

— INCORPORATING —
"SOUND AND CINE"

tape recorder

MAY 1964

VOL. 6 NO. 4

Price 2 /-



- TOWARD BETTER TAPING (2)
- AUDIO SHOW REPORT
- GRUNDIG TK6 REVIEW
- SPECIFICATIONS & STORIES

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



89 The one and only Dakota Staton sings If I Love Again, On Green Dolphin Street, Pick Yourself Up, Meet Me at No Special Place, etc.



54 Tchaikovsky's last and greatest symphony, is here given a splendidly moving rendering by the Sinfonia di London conducted by Muir Mathieson. Also in stereo.



58 The fabulous dynamic Duke Ellington himself in eight great numbers including Stomping at the Savoy, In the Mood and Honeysuckle Rose.



14 Tchaikovsky Symphony No. 5. Sir Malcolm Sargent and LSO combine to give this famous symphony a dramatic and colourful rendering. Also in stereo.



25 Ian Wallace, Joyce Blair and chorus. Some I enchanted Evening, I'm In Love With a Wonderful Guy and all the unforgettable songs from this great musical. Also in stereo.



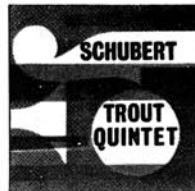
74 Superb Sarah Vaughan in ten great numbers. If I Loved You, Saturday, It's Delovely, You'll find me There, etc. Every one a hit.



76 Unforgettable Art Tatum in person plays Tenderly, Body and Soul Without a Song, Begin the Beguine. 12 superb numbers from the greatest-ever jazz pianist.



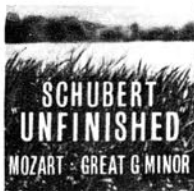
11 Dvorak Symphony No. 5 from The New World. Leopold Ludwig conducts the London Symphony Orchestra in a dramatic and moving performance. Also in stereo.



69 The exquisite playing of the Virtuoso Ensemble matches the beauty of Schubert's celebrated Trout Quintet, which contains some of his most famous melodies.



66 Lily of Laguna, Milord, Come Prima, Dance Every-one Dance, and 14 more played in characteristic manner by the Les Baxter Orchestra.



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



72 The magnificent Platters bring you Sixteen Tons, My Dream, Mystery of You, You'll Never, Never Know, One in a Million. 10 superb numbers.



34 Stardust, How High the Moon, Nearness of You, 'Round Midnight, King David, eight numbers by the vibraphone genius, Lionel Hampton. Also in stereo.



85 Beethoven's Emperor Concerto. A virtuoso performance by Yuri Boukoff with L'Orchestre des Concerts de Colonne under Pierre Dervaux. Also in stereo.



53 These two suites, containing some of Bizet's most thrilling music are given magnificent performances by the Sinfonia di London under Muir Mathieson. Also in stereo.



71 The smooth sound of the Nelson Riddle Orchestra in Touch of Your Lips, Body and Soul, The Tender Touch, As you Desire Me - 11 favourites in all.



2 Grieg Piano Concerto, Alexander Jenner in an electrifying performance with the Bavarian State Radio Orchestra conducted by Odd Gruner-Hegge.



1 Tchaikovsky Swan Lake, John Hollingsworth conducts the Sinfonia di London in a great performance of this well-loved ballet music. Also in stereo.



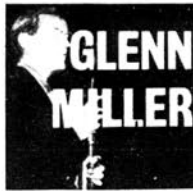
70 The Archduke Trio. Beethoven's inspiring masterpiece here receives a truly outstanding performance from the Lovengren - Martin - Hooton Trio.



45 Crazy Rhythm, Bijou, I cover The Waterfront, Northwest Passage, Blowin' Up a Storm, etc. The master clarinetist plays 12 numbers in great style. Also in 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 in stereo.



77 In the Mood, Bugle Call Rag, Chattanooga Choo-Choo, Serenade in Blue. 9 original tracks by the immortal Glenn Miller and his band.



49 Beethoven Fidelio Overture, Brahms St. Anthony variations, Mendelssohn Hebrides Overture, Wagner Siegfried Idyll. Superb interpretations. Also in stereo.



31 Rimsky-Korsakov's Scheherazade, Sir Eugene Goossens conducts the LSO in a breathtaking performance of this rich and exotic masterpiece. Also in stereo.



65 Our Love is Here to Stay, The Nearness of You, Guilty, and nine more great hits, all with America's top vocal group, the fabulous Four Freshmen.



91 Barbara Leigh with all-star cast and orchestra sing It's Never Too Late, I Could Be Happy, With You, We Said We Wouldn't Look Back, 12 in all. Also in stereo. Tape.



63 Cuban Carnival, Yesterdays, Blues in My Heart, and eight more great numbers played by George Shearing with vocals by Dakota Staton.



6 Kismet, Full cast production. Brand new arrangements. Star artists sing Stranger in Paradise, Baubles, Bangles Beads, This is my Beloved, etc. Tape.



81 Some of Chopin's loveliest melodies magnificently played by world-famous pianist Fou Ts'ong—The Four Ballades, Nocturne in F Sharp Major, etc.



13 Gershwin's Rhapsody in Blue and American in Paris, Pittsburgh Symphony Orchestra conducted by William Steinberg. Jesus Maria Sanroma, piano. Also in stereo.

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The WRC plan offers you an exciting and varied annual repertoire of more than 70 selected tape releases, covering classics, jazz, shows, ballet music, light music and 'pops'. Every one is a superlatively recorded 3½ ips mono tape (or 12" LP—mono and stereo). Tapes are offered to you at the

privilege club price of 29/- (plus a small charge for post and packing—much less than you would pay elsewhere for recordings of anything like this quality).

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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. NEW CLUB MAGAZINE.

The new club magazine contains 48 pages, many in colour. Packed with fascinating features, information, competitions and special offers, it comes free to all WRC 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.

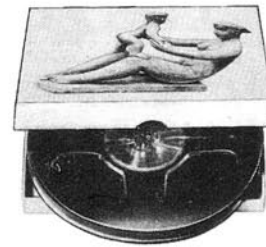
The more you buy, the more you save! After fulfilling the minimum membership obligations, you earn another tape of your own choice free for every extra three you buy!

7. EXCLUSIVE EXTRA RELEASES.

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

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tapes

12" LPs

Tick what you want

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

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

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To WORLD RECORD CLUB (Dept. TRR 2)
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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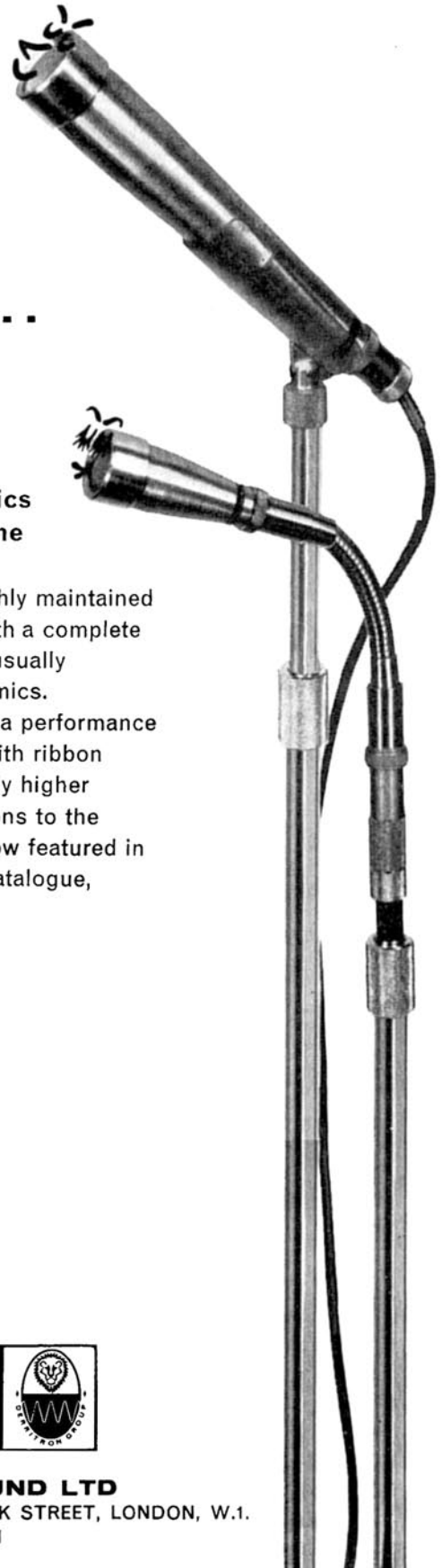
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TAPE RECORDER

Editor - - - - - MILES HENSLOW
 Editorial Offices - - - - 99 Mortimer Street, London, W.1
 Telephone - - - - - MUSEum 3967 to 3969

EDITORIAL

THERE was a very good selection of tape equipment at the Audio Show, and the tape manufacturers were there in force to lend their support. The B.B.C. F.M. *Multiplex* stereo programmes offered wonderful opportunities for equipment to be properly used and demonstrated and, in fact, everything was Set Fair for tape to be seen and heard at its best. In some demonstration rooms it was: in others the opportunities were rather sadly missed. From the other side of the fence—from the customer's viewpoint—it was obvious that the search was for quality from tape as a whole, rather than a browsing round to inspect tape recorders. This fact probably conceals an important message for the organisers and planners of any future shows which may cater for a bigger cross-section of the general public: it has doubtless already registered in the minds of exhibitors. Briefly, those who want to hear the possibilities of tape in relation to high fidelity equipment will not want to be elbowed and jostled in a room where the noise level has reached the threshold of pain: contrariwise, those who come to see, handle and choose a tape recorder for all-round home entertainment will not appreciate an atmosphere of highbrow hush. Both sides of the public taste have got to be allowed for, and the twain are going to be very unhappy if they have to meet.

We refer deliberately to future shows with bigger audiences because it seems that at long last the wind is blowing in the right direction—in the direction of one of the large exhibition halls of London. This is no question of a little bird whispering in the editorial ear: it was a definite statement from the show's organizer, Cyril Rex-Hassan, to the effect that a larger home for the annual exhibition was being actively sought, and that there was a very strong possibility that it might be at Earls Court or Olympia next year. Our readers know our views on this subject and we think they will be as delighted as we are to hear the news—even though it is at the moment still in the realms of "probability". The views of the Trade are still slightly split. Some feel that the quieter and more select atmosphere of a large hotel is likely to be better than a barn-like expanse of an exhibition hall for hi-fi demonstrations: others share our view that the more people who can be introduced to high fidelity listening the better. And those readers who have little interest (as yet) in hi-fi matters, and who therefore could not care much less about the audio show, may suddenly find that this very different type of show that we envisage is, for the first time, exactly their cup of tea. The whole idea behind the enlargement of the show is to allow it to grow up. It will be ten years old next year and it has outgrown its suit which is confining it most uncomfortably. By charging the public for admission and (most daring move) letting everyone know that there is such a thing as hi-fi, it is probable that many thousands of people will find their way to the show for the first time. They will include seasoned hi-fi enthusiasts, newcomers who want to know what it is all about, and people who (quite correctly) will expect to see and hear every type of tape recorder on the market. All this is going to take a lot of planning, but we have little doubt that it will be well planned and most successful—and the tape manufacturers who have been putting on such an interesting series of attractions at the annual show in recent years will, for the first time, be playing to a new and large audience which may well be made up of "new business".

It is maybe a little early to become enthusiastic about something which (at best, and if it happens at all) is still eleven more months and ten more days distant. But the people who have found it difficult to get exhibition space at the annual show for one reason or another may find the present time an ideal time for applying the pressure in the right direction. They may think it a good point to remember that this projected exhibition of much larger size is bound to cost more



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MEMBER OF THE
 AUDIT BUREAU
 OF CIRCULATIONS

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money in terms of initial outlay. Even though the organisers know that the success should be comparably greater they will (being only human) be pleased to know that they have a lot of potential support. And in order to get this they will have to welcome some new faces. We have always held the view that everyone *genuinely* connected with good audio products should be entitled to show his wares. We hope that the projected move will make this thing possible. Anyway, we have said our piece. Let those who are interested make haste to make their own voices heard.

We think that there are quite a few ways of enlarging the Audio Show. It should *always* retain the emphasis on high fidelity, and it should always exclude the band-waggon-riders; but provided that the inner temple is dedicated to hi-fi there is no reason why other sections of the main exhibition should not deal with kit construction, sound as applied to cine, tape recording, etc. Instead of crowded hotel bedrooms and corridors we should have specially built demonstration rooms. Those who have never been interested in hi-fi will have a chance to see and hear it at its best. Those who have never had much time for cine will at least be able to see how dependent it is upon sound. Those who like the other things, but who have not much time for tape, will have a chance to convert themselves. Music lovers will, we hope, be specially attracted by the opportunity of seeing—at intelligently planned "side-shows"—just how important the whole audio set-up can be when it comes to enjoying music at its best. And that is, after all, the only reason for the existence of these electronic gadgets in our homes.

As a concluding sentence let us congratulate the organiser for all that he has so far done, and let us hope that he has a much bigger job to do next year!



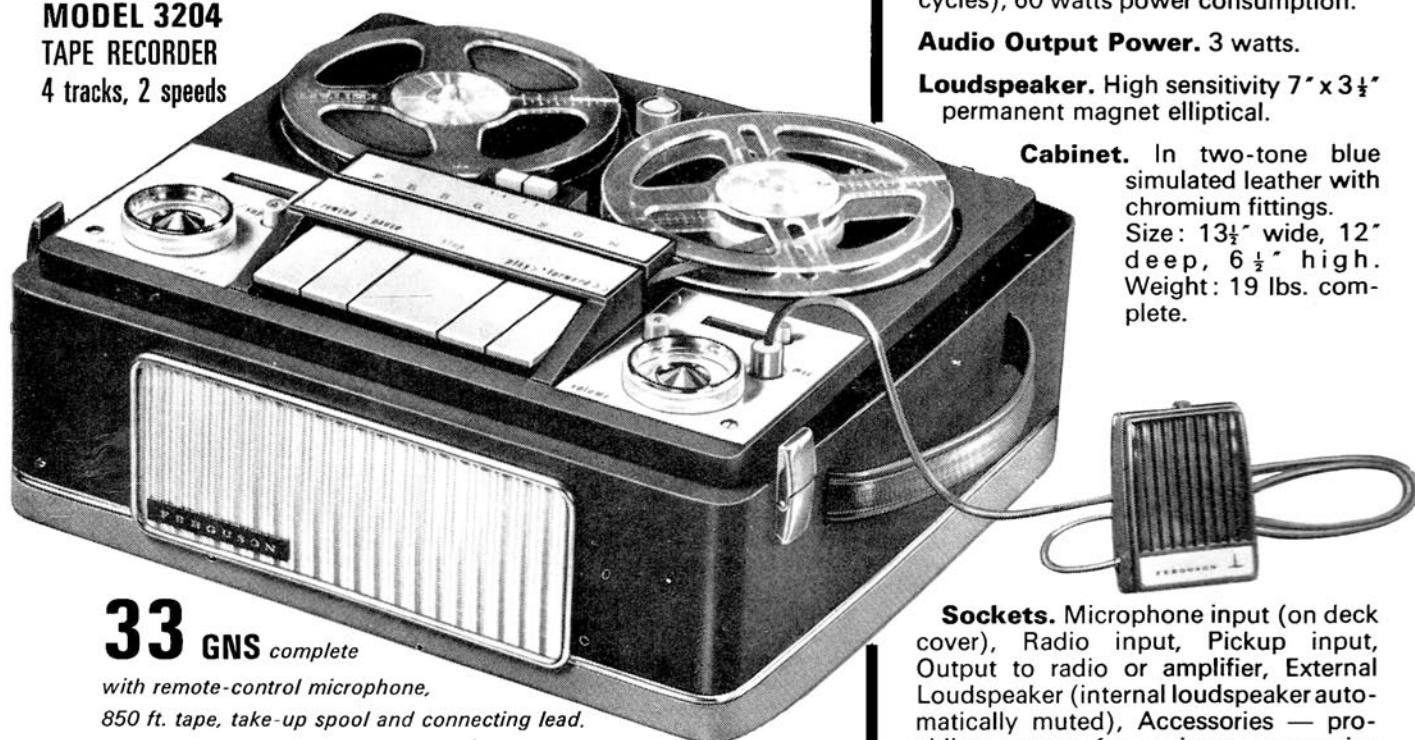
● Our cover picture, kindly supplied by the BBC, shows the stereo control panel at a recent stereo recording session in Manchester. This very fine equipment is of BBC design.

A TAPE RECORDER IS ONLY AS GOOD AS ITS DECK

This one is very good indeed

To judge the technical perfection of the new Ferguson model 3204, you have only to study the tape deck. Designed and precision-built by Ferguson's own engineers, it is the foundation on which is built a superb piece of equipment with meticulously balanced sound amplification and finest quality reproduction. Clarity and purity are combined with a multiplicity of features for infinite variety in your sound recording, compactly contained in a cabinet with a style to match the performance.

