

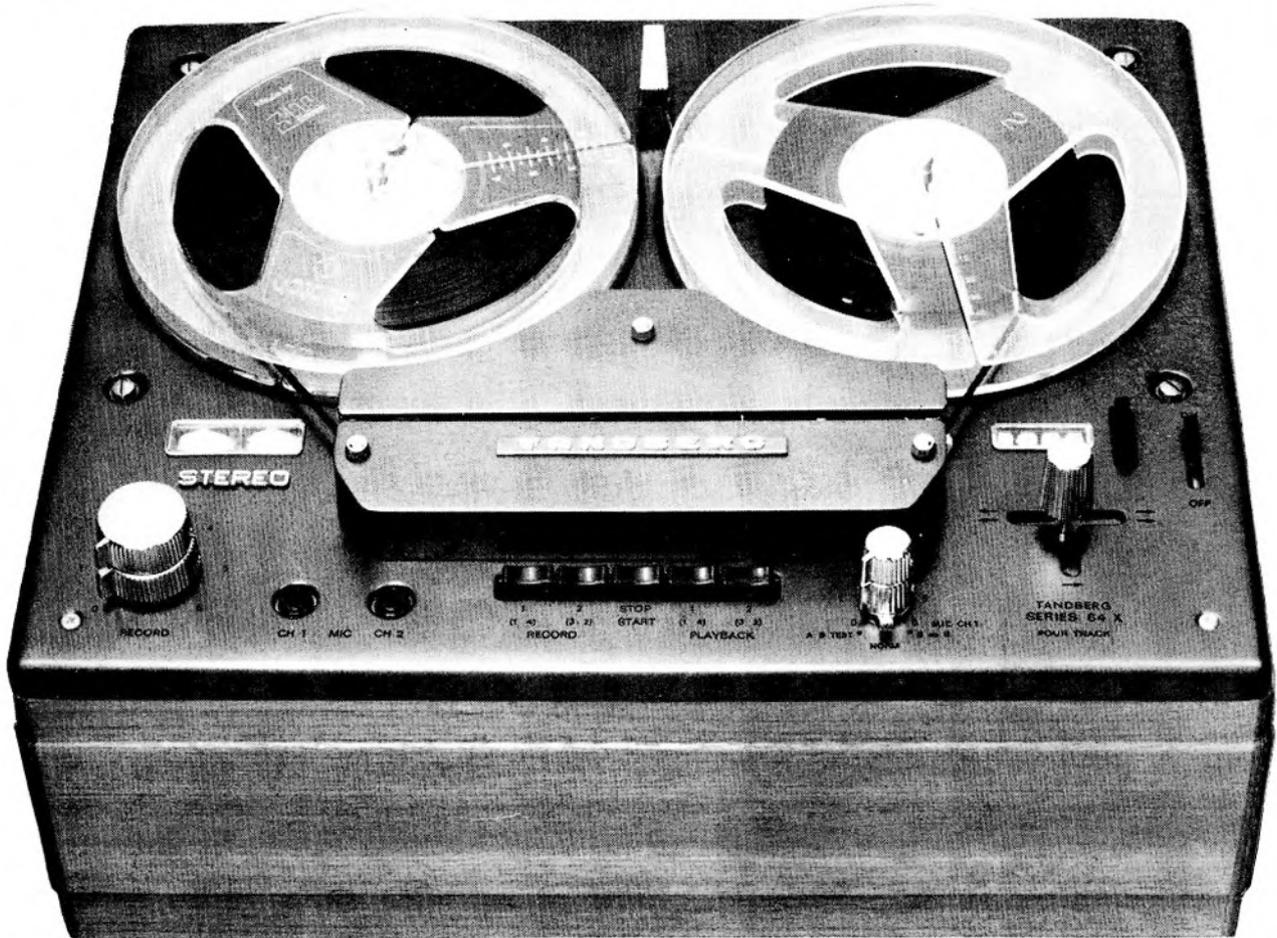
JUNE 1967 TWO SHILLINGS

tape recorder



SONY TC 350A AND WHM FLUTTERMETER REVIEWS • A SIMPLE TAPE ERASER
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The world's best stereo tape deck plus new bias head for guaranteed frequency response and unbeatable signal to noise ratio

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Frequency Response:

7½" per sec: 20-25,000 c/s
(± 2 dB 30-20,000 c/s).

3¾" per sec: 20-18,000 c/s
(± 2 dB 30-15,000 c/s).

1¾" per sec: 30-12,000 c/s
(± 2 dB 40-8,000 c/s).

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7½" per sec: 62 dB. 3¾" per sec: 59 dB.
1¾" per sec: 56 dB.

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* A fully transistorised oscillator circuit.

* Cathode follower outputs.

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* 'Sound on sound' facilities.

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PHILIPS — BASF

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| 5" 600' | 21/- | 16/10 | 4" 600' | 25/- | 20/- |
| 5 1/2" 900' | 28/- | 22/6 | 4 1/2" 900' (BASF) | 30/- | 24/- |
| 7" 1200' | 35/- | 28/- | 5" 1200' | 42/- | 33/8 |
| LONG PLAY | | | 5 1/2" 1800' | 55/6 | 44/6 |
| 3" 210' | 9/- | 7/3 | 7" 2400' | 77/6 | 63/- |
| 4" 450' | 14/6 | 11/8 | TRIPLE PLAY | | |
| 4 1/2" 600' | 21/- | 16/10 | 3" 450' | 22/- | 17/8 |
| 5" 900' | 28/- | 22/6 | 4" 900' | 39/- | 31/3 |
| 5 1/2" 1200' | 35/- | 28/- | 4 1/2" 1200' (BASF) | 49/- | 39/3 |
| 7" 1800' | 50/- | 40/- | 5" 1800' | 66/- | 52/10 |
| 8 1/2" 2400' } BASF | 72/6 | 58/- | 5 1/2" 2400' } | 90/- | 72/- |
| 10" 3600' } ONLY | 95/- | 76/- | 7" 3600' } (BASF) | 115/- | 92/- |

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| 5 1/2" 900' | 27/6 | 22/- | 4" 600' | 24/6 | 19/6 |
| 7" 1200' | 35/- | 28/- | 5" 1200' | 41/9 | 33/6 |
| LONG-PLAY | | | 5 1/2" 1800' | 55/- | 44/- |
| 3" 300' | 9/6 | 7/6 | 7" 2400' | 76/6 | 61/- |
| 4" 450' | 14/6 | 11/8 | TRIPLE-PLAY | | |
| 5" 900' | 27/6 | 22/- | 3" 600' | 24/9 | 19/6 |
| 5 1/2" 1200' | 34/6 | 27/6 | 4" 900' | 38/6 | 30/6 |
| 7" 1800' | 49/- | 39/- | DYNARANGE (L/P) | | |
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| LGS 26 | 600' D/P 4" reel | 25/- | 17/- | 49/- | 93/- |
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|-------|-------------------|------------|------|-------|-------|
| PE 21 | 1200' S/P 7" reel | 35/- | 19/6 | 55/6 | 105/- |

Also available at substantial reductions:

| | | | | | |
|-------|-----------------------|------|------|------|-------|
| PE 31 | 1200' L/P 5 1/2" reel | 35/- | 24/6 | 71/- | 137/- |
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|-------|----------------------|------------|------|-------|------|
| GS 15 | 900' S/P 5 1/2" reel | 28/- | 15/6 | 45/- | 84/- |

ALSO AVAILABLE AT SUBSTANTIAL REDUCTIONS

| | | | | | |
|-------|-----------------------|------|------|-------|-------|
| GL 15 | 1200' L/P 5 1/2" reel | 35/- | 24/6 | 71/- | 137/- |
| GL 18 | 1800' L/P 7" reel | 50/- | 29/6 | 86/- | 165/- |
| GD 15 | 1800' D/P 5 1/2" reel | 52/6 | 42/6 | 126/- | 246/- |

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

| | List Price | One | Three | Six |
|------------------|------------|------|-------|-------|
| 1800' on 5" reel | 66/- | 34/- | 101/- | 198/- |

ALSO AVAILABLE AT SUBSTANTIAL REDUCTIONS

| | | | | |
|----------------------|------|------|-------|-------|
| 450' on 3" reel | 22/- | 14/- | 40/6 | 78/- |
| 600' on 3" reel | 27/6 | 17/6 | 51/- | 99/- |
| 900' on 4" reel | 39/- | 24/6 | 72/- | 140/- |
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|----------------------|------------|------|-------|-------|
| 900' on 5" reel | 28/- | 16/6 | 48/- | 90/- |
| 1200' on 5 1/2" reel | 35/- | 22/6 | 65/- | 125/- |
| 1800' on 7" reel | 50/- | 28/6 | 84/- | 160/- |

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

SCOTCH 3M TAPE — HALF PRICE!

Brand new, fully guaranteed, premium grade, polyester base magnetic tape, double coated for the electronic industry.
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| | | |
| Total for post and packing | | |

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 (Print Please)

June 1967

Rumpus in Court

REVELATIONS of CINECORDER'S DOUBLE LIFE

Bench "Amazed"

By our Special Correspondent

A WELL-KNOWN tape recorder, the "Cinecorder" was found guilty yesterday of leading a double life. The case was, however, dismissed by the bench, the judge ruling that it was in the public interest for the Cinecorder to continue to play what he described as "its amazing double role."

The Prosecution's case was that the name Cinecorder implied an exclusive use by the cine enthusiast. Witnesses would, however, testify that on repeated occasions they had seen and heard the Cinecorder doing the work of a high fidelity tape recorder, and on other occasions accompanying amateur cine films with synchronized sound.

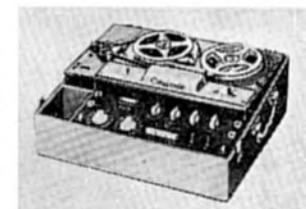
"Impedance"

Asked in cross-examination how he could be certain on one of these occasions that it was the Cinecorder, one of the witnesses was reprimanded by the bench for impedance when he heatedly replied that only an idiot could fail to recognise the Cinecorder's smooth, clean performance.

Sensation

Climax of the case came when the manufacturer of the Cinecorder and one of the country's largest hi-fi and tape recorder dealers, R.E.W. (Earlsfield) Ltd. caused a sensation by testifying that the demand for the Cinecorder had been so great that he had been able to reduce the price from £75 to 59 gns. He attributed the high level of demand not only

- TAPE DRIVEN CAPSTAN AND STROBE
- TAPE TIME INDICATOR
- INPUT SELECTORS
- TWO CHANNEL MIXING
- SEPARATE TONE CONTROLS
- PUSH BUTTON FUNCTION SELECTOR
- COMBINED TAPE/PROJECTOR START SWITCH



THE ACCUSED

to the superb performance of the machine, but also to its unique features which appealed to every facet of the tape recording world.

In his summing up the judge said he applauded the manufacturer's public spiritedness in offering such value for money. This, he said, was the sort of thing the country needed today. In dismissing the defendant without a stain on its character he hoped the verdict would be instrumental in drawing the attention of the general public to the unique features of the Cinecorder...

