "Tricolumn" loudspeaker are available in reprint form from Hi-Fi News, 99 Mortimer Street, London, W.1. Price 2s. 6d. post free.

Tape Bargains in all sizes. Example: Top Brand 5½ in. 1,200 ft. 19s. 6d., P. & P. 1s. 3d. S.A.E. for list. Large choice of new and used recorders.—E. C. Kingsley & Co., 132 Tottenham Court Road, London, W.1. EUS 6500.

Ferrograph 5A/N, 422 and 424, Revox E36, etc., always in stock.—City and Essex Tape Recorder Centres (see page 170).

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

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

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Recorder need Repairing? Then let City and Essex Tape Recorder Centres do it for you expertly and economically (see page 170).

Revox latest F36, Telefunken series 75, 85 and 95 and Truvox series 80 (latest 3 speed versions) always on demonstration and for immediate delivery at the hi-fi tape specialists. 48 hours' service for professional tape copying. N.R.S. 16 Kings College Road, London, N.W.3. PRI 3314.

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

(Continued on page 182)

Index to Volume 4 of THE TAPE RECORDER

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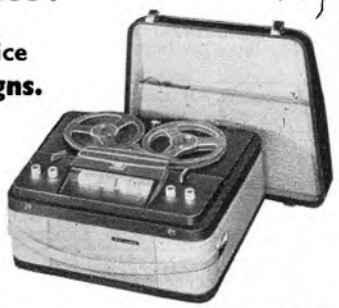

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