MODEL 3204
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4 tracks, 2 speeds



33 GNS complete

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850 ft. tape, take-up spool and connecting lead.

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Controls. Volume/Recording level. Tone combined with mains On/Off. Piano-key tape motion controls comprising: Play/Record, Pause (temporary stop), Fast Forward, Fast Reverse, Stop. Record button interlocked with tape motion keys. Playthrough/Superimpose button. Track Selector push buttons. Speed Selector switch. Digital Tape Position Indicator with instant zero reset button.

Speeds. $3\frac{3}{8}$ i.p.s., $1\frac{7}{8}$ i.p.s.

Spool Size. $5\frac{1}{2}$ " maximum.

Tracks. Four. Recording sense to generally accepted standards (1st and 3rd tracks left to right).

Playing Time. Using four tracks and maximum spool at $1\frac{7}{8}$ and $3\frac{3}{8}$ i.p.s.

Standard Tape	3 hours	6 hours
Long Play Tape	4 hours	8 hours
Double Play Tape	6 hours	12 hours

Rewind time $2\frac{1}{2}$ minutes either direction (850 ft.).

Power Supply. 200-250 Volts (50 cycles), 60 watts power consumption.

Audio Output Power. 3 watts.

Loudspeaker. High sensitivity $7" \times 3\frac{1}{2}"$ permanent magnet elliptical.

Cabinet. In two-tone blue simulated leather with chromium fittings. Size: $13\frac{1}{2}"$ wide, $12"$ deep, $6\frac{1}{2}"$ high. Weight: 19 lbs. complete.

Sockets. Microphone input (on deck cover), Radio input, Pickup input, Output to radio or amplifier, External Loudspeaker (internal loudspeaker automatically muted), Accessories — providing power for various accessories including transistor-operated units.

It's got other talents, too! This tape recorder is a twin set and can be used in partnership with the Ferguson 3006 record player, acting as an extension amplifier/loudspeaker for the playing of stereo records.

Audio Course at Slough College

SIX lectures covering all aspects of sound recording and reproduction began at Slough College on April 21st. The speakers include Graham Balmain, Ralph West, George Pontzen and J. C. G. Gilbert. The fee for the course, which is held on Tuesday evenings from 7 to 9 p.m., is £1. Further details and application forms are available from: **Slough College, William Street, Slough, Buckinghamshire.**

Blind Landings to be Taped

THIRTY EMI RE321 battery portable recorders are to be used in an evaluation of the merits of blind landing systems. Expected to last up to five years, the recorders will gather data from ground equipment for subsequent comparison with pilots' logs at the Farnborough Air Establishment.

Epsilon Labcorder

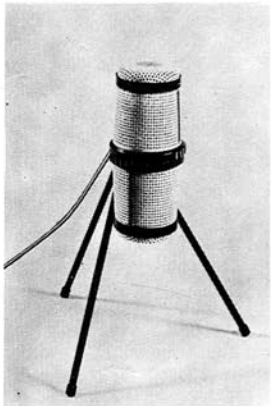
DESIGNED specifically for laboratory use, the MR800 Labcorder has facilities for recording speech and low frequency pulses. It is equipped with an automatic gain control and has a frequency range, at 15 i/s, of 200 c/s to 10 Kc/s. Three other speeds are included—7½, 3¾ and 1¾ i/s. When switched to FM replay the response at 15 i/s stretches from zero to 5 Kc/s, ± 0.5 dB. Wow and flutter figures at this speed are 0.06% RMS.

Taking 7 in. spools, the Labcorder has a wide range of potential applications. When used in combination with a pen-recorder it enables data required for permanent storage to be separated from irrelevant information and, utilising the Labcorder's speed ratio of 8 to 1, can either extend the effective frequency response of the pen-recorder or contract the time scale of the information recorded by the pen.

Manufacturer: Epsilon Industries Limited, Faggs Road, Feltham, Middlesex.

A.K.G. Price Reductions

POLITECHNA (London) Limited, U.K. distributors of A.K.G. products recently announced price reductions for several of their microphones. In the domestic range these include the D11C dynamic cardioid, reduced from £6 10s. to £6; the D12 dynamic cardioid from



★
**AKG D77
Stereo
Microphone**
★

£34 to £28; the D58 'close-talk' from £11 10s., and the D77 stereo cardioid from £15 10s.

Details of the price alterations of professional models can be obtained on application.

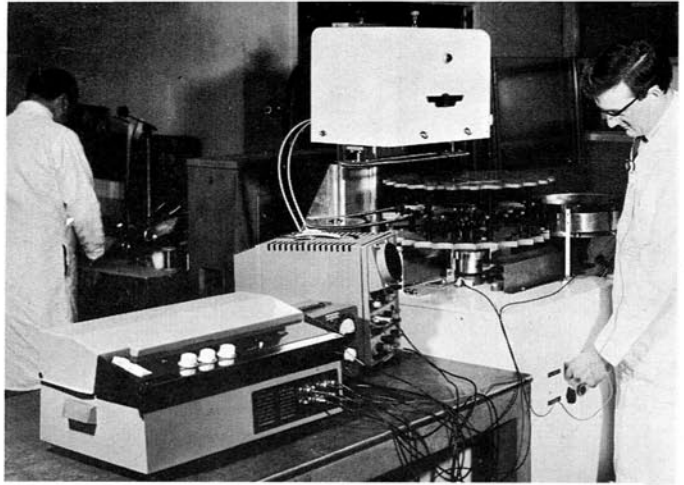
Distributor: Politechna (London) Limited, 3 Percy Street, London, W.1.

Telefunken Comment on the Magnetophon 96 Review (April)

OUR principals in their specification for this model allow a ±2% tolerance on the speeds and the bulk of the production naturally falls well within this tolerance. Occasionally, as in all mass produced equipment, there is the odd machine which, although within the specification, does come nearer to the tolerance limits and it is a possibility that your reviewer had such a machine. The Magnetophon 96 has been on the market for some two years and its service record has shown no indication that a design fault exists in the drive mechanism, and on the few occasions where speed instability has been experienced replacement of the intermediate drive wheel has cured the trouble."

Welme Corporation Limited.

WORLD OF TAPE



An MR800 Labcorder being used to record the vibrations of bearings and mountings of a Wehmiller Bottle Inspecting Machine.

A Paper-Back on Tape

A PAPER-BACK version of Douglas Brown's well known book *Tape Recording and Hi-Fi* was published recently by Arco. First printed in 1961 it is well written in a lively non-technical style and retails at 5s.

Components for the Microphone Amplifier

WE have been asked by Mr. Foord, to point out that the GET106 transistor, used in his construction article in our March issue, can be obtained from: Henry's Radio Limited, 303 Edgware Road, London, W.2.

Challen Service Note

WE are advised that spares and service for Challen recorders are now available from: **Tape Recorder Maintenance Limited, 323 Kennington Road, London, S.E.11.**

More Stolen Equipment

NINE recorders and three pieces of hi-fi equipment were stolen from a van belonging to Howard Limited, at Kings Cross Station on Thursday March 5th. A reward of 25% of market value is offered for information leading to the recovery of the property.

Details of the equipment are as follows (serial number given in brackets): Butoba MT/5 (511726) and mains unit (97246); Butoba MT/5 (513693); Butoba MT/5 (514912) and mains unit (94986); Wyndson Trident, ¼-track version (29164); Spectone 161 (1349); Telefunken KL.85, green cabinet, 3W model (818853).

All the above-mentioned equipment was second-hand, while the following were new: Elizabethan LZ/29 (2931651); Truvox R.92 (62688); Telefunken KL85KL, grey cabinet model, (865259); Leak Stereo Amplifier (2283-42-64); Connoisseur Craftsman 111 Turntable (3-2284); Decca Deram A.R.I. Arm (no serial number).

Anyone being offered any of these should report the matter to his local Police Station or contact: **Howard Tape Recorders, 218 High Street, Bromley.**

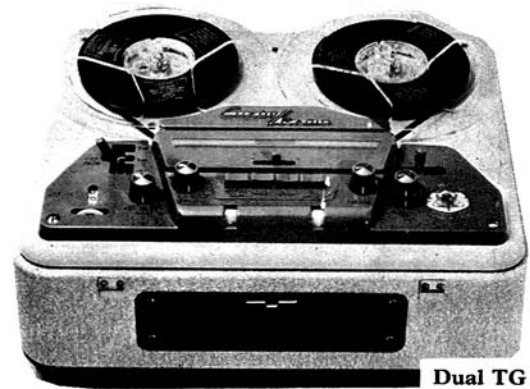
Sennheiser MD21

THE latest addition to the wide range of Sennheiser microphones, now obtainable in this country, is the MD21. Available in low, medium and high impedances, it has acclaimed response from 50 c/s to 15 Kc/s, rising slowly by 5 dB above 1 Kc/s. Several accessories are available, including a desk stand and wind screen. The dimensions of the microphone, a moving coil type, are approx. 4¼ x 2 x 2 ins. The list price is £16 12s. **Distributors: Impetron Limited, Impetron House, 125 Gunnersbury Lane, Acton, London, W.3.**

TAPE AT THE 1964 AUDIO FESTIVAL



Philips EL3566 in Console Form



Dual TG 12A



Luxor MP 424 Stereo

THE eighth annual London Audio Festival and Fair, occupying five floors of the Hotel Russell, opened on April 2nd. When it closed, at 8 p.m. on Sunday April 5th, nearly 60,000 visitors had passed the turnstiles. It is claimed by the organisers that the figures for Saturday were the highest ever recorded on a single day since the Fair began. 36,800 visitors entered the exhibition on that day alone, compared with a total of 37,600 visitors during the four days of the 1963 Fair.

Tape played a greater part this year than ever before, with 42 of the 87 exhibitors specialising in the manufacture of recording equipment and accessories. Twenty-seven foreign manufacturers, from Austria, Canada, Germany, Holland, Hungary, Japan, Norway, Sweden, Switzerland and the U.S.A. made the exhibition truly 'International'.

Video Recording Makes Debut

Video recording was shown for the first time in the *Scotch* demonstration room and visitors had the opportunity of watching what amount to pre-recorded films, and of seeing themselves on tape. A *Precision PT-3V*, playing at $6\frac{1}{2}$ i/s, coupled with a *Pye* industrial television camera, was used to illustrate the strength of 3M *Videotape*. At one point in the demonstration the tape transport was stopped and, with the head rotating within the helically-wound tape, a still frame was shown. The strain to which the tape was subjected was said to be equal, in one second, to that imposed on $\frac{1}{4}$ -inch audio tape when played 145 times at $3\frac{3}{4}$ i/s. It is claimed that the tape will stand more than ten minutes in one position before the oxide structure begins to disintegrate.

Also on show in the *Scotch* demonstration room was the *Revere* Tape Cartridge Player, the subject of a report by John Berridge in our February issue.

A One-Man Orchestra

Another interesting demonstration, given by *Agfa*, was of the *Mellotron*, a versatile organ operating on the unique principle of using tape to supply the melody. A piano-style keyboard is used to operate 1,250 instrumental sounds recorded from actual instruments on 72 tapes. Each tape is 40 ft. in length and has three tracks. A single key depressed by the left hand will bring into action a complete accompaniment, played on drums, piano, brass or any other of 18 selections available.

To this accompaniment, a simple tune on the right-hand keyboard will provide a lead melody, making the organ ideal for those only able

to play 'by ear'. A system of numbered notes allows a completely non-musical person to play, in effect, a small orchestra.

The official theme of 'Initiation' was to be found in only a few demonstrations. Perhaps *MSS* fulfilled the test most practically, with an interesting film entitled *Journey Into Tape*, which gave an insight into the problems involved in the manufacture of recording tape.

Four Free Lectures

Four Grundig *Automatic* recorders were kept hard at work in the *BASF* room over the four days, dubbing talks on sound effects, slide-synchronisation, and other aspects of creative recording. The copies thus made were then presented to the visitor who had monitored the tape through an *AKG* headphone.

The 'professional' field was well represented by *Peto Scott*, *EMI* and *Elcom*. *Peto Scott*, U.K. Agents for Philips' high-quality equipment, demonstrated professional audio equipment, including the *EL3566*, recently supplied to the BBC. On show for the first time in this country was a message repeater, for specialised use with airport P.A. systems.

The *RE321* battery portable, and *TR52* recorders, both popular with amateur enthusiasts, as well as professional recording and broadcasting companies, were exhibited by *EMI*, along with a rack-mounted version of the *311*.

Elcom, a newcomer to this year's Fair, displayed two mixer units, both of which made use of stud attenuators. Available with four or ten channels, they were shown along with the range of *Elcom* components, including connectors, faders and switches.

Three Machines in One

A new *Stuzzi*, the *Disc-Corder* made its debut, and selling at £61 19s. provides its owner with a combined battery-powered tape-recorder, record player and transistor radio. A mains adapter and extension speaker are among the range of accessories available for this unit. Accompanying this rather unusual combination was the *Tricorder*, claimed by *Stuzzi* to provide a good recording of piano music at its slowest speed of $15/16$ i/s.

Another new portable recorder has been introduced by *Butoba*. The *MT22* is capable of holding 6-inch spools with the lid closed, and plays at $1\frac{7}{8}$, $3\frac{3}{4}$, and $7\frac{1}{2}$ i/s. The frequency range at $7\frac{1}{2}$ i/s is said to

TAPE AT THE 1964 AUDIO FESTIVAL



Stuzzi Disc-Corder



Planet U.1 Tape Deck

stretch from 40 c/s to 18 Kc/s. The power supply can be taken from eight 1.5V dry cells, two rechargeable accumulators, a 12V car battery, or from a mains convertor which also houses the charger. Remote control facilities for this model are very comprehensive due to the considerable use of solenoid switching.

A Remote-Controlled Tape Deck

Also equipped with solenoid controls, the U.1 15 Tape Deck, exhibited by Planet Projects, plays at $3\frac{1}{2}$, $7\frac{1}{2}$ and 15 i/s, and is available with non-remote, semi-remote and fully remote control. The latter version is supplied with all transport controls, with the exception of speed, mounted in a single unit at the end of a cable. Unlike the semi-remote model, which is otherwise identical, an emergency stop button is located on the deck.

A new accessory for the 202 was a source of interest at the Fi-Cord booth. It takes the form of a rechargeable power unit and provides an economical alternative to the rather expensive mercury batteries stipulated for the recorder. Two other products on show were a transistorised mixer and a battery-powered amplifier and speaker unit.

Kodak Versus BBC Multiplex

BBC Multiplex Stereo formed the basis of a demonstration by Kodak. The signal direct from the receiver was compared with the output from a Tandberg, monitored less than a second after it had been recorded on Kodak tape. Frequent switching from the direct to the recorded signal showed little audible change in quality other than a faint hiss from the tape. The exceptional performance of the Tandberg

was illustrated when a tape was played at $1\frac{1}{4}$ i/s with surprisingly good results.

The Truvox Series 90 Tape Unit was the popular choice of several exhibitors of cabinets and hi-fi equipment, and showed itself to be capable of an impressive performance.

The Revox 736, another stereo tape unit, was played through two Quad Electrostatic Speakers, and gave forth very pleasant quality, although the background hiss, in common with another 'semi-professional' recorder, the Akai Model 345, appeared to indicate the sad absence of a de-gausser amongst the exhibitors.

Moving now from recorders to microphones, 'The Triffids', a musical group, formed the subject-matter for the AKG range. In the Grampian room, however, microphones had taken second place to an artificial echo unit. The beneficial effect of this piece of apparatus on certain sounds was shown very clearly when an atrociously dull recital of one of Shakespeare's more widely known songs was greatly improved by the addition of reverberation. Its use in a hi-fi set-up is questionable, however, as no professional recording would be issued in such a 'dead' state as that—unless it was intended for demonstrating echo units. Its advantages would seem to be more with the recording enthusiast who is sufficiently interested in realism to want a more lifelike echo than that obtainable from a staggered playback head.

Additions to the range of S. G. Brown head-sets, including the Diplomat 3C. 604 and its control unit the 12C. 100, gave very good accounts of themselves when used to relay music from a Grundig stereo recorder. The Diplomat makes use of ceramic transducers.

Portable Hi-Fi on Tape

Telefunken demonstrated the quality now possible from battery recorders by playing their M300 through external speakers, using a high quality radio as a playback amplifier. Its fidelity considerably exceeded that obtainable from several current mains models of a similar price, having an excellent overall response. Also on show in the Telefunken demonstration room were the Magnetophon 96 and M26KL mains recorders and a range of microphones and accessories.