- VOLUME CONTROL FOR "MONITOR" PHONES OR SPEAKER
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- SHIFT-TRACK LEVER FOR DUAL RECORDINGS
- REMOTE CONTROL CONNECTION

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JUNE 1967 VOLUME 9 NUMBER 6

INCORPORATING
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COVER PICTURE

Supplied by *English Electric-Leo-Marconi Computers Ltd.*, our cover illustrates the testing of a *System 4* multi-channel data recorder. The *System 4* range comprises one 7-track and three 9-track machines, the latter capable of accepting 240 thousand digits per second.

SUBSCRIPTION RATES

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

BRENNEL, BRENEL, BRENNELL, Brennell. We have been analysing the results of our April Questionnaire—an arduous but rewarding task which will be completed, we hope, in time for a detailed report in the July issue. Meanwhile, here are some first impressions:

Initial fears were that the replies would be unduly biased, on the grounds that the soldering-iron brigade would be more inclined to return their questionnaires than the less-technical, casual reader. This problem has certainly not arisen, however, and we are confident that when the percentage demanding more space for 'Articles for Beginners' is weighed against readers demanding less, the result will be more or less neutral—implying that we may continue our present policy for coverage of that particular aspect of tape recording.

What we are looking for, and what we are finding, are those subjects and columns that readers as a whole like or dislike. It is these major swings, in one direction or another, that will provide the concrete evidence for a change in editorial balance. Such strong preferences are already visible, in the shape of a desire for more equipment reviews and, rather unexpected in this office, more readers' problems.

One of the strongest sways of opinion (swaying, we were gratified to note, in a direction we have followed for many years) concerned coverage of tape club meetings and activities. Readers are not interested in club news even, in some cases, when they are themselves club members.

Although it was only possible to arrange reply-paid facilities within Britain, we were pleased to observe a substantial number of overseas readers returning the questionnaires, often with accompanying letters giving a more detailed insight into personal and national recording habits. Along with the replies from five continents came an intriguing one from nearer home. It was submitted in the name of a London computer who (which?) desires to see more coverage of data recording topics and which (who?) owns (or perhaps this is the man who feeds it) several *Revox*'s.

Seventy-five per cent of *Brenell*-owners proved to be particularly bad at spelling, as may have been gathered from the head of this column, though this in itself represents a sizeable proportion of the readers who replied. We would hesitate to suggest that our readers are typical of the nation's recorder-owners, but were both pleased and surprised to see the very substantial number of readers possessing *Ferrograph*, *Truvox* and *Brenell* recorders and decks. *Leavers-Rich* and *Nagra* were well down in our lists, but we were pleased to see that at least a few of our readers combine such discrimination with such wealth. A bar-chart of manufacturers and sales figures is being prepared for the July issue.

We were interested to note at the Audio Fair that we are not alone in wishing to know the

opinions and needs of tape enthusiasts. Both *Ampex* and *Akai* combined a market survey with a competition, though we were a little confused about the ethics of competing ourselves for the very attractive prizes. They were more concerned with the composition of the ideal tape recorder than the ideal *Tape Recorder*, however, and have a common desire, visible throughout the industry, in identifying the features that attract a potential customer. Does a buyer appreciate the finer points of engineering, or is the external finish and the visual advantage of vertical spooling of greater importance? Is a fairly good recorder with moderately good internal speaker more competitive, in a retail demonstration, than the combination of excellent recorder and poor (monitor-only) loudspeaker? These points are not the offspring of editorial cynicism; they are major problems confronting tape recorder designers. In our position midway between manufacturer and consumer, and in the knowledge that we possess a dependable and co-operative readership, we have high hopes of dispelling some of these difficulties in the near future.

FEATURE ARTICLES

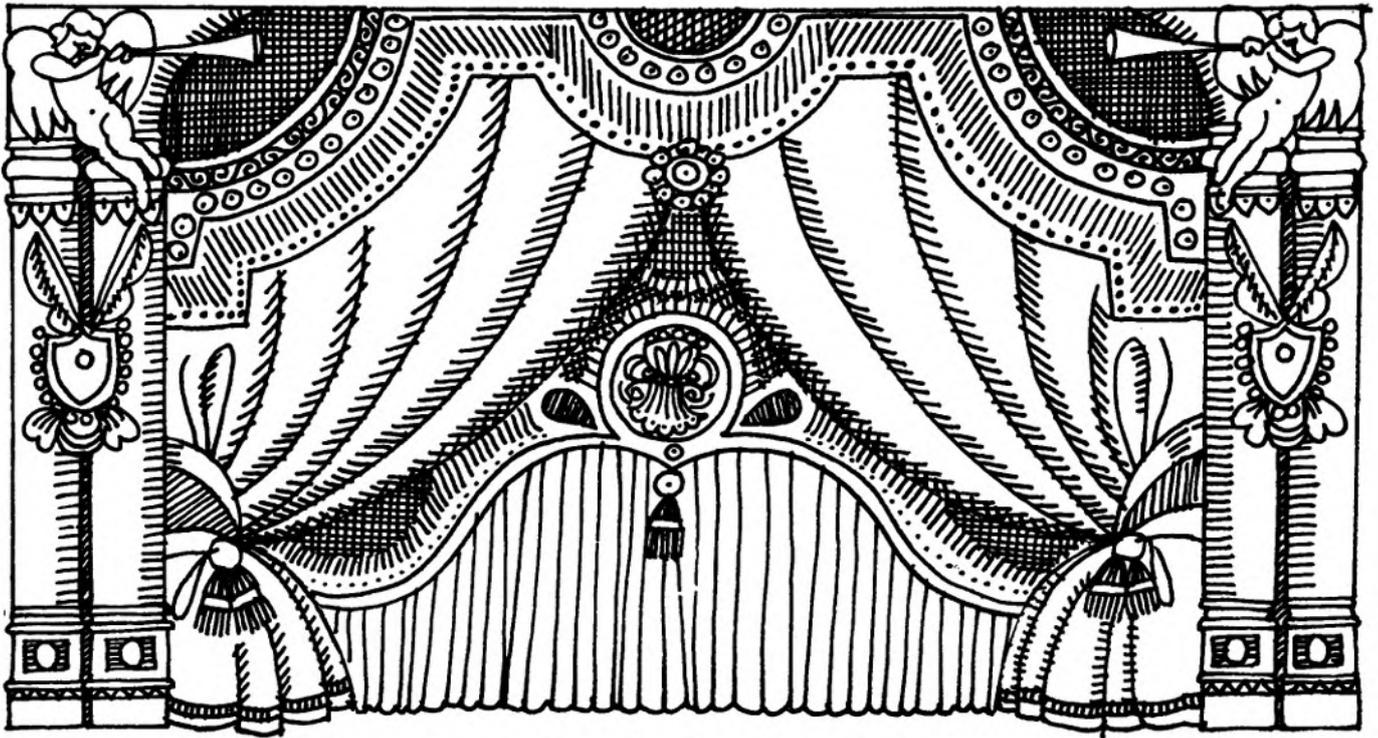
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GRUNDIG

WORLD OF TAPE

NEW THINKING AT THE BBC

THE problem of storing, finding and handling sound-effects is one that has long bothered broadcasting organisations. A new solution, which will eventually be manufactured on licence for the professional market, has been developed by BBC engineers. It centres on a matchbox-sized cassette holding 15ft. of $\frac{1}{4}$ in. tape on a small spindle. Each cassette has a 30-second capacity at $7\frac{1}{2}$ i/s and may be labelled with title and duration of its contents.

The playing mechanism is of ingenious design, being activated by the action of pressing the cassette into a rectangular recess; this locks it in position and sets the unit to standby. When this automatic threading operation is completed, after some $1\frac{1}{2}$ seconds, the green start button is illuminated. Playback commences immediately this button is pressed. The tape is gravity-fed, from the capstan, into a small chamber from which it is rewound almost instantaneously when the button is released. If the button is held down, the mechanism trips automatically at the end of the tape. A reject button unthreads the leader tape, when desired, and protrudes the top edge of the cassette above the deck.

The speed of rewind is such that a single pair of footsteps might almost be blended into an indefinite walking effect, though this is not intended. A four-channel demonstration unit proved extremely versatile, however, and was employed to create several variations on a motor accident theme from a series of 'individually boxed' effects. The operator certainly needed to concentrate on his task, inserting and removing effects while one of the other four were playing, but could concentrate his dexterity on timing the sounds rather than splicing and joining lengths of tape.

Additional features were continuously variable speed on one of the four drives, and recording facilities on another. Sound-effect sequences could be fed 'live' from the machine, dubbed on to a conventional recorder or, within the 30-second limitation, placed on a single cassette. It was explained that the 30-second period was quite adequate for practical use.

The drive mechanisms are solenoid-controlled and may be operated from a distance when required. Each cassette is driven by a *Papst* synchronous motor.



PURCHASING PTFE

POLYTETRAFLUORETHYLENE rod, advocated on several occasions in this magazine as a cure for tape 'squeak' when mounted in the guide path preceding the heads, may be purchased from *G. H. Blore Ltd.*, 480 *Honeypot Lane, Stanmore, Middlesex*. The company are prepared to sell the plastic direct to the public in lengths of not less than one foot. Prices are related to rod and tube diameter, but amount only to a few shillings per foot in sizes of $\frac{1}{4}$ in. and smaller. A price list is available from the company on request and readers are asked not to send payment in advance as this creates administrative problems.

SHARP SERVICING

SINCE publication of the *Sharp RD-504* field-trial in *April Tape Recorder*, several readers have written to comment on favourable servicing experiences with the distributor, *Wholesale Supplies (Swinton) Ltd.* The company have also advised us that a well equipped and fully staffed service organisation is maintained at their 16-18 Worsley Road, Swinton, Manchester address. Spares will be available for all Sharp equipment for five to seven years after the discontinuance of any model. Service manuals are available and every effort is made to ensure that after-sales-service is maintained.

FBTRC DISCUSS LOCAL-RADIO PROSPECTS

THE relationship between recording enthusiasts and provincial broadcasting stations was discussed at a recent meeting between *A. W. Coysh* (Deputy General Manager, Local Radio Development) and *John Bradley* of the *Federation of British Tape Recording Clubs*. Stations have already been planned for Brighton, Leicester, Nottingham, Stoke-on-Trent, Manchester, Merseyside and Sheffield and these would be supplied by material from free-lance radio journalists and professional interviewers. It was thought probable that space would be found for topical amateur contributions of between $1\frac{1}{2}$ and 15 minutes, provided these were well produced and suitable for instant use. A panel of local enthusiasts might be formed to screen submitted material. A detailed account of the meeting is given in the *1967 Summer Bulletin*, produced by the FBTRC at 33 Fairlawnes, Maldon Road, Wallington, Surrey.

NEXT MONTH

TO BE PUBLISHED ON Wednesday 14th June, the July *Tape Recorder* will include advice from *V. D. Capel* on the care and repair of plastic cabinets. Readers wishing to construct their own *Nagra* may gain some tips from *David Kirk's* visit to *Kudelski*, while budding carpenters are offered, at the hands of *G. T. Rogers* and *J. P. Faber*, a console for the *Ferroglyph*. We hope also to include the results of our April Questionnaire.

TRUVOX MOVE SOUTH

AFTER ten years occupation of their Neasden factory *Truvox* have moved to

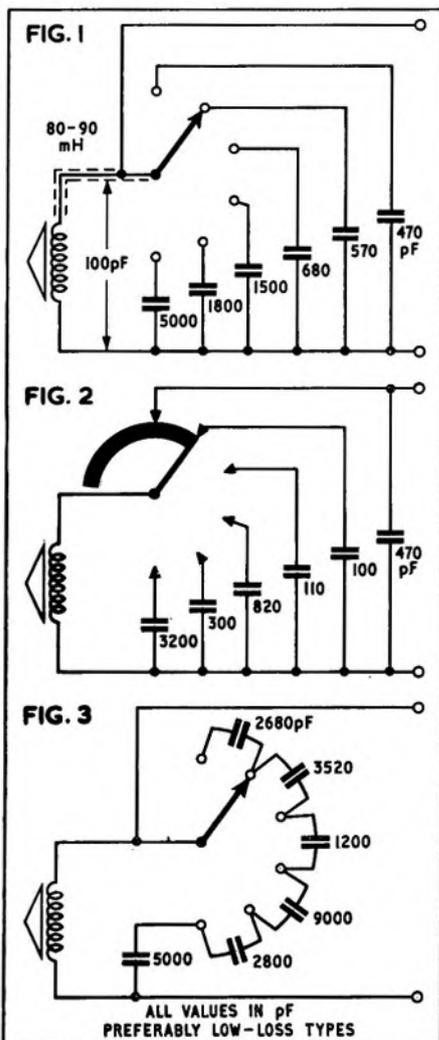
larger premises at Southampton. The new site was recently vacated by *Thermionic Products Ltd.*, who have long been associated with *Truvox* as members of the *Controls and Communications Group*.

All correspondence with the company should now be addressed to *Truvox Ltd.*, Hythe, Southampton (Tel. 0421 4 3265).

MINIFLUX POSTSCRIPT

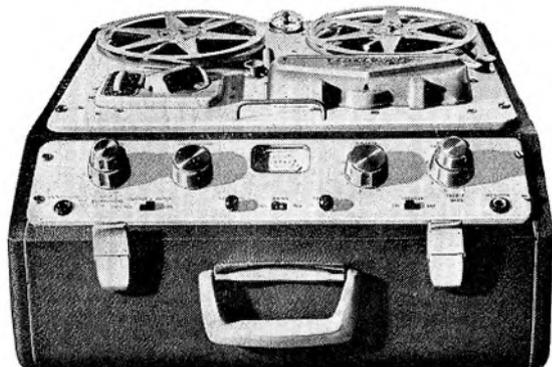
THE Miniflux Universal Preamplifier, construction of which was described in the April issue, did not show means for varying the head tuning capacitor *Ct* as this was originally arranged to be achieved externally. If it is desired to incorporate all *Ct* values within the preamplifier, a further switch wafer can be ganged to the equalisation control. Three ways of varying *Ct* in accordance with the published values are illustrated here. In the case of *fig. 3*, the various *Ct* values are selected so that their total series value results in the same tuning values given in *figs. 1* and *2*.

It is stressed that the given values not only depend on head inductances, but lead capacity must also be taken into consideration. The values given include about 100pF, which is roughly equal to the capacitance of 12in. of standard Miniflux screened lead.



MODEL 633

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Built to endure**

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633—1½, 3½ and 7½ i.p.s.
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tape reviews

CLASSICS BY GEORGE GOODALL
JAZZ AND FOLK BY TONY FARSKY

THE SOFT SWING Stan Getz Quartet, Stan Getz (tenor), Mose Allison (piano), Addison Farmer (bass) and Jerry Segal (drums). **World Record Club TT467**, 3½ i/s twin-track mono. 29s. 6d.

TWENTY YEARS AGO Stan Getz was a reigning figure in the jazz kingdom: he was referred to as "the Cool One", "the white god of jazz" and "The saxophonist". He took the sound produced by Lester Young and refined it to the ultimate in purity of tone. Add to this his incredible flow of melodic inventiveness and swing, and it must be admitted that the flow of adjectives is entirely justified.

This recording from two sessions in 1957 was made soon after his return to America following personal tragedy and long illness. It predates, by five years, his bridging of the jazz/pop gap with the single of *Desafinado* (from the *Jazz Samba Album*), which "sky-rocketed Getz into a heady position in the pop industry", and set off a wave of bossa-nova recording by jazz musicians.

The jazz on this tape rates among the best of Getz's recordings, in fact critic Martin Williams says it is *the* Getz record. The up tempo numbers, *This Can't be Love*, *All God's Chillun . . .*, *Smiles*, *Bye Bye Blues* and *Down Beat*, some of them taken at a cracking pace, show Stan relaxed with music simply flowing out of him. The ballads *Time after Time*, *All The Things you Are* and *To the Ends of the Earth* are full of lightness and feeling.

The first session had a rhythm section made up of Mose Allison, piano, Addison Farmer, bass, and Jerry Segal, drums; while on the latter date it was Lou Levy, piano, Leroy Vinnegar, bass, and Stan Levy, drums. Both groups provide first class backing for Getz's tenor.

If your collection is short of Getz you should get this; if you already have other recordings of Stan you should have this one too. **T.F.**

CHOPIN/LISZT Sonata No. 2 in B Flat Minor (Chopin) and Sonata in B Minor (Liszt). Daniel Wayenberg (piano). **World Record Club TCM67**. 3½ i/s twin-track mono. 29s. 6d.

THERE IS AN ENORMOUS repertoire for the solo pianoforte. Most of the great composers since Mozart have written serious and extended compositions for it, and earlier keyboard music can very often be performed satisfactorily upon it. Chopin and Liszt, however, are associated with the piano more than other composers; indeed Chopin's greatness is built up on a musical output devoted almost entirely to the piano.

The two piano sonatas recorded here are not ordinary sonatas in the classical sense of the word. They were written at a time when romanticism was well under way. Classical forms were being bent and stretched to accommodate the more complex harmonic structures that composers were using to express their ideas. The B Flat Minor sonata of Chopin's on this tape follows a four movement form, but there the classical concept ceases. The famous Liszt sonata is one extended 'movement', with internal division into six contrasting sections, and so has little formal connection with its classical antecedents.

Daniel Wayenberg is a most accomplished pianist. Both sonatas have considerable technical difficulties which he deals with competently. But his tone does lack subtlety, particularly in the slow third movement of the Chopin sonata (the well known *Funeral March*) where the score marking *pp* is barely observed. To those wishing to make their first acquaintance with this music, this may well be a satisfactory issue, for the recorded sound is warm and pleasantly close. Those who are already familiar with the music, however, and are wanting the finer points of musical expression, must look elsewhere. **G.G.**

A NIGHT ON THE TOWN Seven items by Oscar Peterson (piano), Herb Ellis (guitar) and Ray Brown (bass). **World Record Club TT497**, 3½ i/s twin-track mono. 29s. 6d.

THIS RECORDING OF the trio with nightspot atmosphere was made at the Town Tavern, Toronto, in 1958.

Sometimes I like Oscar Peterson; sometimes I do not. There is no denying his fantastic technique: he has few equals in this respect. Neither is there any doubt about his ability to swing, as this tape amply demonstrates. Perhaps, like Tatum, it is a case of *too much* technique, which on some occasions gets in the way and crowds out the music.

On this tape there is technique, invention and swing in plenty, but any sign of real jazz feeling is sadly absent. Instead of the subtle drumming of Ed Thigpen we now associate with the trio, we have Herb Ellis on guitar alongside Ray Brown's bass. At times Ellis appears to be vying with Peterson to produce the most soul-less sounds, and winning easily.

The programme consists for the most part of standards like *Sweet Georgia Brown*, *Should I and Moonlight on Vermont*. It is only with the tuneful Benny Carter compositions *When Lights are Low* and *Pennies from Heaven* that the frantic, 'I can play more notes louder than You', element subsides a little, and we get two numbers with some musical interest.

This is far from being typical of Peterson's better recordings. No marks to WRC for issuing this one. **T.F.**

MOZART HORN CONCERTOS Dennis Brain (horn) and the Philharmonia Orchestra conducted by Herbert von Karajan. **Columbia TA-33CX1140**, 3½ i/s twin-track mono. 40s.

THESE ARE CLASSIC performances of great classical works. The Mozart horn concertos have an intimate, almost chamber music quality as Dennis Brain plays them here. They are tuneful works and it is difficult to imagine

them being played with more charm or expertise than is the case here. It is tragic that Dennis Brain's lifespan was so short. This tape comes as a strong reminder of his capabilities.

The recording quality is not of the highest standard, though is satisfactory for smaller machines. There were one or two patches of drop-out on the review copy, but nothing that was seriously disturbing. **G.G.**

SCHUBERT Quintet in A Major (The Trout) and Quartettsatz. Karl Engel (piano) and the Drclo Quartet. **World Record Club TT469**. 3½ i/s twin-track mono. 29s. 6d.

SCHUBERT IS POSSIBLY the most domestic of all composers. Spending his time playing music in the homes of his friends and writing music for them, spending holidays walking through beautiful countryside, his short life seems to us idyllic, though in truth his real worth was not appreciated during his lifetime and he found it a struggle to make a living. His most important contributions to music are his songs of which he wrote over six hundred. Their merit was praised by no less a person than Beethoven and time has indeed confirmed his judgment. Schubert's contribution to chamber music is also an important one and the two works recorded here are fine examples. The *Trout* Quintet, so called because the tune of his song by the same name is the theme for a set of variations in the fourth movement, is unusual in that a double bass is included in the scoring. Many a double bass player must be glad of this opportunity to play chamber music, though his part is not the most exciting one.

The quality of the recording issued here is very good, and no one need be put off buying the tape on that score. However the performance, though competent, is rather pedestrian and careful. This is less apparent in the *Quartettsatz*, possibly because the music here is more serious and has more substance. So if it is just a competent performance of these works that you require this tape supplies all your needs, but if you seek an especially vital performance of the quintet, you will be rather disappointed. **G.G.**

DVORAK/GLAZOUNOV Concertos in A minor for Violin and Orchestra. Nathan Milstein (violin) and Pittsburgh Symphony Orchestra conducted by William Steinburg. **World Record Club TT511**, 3½ i/s twin-track mono. 29s. 6d.

IN TERMS OF musical architecture the Dvorak violin concerto is not the most magnificent of concertos, nor is it the most profoundly expressive. However, it is very pleasant and tuneful, and when coupled with the Glazounov violin concerto as it is here it makes a splendid programme. This is specially true when both are played as they are here by Nathan Milstein, a violinist who for me can do no wrong.