As always, the Fair was accompanied by outside exhibitors, holding demonstrations in nearby hotels. An impressive display of Heathkit equipment was given close to the Russell, in Southampton Row. Visitors were able to hear and try out audio and amateur radio equipment, and test gear, after which they were invited to listen in comfort to three complete hi-fi stereo systems each of which was designed to cater for a different price range and floor space. The room in which these demonstrations took place were ideally suited to the purpose of sound reproduction, with extensive carpeting and curtaining eliminating any possible 'boomy' or 'closed in' effects. A far cry from the converted bedrooms of the Hotel Russell.

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BIAS IN TAPE RECORDING

Part 3

LAST month it was shown that the *amplitude* of the bias signal in a tape recorder must be critically adjusted if the best results are to be obtained. A less critical, but nevertheless important, factor is the *frequency* of the bias supply.

Ultrasonic Frequencies Necessary

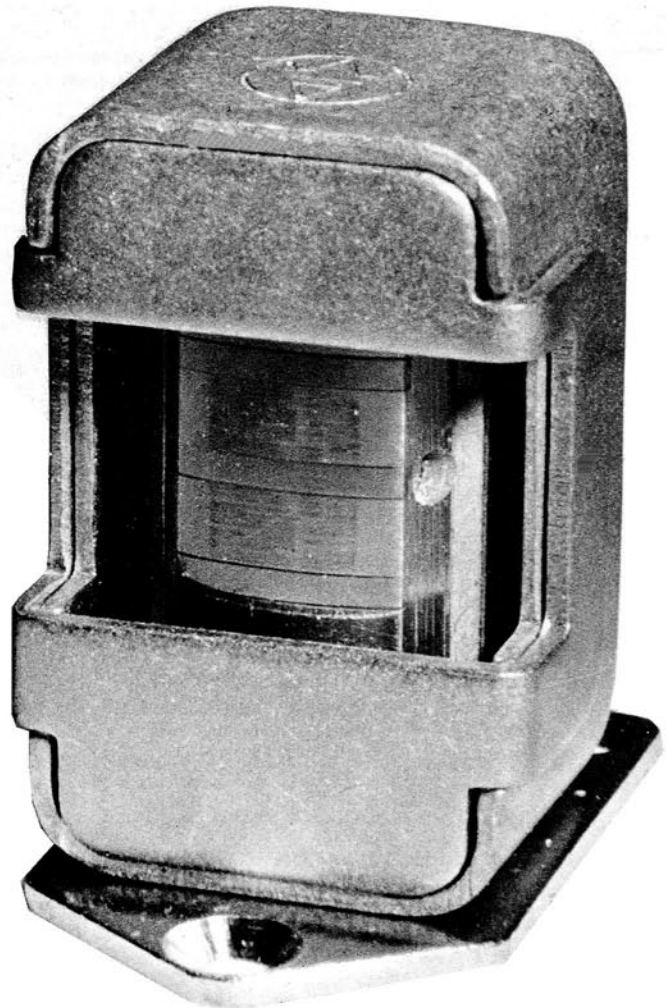
The bias frequency must be fairly high so that when the tape is replayed there is no audible output of the bias signal. In other words if the bias frequency were, say, 8 Kc/s, then on playing back the recording, a whistle of this frequency would be heard. At slightly higher frequencies the bias output is reduced by the 'gap effect' at the playback head, and also by self-demagnetisation in the tape coating. From this it might be thought that a bias frequency of about 15 Kc/s would be sufficient, since not many commercial machines can reproduce much above 10 Kc/s; however a bias frequency of 15 Kc/s is not high enough for the following reasons.

Frequency Beating

When a recording is being made, the bias and audio signals are both present in the record head. Now suppose that the bias frequency were 15 Kc/s. If part of the audio signal applied to the signal head were to consist of a frequency of the same order as that of the bias, then trouble could be encountered due to the appearance of the 'difference frequency' due to residual non-linearity in the system. This simply means that with a bias frequency of 15 Kc/s, and an audio frequency of 14 Kc/s, it is possible for a signal of (15 minus 14) Kc/s, namely 1 Kc/s, to be present on the recording. In other words, two high frequency signals, which would not themselves be heard on playing back the tape, can give rise to a lower audible frequency which would spoil the recording.

Of course, one is not likely to encounter a continuous audio input frequency of the order of 15 Kc/s, but such frequencies are common as components of complex audio signals, and a low bias frequency can cause disturbing interference effects between the bias and audio signals. To prevent these effects, the bias frequency is usually at least four or five times the highest anticipated audio frequency.

A fault of a similar nature is sometimes experienced in stereophonic tape recording where separate bias oscillators are used for the two channels. When recording, a whistle may be heard at the output of the record amplifiers due to the bias supplies of the two amplifiers being of different frequencies (the smaller the difference between the two frequencies the lower the frequency of the whistle). To tune both oscillators to the same frequency the machine should be set to the record position, and the output of one of the record amplifiers monitored on a pair of good quality headphones, or better still, on a loudspeaker.



The Adjustable Coil

A bias oscillator coil usually has a core of the iron-dust variety, which is adjustable on a screw thread. Both cores (in a stereo machine using separate bias supplies) should first be positioned centrally in their respective formers; then one of the cores should gradually be adjusted until the frequency of the whistle decreases to zero. If the frequency increases, then it is the other coil which should be adjusted. When the whistle has vanished both oscillators are tuned to the same frequency.

Fig. 1 shows an exaggerated asymmetrical waveform ABCDE. It can be seen that the peak amplitude of the positive part of the waveform is 45V, whereas the amplitude of the negative part is only 15V. If a constant voltage of 15V is subtracted from this waveform (i.e. the curve is re-drawn 15V lower down) then the curve FGHJK is obtained which is symmetrical about the axis OX. This means that the asymmetrical waveform ABCDE may be regarded as the sum of the sinusoidal waveform FGHJK and a constant voltage of 15V.

The effect is that with an *asymmetrical* bias waveform, the process of biasing is actually a combination of AC and DC, and the DC component, as was explained last month, gives rise to excessive hiss.

Therefore, a lower level of background hiss is attainable when a *push-pull* bias oscillator is used, since this type of oscillator usually gives an output waveform which is much nearer to a perfect sine wave than that obtained from a single-pentode type of oscillator.

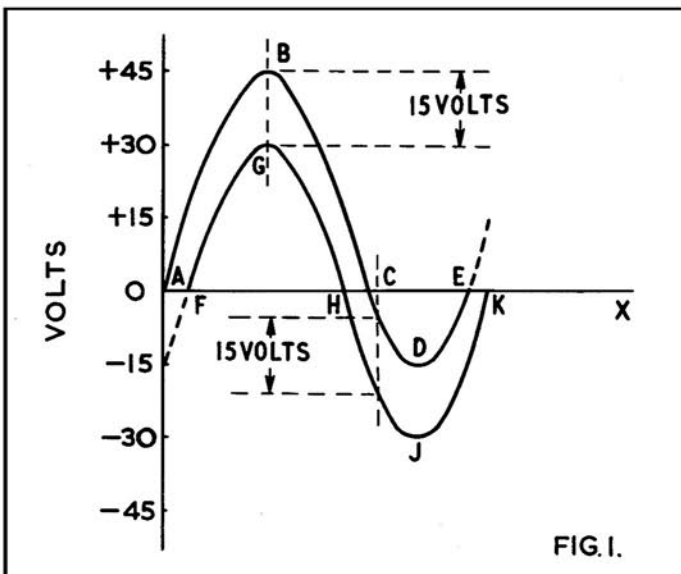


FIG. 1.

TAPE SPECIFICATIONS —AND STORIES

IT has been said that not only can a blindfolded man not tell the taste of a five shilling cigar from a sixpenny one, but he rarely knows whether either is alight or not.

There is, I suppose, as much mumbo-jumbo surrounding tape as anything else in audio, or electronics, or even in brandy and cigars. However, while one can hardly give technical descriptions of the latter which mean something in terms of taste, flavour and aroma, most engineering hardware can be described, and specified, so as to give the user a clear idea of its performance. Indeed the necessary tests are usually standardised by the British Standard Institution (BSI) and the specification can thus be confidently used to compare different items of the same kind as well as being generally understandable by all concerned. Even household articles, whose users may be ill-equipped to compare specifications, can often be chosen on the basis of a BSI mark or the approval of some independent consumer organisation.

In spite of this, there is no BSI specification, nor even general professional agreement, on any but the most elementary features of domestic audio equipment, and none at all on any aspect of performance quality. Specifications there are a-plenty, of course—you can collect an armful at any exhibition—but comparing one with another may be quite another matter, even if you can understand them. And that is really the point of this article. Specifications so often fall between two stools; many are imprecise to the professional and at the same time too detailed for the domestic user, and thus they are confusing and often misleading to both.

Look, for instance, at the tape specification (Table 1) shown here—imaginary, but nevertheless fairly typical in form, although the figures are not intended to suggest any typical or desirable values. Let us go through the entries in order, examining the meaning of each and its usefulness to the domestic user.

TABLE 1
TYPICAL SPECIFICATION FOR DOMESTIC TAPE (STANDARD)

Magnetic

Coercivity: 275 oersteds
Remanence: 700 gauss
Saturation Induction: 850 gauss

Electrical

Sensitivity: ± 2 dB referred to reference tape XYZ123

Uniformity: $\pm \frac{1}{2}$ dB within reels }
 $\pm \frac{1}{2}$ dB short-term } at 1 Kc/s
 ± 1 dB reel-to-reel }
 ± 2 dB at 10 Kc/s

Dropouts: Negligible

Frequency Response: 40 c/s-16 Kc/s at $3\frac{1}{2}$ i/s
40 c/s-8 Kc/s at $1\frac{1}{2}$ i/s

Bias Required: $\pm 15\%$ of that for reference tape XYZ123

Distortion: Less than 2% at 0.2 Maxwells

Background Noise: 65 dB below peak recording level

Modulation Noise: 54 dB below peak recording level

Print-Through: 56 dB below peak recording level after
72 hours at 70°F.

Mechanical

Elongation: 1.0% elastic at 4 lb. for one minute

Yield Point: 4.5 lb.

Tensile Strength: 6.2 lb.

Humidity Expansion: 12×10^{-5} per 1.0% R.H.

Humidity Range: To 100% R.H.

Temperature Expansion: 25×10^{-6} per 1°C.

Coating Thickness: 0.45×10^{-3} in.

Base Thickness: 1.5×10^{-3} in.

Width: 0.246 in. ± 0.002 in.

The *Coercivity* of all domestic tapes lies between 250 and 320 oersteds, approximately. Since other factors such as coating thickness, oxide dispersion, magnetic density and surface quality may together have much more influence on the performance of the tape, the term 'medium-coercivity' would suffice. This ensures that the tape can be biased and erased on domestic machines and distinguishes it from 'high-coercivity' tape which is intended for professional use. 'Low-coercivity' tape constituted the bulk of the early production, incidentally, and is not used now.

Magnetic Characteristics

Remanence is not a particularly interesting quantity because, again, coating thickness and density come into any calculation of sensitivity based on it. 'Remanent Induction' per $\frac{1}{4}$ -inch tape is nearer to being useful, although its measurement involves the condition, unrealistic in audio recording, of magnetic saturation of the tape.

Personally, I would like to see the 'anhysteretic remanent induction' used as a measure of tape sensitivity. Despite its ugly and forbidding name, this quantity is just what we want, since it is obtained from a bulk sample under laboratory conditions resembling those experienced by the tape on a much smaller scale when it passes a recording head. The latter involves a high-frequency (bias) field mixed with a low-frequency (audio) one, whereas the anhysteretic measurement is more conveniently made with a low-frequency field (50 c/s, perhaps, representing the bias) mixed with a direct field to represent the audio. However, the results represent the practical conditions very well provided that realistic values of field are applied. Nevertheless, we shall probably have to be satisfied with the remanent induction for the moment.

Saturation Induction is, as far as I can see, quite useless to any tape user, domestic, professional audio, or industrial.

★

Sensitivity as presented here is not, of course, very helpful to the user, since he doesn't have a sample of reference tape XYZ 123, and isn't likely to have unless he is a contract customer. It doesn't tell him how the tape relates to other makes, and no one else is likely to either except perhaps the reviewers in the tape magazines. The entry *would* be useful, however, if XYZ123 were a BSI reference tape of which anyone could have a sample. The idea has been successfully practised in Germany for several years now, and most European manufacturers relate sensitivity (and many other quantities) to this DIN reference tape. Their specifications are thus immediately comparable. We can only hope for either a BSI reference tape or an anhysteretic measurement to be adopted soon. Until then we must comfort ourselves with the thought that the sensitivity of most ordinary domestic tapes lies within a total range of 4 dB, which will not worry most users (see next section). But note that 'High Output' tape may be 4-6 dB more sensitive than the average, and Triple-Play 2-6 dB less sensitive than the average.

Electrical Performance

Uniformity (or Sensitivity Tolerance) is interesting, especially if you do much editing, although one's sensitivity to changes in output has been much exaggerated in the last few years.

A digression here may be of interest. During a recent short talk to the BSRA on this subject of specifications, two passages of chamber music were played. The first was 'doctored' with a steady fall in level of 2 dB over 20 seconds followed by an almost instantaneous return to the original level. The audience were told this only after the piece had finished, and were thus partly prepared then for something similar in the second. This contained three fairly rapid dips in level of 4 dB, followed by a fall of 4 dB over two minutes and a rapid return to the original level, which was also explained afterwards. As far as I could gather later, most of the audience of eighty or so noticed nothing amiss

TAPE SPECIFICATIONS —AND STORIES

By: Graham Balmain

in either piece, a few expert professional listeners noticed the rapid 4 dB changes only, and one man claimed to have heard all the changes.

This is not to say, of course that domestic users cannot hear changes of 4 dB, just like that; they might well have heard the 2 dB changes if the programme had consisted of sustained organ notes or similarly steady material. But it does suggest that the maximum rapid change in mid-frequency of 2 dB (± 1 dB) suggested by our 'specification' is entirely adequate for most purposes, and that changes of 3, 4 or even more decibels might be acceptable in some applications. The effect of changes in high-frequency sensitivity is much less marked, in ordinary mixed programmes material anyway, than at mid-frequencies.

Apart from the figures, however, this entry for uniformity is incomplete. The tape speed must be given, since a 1 dB change in a 1 Kc/s signal at $7\frac{1}{2}$ i/s could easily turn into a 2 or 3 dB one at $1\frac{1}{2}$ i/s. The bias condition must be stated, because, for instance, an increase in bias may reduce variations due to changes in the surface of the coating but exaggerate those due to changes in its thickness. Finally, 'short term' must be defined, since the rate at which output level changes may have a great influence on whether the change is audible or not.

Specifying Dropouts

Dropouts are not the same as short-term changes. They are heard as catches or hiccups in reproduction, whereas changes are appreciable as such. However, we know little about expressing them in figures which relate to how they sound (hence, presumably, this vague entry). Anyone trying to do so at this stage would be sticking his neck out too far. In any case, figures (or even 'negligible') would be useless without stating also the track width, the tape speed and the signal frequency; and even then one machine might emphasise the dropouts while another minimised them, depending on wrap-round, pad pressure, tape tension and so on. Since vagueness is merely a vague way of saying nothing, and precision here is impossible at this time, I have no hesitation in recommending you to ignore the statements about dropouts. Listen to the tape on your own machine—it's the only way!

Frequency Response is much less to do with the tape than the machine. Apart from its being given as a frequency range (no dB figures), not a response, the bias condition has not been stated. This entry will help no one as it stands. Tape of itself has no frequency response anyway, only a wavelength response which contributes to the overall frequency response of a record/playback system in action, and its contribution can vary according to the heads used. Although the wavelength response could be used in specifications, it is extremely difficult to determine accurately, and I fear our only hope again is the BSI reference tape and a standard test machine.

★

The entry for *Bias Required* calls for much the same remarks as I made about *Sensitivity* and ties in also with *Coercivity*. The latter entry could be omitted altogether if a future BSI specification were to require that the bias for domestic tapes fell within certain limits—expressed in terms of magnetic field strengths—or, alternatively, that the overall performance under standard bias conditions lay within certain limits. It is surprising, incidentally, how small the differences between the various domestic tapes are, even now, when they are all used with the same average bias. The *Bias Tolerance* figure should be included.

The *Distortion* entry is a useful way of comparing the signal-handling capacity of tapes, provided certain other things are known: the type of distortion (e.g. 3rd harmonic, or total) the signal frequency; the tape speed; the playback channel equalisation for which the figure holds; and, again, the bias condition.