The technical standard of the recording is outstanding in the field of 3½ i/s tape records, having some of the best sounding string tone I have heard in this medium. The acoustic setting is rather reverberant, with the orchestra sounding in a different setting to the violin, but not different enough to prove distracting. The background is quiet, and the tape is well worth playing through wide range gear.

(continued on page 241)

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TAPE REVIEWS CONTINUED

It is interesting to note that Glazounov was a pupil of Rimsky-Korsakov and doubtless acquired much of his mastery of orchestration from his teacher. Glazounov is separate from the other members of the Russian school, however, preferring classical forms of composition and adding to them his characteristic orchestral colour.

For once in a while this is a tape that can be recommended without reservations, and it should prove popular. **G.G.**

JAZZ ULTIMATE Eleven items by Bobby Hackett (trumpet) and Jack Teagarden (trombone). **World Record Club TT463**. 3½ i/s twin-track mono. 29s. 6d.

ALTHOUGH BOBBY HACKETT and Jack Teagarden have long associations with Chicago Dixieland jazz, neither of them can be exclusively categorised as belonging to any particular style of playing.

Bobby Hackett made his appearance in jazz in the thirties and was featured in the famous Benny Goodman Carnegie Hall concert, playing beautiful Bix Beiderbeck style solos. These days he is not much heard playing jazz, but works mainly providing backing for such singers as Jackie Gleason and Frank Sinatra.

Jack Teagarden of course appears much earlier in the development of jazz. Throughout the thirties his great trombone playing was heard with the first Benny Goodman groups, the Louisiana Rhythm Kings, The Mound City Blue Blowers, etc. After the late forties, however, when he was with the Armstrong All-Stars, Teagarden found it more and more difficult to get work; in fact the story is that Hackett organised this session, in Hollywood in 1957, together with a new recording contract for him.

Hackett and Teagarden are accompanied by Ernie Caceres (clarinet and baritone), Peanuts Hucko (clarinet and tenor sax), Gene Schroeder (piano) and Jack Lesberg (bass), all of whom are veterans of many Dixieland groups. The programme, which includes Dixieland standards like *Oh Baby*, *Indiana*, *I Found a New Baby* and *Way Down Yonder in New Orleans* is pleasant enough, but is not a fair representation of this style, and very far from the 'Ultimate' in jazz as the title boasts.

With so much good Dixieland material around, much of which features Teagarden and Hackett, it's a pity that WRC chose this one for issue. **T.F.**

MENDELSSOHN Symphony No. 3 (Scottish). Leipzig Gewandhaus Orchestra conducted by Franz Konwitschny. **World Record Club TT507**. 3½ i/s twin-track mono. 29s. 6d.

MENDELSSOHN'S TALENT as a composer showed itself at a very early age. Two of his best known works, the octet and the *Midsummer Night's Dream* overture were written before he was 18 years of age. When he was a mere twenty years old he was offered, and turned down, the Chair of Music at Berlin University. He preferred at that time to travel, thereby gaining greater acclaim. However it was a short career, its crowning moment doubtless being the first performance of the oratorio *Elijah* at a

Birmingham festival which took place about one year before his death at the age of 38. One of Mendelssohn's posts was that of conductor of the Gewandhaus Concerts in Leipzig so the orchestra performing the *Scottish* symphony for us on this tape has a fine Mendelssohn tradition behind it.

The symphony was inspired by a visit to Scotland when Mendelssohn was 20 years old. Some thematic material was committed to paper at the time of the visit, but it was 12 years later that the symphony was first performed. It is a tuneful, pastoral work, reminding one in places of Beethoven's *Pastoral* symphony. The music is not without its climaxes, though the development of ideas is not as powerful as is the case in the Beethoven symphonies for example. The programme note included with the tape (and why is it that only World Record Club think it worth while to include one?) claims to hear Scottish tunes and rhythms in the music, which to me at any rate are not immediately apparent.

The quality of the recorded sound is satisfactory and the performance is one that should stand up to repeated hearings. A pleasing issue. **G.G.**

RAVEL *Daphnis and Chloe*. French Radio and Television Chorus and the Theatre Des Champs-Elysees Orchestra conducted by D. E. Inghelbrecht. **World Record Club TT438**. 3½ i/s twin-track mono. 29s. 6d.

ONE WOULD HAVE hoped that a programme of Ravel's *Daphnis and Chloe* with a French chorus, orchestra and conductor would be well worth listening to. However, this issue is so marred by a strident and congested recording that it cannot really be recommended. Even steep filtering does not remove the stridency, and the louder passages I found uncomfortable to listen to. A pity, because Ravel's ballet music is a favourite with a number of music lovers. **G.G.**

EARL'S PEARLS Earl Hines and his Quartet, Earl Hines (piano and vocal), Calvin Newborn (guitar), Carl Pruitt (bass) and William English (drums). **World Record Club TT472**, 3½ i/s twin-track mono. 29s. 6d.

IF THERE ARE MORE different styles of jazz piano-playing than is the case with other instruments, it was Earl Hines who made this possible when, in the late twenties, he brought to the keyboard an entirely new conception, giving the piano a solo voice alongside the trumpet, trombone and clarinet. The classic recordings he made with Armstrong are enough to justify reference to Hines as a Jazz Giant. But he is not just an historic figure, he has remained on the jazz scene for forty years and today he is playing better than ever.

Now he has emerged out of the relative obscurity of the forties and fifties to the critic's acclaim in the sixties, and it was this recording, made in 1960, that was the beginning of his rapid climb to popularity.

To appreciate the full force of Hines's exuberant, highly individual playing, you need to hear him in person, but the performances on this tape are a good example of his recent work.

Playing a typical programme of twelve

standards, including *Saint Louis*, *Boogie Woogie*, *Tea for Two*, *Stealin' Apples*, *Willow Weep for Me*, *I Can't Believe . . .*, *Rosetta*, *Satin Doll*, *Manhattan*, *You Can Depend on Me*, he is well supported by Calvin Newborn (guitar), Carl Pruitt (bass), William English (drums).

It may be that some of Hines's admirers will feel that the rhythm section is more of a handicap than an aid to these performances. Certainly Hines can manage quite well without backing, and maybe the group are a little too enthusiastic at times; but even so, for my part this is a tape well worth having. **T.F.**

THE ANATOMY OF IMPROVISATION Ten items by Dizzy Gillespie, Art Tatum, Roy Eldridge and others. **World Record Club TT526**, 3½ i/s twin-track mono. 29s. 6d.

CRITIC LEONARD FEATHER in his *Book of Jazz* devotes a chapter to *The Anatomy of Improvisation* and ten of the musical examples which illustrate that chapter are taken from the performances on this tape. But it is by no means necessary to resort to the book to enjoy this excellent collection of varied 1949-1956 mainstream and modern sessions, although the book with its transcription and analysis of solos does lead to greater appreciation of the music.

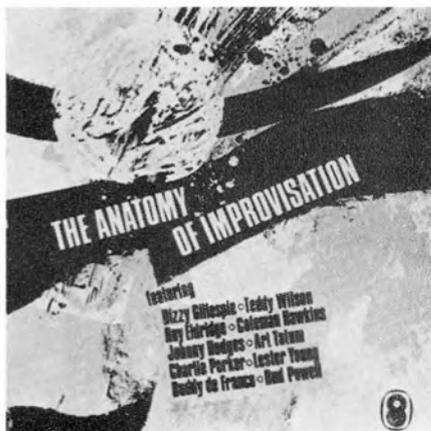
My own favourites among a host of good things are: *Blues in B Flat*, by a wonderful trio made up of Art Tatum, Benny Carter and Louis Bellson; *Blues for the Oldest Profession*, by the Teddy Wilson Trio; and *Jessica's Day*, by the Dizzy Gillespie Big Band.

Gillespie also features on *Bloomido* with Charlie Parker and a very fast and exciting *Trumpet Blues*: swopping phrase after phrase in chorus upon chorus with Roy Eldridge.

A very fine solo from Lester Young precedes one by Parker on the *Opener*, a fragment from a 'Jazz at the Philharmonic' concert. Coleman Hawkins is heard on *Platinum Love* and Johnny Hodges features with a group of Ellingtonians on *Confab with Rab*.

The insipid and boring clarinet of Buddy DeFranco is on *Monogram*, and the late Bud Powell provides a nice contrast in piano style to Art Tatum and Teddy Wilson with *Hallucinations*.

A good buy if you do not happen to have too many of these items on your shelves already. **T.F.**



■ FEEDING THE FIFTEEN HUNDRED

READING reports, one senses a gap between the number of recorders sold and the number in reasonably sustained use. It would appear that there is an early fascination for capturing the sound of events but there then comes a time when the owner of the machine feels his activity with the recorder is superficial and it is used less and less.

One way in which a tape recorder can be fully deployed in a worthwhile community sense is as an instrument in a hospital broadcast service. It is the experience of one such service I wish to recount, to illustrate its potential and problems and to encourage speculation among tape recorder owners about forming one in their own area. Where a service already exists, I would like to promote the benefits of mutual exchange of techniques and programme ideas.

The Hospital Broadcast Service at Colchester has the benefit of a first-class professional electronics engineer and a committee of ten who, between them, are associated in other fields of community work in the town.

The service was formed some three years ago, to serve three hospitals. Its coverage has now been extended to five, new headsets and improved ward amplifiers being supplied to give a total audience potential of 1,500 persons.

Born out of a combination of events, the service had its roots in the Colchester United Supporters' Club and the Colchester Community Service, organisers of the town carnival,

Mayor's Ball and other local charity events. The Supporters' Club were already then using a hired telephone line to broadcast football commentaries to some of the wards of two local hospitals. The Community Fund were seeking a field to channel money from one of their events into a useful charitable enterprise. There being no individual contact between members of each group, a new group, already experienced in voluntary work, came together.

It was decided that there was an avenue to be explored producing record requests for patients and staff in hospital—something which would extend the service of the football commentaries. Money was donated by the Supporters' Club and town carnival organisation to meet initial expenses.

SAT BACK AND WAITED

Transmission equipment, turntables and a specially constructed mixer were installed in the football clubroom and the writer made the first broadcast, introducing an *Anglia Television* executive, Dick Joice, who was to open the service. This was December 22nd, a Sunday morning.

From then on, we sat back and waited for the requests. So few came that it was hard to make up a programme.

In those early days we learned that a small group standing on its own feet was not like the committee of an organisation with many members committed to give it support. Help

had to come entirely from within our group of ten people. Realising that the service simply needed publicity, we started to tour the wards, with permission, to explain our aims. We asked for requests, and noted them down. A borrowed *Fi-Cord 202* captured the voice of the patient making the request, and this was found an attraction to other patients, keen to hear the recorded voice of personal acquaintances. It was hard work but, as a result, we always had enough to make up the Sunday programme.

The turning point was the discovery that although patients were delighted at the opportunity of making personal requests, nothing would induce them to send them in letter or postcard form. We decided, therefore, to supply printed cards, reducing the work required of the tiredly sick listener simply to filling in the title of the recording, the name and hospital address of the intended recipient, and a message.

Boxes were placed on the walls, again with permission, and in these we popped the cards with a cartoon-illustrated notice above. Patients, and particularly visitors, saw them as they came to the ward entrances. This system caught on. The requests increased until we had to extend the Sunday morning transmission time and then carry on another hour into a weekday evening. Somewhere in the region of five to six thousand requests are now played in the course of a year.



FEEDING THE FIFTEEN HUNDRED

BILL TUCKER DESCRIBES THE POTENTIAL AND PROBLEMS OF THE COLCHESTER HOSPITAL BROADCAST SERVICE

Meanwhile the committee needed money and organised a winter bazaar. Not easy without a large membership, but asking different charitable organisations to be responsible for one stall spread the load.

Friends formed a supporting club of some six people who have organised two successful summer fetes, allowing us to buy further portable tape recorders and other equipment. The carnival fund makes a donation and the football supporters' club makes a substantial gift by paying for the annual hire of some of the private telephone lines used.

Those with technical ability devoted time to extending the wiring into wards not equipped to receive radio broadcasts.

As the service extended and became more active, problems arose. One was the need to cope with short-term patients, their requests having to be broadcast the week they were received; we required warning if a person died between our receiving a request and its transmission. Requests had to be arranged for lonely old patients having no relatives to choose records for them. Tabs had to be kept on patients moving from one hospital to another.

SURPRISING NUMBER

We found, incidentally, a surprising number of older people who like popular music, though there were, of course, many requests for old tunes which often proved a problem to locate.

This leads to another important aspect of the service. We receive expert advice on records and full co-operation from a member owning a music shop, and we have had great success in an appeal for donated discs, discarded records being supplied also by the local public gramophone library. The upshot is that we have 3,000 records looked after with an efficient filing system by the wife of our chairman, who has had to give up a bedroom of her house as a store.

MAJOR EVENTS

The Colchester service, building up an outside broadcast unit, has covered several major events in the town; events have also been recorded on tape, edited to a linking commentary. We have taken Fi-Cords to the homes of patients' relatives too infirm to visit the hospital, and recorded messages and requests. There is great excitement when, during our two-hour Christmas programme, a mother is able to hear her children's voices. We have relayed operatic concerts, charity football matches, and other events making a lively sound picture. We try not to ape the BBC, but to produce locally-flavoured magazine-type programmes. Several programmes are pegs upon which to hang music of a kind—children's half-hours, tune-identifying, late-night music, and so on.

With a portable bought from the proceeds of a fete, our female interviewer compiled a

programme of discussion with prominent local women. My own programme *Hotch Potch* comprised out-of-the-way snippets of information, news and views, and actuality events such as a recording of the local chimney landmark being blown up by the army. Archaeologists have been interviewed at a Roman dig.

A recent questionnaire obtained patients' views of existing programmes, and ideas for the future. The replies reveal that people cannot wear a headset for two hours. New lightweight headsets may ultimately solve this problem.

What we would like to know is the nature of problems experienced by other services, the type of programmes they have found most popular with patients, and the most suitable times for transmission in relation to the hospital routine. I would like to see a federation of hospital broadcast services, perhaps with its own newsletter, which might well reveal this type of service to be more widespread than is generally thought.

Left to right: The author conducts an interview at an archaeological excavation of a Colchester Roman Road. Chairman Keith Southern with two guest announcers. At the listening end—0.2% of the potential audience, excluding bear.



tape recorder service

BY H. W. HELLYER NO. 66 FERGUSON 3214 AND EQUIVALENTS

FOUR principal machines are covered in this last article of the three-fold treatment of Thorn tape recorders. These are the *Ferguson 3214*, *Marconiphone 4210*, *HMV 2208* and *Ultra 6206*. The deck used is the $\frac{1}{2}$ -track, three-speed *DC43*. Its first identifying feature is the placement of the keys at the right of the upper chassis.

As a diversion, it is interesting to note that this style is also used by *Uher* and *Telefunken* in their battery models. *Magnavox*, the later *Philips*, *Van Der Molen* and most of the *Loewe-Opta* range cater for the right-handed key-pusher. But the several models using the new *BSR TD20* deck, *Truvox* models with their own deck, *Akai* with the *X-IV*, *Revox*, and the table *Telefunken*s, favour the left-handed key player. *Philips* seem unable to make up their mind, while *Grundig*, after years of a firm nonsense two-handed approach, have gone over to a single do-everything knob. Other people, like *Tandberg* and *B & O*, need a key and shift control action. There is scope for some ergonomic argument here, methinks. Let's set Peter Turner going again!

In fact, the layout of the *Thorn DC43* deck is very good, and quite different from previous types in the range. Two features of special interest are the combination manual and solenoid-operated Pause control and the indirect flywheel drive.

SINGLE MOTOR

Fig. 2 shows the general layout of the drive system, which is pulley-wheel operated from the single 225V 50Hz motor. Note the tapping of the motor feed on the appropriate voltage point of the mains transformer in our circuit on the adjoining page. Note also that an overseas version of this motor, 117V 60Hz, is available.

Much has been said about wear of rubber pulleys, and dire consequences are threatened from time to time in these pages as a result of unwary users leaving pressure rollers, drive pulleys, puck wheels and even the motor-to-

flywheel capstans of portables engaged when not actually turning. Our Deputy Editor is especially strong on this point—probably as the result of some traumatic early experience. No doubt his Rorschach blots all come out like three-step pulleys! But, seriously, he is quite right. Pulley wear is one of the prime causes of wow: in some machines it is virtually unavoidable. The moment of starting, where maximum torque is needed, is the telling time for pulley drives (and belt drives, for that matter). Thorn attempt to reduce the problem in their characteristically thorough way.

PRE-ORDAINED AMOUNT

The motor pulley is arranged to give a degree of slip when the torque exceeds a certain, pre-ordained amount. The stalled torque is, naturally, lower than the running torque at maximum speed, so a controlled slip is allowed by the fibre washers and spring between the sections of the drive pulley as the drive engages and runs up to speed. This takes less time to happen than it does to write, so the user need have no fear of that annoying symptom of dragging the recording up by its bootlaces that can occur on many machines with higher prices and reputations than those under present consideration! The overall result of this drive method is that there is much less 'grip-and-skid' than usual, and less wear and tear on the pulleys. As an incidental bonus, the smooth take-off will lessen tape wear—a lesson that needs learning by one or two of the recent entries to the deck market, whose snatch can even cause a stripe effect on new oxide.

Another diversion, if I may. The gradual approach to starting speed annoys some readers. It happens on several models, but is best accepted—or overcome by judicious use of controls. The *Telefunken M.300* method of counteracting it by actually muting the amplifier for a two-second starting period may smack of brute force, but even that is better than ruined tapes.

With belt-driven, single-motor machines, the flywheel runs continually and engagement of the pinch roller ensures almost instantaneous driving of the tape. But puck-drive systems, and other types such as the belt-tension drives or direct drives (employed in battery portables), must have high initial torque, must overcome the inertia of the flywheel or other driven parts, and will always have a short 'run-up' period. With a finely balanced machine this is hardly noticeable, but some operators prefer to make a clean start by engaging the Pause control, then inaugurating the Start sequence, allowing the second or two necessary for the mechanism to settle to speed, and neutralising the Pause control.

Unless we are fortunate enough to possess

more than the statutory number of hands, this sequence is not possible on some machines—even some very good ones. It needs a 'lock-on' pause control; one of those features which so many readers commended for the 'ideal' machine we argued about in these pages not so long ago. Incidentally, the *Thorn DC43* deck has a latching Pause key, neutralised by the Stop action or double-depression, as well as a remotely operated pause control, solenoid acting. Reference to the main circuit shows that this function is also protected by a click suppression circuit, the diode D1, a BY124, being the important part of this design feature.

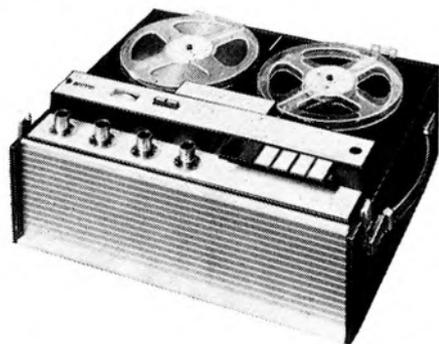
While on the subject of solenoids, we should consider the rather important adjustment procedure for this deck. Solenoids do not go out of adjustment easily, and the most prevalent cause of weak relay or solenoid action on any deck is a drop in the DC supply voltage for this part of the circuit. This deck uses a selenium rectifier for the purpose, a H131/PD900, which is supplied with 23V from a separate secondary of the mains transformer, giving 30V DC. There is an 820-ohm resistor in series with the autostop solenoid and a 75-ohm resistor in series with the pause solenoid. Each circuit has a 450 μ F electrolytic acting as reservoir-charge component. The deck is too new for us to have had any voltage troubles, but experience tells us that selenium rectifiers can age, so when checking erratic solenoid action please make the voltage supply the first point of attack. Owners of older *Grundig* models will know just what I mean!