While this will tell you at what relative levels various tapes overload (5% 3rd harmonic distortion is usually taken as the 'overload' point, actually) it will not tell you how rapidly they do so. Some tapes will accept 5 or 6 dB more input after the 2% point before they give 5% distortion and another 2 dB for 10%, while others may need only 3 dB

more for 5% and another 1 dB for 10%. Some statement along these lines would obviously be helpful for comparison purposes. Note also that some tapes overload more rapidly than others at short wavelengths (high frequencies and/or low tape speeds) and that this behaviour does not necessarily correspond to their mid-wavelength performance. However, this is extremely unlikely to affect domestic users.

Tape Noise

Background Noise is obviously a helpful entry, if properly qualified. This one needs the reference-signal frequency, the tape speed, the track width, the playback equalisation and the distortion figure at 'peak recording level' (which I prefer to call 'maximum modulation' to avoid confusion with measurements from true peak-reading meters). In other words, it needs to be referred to the conditions for the *Distortion* entry, with the track width added. The type of meter used (peak, RMS or average-reading) and whether the measurement is 'weighted' or unweighted must also be stated. A peak measurement probably gives the best idea of the audible effect of the noise. A 'weighted' measurement is made through a filter whose frequency response approximates to that of one's hearing at low (40 phon) levels; it attenuates slightly at frequencies above 10 Kc/s and sharply at those below 500 c/s.

Modulation Noise—the 'noise with-the-signal' which may cause slightly fuzzy sound if excessive—is fairly well related to the Background Noise and is anyway unlikely to bother domestic users. If it is included, the same remarks apply as for background noise, with the addition of the method of exciting the noise. I would not include it in a domestic specification, however.

TABLE 2

SUGGESTED FORM OF SPECIFICATION FOR DOMESTIC TAPE

Magnetics

Coercivity: Medium

Remanent Induction: 0.6 Maxwell per $\frac{1}{2}$ in. tape.

(An hysteretic measurement later?)

Electrical

Sensitivity: Not at present; in terms of a BSI reference tape later?

Uniformity (1 Kc/s at $3\frac{1}{2}$ i/s, biased for max. output):

$\pm \frac{1}{2}$ dB within reels;

$\pm \frac{1}{2}$ dB within 100 milliseconds to 1 second;

± 1 dB reel-to-reel

(10 Kc/s at $3\frac{1}{2}$ i/s, biased for max. output at 1 Kc/s)

± 3 dB

Frequency Response: Not at present; in terms of a BSI reference tape and machine later?

Bias Required: Ditto

Bias Tolerance: $\pm 15\%$

Distortion (Recorded Induction of 1 Kc/s recorded to 2% 3rd harmonic maximum output, at $3\frac{1}{2}$ i/s, biased for maximum output, CCIR Playback): 0.2 Maxwell.

Overload Point (5% 3rd harmonic, recorded as above):

0.32 Maxwell, or +4 dB from 2% point.

Background Noise ($\frac{1}{2}$ -track working, referred to 2% D₃ conditions above):

-54 dB, unweighted RMS measurement.

-45 dB, weighted peak measurement.

Mechanical

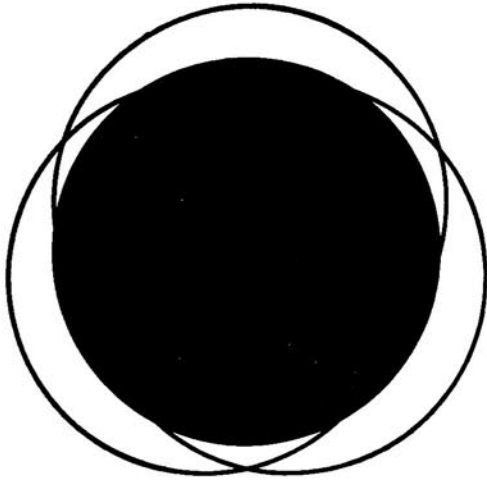
Temperature Range: 120°F max.

Working Tensions: Standard, 80 gm.

Long-Play, 60 gm.

Double-Play

and Triple-Play, 40 gm.



How round is Round ?

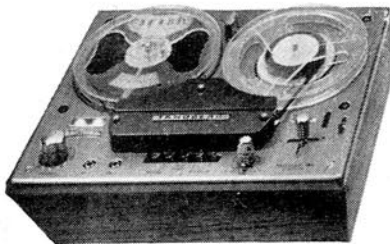
Precision engineering to a microscopic degree is entailed in the manufacture of Tandberg Capstan and Flywheel assemblies. Only by adherence to the most exacting manufacturing processes is it possible to turn out tape recorders, with "Wow and Flutter" figures that measure up to Tandberg requirements*, every time, repeat "Every Time"!

A very good example is the "Roundness" or perhaps surprisingly the "Unroundness" of the Capstan. As you probably know, by centreless grinding the Capstan is ground to a very precise dimension, but unfortunately, there is always a tendency in this procedure, to get an uneven number of "corners". These corners cause an uneven transport of the tape due to the varied radius of the Capstan.

In addition, an even more dangerous WOW component is caused by the movement of the Capstan's centre, due to unroundness. The latter component will be more serious the greater number of corners there are. The unroundness, defined by the difference between the inscribed circle and the circumscribed circle, should be less than 0.001 m.m. when there are 3 corners, and about 0.5/1000 m.m. with 5 corners. Only one European Capstan Manufacturer has so far been able to meet Tandberg's specification.

Mr. A. Tutchings reviewing Tandberg Series 6 in The Tape Recorder :- "At 7½ i/s the flutter remained below 0.1% RMS for very long periods, only very occasionally did it rise to 0.11% where friction effects happened to build up to a maximum. At 3½ i/s the readings averaged 0.12% RMS with very little change in reading from beginning to end of reel".

*Wow and Flutter 0.15% R.M.S. 7½ i.p.s.
 .02% R.M.S. 3½ i.p.s.
 0.3% R.M.S. 1½ i.p.s.



Write for details of
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 Tape Recorders and
 28 page booklet of
 Technical Reviews.

Tandberg

ELSTONE ELECTRONICS LIMITED
 Edward St., Templar St., Leeds 2. Tel : Leeds 35111 (7 lines)

SPECIFICATIONS AND STORIES—Contd

Print-through is not interesting to the domestic user, I think. I have yet to meet one who has ever heard print-through on his own domestic equipment, because the machine background noise is almost invariably high enough to mask it thoroughly. If it is stated, the signal frequency and level, the bias condition, the tape speed and the tape tension must be added.

Frankly, I see little use for the first three entries. Anyone or any machine allowing tape to get anywhere near the conditions implied there deserves anything that may happen to them. Recommended working tensions should be quoted, however. One might perhaps specify the elastic elongation at a loading of about half a pound (200 gm, which is more than there should be on any respectable machine) but this should be negligible anyway.

The Humidity Expansion is unnecessary because the amount involved is genuinely negligible with any modern base material. The same applies to Temperature Expansion, which is also misleading because almost all modern base materials simultaneously contract in length and expand in width when heated. At a certain critical temperature the process becomes irreversible and often catastrophic, so that the Temperature Range is useful as a warning. The Humidity Range is unnecessary, since all base materials now used will withstand 100% Relative Humidity without undue effect; slight curl, perhaps, on acetate-based tapes.

The Coating, Base Thicknesses and Width are included for interest, presumably, since they are fairly well standardised and have little direct meaning in terms of average performance. Provided the right length goes on the right spool and the tape fits the guides, everyone should be happy.

We are now left with the solid core of useful information shown here (Table 2)—a real specification in a standard form which can easily be compared with others. Should the BSI one day standardise testing conditions and specify a national reference tape, the whole thing could become much simpler still, to everyone's benefit.

One last point. In spite of all this emphasis on performance quality and tolerances among the makers of branded tapes, some users will buy cheap tape in white boxes and swear that it is better than anything else on the market. If it pleases them, they have every right to do so; it is their ears (and yours) which count in the end, not the figures.

In some ways this is rather like the story of the scientists who tried to find an objective method of testing the consistency of cheese. After much experimenting they regretfully admitted that no machine they could think of would estimate the consumers liking for the cheese as well as the old man who stuck his thumb into it.

Sometimes, as with dropouts, we just do not know enough to express things in figures. But the desire to do so is not an obsession with figures as such; it is the cold necessity to tell potential users whether they are likely to be satisfied with the product or not without actually giving away millions of free samples. Provided the figures mean something in terms of what the user will hear, and provided the specification is firmly confined to such figures, we can now achieve most of this aim and will certainly achieve more of it in the future. However, it is up to the user to demand clear, precise specifications as much as to the manufacturer to produce them; and this applies to any product where taste has as much influence as technical merit. Who knows? One day you may even get specifications for brandy and cigars!

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TAPE RECORDS REVIEWED



★



★



★



★



LOVERS of English music, particularly the more colourful semi-light orchestral variety, will find much to enjoy on the HMV tape called *English Ballet Music* (TA-ALP 1873). This includes *The Perfect Fool* suite by Holst, Walton's *Façade* and Britten's *Simple Symphony*, with Sir Malcolm Sargent conducting the Royal Philharmonic Orchestra. The recording is very bright and clear, with plenty of orchestral colour to match the lively episodes in the music. On very wide range equipment the sound is a little too bright and slightly edgy, but the overall quality is certainly exceptional for a 3½ i/s mono tape.

The Holst, comprising the *Dances of Earth, Water and Fire*, is brilliant evocative music with fine displays for the brass sections of the orchestra; *Façade* entertains admirably, whether considered as satire or simply clever orchestral fun; and the *Simple Symphony*—scored for strings only—is a delightful work based on material originally prepared by Britten in his childhood. Anyone who claims not to like Britten should be played the second movement of this—its delicate pizzicato is irresistible.

Also for strings alone is Dvorak's *Serenade for String Orchestra*, which is joined by his *Nocturne in B Major* and Grieg's *Holberg Suite* on WRC TT51, with the Sinfonia of London conducted by Alexander Faris. This is all light classical music of a relaxing and unpretentious kind, pleasantly performed but a little lacking in vitality at times. The recording is clear and natural, but there is a suspicion of drop-out occasionally.

Jumping now from concerted strings to solo oboe, we have *The Art of Leon Goossens*, with the master himself accompanied by Gerald Moore at the piano on HMV TA-CLP 1525. This is a recital of thirteen 'set pieces' displaying (and demanding) a full range of styles and the utmost virtuosity; but as Mr. Goossens is one of the few oboists who could even tackle a recital of this sort in the flesh before an audience without difficulty, despite the terrors of the instrument, we are absolutely safe here and receive some really beautiful playing. Ten composers are represented on this tape (either straight or arranged), and the recital starts with the *Sinfonia* from Bach's *Easter Oratorio*. The recording is generally good, but has a touch of distortion at times which was noticed on high quality loudspeakers but not on an ordinary tape recorder.

An entirely different kind of wind playing is offered by Woody Herman on alto saxophone and clarinet, with the support of five other musicians, on the *Woody Herman Sextet* (WRC TT323). His accomplices are: Nat Adderley (trumpet), Charlie Byrd (guitar), Eddy Costa (piano and vibraphone), Bill Betts (bass) and Jimmy Campbell (drums).

Twelve pieces are played in a cool clean immaculate style which is relaxing in the best modern jazz (or Herman?) manner. The recording is clean and clear, but the level fluctuated somewhat on the second track of our copy.

On an altogether vaster, but not necessarily more classical, scale is *The Splendour of the March* on HMV TA-CLP 1684. The Band of H.M. Royal Marines is conducted by Lt.-Col. F. Vivian Dunn in performances of twelve pieces of varied stock, including arrangements of music by Wagner, Sibelius, Sullivan, Saint-Saens and Chabrier. In addition, there are specific military marches. This Band is one of the best brass/military combinations to be found, and plays with something like the precision of a symphony orchestra. For those who like these particular kinds of sounds (and there are about 3,000 brass bands in Britain, so there must be many) this tape should provide some interesting and rewarding listening. The recording is fair, but there was an odd kind of high frequency 'breakthrough' once or twice on our copy.

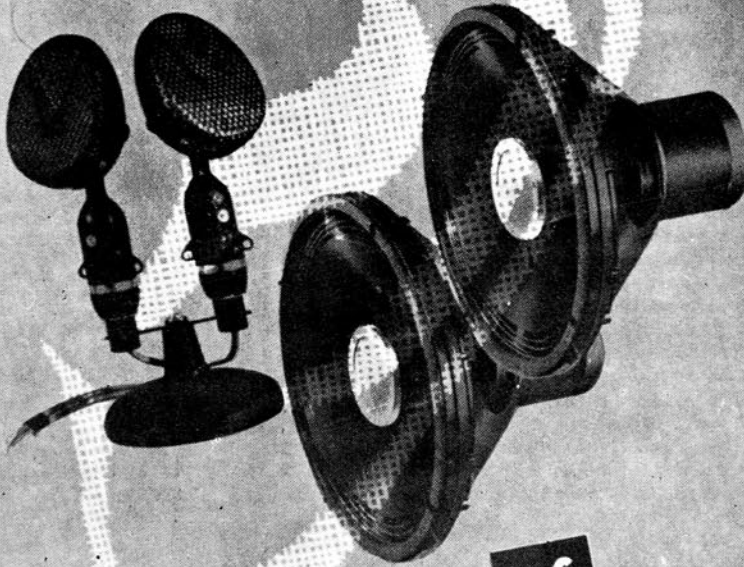
Our last music-tape takes us back across the Atlantic for *Jerome Kern Spectacular*, starring Ray Ellington, with Valerie Masters, Barbara Virgil, the Mike Sammes Singers, and the New World Show Orchestra conducted by Alan Braden, on WRC TT207. A dozen Jerome Kern songs make up this 'Spectacular', including old favourites like *Of Man River*, *The Last Time I Saw Paris*, *Who, The Folks Who Live on the Hill*, *The Way You Look Tonight* and *They Didn't Believe Me*. Seven of these feature Ellington himself, with his own special style; anyone who likes Jerome Kern sung in a straight traditional manner will not like his treatment, but if you prefer your Kern mutilated in this particular way, it is very well done and the recording is excellent.

Sound Effects Number Two is the self-explanatory title of a tape by *Global Products*, the first recording of this type we have received for review. Available at 3½ i/s full-track or 7½ i/s full- and half-track, the thirty sequences last a total of 29 minutes. The review copy was at 3½ i/s and contained no audible wow or distortion, though in a few sections there was slight background hiss.

The recordings range from aircraft engines to lawn-mowers, wood sawing to vacuum cleaners, and are generally remarkably free from irrelevant distractions. The air-raid sirens are particularly impressive, being almost entirely free from external sounds. Eleven effects cover the wide range of railway sounds, two of which are slightly marred by a high level of bird-song. The ninth sequence is a Wurlitzer Pipe Organ demonstration, showing the instrument's great versatility. A talking budgerigar, in the final section, shows off its considerable poetic vocabulary but gives no technical details as to how the effects were recorded! All-in-all this tape is very good value at £1 2s. 8d.

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TOWARDS BETTER TAPING

PART TWO — CONNECTING AND EQUALISING

LAST month it was shown how the tape beginner can improve the quality of a radio or TV tape-recording considerably above that obtainable by dangling the microphone in front of the loudspeaker. This is achieved by extracting the electrical signal either from across a load resistor in place of the loudspeaker or, preferably, from the detector output—across the volume control, for instance.

The great importance of adequate mains isolation was also stressed. One cannot over-emphasise the lethal nature of a tape recorder, microphone or loudspeaker when connected to some external equipment of mains-connected-chassis design. There is only one completely successful solution, and that is to employ a 1-to-1 ratio mains-isolating transformer between the mains supply and the mains-connected-chassis equipment, whatever it may be, as was fully explained last month. The chassis of the external equipment may then be earthed and made perfectly safe electrically while also considerably easing the hum problems. Never connect an earth to the metal chassis of equipment of mains-connected-chassis design.

The Programme Source

Before we go on to see how an external loudspeaker system can be connected to a tape recorder in the 'popular' price range, let us consider programme inputs other than those derived from a radio, television or microphone. From the tape recordist's aspect, another most important programme source is that from a gramophone pickup, for the purpose of taping discs.

Many recorders of the type under consideration feature an auxiliary or 'radio/gram' input socket in addition to the microphone input. We saw last month that it is to such a socket that the radio or TV sound signal is applied. The input impedance here is generally around 500 K (0.5 megohm) or thereabouts and a typical input voltage is 200 mV (that is, 0.2V).

This sort of voltage is obtainable from a radio or television sound section, either at the detector or from across the speaker circuit load, that is towards maximum volume, so all is well in this respect.

About Frequency Responses

Moreover, this input is usually *unequalised*. That means that equal amplification is given to all frequencies over the audio spectrum (within the frequency limits of the equipment, of course). This is just what is wanted for radio input, since on a good set there should be no excessive attenuation or amplification at one range of frequencies relative to another over the spectrum. We have the effect illustrated diagrammatically in fig. 5.

From first principles, this means that any sound signal in the audio spectrum at the output of the radio or TV set will give equal record intensity provided, of course, that the set output signals are of equal level at all frequencies (as transmitted).