EAGER SCREWDRIVER

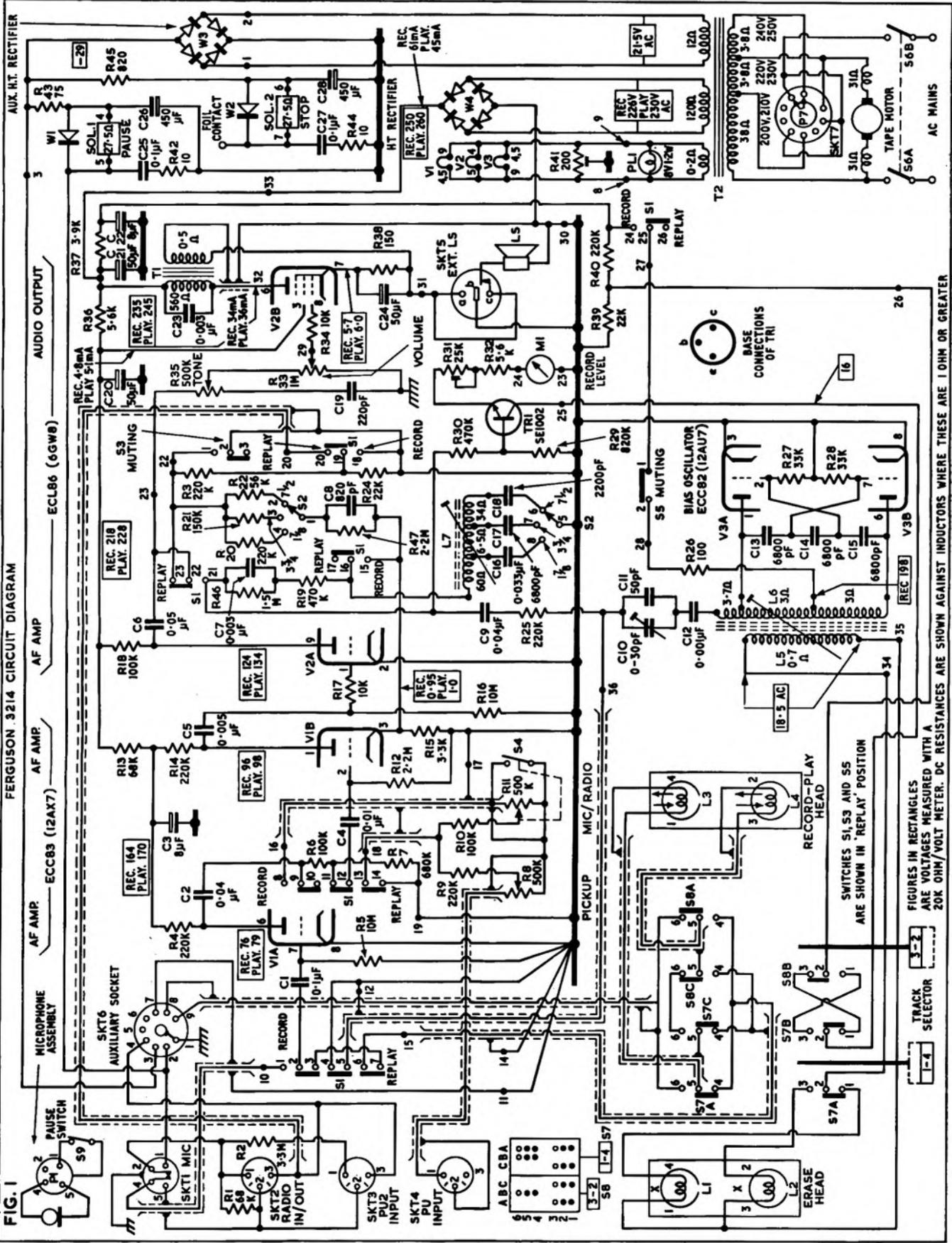
The autostop solenoid is the important one, as maladjustment will affect the complete key operation. There is a temptation on the part of some folk—regrettably, some service workshops—to dash in with eager screwdriver and pliers when controls fail to do their proper job. First check that when the stop solenoid is energised the lower edge of the key insert is just out of contact with the latch plate. The latter can be adjusted by the nut and rod linkage to the solenoid. To check, engage record and start keys and operate the autostop. This should just trip the latch plate. Check then that normal stop key action also trips the latch and make final adjustments before locking the nut. A touch of shellac (borrow the wife's nail varnish) will do for this job. It is just sufficient to hold the nut on the exact thread turn but easily broken for re-adjustment if subsequently needed. The autostop relay is the one below the key assembly.

The pause solenoid, at the left, is rather a different proposition. Its components and action are more easily seen when the plastic

(continued on page 246)



FERGUSON 3214 CIRCUIT DIAGRAM



tape recorder service

deck-cover is removed. One colleague fell about the room with amusement when he saw how this control system was intended to work; but though it looks a little primitive, with rods, bent links and apparently flimsy auxiliary brakes, it is quite effective. Appearances can be deceptive—as anyone who has turned his nose up at *Sony* linkage systems may have learned. There is one thing about a bicycle spoke type of rod control, unless some ham-fisted fellow puts a kink in it: alteration in length is hardly likely.

With the DC43, there are two adjustment nuts, one each side of the solenoid plate. Then comes the lug on the angle bracket, a fairly easy compression spring and a locknut which is only intended to regulate the spring. First, with the machine disconnected, press the play key. Note that there should be a third of an inch—all right, you Hertz-minded types, 0.333in.—between the brake pad B in fig. 3 and the spool carrier. Adjust the outer nut, 2, for this clearance. Plug in, switch on, allow to warm up for a few minutes, operate the play key and energise the pause solenoid and note that the clearance between the capstan spindle and the pinch roller should be between 0.01 and 0.015in. Adjust Nut 1 to achieve this. Check that the brake is now applied to the spool carrier, then check the manual pause action by operating the stop key and depressing the pause key. If the clearance is not again 0.03in., the lug L will have to be bent to ensure this. But always go back over the whole sequence again afterwards to make sure the swivel plate has not been made to bind by over-adjustment.

In the circuit (fig. 1) there are two points of particular interest. First, the speed-conscious equalisation circuit, and second, the transistor-operated meter control circuit. On playback, the bass boost is provided by the series negative feedback network from V2a anode to V1b cathode via S1 (21-23) and S2 (2-4). The latter selects the appropriate time-constant for the speed and is operated by the speed switch. The former is part of the record/play switching sequence.

LOADING COIL

When record is selected, the feedback again comes into operation by S1 (15-17), but this time the loading coil L7, with its appropriate tapped capacitor tuning, is shunted across the 3.3K cathode resistor of V1b to give the necessary treble boost. This inductance, L7, is tuned, but should not normally be adjusted unless the circuit components have been changed. If it is necessary to check the adjustment, a valve voltmeter between the top end of the tone control, i.e., the output from V2a, after C6, capacitor, and chassis, will provide a means of output signal measurement. A signal at the top end of the frequency range (18kHz is recommended) is injected. This should be fed to the microphone input via a 100k μ F capacitor and, to save making up special plugs, can be attached to the signal side of the C1 coupling to V1a grid. With the speed set at 7½ i/s and record selected, L7 should be adjusted for maximum output on the valve voltmeter. Sometimes, a maladjusted L7 will give the

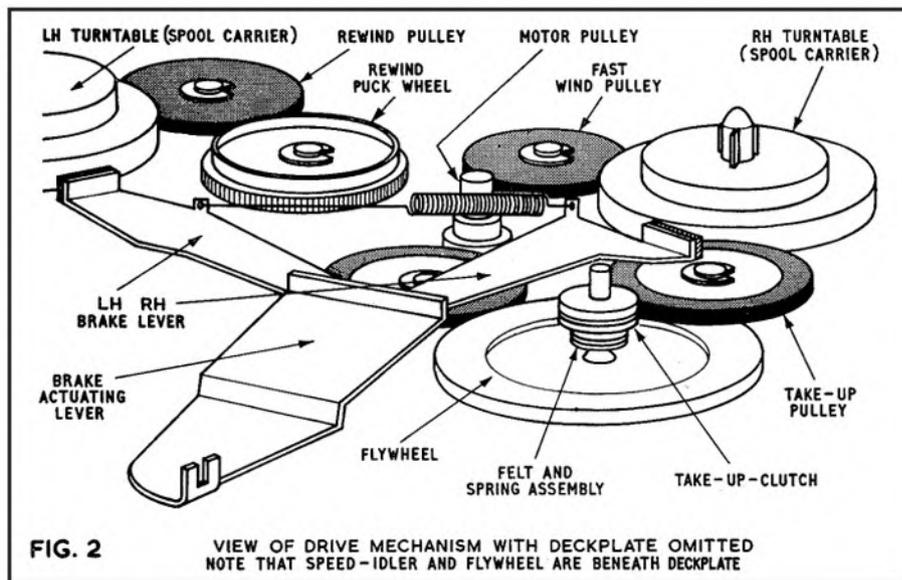
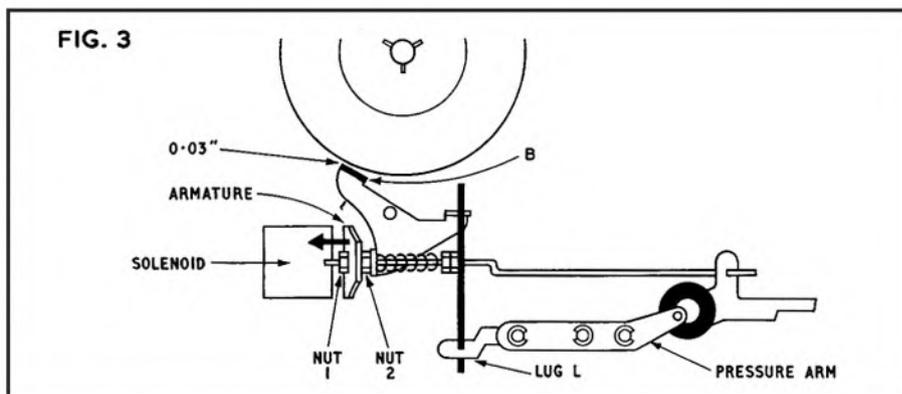


FIG. 2 VIEW OF DRIVE MECHANISM WITH DECKPLATE OMITTED
NOTE THAT SPEED-IDLER AND FLYWHEEL ARE BENEATH DECKPLATE



effect of insufficient recording bias, and if attention has been directed to the oscillator and it is found that the capacitor C10 has to be altered to its limit to increase bias and gain a bit of extra response, L7 tuning should be checked.

The recording level indicator in this range of models is an edge reading *Smiths* meter mounted so that the 'edge' lies in the horizontal plane—i.e., the operator looks down on it. Great care should be exercised in handling this meter as its movement is susceptible to knocks and the construction prevents you getting at the inside of the plastic casing to make adjustments to the movement. The transistor is a constant load device, preventing the meter from imposing a differing load to the output from the amplifier's third stage with changes of output and frequency. This is a slightly more sophisticated approach to the problem than the usual filter network that damps the whole output and tends to give slightly false readings when a full tone of fairly high frequencies builds up a charge voltage across the capacitive section of the filter and applies its voltage to the meter. The series resistor, R31, allows zero setting by limiting the emitter bias. Note that this is an *n-p-n* transistor in a common-emitter mode, with the collector at a constant positive voltage determined by the tapping from the HT divider network R40/R39, via the switches S7B/S8B,

sections of the track switches. The reason for this method of routing is to isolate the meter circuit and avoid damage when both track buttons are pressed—as they have to be for dual replay. If the record key were pressed under these conditions we could easily overload and damage both transistor and meter. At the present cost of meters, this is a fate we wouldn't wish upon even the most ham-fisted user.

COMPONENT CHANGES

One or two component changes have been made since the first models were produced. In early models, the following components were different: R6—220K, R7—470K, and R47 in the feedback network was omitted. R19 was connected directly between contacts 16 and 21 of S1, omitting the R46/C7 network. Although *EMI* tape is normally used, some earlier machines were issued with *Scotch* tape and changes were made in the equalisation circuit, R21—220K and R22—100K, while the bias feed was altered by making C11 a 30pF component.

As a parting shot—we have found that some tapes, notably *BASF*, give fierce static on rewind—any comments from our vocal band of theorists?

(Readers experiencing this trouble, and tape 'screech' at normal speeds, might find it worthwhile to experiment with PTFE. See page 237—Ed.)



PERSONAL BIAS

THE AUDIO FAIR—AN UNOFFICIAL REPORT BY JOHN ASHCROFT

FREE samples wouldn't have brought bigger crowds. "It's incredible," fumed Ebenezer, elbowing through the mob, "they're all phonotropic". Certainly the biggest crowds had swarmed into the rooms featuring the greatest racket, and we heard occasional sounds suggesting a racket in *any* sense of the word, with open doors snarling like beasts across the corridor at each other.