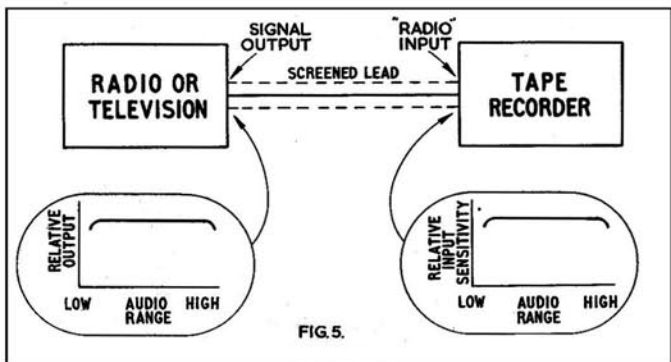


FIG. 5.

Fig. 5 When a programme signal is applied to an 'unequalised' tape recorder input socket the signal should have a 'straight line' frequency response, as this diagram shows.

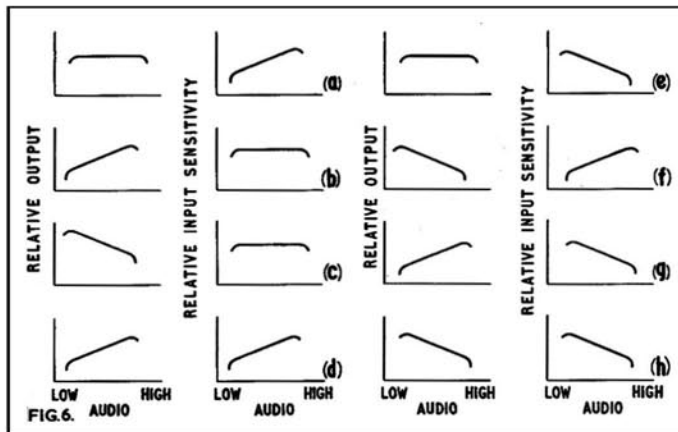


FIG. 6 These combinations of frequency responses are explained in the text.

Now let us consider various combinations of responses, as shown in fig. 6. At (a) we see that the output from the programme source has a straight response while the input sensitivity of the tape recorder is tilted in such a way that the high audio frequencies give a greater depth of recording than the lower ones. An unequalised direct coupling (fig. 5) to such an input, would make a tape record with far too much treble. The same would be the case with responses such as at (b), while the *two* treble-rising responses at (d) would give even greater treble and would be almost certain to cause treble overloading and consequent distortion, especially on high-pitched transient sounds.

Bass boosting would result from (c) and (e), while excessive bass boosting and treble cut would occur from two responses such as at (h). Since the two responses both at (f) and (g) are mirror-images of each other, the emphasis on one would be equalised by the de-emphasis on the other. Here, then, we have the concept of basic equalising, the two responses together giving an effective straight-line output.

It is often difficult for the beginner to know exactly whether a programme source is causing over-emphasis of the bass or treble or whether, in fact, the response of the selected programme channel of the tape recorder itself is flat or emphasised bass- or treble-wise.

As intimated, over-emphasis could lead to over-recording at the high or low end of the audio spectrum, and this is not normally indicated on the record level indicator, as this often responds to the *mean* of the level of the sound signal applied to the record head.

At this juncture it must be made clear that the responses shown in fig. 6 and all the remarks in the foregoing paragraphs do not relate to the internal equalising within the tape recorder itself, nor to any equalising which may exist in the channel from which the programme signal is derived. So far, we are considering the nature of the signal in terms of frequency at the *output* of the programme source and the sensitivity, relative to frequency, of the tape recorder *input*.

The 'Gram' input

Now to get back to the problem of making a tape record from a disc record. As we have seen, many machines have a 'radio' input of high impedance and which needs some 200 mV to load fully. Instead of an ordinary radio signal obtained by one of the methods detailed in last month's article, we could connect to this input the signal which appears across the volume control of, say, a radiogram or record reproducer (see fig. 4, last month). In that way we could record a disc record equally as well as we can record a radio programme. Remember, though, that many inexpensive record reproducers (and radiograms) have mains-connected-chassis, thereby making it necessary to use our old friend the 1-to-1 ratio isolating transformer.

Some crystal pickups give an output across a high impedance equal that of the sensitivity of some 'radio' or 'auxiliary' tape recorder

(Continued on page 154)

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TOWARDS BETTER TAPING—Contd.

inputs, and such pickups can, in fact, be connected direct to that socket for making a tape record of a disc record; that is, with reservations.

One is that the output voltage from the pickup must, of course, be sufficient to give full recording modulation, as shown on the record level indicator, and another is that the output from the pickup must be 'straight' frequency-wise. Crystal pickups working across a high impedance load (0.5 megohm up to about 2 megohms, depending upon the type) give an output which calls for little or no equalising, meaning that we get the effect similar to that shown in fig. 5 by direct connection.

Magnetic pickups, however, need an equalising network interposed in their output leads, as also do some crystal and ceramic pickups working into a medium-impedance load. Without equalising on this kind of pickup, we would get the response combination similar to that shown at fig. 6 (b), where there would be an abundance of treble and not much bass.

When an equalising network, which usually consists of a resistor-capacitor network, is connected between the pickup and the tape recorder input socket, the pickup signal is attenuated or reduced in level and if the pickup output when unequalised is only just sufficient to drive the recorder, when the network is connected it may be found impossible to push the recording up to full modulation on the record level meter or indicator.

As a result, the background noise would probably be high on replay (see last month's article) and one may then be tempted to delete the equalising arrangements to secure greater modulation. Here, then, are some of the problems connected with plugging a pickup directly into the tape recorder. (Also, readers are warned that the Copyright laws make the re-recording of commercial discs without permission an offence—Ed.)

Low-Level High Impedance Input

Note, though, that on some machines the *microphone* input socket is at high impedance with a sensitivity of from about 2 mV up to 10 mV or thereabouts. Such an input would probably be used for the connection of a crystal or ceramic microphone, which is of high or medium impedance at low-level output.

Eliminate the Tone Control

Quite reasonable results have been obtained by plugging into a socket of this kind a crystal or ceramic pickup, and provided the input impedance is high enough, equalisation is not needed, as has already been explained.

By far the best idea is to take the disc record programme signal from across the volume control of a record reproducer or, indeed, from the 'monitor' output of a hi-fi pre-amplifier or control unit. A point to note here is that the programme output signal should be extracted *before* any tone control networks, where the signal output is 'flat' (see fig. 5). If the signal is extracted after the tone controls too great an emphasis on bass or treble may result on the tape, remembering that tone controls are included essentially to correct for room acoustics.

Pre-amplifiers and control units designed to cater for supplying a signal input to a tape recorder have the 'monitor' (so-called) socket connected before the tone controls. This means that the programme can be listened to normally from the loudspeakers with the tone controls set to suit the conditions of the listening room, while the same programme signal fed to the recorder remains uncorrected.

If one is lucky enough to possess a machine with mixing facilities, then in addition to the signal from, say, a radio or disc record, a signal from a microphone can be recorded upon the tape simultaneously. The question of mixing, however, will be considered in greater detail in a future article, as also will the connection of external loudspeakers, which cannot be looked at this month—after all—owing to a lack of space.

SUBSCRIPTION RATES

The Subscription rate to *The Tape Recorder* is 30s. per annum (within the British Isles) and 32s. 6d. per annum overseas (U.S.A. \$4.50). This includes a free copy of the annual index. The same rates apply to *Hi-Fi News*.

The Tape Recorder, 99 Mortimer Street, London, W.1

Readers' Problems

A Novel Use For the Gramdeck Pre-Amp.

Dear Sir, I am the owner of a Philips EL3541/H recorder, which has facilities for stereophonic playback with the aid of the EL3774 pre-amplifier. The output of the stereo socket is 1 mV at 1 Megohm.

As I already own a Gramdeck pre-amplifier, would it be possible to use this with a matching transformer instead of the Philips pre-amp? Yours faithfully, R. W., Barnsley.

It should be possible to use the Gramdeck pre-amplifier directly coupled to the Stereo socket of the EL3541, without a step-down transformer. If there is an impedance mismatch, it may be possible to overcome this with a series 470 K resistor and a 47 ohm shunt resistor across the Gramdeck input. Although the rated output at the stereo socket is 1 mV, this is at the test frequency of 166 c/s, and at mid-range there is more output available on playback, which should allow you to experiment with gain levels for stereo replay without the need for a transformer.

There is no harm in trying this, and it would be interesting to know the results of your experiment.

Speed Fluctuation on the RK3

Dear Sir, I would be grateful if you could help me with a problem regarding my Robuk RK3. It was recently overhauled by the shop where I bought it, but the trouble remains.

The sound is un-natural on 3 $\frac{3}{4}$ i/s and the tape sometimes stops and will only re-start on depressing the stop button followed by the record or play button. The trouble is also apparent on 7 $\frac{1}{2}$ i/s but to a lesser extent. Sustained notes are 'funny', the tape stopping momentarily but starting on its own at this speed. I would be very pleased for any suggestions on how to cure this extreme 'wow'.

Yours faithfully, D. C. T., Cardiff.

Your problem appears to resolve to a lack of capstan roller pressure on the Robuk RK3. I am surprised that your dealer has not successfully located and cured this. The usual cause is a sticking slide lever, the lever which engages the underside of the pressure roller bar. Remove the top plate and you will see a slotted slide in which the tape guide pin travels. Clean this off thoroughly, regrease very lightly and switch to Play and Off alternately several times, aiding the lever travel with your fingers. Make sure the 4BA locknut is correctly positioned.

A further trouble that aggravates this fault is a spool binding on the rather loose top-plate. Cure is to raise the spool carrier. You will note securing screws near the top edge of the carrier hub, accessible from above if you raise the hub spindle slightly with your fingers. You need a good screwdriver— $\frac{1}{8}$ in. blade, about 6 in. long, for this job. Don't damage the screw heads, they are the very devil to get out when scarred.

Building a Stereo Recorder

Dear Sir, I am thinking of building a stereo tape recorder, using the Magnavox Studio tape deck fitted with Marriot Series X $\frac{1}{2}$ -track heads, and two Ultra-Linear LT45X tape amplifiers, connecting one to the upper track and one to the lower. Could you please tell me whether this would be a satisfactory method, as the LT45X is designed primarily for $\frac{1}{2}$ -track operation, having an input sensitivity of 2 mV and an erase voltage of 20V.

I have already been in touch with the manufacturers, but their answer was as follows—"This amplifier is intended for use with the Studio deck, and if these heads are standard it should be satisfactory. There are no track-switching facilities".

You will appreciate that this reply did not really answer my query as the standard heads on this deck are usually the Bradmatic $\frac{1}{2}$ -track; and in any case the question of track switching facilities did not arise in the set-up I had envisaged. I would be extremely grateful for any assistance you could give me in the matter.

Yours faithfully, S. P. R., Gorleston-on-Sea.

There would seem to be no objection whatever to your coupling your two Linear amplifiers to the Marriot $\frac{1}{2}$ -track heads in the way you describe.

The manufacturer's reply, interpreted, implies that the amplifiers are capable of adaptation, even if the heads were not the standard type used with

a Studio deck—but makers are notoriously cagey in advising where other people's equipment is concerned. It so happens in your case that the heads are standard, so you could go ahead. You may find that you have a little too much treble boost with $\frac{1}{2}$ -track heads, but the amplifier can take care of that. If you could first check by playing back a test tape, then record, with the amplifier set up as for the best playback, any small change you may wish to make would only involve adding a little resistance to head feed or more capacitance in bias take-off. You may want to increase the by-pass of the cathode of the 2nd stage—but this is a matter for experiment.

Capacitive Cross-Talk

Dear Sir, I am using the Akai 33D with Akai pre-amp R 220-S Akai power amp SM40, and am writing to seek your assistance and advice to help solve a difficulty which, so far, has baffled me.

I find that when I playback $\frac{1}{2}$ -track mono tapes I get a leakage of music from the parallel track (not from the reverse track) that is, if I am playing Track 1 I can hear music coming in from Track 3 and vice-versa. Similarly, if I playback Track 4 I can hear music from Track 2 and vice-versa. I think this is rather different from cross-talk which concerns adjacent tracks.

The leakage is apparent on $\frac{1}{2}$ -track mono tapes recorded on the Akai and even those recorded on the Sony 521 and the Grundig TM64. These same tapes play perfectly on the other machines.

I have checked the selector switch carefully but could find no fault—also the circuit of the pre-amp and the connections from the playback head. Our tests showed that the offending head was somehow giving a signal even when it was supposed to be switched off—and the signal was only killed if the head connection was disconnected from the deck or the volume control for that track was set at zero.

It was suggested that the playback head might require re-aligning—and I read your advice to M.G.O. Huddersfield under Reader's Problems in your October 1963 issue—but this also did not cure the leakage. I shall feel indebted for your advice in this matter and look forward to your reply.

Yours faithfully, A. E. R., Calcutta.

We would not think that you have a misaligned or faulty head, but that this problem derives from the system of head switching. The unused coil is still connected to the track switch. Capacitance of the leads is such that pick-up between adjacent leads is made possible. You may find that re-dressing the leads between heads and track switch will improve things; but we would favour an alteration in the wiring which short-circuits the unused coil. You can do this by changing the track selection circuit so that the ground end of each coil is commoned, and the upper end taken to the outer poles of the double-contact switch, so that the feed line, now lined at outer ends, connects the appropriate track winding, and the other winding is shunted across.

Setting the volume control of the unused track to zero is the correct procedure when playing back $\frac{1}{2}$ -track mono, and is a better method of reducing the fault than making the above modification. With gain control advances, the high efficiency of the pre-amplifier circuits makes it inevitable that even a very small signal will be amplified sufficiently to be discerned.

(Continued on page 169)

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by H. W. Hellyer

TAPE RECORDER SERVICE

THERE are many different 'miniature' tape recorders on the market, from the eavesdropping plaything that is sold by its novelty value, to the tycoon's status symbol that is a conventional built-in extra with the company car. Perhaps the most well-known is the Stuzzi *Memocord*, which originally appeared under the publicity slogan—"The World's First Pocket Size Tape Recorder".

From the servicing aspect, reduction in size often brings increased worries. Opening one of these midgets can require the finesse and precision of a locksmith; luckily, Stuzzi have been in the electro-mechanical business long enough to avoid the more obvious pitfalls, and the *Memocord* is a fairly straightforward recorder.

This is a single speed machine, with the tape driven directly, the motor pulley acting on a recessed tyre in the flywheel, as shown in fig. 1. The flywheel is pivoted to engage the spool carrier. The resultant speed varies according to the amount of tape on the 100 ft. spool, and is a mean value of $1\frac{1}{3}$ i/s. At 15 minutes for each of the four tracks, this gives a full hour's playing—time enough for our busy executive to learn his after-dinner oration.

Standard Battery Supply

The batteries used are standard types: 9V for the three-transistor amplifier, and 1.5V for the motor from a penlight cell. Motor current is approximately 65 mA and the amplifier battery has to deliver only about 11 mA. This will give a playing time of up to 12 hours, depending on the periods of use. To get the most from the batteries, it is necessary for the motor tension to be accurately adjusted. A compensating resistor is inserted in the motor feed, however, which enables the speed to be adjusted by keeping the battery voltage (applied to the motor via the slider resistor) down to 1.1V. Normally, the slider is within the first third of its travel from red to green. The motor is sprung into engagement with the flywheel, and the pressure should be such that 40-50 gm. tending to hold the pulley off the tyre will just permit drive. Any greater pull should decouple the motor. The holding spring can be adjusted for this tension.

The flywheel position is also important for correct driving torque. The flywheel axle arm must be vertical to the chassis and the engagement spring should be set so that torque in both directions lies between 100

and 150 gm. This is measured by loading an empty spool and hooking a spring balance to a loop in a single turn of cord, and the measurement should be done with the track switch in the 1-4 position.

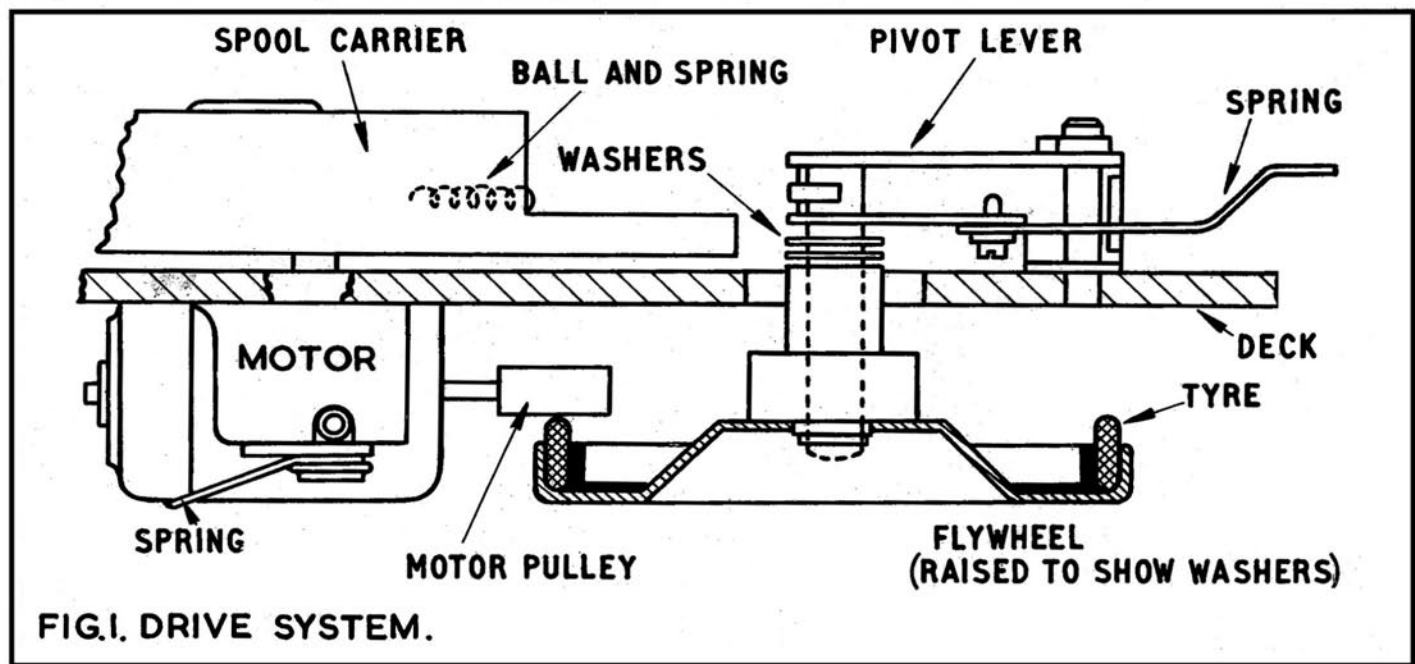
Ingenious Tracking Arrangement

The track switch is an ingenious arrangement which shifts the head plate bodily to place the appropriate track in line with the tape. Apart from noting that the lever has full travel, there is no need for other adjustment, but the final position of the heads themselves is made by bending the plate on which they are mounted. After this, the pressure pad can be set to give correct placing against the head facing. There is no withdrawing action of the pressure pads, as with conventional mechanisms, and for this reason, the setting of the pressure pad is of even greater importance than usual. Any complaint of tape-squeal usually indicates maladjusted pressure pads on these models.

Before leaving the subject of the tape drive, it is well to mention the axial play of the flywheel, which sometimes causes bother. It should be about 4 thou. Less than this should be suspect, and the mounting washers will have to be inspected. On earlier machines these were fibre and it may be as well to replace them with the metal types used on later production runs. It saves wear and tear, and again, improves battery life.

No Need for Brakes

The direct drive used on machines of this nature means that there is no need for brakes, clutches or even a pinch roller, and in some respects this simplifies the servicing problem. In others, of course, it makes it even more important to ensure that the drive is as perfect as can be. For example, the makers stress that speed should be checked with a stroboscopic disc. The disc is mounted on the flywheel, and can be calculated with reference to the frequency under which it is illuminated: for 50 c/s mains, 63 black and 63 white segments will indicate a flywheel speed of 95.2 rpm when in synchronism; for 60 c/s mains, 76 each segments give 94.6 rpm indication. This is approximately equivalent to a spool speed (the driven spool) of 18 rpm. When adjusting the slider mentioned formerly, to obtain these conditions, always ensure that the battery voltage is correct.



Removing the Motor

To remove the motor, it is only necessary to remove the front cover by opening out the spring clip at either side, disconnect the four wires from the heads and two from the motor, marking the connections for identification, removing two circlips at the rear of the printed circuit panel, two circlips near the motor, the retaining plates and the spring. When this is done, the motor, with its nylon housing, can be removed. When refitting, reverse this procedure, but remember to check the tension adjustments and measure the motor current.

A great deal depends on these adjustments; although one is hardly likely to bother about wow and flutter, or worry overmuch because the frequency response, specified at 400 c/s to 3 Kc/s, is only meant to cater for speech.

Several Interesting Features

Electrically, the Memocord has several interesting features. Although it is only a three-transistor circuit, the output is rated at 20 mW into 24 ohms. The internal loudspeaker also acts as moving coil microphone when the machine is switched to Record (red button pressed). External microphones can be used, and quite a wide variety of accessories are available from the distributors—Recording Devices Ltd., 44 Southern Row, Kensington, London, W.10. The input level is 0.3 mV, and the input impedance, 3 K.

To check sensitivity, a 1 Kc/s signal should be fed into the input via a series resistor of 100 K. The input level (at the generator) is set to 4 mV, the machine switched to Record, and the output at the OC72 collector measured. This should be 2V. The next step is to switch to Playback and check the output from the fully modulated tape. Within 10% of 3V should be obtained at the same measuring point. The sensitivity can be set by adjusting the 220-ohm preset which is accessible through the printed panel, near the output socket, for this playback voltage. It is important to note that this must be done with a tape modulated in the way noted above: the reason is that the insertion of the input plug removes a 47-ohm resistor which is used to damp the internal microphone and cut down motor noise. Actually, there is very little noticeable noise under good conditions, and the rated figure of 60 mV across a 30-ohm resistor at the output socket, measured with no signal, is on the modest side.

No Oscillator

Correct erasure is important, and here we have another of the Memocord's individual features. The coils of the erase head are energised across the motor supply, and the correct current in each coil should be 6 mA. The action of the track switch mechanically places the appropriate gap in position. This means that there is no oscillator, and recording bias is obtained by omitting the feed capacitor to the R/P head, and thus obtaining a measure of DC bias. One point to note about this type of circuit is that a lack of erasure may indicate that the motor battery is low, and have nothing to do with the amplifier at all.

Another factor that can be misleading is the apparent difference in volume between the four tracks. As noted above, replay output is preset, and volume control is automatic, but because of the difference in speed between opposite ends of a spool of tape, the take-up spool being directly driven, the recorded volume may appear to differ when changing tracks at the end of a run of tape. To compare, always check the playback of a 'standard' input at a rough mid-tape position.

Remote Operation Facilities

A special socket is fitted to allow the machine to be operated by remote control. If the motor fails to run, or the flywheel appears to bind, check this socket, to make sure the contact is good. After this, look to the flywheel mounting, as mentioned formerly, and the fibre washers. It may also be necessary to allow for wear of the flywheel insert tyre by roughening the motor pulley slightly, but this is not a course to be recommended. The usual symptom here is that the motor runs, if intermittently, but the flywheel does not adequately drive the spool. The spool hubs can be lubricated with a light grease or medium oil, but great care must be taken to avoid getting lubricant on the flywheel tyre.

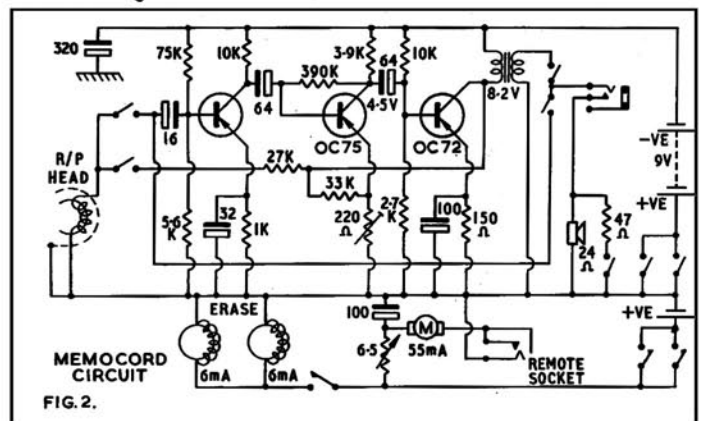
Differences Between Models

There are some differences between early models and the later production runs. On the first Memocords, it was necessary to hold down



the red button continuously while recording, and when the button was released, both motor and amplifier circuits were disconnected. This was a simple safety measure which was superseded by a more practical record lock on later machines. Depressing the white or cream button for replay was a normal hold action which is neutralised by a touch on the red button.

On later models, the microphone is mounted on the cover plate instead of on the printed circuit panel as previously. One washer and screening can be omitted when this form of construction is employed. For most interview work, an external microphone is an advantage. Among the accessories are two very useful external microphones, one of them a hand microphone-cum-loudspeaker and the other an unobtrusive lapel microphone. An extension loudspeaker is also available, and single and double earphones, plus the usual telephone adaptors, remote control and transcription lead. The tape supplied with the Memocord is numbered for position placing, but is a standard 1/2 in. width, and spools are easily replaced. When new tape is fitted, the wording should be at the top. First, it is necessary to wind the tape to the top spool, then put the track switch in the Track 4 position, undo the screw and take off the cover, remove the tape from the guides and remove both spools. These simply pull off, being retained on the hubs by a sprung ball which bears against the inner hub of the spool. When the new tape is fitted, it can be placed in the guides and run over the head path, but care must be taken to hold the pressure pad clear, as this does not withdraw. Gently does it, for the pressure pad tension is another important factor for successful use of this handy little device which one executive has called "the notebook of this automated age".



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MONARCH WORKS, OLD HILL

our readers write

... about a modification to the TK1

From: G. E. Richardson, 378 Whippendell Road, Watford, Herts.
Dear Sir, Owners of the Grundig TK1 battery recorder may be interested to know that it is possible to monitor via headphones from two points on the speaker transformer.

Two wires soldered to the lugs can be routed inside the case to a convenient hole in the microphone compartment. A small plug and socket arrangement fitted here will give the user the added facility of being able to monitor recordings as they are being made—without experiencing troublesome feedback that occurs if the signal is monitored through the loudspeaker. The playback volume control should be turned right down as the signal in the headphones is controlled by that controlling recording gain level.

Yours faithfully.

... about 'a squeaking effect'

From: 588026 Cpl. J. E. Lane, Arm. Serv. Flt., Armament Squadron, Royal Air Force, Khormaksar, BFPO 69.

Dear Sir, Referring to 'A Squeaking Effect' (Readers' Problems, February) I have owned a Sony TC500 stereo tape recorder since it first became available in December of last year. After some use I experienced a similar fault to that of D. D., Tottenham, a squeak occurring about once a second, affected by the volume controls, and also audible, faintly, from the region of the heads.

As this is my first ever tape recorder, I have been lubricating and cleaning as per the handbook, and had but recently given it a check over. Although the local agent has a Japanese technician from Sony available in case of trouble, I thought it better to check my own work first. Sure enough, I hadn't adequately cleaned the felt pad that bears on the tape guide preceding the heads on playback. This appeared alternately to pinch and release the tape, causing a vibration along the tape under tension between the reels. The head picked it up, and it became annoyingly obvious at the speakers.

Although Sony recommend 'denatured alcohol' I had to use surgical spirit, applied with a handkerchief, which cleared the trouble completely. Now that I know what to look for I've had no further trouble. In fact apart from this minor snag, and the necessity for getting the 'feel' of the playback rewind control I am very satisfied with the machine. If the play-wind switch is moved between positions quickly, the reels tend to over-run, the tape slackens, and in extreme cases allows the automatic shut-off switch to operate. Moving the knob smoothly gives the feel of the drive disconnecting and the brakes being applied, and everything works as it should. I believe this is due to the use of several rubber wheels instead of a belt to transmit the drive from the single motor, otherwise it seems a good system, particularly in this climate where belt-driven recorders seem to give no end of trouble.

In case the point arises as to why a raw amateur should buy a comparatively advanced machine: it has to last me a good few years so stereo is a must to my mind, I can expand the hobby more or less as I please with what is already built into the machine, and last but not least it costs £62 10s. here in Aden. A bit different from U.K. prices.

By the way, do other manufacturers supply with the recorder such items as screwdrivers, scissors, oil etc. together with patch cords as do Sony.

With reference to the letters on pre-recorded tapes, stereo and mono, in my opinion the Americans win hands down. Most labels are available here, and in particular, Columbia get my vote.

Yours faithfully.

... and the trials of a tyro

From: G. A. Brewster, 5 Dagger Lane, West Bromwich, Staffs.

Dear Sir, Being a regular reader of your magazine, though I must confess that I do not understand the technical details, I thought the trials of a starter in the art might be of interest to your readers. I own a Philips mains machine, plus a Stella battery portable, and collect mostly music, of unusual instruments whenever possible.

It started in 1959 with a premium bond; I had £40 so looked around for something of about that price. What I was looking for I could not say, but I finished up with a £70 model, that was going cheap in a stock-taking sale. The reason for this was that though brand-new and complete with twelve-month guarantee, it was out of date by some

three or four years. It looked good to me, and as luck would have, with certain limitations, it was.

The recorder in question was an Elizabethan, fitted with the early Collaro Transcriber that plays and records in both directions, and weighs 40 lbs! After the usual period of noises, voices and music from the radio, I got the hang of it—and then ran into trouble.

First it would not run in one direction at all, but that was put right by the local service agents; the next was more difficult. If a recording was made, it would play in either direction using one of the two sets of heads, but if the other set was used, it would not record properly. If the tape was turned over, cross-talk was heard.

At this stage, I repeat, I was ignorant of all aspects of these machines, but having read somewhere of print-through, I started recording at half-level, but with no improvement. I sent it back to the shop but, on its return, a week later, it appeared to be no different. Next the local service agents had it, but they too seemed unable to find a cure. I decided it was not worth bothering about, as I could use the heads that did behave, so continued in this manner for about a year.

What happened next increased my knowledge of tape recorders (and of service agents too I might add). While cleaning the deck with the machine playing I noticed that if I pushed the tape down a fraction of an inch, the volume increased. The two heads on that side were low, so I unscrewed them, inserted small brass washers under each screw, and the trouble was cured.

But what were the engineers doing that they did not notice this misalignment—a not uncommon fault?

I used the machine until I bought the portable, when I discovered the Elizabethan would not erase tapes made on the new machine, and also the motor bearings were getting a bit noisy.

I now have many tapes of interest (to myself anyway), and marvel at the number of people I have come across who have had machines for years and still have only the original tape that came with it; some do not even use that any more!

Yours faithfully.

... about the wild-life recording competition

From: D. C. Burton, 40 Western Gardens, London, W.5.

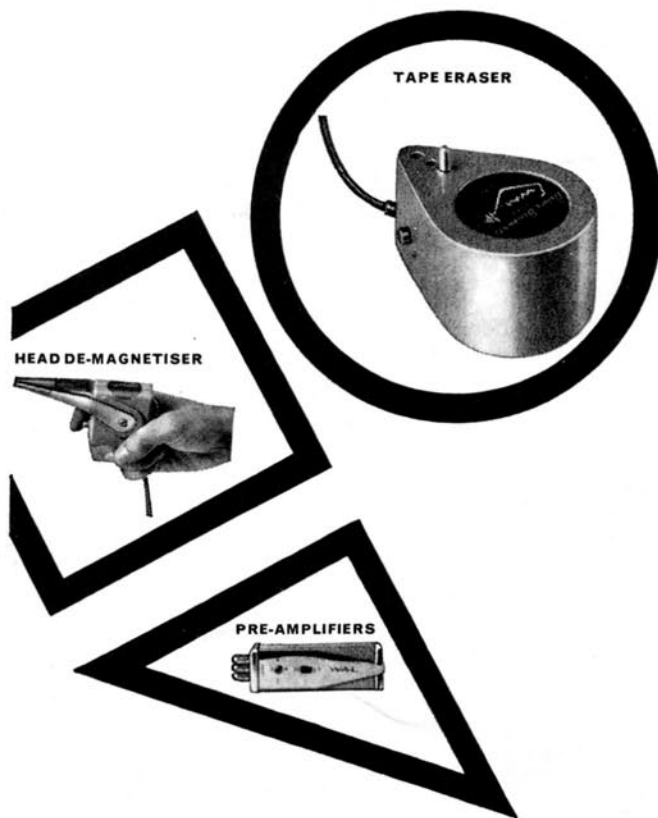
Dear Sir, With reference to the recently announced BBC recording competition—when it was announced, the competition seemed to be just what so many of us had been waiting for, and it was a bitter disappointment to find that 3½ i/s was ruled right out.

Yours faithfully.

Tape Equalization Table

This table was unfortunately omitted from the short feature on page 119 last month—'Notes on Standard Tape Equalization Characteristics'. We apologise for the inconvenience caused through our oversight.