But most demonstrations were rational and well worth queuing for. Which reminds me . . . Neb and I were waiting patiently by one door; two other leaflet clutchers joined us; in thirty seconds we had a most impressive queue. The door opened, out slipped one Merseysider, in popped Ebenezer, and the door closed again. "Hey," came a plaintive cry, far behind me. "What is this?" I broke the news that it was the nearest "gents", and the queue vanished like magic.

Oh, and while sampling the hospitality of your Editor in the lounge provided, we saw one of the magazine staff drop a whisky glass into the sink and jump five inches off the carpet. I attributed this gymnastic display to the temperature of the water, but he claimed somebody had wrongly connected a thousand watt amplifier somewhere, and fed the live wire up the waterpipes to earth the brute. The more I considered possible ramifications, the more dubious I became about the Hotel's plumbing generally, but oddly enough this phenomenon affected only two of the chaps in the lounge, and dark suspicions arose that this was their excuse to get off the fatigue-squad.

And when, on behalf of our club, I asked if I could interview John Bradley of the Federation at his convenience, I didn't expect to be taken so literally. But the Federation room was crowded and the adjoining bathroom was the only quiet place we could find, so we retreated into it and sat on the furniture provided.

John chose the best seat; I suffered a fundamental disagreement with the edge of the bath, and the recording had a really authentic bathroom acoustic. I'm thinking of applying for a job as *Tape Recorder's* only plumbing correspondent.

Several demonstrations really impressed us. *STC*, for instance, taping a pianist before our eyes and comparing the results from different microphones on replay with flashing-light cues; and *Revox*, with four machines each playing

one track of a four-channel stereo recording into a separate *Quad* electrostatic, with wonderful spread and never a wobble in the timing . . . I've tried similar stunts on my three mains machines, and count myself lucky if I go half a minute on replay before an infinitesimal variation produces a hint of total chaos.

Most demonstrators were pleasantly frank, only too eager to hear criticism and good-naturedly reply to it; but a few came close to having the pedestals kicked from under them by an Ebenezer gumboot. One famous name was replaying an enormous spool on a studio machine, and the sound was excellent, but the tape was squeaking against the spool's rim on each revolution. Ebenezer quite amiably remarked that it was somehow reassuring to the amateur to find that even a professional using such equipment could encounter this problem.

"But we don't," was the snapped retort. "A member of the public must have been tampering with the tape or the machine." It was said so accusingly that Ebenezer showed danger-signs, so to change the topic I politely asked: "Is there any chance of your latest battery-portable coming out in a stereo version?" The rep didn't deign to reply verbally; he just pointed to a stereo model at the far side of the room, and walked off with a hint of a shrug. Now this stereo version was one of the Fair's surprises, to us at least, and I must admit that before considering buying it I'd wonder if the service department had a similar attitude.

Talking of portables, along with dozens of other visitors I was carrying the *Phillips* cassette model for interview work. Thinking of a directional microphone with less handling noise, I visited the *Beyer* stand; the staff gladly let me plug in some of their exhibits and conduct an impromptu field-test, and their *M.80* in particular gave pleasing results. This made a gratifying contrast with the "locked cases and armed guards" atmosphere in some quarters . . . not that I can really blame the latter exhibitors, though, after half a capacitor microphone vanished permanently from one stand in between two blinks of an aghast exhibitor's eyes!

On microphones, again, I was in the *Lustraphone* room during a *Radiomic* demonstration which was taped for an American broadcast. Mr. Pontzen, Jnr., strolled out into the corridors, maintaining a commentary and inviting

visitors to comment on the Fair; and it was quite exciting to stand by the monitor speaker and follow his progress.

One of the most eagerly-awaited demonstrations gave us the worst let-down. The amplifier controls may have been skew-whiff; the prepared tape may have been chronically recorded; or masses of oxide may have been plastered on a head; but the sounds produced by a world-renowned recorder were horribly coloured, with muffled narration, boomy honky bass, obnoxious middle and very little top.

Yet a tape prepared by amateurs, played from a similar machine at the same demonstration, sounded marvellously crisp and natural . . . and what really upset us was that no one else seemed aware of the difference; fellow-visitors all sat through the first section with dedicated "this is hi fi—you can feel the thump!" expressions.

Sunday evening saw the hottest, stickiest and most determined throng, while patience frayed and exhibitors visibly wilted. In self-defence *Brenell* opened their windows slightly for their final demonstration, and from my back-corner seat a charmingly civilised chat was utterly drowned by Holst's *Jupiter* theme blaring in from a demonstration elsewhere: what it sounded like in the room where it was played, I rather hate to think.

At times the Hotel resembled the United Nations. An amazingly unruffled Cyril Rex-Hassan told me about three thousand overseas visitors had signed the book or left cards, and I'm sure every one of them (plus a hundred thousand natives) danced on Ebenezer's carbuncles; but it was all in a good cause.

Two last indelible memories: Ebenezer and I adjourned to several glorious pints and a mountain of cheese sandwiches and chunks of veal and egg pie in a nearby pub, and the bartender leaned confidentially close and whispered: "Do you know—just *what* the 'ell is *basuff*?"

"Never heard of it," I mumbled through the pie, suspecting a new drink.

"Nor had I," he admitted darkly, "until a few days ago . . . and now there's millions of people running round this district with great bags full of it".

This seemed alarming, if not downright sinister; so we hastily downed the dregs and scoffed the crumbs and trundled to the door, picking up from beside the bar our *BASF* carrier-bags crammed full of leaflets and catalogues. I glanced back as we left; never will I forget the expression on the bartender's face.

Outside, the air was cool and clear; light drizzle misted the removal lorries outside the Hotel Russell as we passed, and neon signs were reflected brightly in the road. At Russell Square station we entered a condemned cell disguised as a lift, and finally tottered into a train. With a thankful groan I slumped on to the seat, stretched my legs, and took the weight off my raw, throbbing feet. I felt half as energetic as a wet flannel.

Ebenezer chortled, and pointed at an advertisement across the compartment.

FEELING SHATTERED?
—it asked, and advised us to try *Phillips' Tonic Yeast*.

"Mmmmm," mused Ebenezer. "Wonder if you can buy *that* in a cassette?"



recorders and recordings heard at the 1967 international audio festival and fair

THE YEAR THEY LEFT WELL ALONE



Above left: Bob Fisher discussed the day's renderings with two student-pianists while above right a *Revox/Vortexion* system is prepared to take the signals from the demonstration STC microphones.

Immediate left: The *Erenell* exhibit, feeding *Tannoy* loudspeakers.

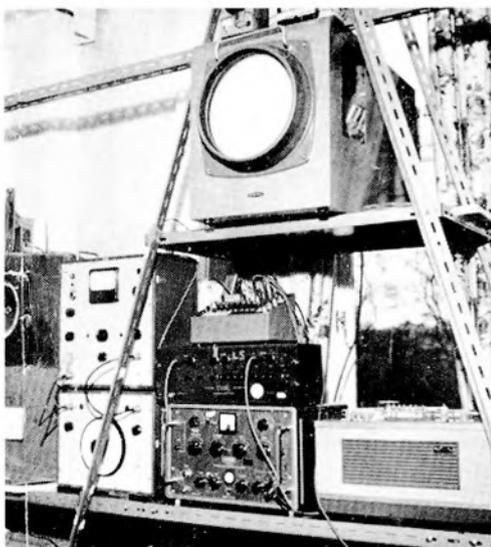
Right: A *Revox* approach, through *Quad* speakers, to four-channel stereo—£180 per channel.

Below left: *Tape Recorder Developments* stereo tape unit shown alongside the basic deck.

Below right: *Dual TG 27* budget-stereo tape unit. **Below right:** Part of the *BKSTS* array, showing 15 1/s *Revox* minus head covers (it was correctly threaded), oscilloscope and (just visible at top) PPM and VU-meter.



recorders and recordings heard at the 1967 international audio festival and fair



NINETY-three exhibitors have dismantled their stands, packed their bags, and left the Hotel Russell. Seventy-eight bedsteads are hauled from the hidden hotel depths and returned to the now-deserted demonstration rooms. Forgotten STC capacitor microphones, a Truvox tape unit, several Ortofon cartridges and lengths of hastily-dismantled BKSTS angle-iron litter the corridors, awaiting the arrival of the men with brooms. The 1967 Audio Fair has ended.

For the press there is anti-climax, but for many manufacturers the satisfaction of well-attended demonstrations, a host of new orders, and the relief that all (well, nearly all!) has functioned smoothly.

In terms of exhibited products, 1967 has been very much a year of 'leaving well alone'. An acute shortage of new tape equipment, reflected to some extent in the wider hi-fi industry, is compensated by the realisation that last year's models, in general, are not doomed to obsolescence. However, as we shall see, the Fair was not entirely barren.

A growing trend towards closed demonstrations was observed this year, which did little to improve the lot of the editorial feet, though in some cases it certainly helped listeners to form a relaxed judgement of performance. Grundig, back after two years' absence, and Ferguson, entering the exhibition for the first time, both chose the closed technique, though it is significant that each was demonstrating an elaborate range of products. Where the range is simpler, however, many visitors probably prefer the technique of letting the products speak for themselves, with the room adequately furnished with seating and the door left permanently ajar, leaving visitors to wander in and out, or remain, as their ears and interests dictate.

It all depends, of course, on whether an exhibitor's potential customers are prepared to queue to hear a balanced musical programme in quiet surroundings, or prefer informal browsing from room to room.

Though easily overlooked in the Russell bustle, the tiny Agfa Magneton Universal Cassette should fill a long-felt need among tape correspondents. All 3in. PE 31, PE 41 and PE 65 tapes are now being supplied in unbreakable plastic containers conforming to international postal regulations. For larger reels (or longer letters), Novodur plastic library boxes may now be purchased without tape in 4½, 5, 5½ and 7in. sizes. Larger still is the PEV 385 video tape, also displayed on the booth.

Ampex machines continue to fascinate. The 863 records and plays in a conventional forward direction (at £127 10s.); the 1163 will additionally play backwards (at £159 10s.); while the £227 15s. 2163 plays and records in both directions. The demonstrated equipment performed admirably, a professional AG-350 being coyly positioned in an adjoining room to jog the memory of visitors struck by the fragile appearance of the domestic designs.

The expected Akai X-2000 did not, in fact, materialise in time for the exhibition. When introduced later this year, however, it will offer many of the features currently found on the £250 X-355, for some £150. In common with Sony, Akai are now endeavouring to enter the high-quality audio market. The AA-7000 tuner-amplifier will cost a little under £150.

New thinking by AKG was reflected in

several microphones making their debut at the Audio Fair. The D11D HL was unusually versatile in combining a music/speech switch with cardioid, super-cardioid and hyper-cardioid properties. A clip-on moulding provides the means of altering the pick-up pattern, whilst the speech switch gives 10dB attenuation at 100Hz.