CCIR	Time Constant	Turnover Frequency $Xc=R$	Curve
15 i/s	35μ S.	4.5 Kc/s	G
7½ i/s (old)	100μ S.	1.6 Kc/s	D
7½ i/s (new)	70μ S.	2.6 Kc/s	E
3½ i/s (old)	200μ S.	800 c/s	B
NAB			
15 i/s	50μ S.	3.2 Kc/s	F
7½ i/s	50μ S.	3.2 Kc/s	F
DIN (New)			
15 i/s	35μ S.	4.5 Kc/s	G
7½ i/s	70μ S.	2.6 Kc/s	E
3½ i/s	140μ S.	1.3 Kc/s	C
	3180μ S.	30 c/s	
Non-standard			
1½ i/s	280μ S.	680 c/s	A



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*Telefunken 98 4 Tr. St. ... 95 gns.
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Distributor: S. Brown, 42 Queens Drive, Mossley Hill, Liverpool 18.

Philips EL3548

INTRODUCED at the April Audio Fair, the new *EL3548* is styled after the larger *EL3549*. The frequency response at $3\frac{1}{2}$ and $1\frac{1}{4}$ i/s, is claimed to be 60 c/s to 13 Kc/s, and 60 c/s to 10 Kc/s respectively, ± 3 dB. Output power is 2.5W, supplied to a 6 x 4 in. elliptical speaker which is muted when replaced by external speakers. Five-pole DIN sockets provide a total of three inputs (diode, gram, and microphone), and three outputs (diode, headphone, and a stereo outlet which, when used in conjunction with the *EL3787* pre-amplifier and an external power amplifier, permits replay of stereo tapes). The extension speaker socket is a 4 x 19 mm. two-pole.

The recorder is equipped with facilities for inter-track recording and 'parallel-playback', permitting simultaneous replay of tracks 1 and 3, or 2 and 4. Wow and flutter is specified as better than 0.6% peak-to-peak, and the retail price is £40 19s.

Manufacturer: Philips Electrical Limited, Century House, Shaftesbury Avenue, London, W.C.2.

Ampex Produce Educational Recorder

A TWIN-CHANNEL recorder for language laboratories and general educational use has been produced by Ampex. Engineered to withstand abuse and continual operation, its electronic components are guaranteed to give 50,000 hours of service—more than five times the life of the average domestic recorder. The E-65 contains fully transistorised amplifiers and internal speaker.

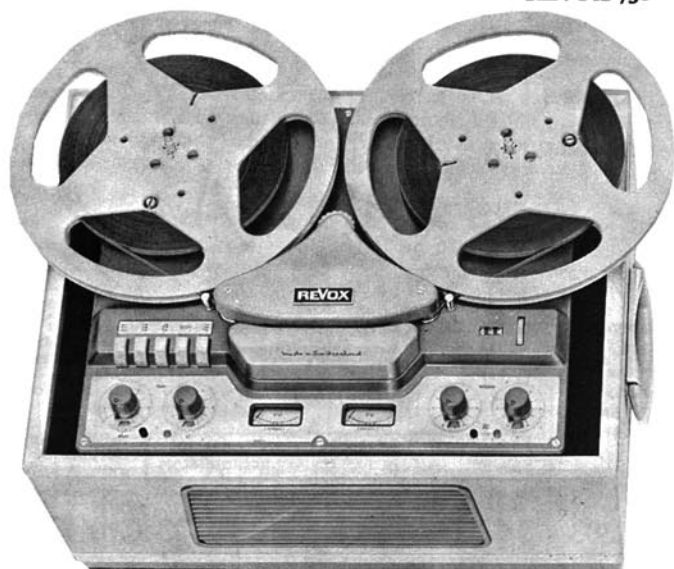
Manufacturer: Ampex (Great Britain) Limited, 72 Berkeley Avenue, Reading, Berkshire.

A New Revox

EXHIBITED for the first time at the London Audio Fair, the 736 is designed for stereophonic recording to the new CCIR characteristic of 70 and 140 μ S, and has speeds of $3\frac{1}{2}$ and $7\frac{1}{2}$ i/s.

Several improvements over previous models include facilities for taking NAB, as well as standard, tape spools of up to 10½ ins. diameter. A selector switch allows the feed-tension to be altered to suit different spool sizes. Dual Vu-meters replace the cathode level-indicators and an even more consistent tape transport is claimed, as a result of several mechanical alterations.

Double-track and ¼-track versions are available, fully equipped for twin channel recording but requiring an extra mono amplifier for stereo replay. The internal amplifier, claimed to have 1% distortion at 6W, can be switched to either channel, or can be used to replay both



tracks simultaneously. In chassis form, the unit retails at £124 19s., and in cabinet form—£132 6s.

Distributor: C. E. Hammond Limited, 90 High Street, Eton, Windsor. (Note change of address).

Dual TG12A

INTER-TRACK transcription and ¼-track stereophonic recording are two of the features offered by the new Dual *TG12A*. Complete with playback power amplifiers, it has a maximum output of 3W per channel, and speeds of $7\frac{1}{2}$, $3\frac{1}{2}$, and $1\frac{1}{4}$ i/s, with a frequency range of 40 c/s to 20 Kc/s, and claimed flutter figures of 0.15% at the former.

Two 7 x 5 in. elliptical speakers are incorporated, which form the base and lid when the recorder is not in use. They can be detached to give a good stereo image.

Included in the range of accessories available for the *TG12A* are several microphones and an impedance matching unit permitting the use of long recording leads with the 10 Megohms input. Two other inputs are included, for radio and pickup. Various mono and stereo microphones and headphones are available. With a maximum spool size of 7 ins. the recorder has a rewind time of two minutes for a 1,200 ft. tape, and weighs 32 lbs. The dimensions are 15½ x 13½ x 10½ ins. and the price is £98 15s.

Manufacturer: Celsa Electric Co., Celsa House, Kelway Place, London, W.14.

PHILIPS EL3548



(Continued overleaf)

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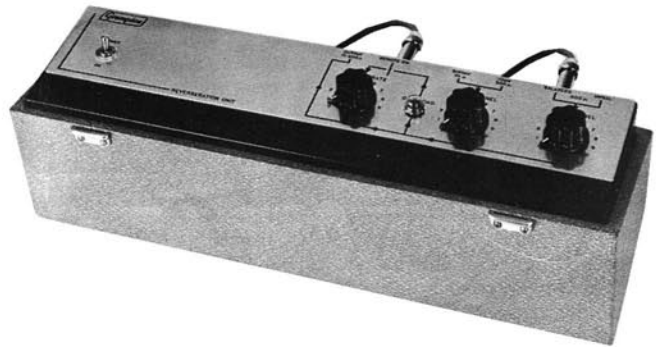
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NEW PRODUCTS—Contd.

Gramplan Echo Unit

DESIGNED to 'bring to life' recordings made in acoustically dead conditions, the Gramplan Reverberation Unit was introduced along with a range of amplifiers and equipment mainly for use with guitars.

Two separate input channels are provided, one low-level, low-impedance, intended for moving coil or ribbon microphones, and one high impedance channel, for guitar or gramophone pickups and tape pre-amplifiers. An adapter is available for mains operation of the transistorised battery-powered unit.



The level of echo is varied by a control which alters the ratio between reverberant and direct sound. The input signal is split along two paths, one of which receives delaying treatment before merging once more with the unaltered signal.

Weighing 12 lbs., and finished in a grey vinyl covered wooden carrying case, the unit retails at £49.

Manufacturer: Gramplan Reproducers Limited, Hanworth Trading Estate, Feltham, Middlesex.

* * *

A.K.G. Dynamic Microphone

POLITECHNA recently announced a series of new microphones including the D9C omni-directional dynamic. Retailing at £4 14s. 6d., it is available in both high and low impedances. A transformer is available for matching long leads with high impedance amplifiers. Other



★
 AKG
 D96
 ★

accessories include a floor stand, clamp stand, and flexible microphone shaft.

The frequency response is 80 c/s to 12 Kc/s, ±4 dB and the dimensions are 2½ × 2½ × 1½ in.

Distributor: Politechna (London) Ltd., 3 Percy Street, London, W.1.

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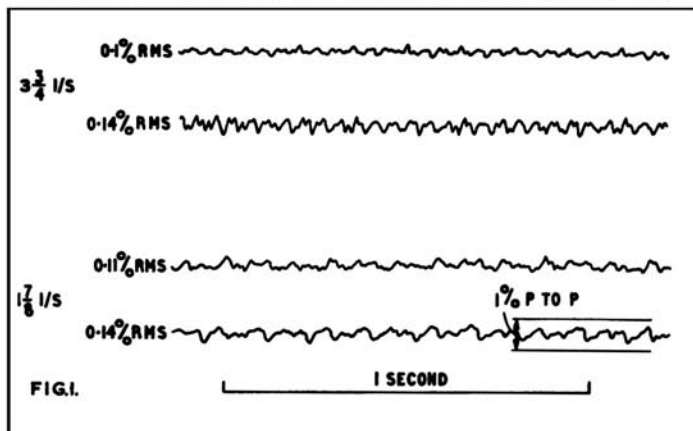
EQUIPMENT REVIEWED

GRUNDIG TK6



Manufacturer's Specification: Current: battery set (six monocells or car battery 6.3V minimum), mains supply (with electronically stabilised power pack for 110/220V, 50 to 60 c/s built-in). **Fuses:** size 5 x 20 mm. semi-surge resisting, 110V-80 mA, 220V-35 mA. **Consumption:** approximately 6W. **Transistors and diodes:** AC116, 2-AC117, AC121, 4-OC304, OC306, OC318, TF78, Z8K, OA70. **Rectifiers:** B30, C600, E12, 5C40. **Standards:** international 1-track. **Tape speeds:** 3 3/4 and 1 7/8 i/s tolerance according to DIN 45511, with dual electronic stabilisation. **Frequency range:** 50 c/s to 13 Kc/s and 50 c/s to 9 Kc/s tolerance according to DIN 45511. **Dynamic range:** 48 dB and 43 dB according to DIN 45405. **Wow and flutter:** ±0.2% and ±0.4% measured with EMT418. **Recording-playback time** (full 4 1/8 in. reel of triple-play tape), 2 hours at 3 3/4, 4 hours at 1 7/8 i/s. **Level and charge indicator:** moving-coil meter. **Inputs:** battery external source, minimum 6.3V, maximum 11V. **Radio:** 5 to 100 mV at 10 K. **Microphone:** 0.3 to 20 mV at 10 K. **Phono:** via socket adaptor 292, 50 to 1,500 mV at 500 K. **Outputs:** Amplifier—approximately 550 mV at 18 K. **Loudspeaker:**—approximately 5 ohms, switchable. **Push-pull output stage:** automatic output change at mains operation—1.6W. At battery operation—0.5W (economical circuit). **Dimensions:** 12 1/8 x 5 1/8 x 9 1/2 ins. **Weight:** 14 lb. **Price:** £68 5s. **Manufacturer:** Grundig (Great Britain) Limited, Newlands Park, Sydenham, London, S.E.26.

As will be seen from the photograph, this recorder has an upright styling, with the tape transport mechanism on one side and the loudspeaker on the other. With the front cover in place it is difficult to distinguish it from a better class transistor radio, and this impression

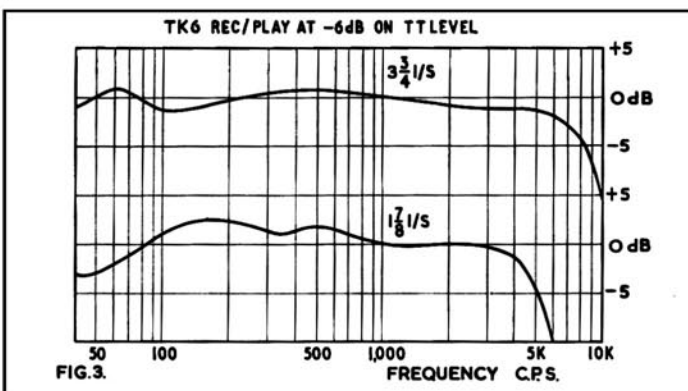
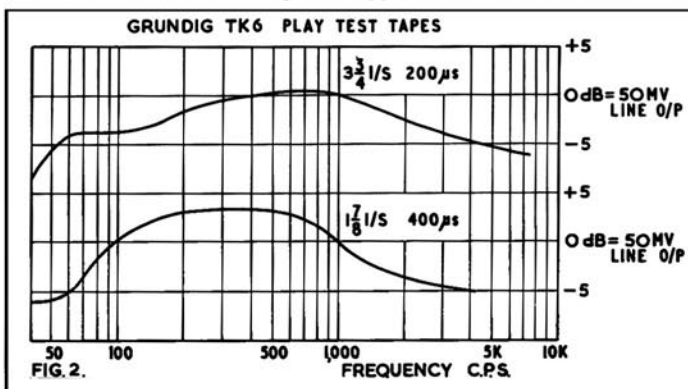


heightened by the special demonstration tape issued with each recorder containing 12 EMI top star recordings. With this machine the young teenager can have the Beatles on tap all the time, or the "top ten" can be taped and reproduced at high level on demand.

Seriously though, this instrument is beautifully styled and well engineered. With a complement of 11 transistors, a bridge rectifier, two diodes and a voltage reference zener diode, it is the most ambitious portable recorder to come our way, apart from one or two professional or semi-professional machines in the upper price brackets.

Speed Tests

The absolute tape speeds were checked with a Philips Tape Strobe and found to be exact at 3 3/4 i/s, and about 1 1/2% slow at 1 7/8 i/s. There was no appreciable drift in speed from beginning to end of a reel, and tests with an external DC power supply indicated that there was no



measurable change in speed over a voltage range of nearly two to one (6.5 to 11.5V).

Wow and flutter were measured by recording a 3 Kc/s tone at each speed and feeding the playback tone into a frequency sensitive circuit so that the short term speed fluctuations could be recorded on a high speed pen recorder to give the 'fluttergrams' of fig. 1. At the same time the flutter waveform was rectified to give an RMS reading for a bandwidth of 300 c/s. To check the Continental method of expressing wow and flutter I have marked ±0.5% or 1% peak-to-peak deviations on one of my pen recordings. It will be seen that there is a small cyclical speed variation at capstan or idler wheel frequency, but that the frequency is sufficiently high for the ear not to recognise it as a change of pitch. With RMS readings under 0.15% at both speeds, the wow and flutter performance can be considered eminently satisfactory.

Playback Response

The playback-only response of the recorder was checked by playing test-tapes recorded to known recording characteristics of 200 and 400 μs. The 6 dB step in the response curves indicates that the playback equalisation is approximately 100 and 200 μs. for tape speeds of 3 3/4 and 1 7/8 i/s, respectively. (Continued on page 165)

IN A WORLD OF SOUND



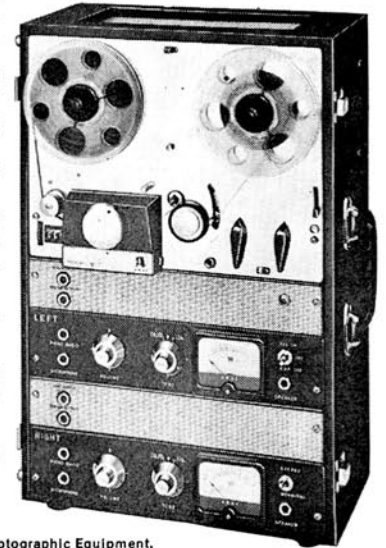
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EQUIPMENT REVIEWED — continued

System and motor noise was 32 dB below test tape level with no tape running. This reading was obtained after the machine had been in operation for about 15 minutes. On switching on from cold, transistor hiss, apparently from the first stage, was very audible, raising the measured noise level to only 23 dB below test tape level, but this noise dropped to a low level when the machine had been in operation for a few minutes.

Record-Replay Characteristics

The overall record-playback responses from radio input to line output are shown in fig. 3. These were recorded at 6 dB below test tape level to allow for the extra high note recording pre-emphasis used for the shorter time constant recording characteristic of this recorder. The responses do not meet the somewhat optimistic claims of the specification, but, in practice, they would satisfy everyone but the advertising copy writer!

A level 12 dB above test tape level was recorded without visible waveform distortion with the record level meter at nearly full scale; the end of the first red sector corresponds to a level 6 dB above test tape level. In practice, on actual programme material, the tape was fully modulated to 12 dB above test tape level on peaks when the meter needle kicked occasionally to the top of the red sector of the meter scale.

Acoustic Response

Bands of filtered white noise were recorded at $3\frac{1}{2}$ i/s, and the sound level on the speaker axis measured with a calibrated microphone to give the electro-acoustic response of fig. 4A.

Subjectively the response sounded well balanced with the speaker facing away from the operator due, apparently, to internal reflection and re-radiation from various parts of the case and covers. A further response was taken from the tape side of the machine, this is shown in fig. 4B. The actual response will depend to a large extent on sound reflection from surrounding surfaces, etc., and is likely to be somewhere between the two limits shown. (Note that response B has been displaced downwards by 10 dB on my graph for ease in plotting, and that the curves be coincident over the range .5 to 1 Kc/s.)

The microphone response was also plotted in a white noise sound field to give the response shown in fig. 5. The response is smooth and level over the range 200 c/s to 10 Kc/s.

Circuit Notes

The circuit consists of a pre-amplifier stage followed by a two-stage amplifier with negative feedback equalisation from the collector of the third stage to the emitter of the second stage. This is followed by a driver stage to feed the push-pull output pair. 10-ohm resistors are switched into the emitter circuits of the power transistors on battery operation to limit the collector current on peaks. A separate power transistor is used as a bias and erase oscillator, and a further buffer amplifier stage is used to feed the half-wave rectifier associated with the record level meter. Still another transistor is used as a series stabiliser for the 9V mains HT supply, a zener diode acts as reference. The DC motor governor circuit uses a further two transistors in the now popular HF control circuit; the motor governor contacts short out a winding on a high frequency oscillator to alter the amplitude of the oscillation. This signal is rectified to produce a DC bias on the control transistor in series with the motor winding.

Comment

The apparent complexity of the circuit really leads to a vast

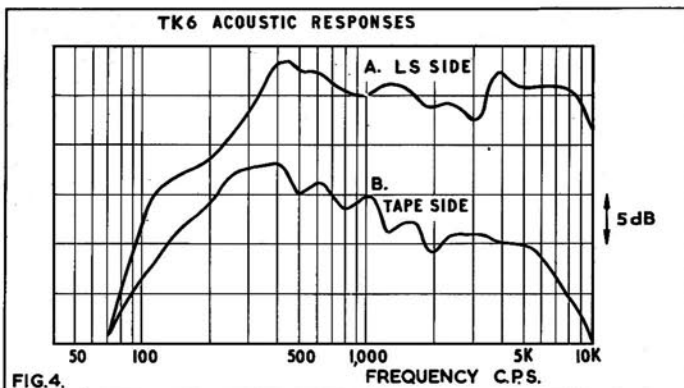


FIG. 4.

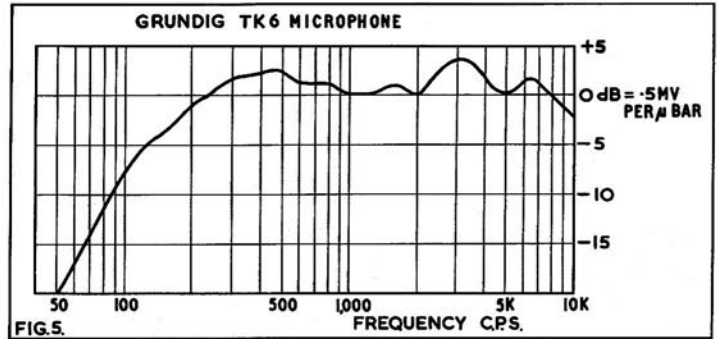


FIG. 5.

simplification in the testing or servicing of this recorder. In the same way, a quick count through the circuit diagram showed no less than 10 pre-set controls (mostly resistors, but a few coil inductance trimmers): these also allow the performance of each individual recorder to be matched to very close limits. Little details, like fitting ferrite beads on the motor leads to suppress radio interference, show that nothing has been spared to make this recorder the best of its type within its particular price range. **A. Tutchings**

ELECTRONIC WORLD TAPES

Distributor: De Villiers (Electronic World) Limited, 16d Stratton Ground, London, S.W.1.

EACH tape was recorded on a 0.1 in. head with a gap length of 0.5 thou., and simultaneously monitored on an 80 thou. head with a gap length of 0.2 thou. at a tape speed of $7\frac{1}{2}$ i/s. Equalisation was adjusted so that the reference tape gave a response level within ± 0.5 dB over the range 100 c/s to 10 Kc/s. The optimum bias for maximum output at 500 c/s on the reference tape was 3.75V. The recording current was maintained at a constant level and the gain of the playback chain adjusted so that the output was 0 dB on the reference tape.

A 10 Kc/s tone was recorded on each tape for a period of one minute. On playback the signal was rectified and fed to a high speed pen recorder to give the drop-out charts of fig. 1.

A is a Standard Play tape with a PVC base of 1.5 mil. and an oxide thickness of 0.5 mil. Short term drop-outs of up to 6 dB were

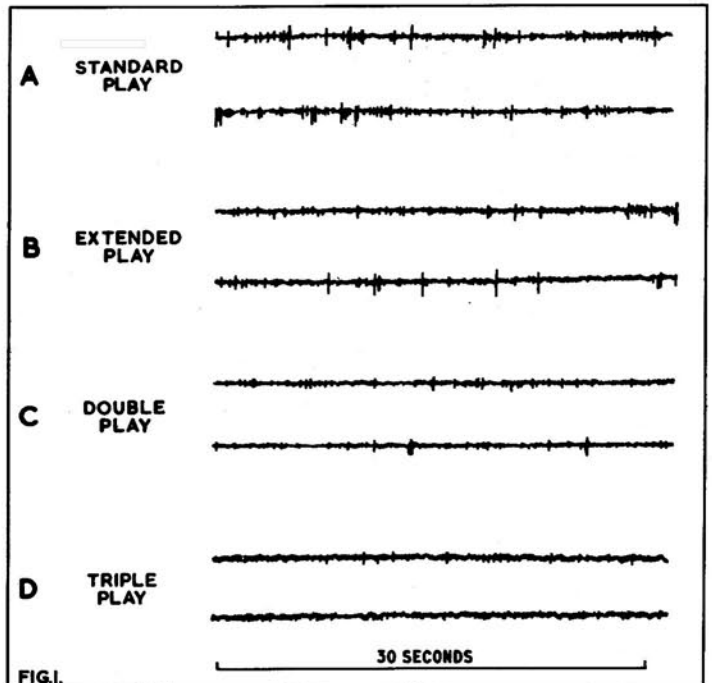


FIG. 1.

fairly frequent but this behaviour is typical of Standard Play tape, where the relatively thick base lifts the whole tape away from the head if a minute surface imperfection or dust particle comes between the head and the tape.

(Continued on page 167)



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EQUIPMENT REVIEWED — continued

B is an Extended Play tape with a polyester 1 mil. base and an oxide thickness of 0.5 mil. The thinner limper base can give slightly if a small bump comes along; the tape surface immediately adjacent to the bump is lifted from the head surface, but the remainder continues to make good contact with the head. The average drop-out is reduced to about 3 dB although there are the occasional higher ones as can be seen on the lower trace of this chart.

C is a Double Play tape with a 0.5 mil. polyester base and an oxide thickness of 0.5 mil. Most drop-outs are less than 3 dB and general amplitude modulation of the 10 Kc/s tone is very low.

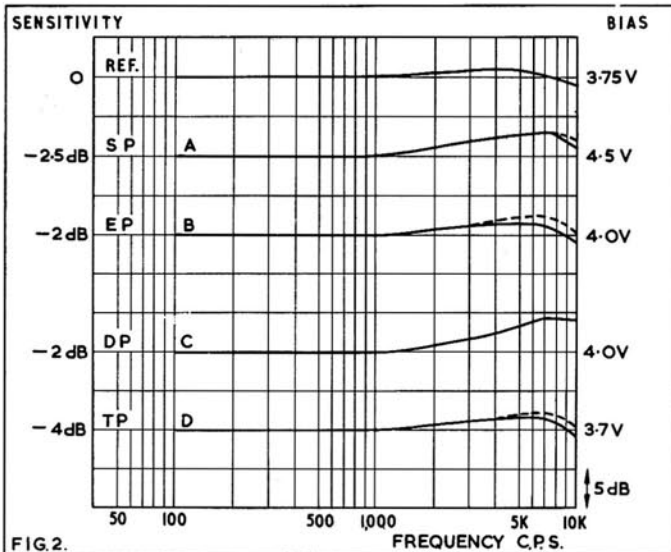


FIG. 2.

D is the new Triple Play tape with an overall thickness of only 0.7 mil. (I have no exact data here, but would guess that the base thickness is approximately 0.3 mil. and the oxide thickness 0.4 mil.). The one minute test shows no drop-outs exceeding 3 dB, but there is a high frequency amplitude modulation in the order of 1 dB which is of course completely imperceptible to the ear. It seems likely that the extremely thin, slightly elastic base could cause this effect, but it may equally well be small change in texture of the oxide layer in this particular sample.

Record Play Tests

The top response of fig. 1 shows the response of the reference tape at the standard bias of 3.75V. The sensitivity of this tape is taken as 0 dB.

The Standard Play tape **A** shows an improved high note response, a higher optimum bias of 4.5V, and a lower sensitivity of -2.5 dB. These measurements all indicate that the magnetic coercivity of this tape is higher than that of my reference tape. This means that print-through is likely to be less, but that both the signal current and bias must be increased by about 20% for best results with this tape.

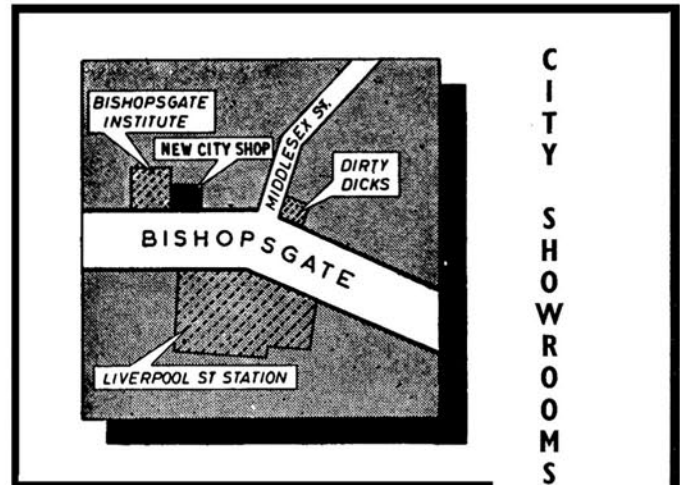
The EP tape needs slightly less bias than the SP tape at 4.0V, and the difference between this and the reference bias (about 7%) is not likely to be significant. The 2 dB difference in sensitivity compared with reference is also unlikely to be noticed, but the record level indicator on most recorders should be allowed to kick slightly higher to make sure that full level is recorded. On this particular sample there was a slight directional effect, i.e. the high note response was slightly better when the tape was moving in one direction.

The DP tape showed a marked rise in high note response with no directional effect and can therefore be recommended for use at low tape speeds or on recorders which require a little more high note response. Again, both bias and signal current should be increased slightly for best results.

The TP tape is 4 dB down in sensitivity on the reference tape and a further 2 dB down on the other tapes. This is almost certainly due to the reduced oxide thickness. The bias is fractionally below reference, and this again is due to the thinner oxide.

The signal current should be increased by 2 dB as for the other tapes as Peak level recording tests show that a level 12 dB above my test tape level is just on the verge of oxide overload. The 2 dB reduction in dynamic range is a small price to pay for the very extended playing time of this tape.

(Continued on page 169)



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EQUIPMENT REVIEWED — continued

Frequency response is slightly better than reference tape and there is again slight evidence of directional effect.

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Readers' Problems

Excessive Take-up Torque

Dear Sir, I own a Reflectograph Model 570 stereo recorder. In an endeavour to improve the wow and flutter performance, particularly at the lower speed, I have replaced the capstan idler, variable speed cone, and capstan pinch roller. However I would still appreciate some information on a feature that has troubled the machine since it was new. Towards the end of the record or playback function, namely, with the take-up spool filling, feed spool emptying, the speed increases progressively, requiring a fair amount of correction via the speed change control. This is accompanied by excessive wow and flutter, making the last few minutes of tape unusable. I have noticed that, when about to start recording or playback with empty take-up spool, the full feed spool, and with the capstan engaged (stroboscope lit), this being the equivalent of the "pause" position on this deck, the spools creep until the take-up spool contains a certain quantity of tape, thus increasing the effective diameter.

From all this I deduce that there is either too much take-up torque or insufficient back-torque, and I assume that this can perhaps be varied by substituting resistors of a different value. I would like to know the value and location of these, if possible. Messrs. Pamphonic appear to have little information on recorders prior to their Model A. *Yours faithfully, H. C., Oxford.*

You will appreciate that this is not a machine that comes in for repair very often, and we have comparatively few notes on it. Messrs. Pamphonic appear reluctant (up to the time of writing) to give detailed information. Our own experience of the deck is that the problem of "creep" is noticeable during the Pause function if the slip-clutch of the feed-spool is hardened. Reverse-torque is obtained, on this deck, by running the feed-spool motor at reduced power, and a simple friction clutch should provide just enough back-torque to prevent over-running. Forward wind depends on the motor current. You may be right in deducing that the resistors require altering, and we would advise fitting a tapped resistor (such as a wire-wound mains dropper) as part of the series-shunt arrangement, altering the tapping until an optimum point is found. But we regret being unable to pinpoint the position—however these resistors should be easy to identify, necessarily being 10W at least.

* * *

Attenuator Matching

Dear Sir, When trying to record from my Rogers HG88 into a Stella 459 I have found that the signal is not sufficient to fully load the tape. I notice that my direct recording lead has a 1.5 Megohm resistor incorporated in the plug. I have experimented with other leads which have no such built-in resistance and find that the signal is too strong. Can you give me any information concerning a compromise value for the resistance?

Yours faithfully, J.H.W., Highcliffe.

The difficulty in matching the Rogers HG88, 150 mV at 10 K into the Stella 459, 3 mV at 20 K, is that to attenuate sufficiently, the matching is seriously disturbed. With the recording lead, and 250 mV loading, the impedance is roughly that of the lead series resistor, 1.5 M. The use of a smaller resistor may help you, and you could experiment in this way, but I would rather see a pi-network comprising from 15-18 K across the Rogers output, with about 1 M in series, and a 27 K or so across the Stella input. That should bring your signal within the acceptable limits.

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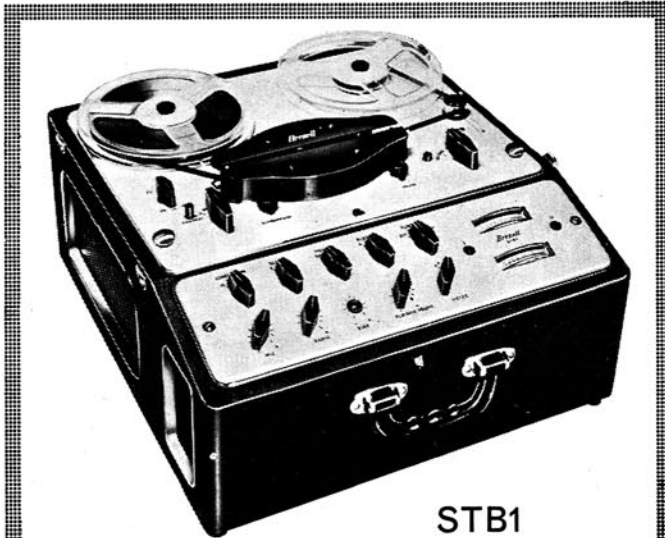
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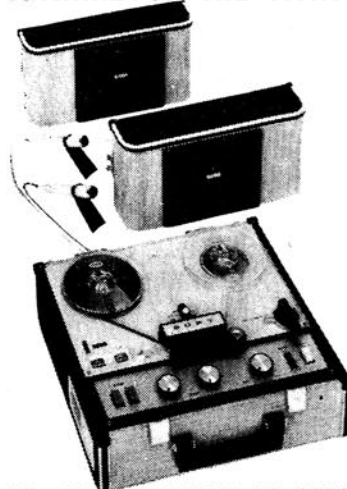


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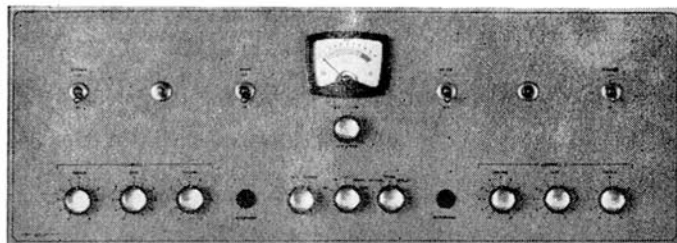


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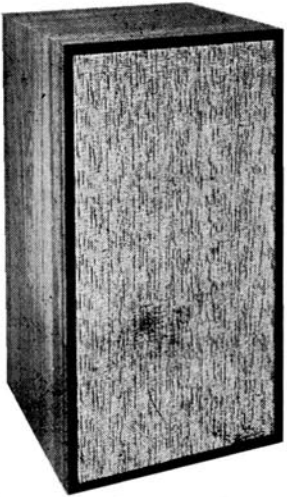
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