Respite from the commercial world was to be found in the British Kinematograph, Sound and Television Society lounge, where an enthusiastic atmosphere vibrated to the sweet emanations of a superbly ugly array of equipment. A Terry Long recording was fed from a Revox 736/HS, at 15 i/s, to a rack of devices simulating, among other effects, 'transistor sound'. At the summit of the angle-iron bench, a VU-meter and PPM could be compared, reacting to the signal feeding the loudspeakers and oscilloscope. Several other exhibitors used the Long/BKSTS recording as the source material for their demonstrations, in the sure knowledge that something near to perfection was at least going in, whatever might come out!

BASF followed their usual pattern of exhibit, offering short 'sound impressions' for visitors to take away. "Television and radio personality" B. D. Walker was in attendance to discuss his recording experiences.

The Bang and Olufsen 2000 continues more-or-less unchanged, offering the convenience of slide controls plus off-tape monitoring, echo, stereo power amplifiers and detachable loudspeakers.

Brenell provided a tasteful demonstration of their STB2, Hi-Fi Tape Link, and mono Mk. 5M Series 3, alongside a Leak valve amplifier and tuner, SME pick-up, Garrard 401 turntable, and Tannoy loudspeakers.

Casting our eyes from the tantalising sight of a BSR disc reproducer operating at a violent angle from the horizontal (the arm is neutrally balanced and then sprung against the disc), we relished the opportunity of assessing whether the TD20 tape deck really does incorporate 'featherlight' controls. The press-tabs did indeed fulfil the manufacturer's claims in this respect.

A static display of Acos products was presented by Cosmocord. The new Series 90 low-price microphones hold promise, comprising the ceramic Mic 93, moving-coil 95 and 96, and crystal 91 and 92. A cardioid characteristic is claimed for the Mic 92. Prices commence at £2.

Centre of interest at the EMI room, from a tape recording viewpoint, was the stereo L4 developed by Stagesound. Rather less expensive is a film-synchronisation version costing £195. As we were to gather later from Uher, modifying battery portables seems an exceptionally expensive business.

A borrowed Vortexion CBL enticed visitors into the Federation of British Tape Recording Clubs room where they were offered entry forms for the 1967 British Amateur Tape Recording Contest and sample copies of the Federation's quarterly bulletin. The latter provides an excellent medium for the snippets of club news once popular in the national publications.

Ferroglyph oscillated between the reproduction of stereo music tapes and British Ferroglyph Owners' Club recordings, apparently

(continued overleaf)

AUDIO FAIR REPORT CONTINUED

leaving bewildered listeners to decide for themselves 'where the stereo had gone'. (The gallant efforts of the BFOC were, in fact, played double-mono.) It is pleasing to see such close liaison between customer and manufacturer. Will our Japanese friends ever imitate *this*?

Ferguson showed the 3216 three-speed recorder as part of their *Unit Audio* system. We have lost count of the number of different cabinets in which this machine has appeared since its 1965 conception, but the *Unit Audio* version, in a plain wooden cabinet with wood-and-Perspex lid, seems a worthy pace-setter for domestic design.

A new name to the Audio Fair, and indeed to the British market as a whole, is the Swiss *Fidela*. Manufactured by the *Waltham Electronics Company*, the range comprises four recorders and several amplifiers and loudspeakers. Cheapest is the 715, selling at £78 15s., which employs a single-motor mechanism and weighs 15½lb. Though described by the importers as a "deck", the 780 incorporates record and replay amplifiers feeding two 7 x 5in. internal speakers. Price of this model is £152 5s. The range is completed by Model 707, at £124 19s., and the 760 at £144 18s. They are distributed by *Denham and Morley Ltd.*

A spray of microphones fanned across the *Grampian* booth wall, centring on the faithful old *DP4*, still going strong eight years after its introduction.

The *TK245*, announced at the Russell by *Grundig*, is claimed the first stereo recorder to feature automatic gain control. An interesting feature is the push-button arrangement of mechanical controls filling a design gap between the more expensive tab-control *Grundigs* and the cheaper single-knob *TK120* style.

We had high hopes that a newly acquired library of Musicassettes would remain intact for ever, in accordance with claims by *Philips* that current machines will not erase tapes in cassettes from which the plastic lugs have been punched. But, alas, we were disappointed, for the new stereo *EL3312* will erase pre-punched Musicassettes, provided the red record button is held down before and during loading. The *EL3312* was one of several components feeding the *Audio Plan* sound system, enabling listeners to compare ¼-track stereo from ½in. tape at 1½ i/s with FM and stereo disc signals. The entire *Philips* range appeared to have been restyled, but closer examination revealed the main changes to be of colour—from various shades of plastic to black. One model with internal improvements was the *EL3302* cassette battery portable, for which increased output power and superior frequency response are claimed, relative to the *EL3301*. Particularly welcome, on this model, was the addition of an external loudspeaker socket.

A number of readers visiting the *Tape Recorder* room expressed interest in a survey relating magnetic tape and commercial recorders to high, medium and low bias categories. Although it is easy to over-rate the problem, this is something we are certainly investigating. In the meantime, *Akai*, *Ferroglyph*, *Revox* and *Tandberg* have extricated themselves from the muddle by recommending, simply, *Scotch Dynarange*. Centre-piece of the *3M* display

was the Scotch self-threading reel; we were left wondering about the consequences of employing it with *Master-tape* self-threading leader!

The tranquil squeakings and rumblings of neighbouring demonstrations were rudely shattered, in the region of Room 112, by the shriek of aircraft engines emanating from *Sony* loudspeakers. We were disappointed to note this return to 'ping-pong' effects, which inhibit rather than enhance the popularity of stereo reproduction.

Last year *STC* demonstrated the comparative qualities of three microphones by reproducing tapes of a string quartet recorded some days previously at a professional studio. This year, however, they achieved the most pleasing and purposeful demonstration of the exhibition by recording the instruments on the spot. Two students of the London Trinity College of Music played for alternate periods on a small grand-piano. The climax to their playing was provided by *STC*'s Bob Fisher, performing with gusto on cymbals. *Radford* amplifiers and loudspeakers relayed the recording, which was made through a *Vortexion* mixer on to a 15 i/s *Revox 736/HS*, to show the subtle differences between two ribbon microphones—the 11 gn. *4113* and £26 *4119*—and the £67 5s. *4136* capacitor. The latter price, for the record, excludes a £35 mains power-pack.

Another departure from run-of-the-mill exhibits was given by *Revox*, where four 7½ i/s *736* recorders fed a quartet of *Quad* speakers with a total of eight instrumental tracks. The Dutch guitarist Wout Steenhuis recorded the tracks individually, hoping that Swiss engineering would hold them in synchronism. Although started automatically by a slide synchroniser, the four machines shared nothing but the Hotel Russell power supply.

As the demonstration showed, the musician's faith was well founded, though we would question the wisdom of employing a *Quad Electrostatic* for bass guitar; it buzzed on occasional peaks.

British deck designs have been in short supply for the past two or three years, judging from the undernourished section in the 1966/67 *Hi-Fi Year Book*. *Scopetronics* are now producing a series of designs based on their *825*, comprising the 10½in. *NAB 1050* at £82, and the 11½in. *1150* at £140, plus a remote-start *825/R* at £89. Remote start/stop and optical stop facilities are offered by a £101 version. A series of transistor preamplifiers are about to be produced, though no price details are yet available.

CHALLENGING MODEL

A number of readers were evidently impressed by the *Tandberg 64X*, though several hinted that they would await the ¼-track *62X*, despite claims of 65dB signal-to-noise ratio. One way and another, this model certainly has proved one of the most challenging designs to appear in recent years and we look forward to the opportunity of reviewing one.

Telefunken practically invented the plastic-tape recorder and their designs vie well with those of competitors. The loudspeakers employed in their demonstration hardly did justice to the *M.204E* and battery *M.300*, however, either through some internal characteristic or unorthodox setting of the tone controls.

All thoughts regarding *Truvox* products were

overshadowed, during the Fair, by the news that the company was in the process of moving to Southampton, where it has now entered premises previously occupied by its sister company *Thermionic Products Ltd.*, manufacturers of instrumentation recorders. The move took place over the Audio Fair weekend, and from what we have heard *Truvox* have a bright future ahead—we wish them well. (Further details of the move are given on page 237.) The *Truvox* demonstration at the Hotel Russell used existing models for an impressive recorded-versus-original display.

A slight familiarity about the *Tape Recorder Developments* deck betrays the identity of its designer—none other than the man behind the *Planet U.I.* A stereo tape unit based on this mechanism is now being produced, to sell at £199 9s. Variable bias, an *Ernest Turner* peak-programme meter, space for fourth tape head, and a four-digit direct reading footage counter must bring this close to the enthusiast's ideal. Silicon-transistor modular circuitry and provision for 10½in. spools are incorporated.

A "switchable rumbling filter" (or so the Audio Fair Catalogue would have us believe) is one of several unusual features of the *Uher 1000L Report Pilot* battery portable. Primarily aimed at the film industry, it includes pilot-tone and strobe synchronising systems, before and after monitoring, switchable automatic gain control (using an optical transducer) and CCIR/NARTB equalisation switching. Like the £108 *4000L* from which it is derived, the *1000L* employs a "collectorless" motor and solenoid pause control. Unlike the latter, it operates at the single speed of 7½ i/s, full-track, and costs some £230.

NO SIGN

No sign, yet, of the *4400* ¼-track stereo portable, though this is believed to be on the verge of introduction, with a ½-track version following later. It will be a welcome successor to the stereo *4004* which, in its day, was one of the finest portables on the market.

The clean, sweet tones of a piano were reproduced in the *Vortexion* room, by a stereo *CBL* feeding direct from its internal amplifiers to a pair of *Wharfedale* speakers. Though uncertain of our *Hi-Fi News* colleagues' opinions, we would categorise this year's *BKSTS*, *STC* and *Vortexion* demonstrations as most closely approaching 'the real thing'.

Most fruitful of the 'outside shows', in terms of tape equipment, was the *Dual* display at the Connaught Rooms. An ingenious gain-control linkage is embodied in the new *TG 27*, a neatly styled stereo tape unit retailing at £61 19s. Quarter-track heads, 7½ and 3½ i/s tape speeds and sound-on-sound facilities suggest a machine of very reasonable value.

What the 1967 Audio Festival lacked in terms of new products, then, it gained through the medium of lively and original demonstrations. Only one element seemed really to be missing: the thoughtful rearrangement of hotel decor. *Shure* went to town with a futuristic, though crudely painted, arrangement of cardboard, hardboard, wood and oscilloscope, while *Quad* achieved the most passable representation of a domestic listening room. But where was the enthusiastic polished salesmanship to disguise the wash-basins and, if not conceal, at least close those bathroom doors?

a simple tape eraser

G. A. CLOUD OFFERS AN END TO THE MISERY OF HALF-TRACK/QUARTER-TRACK EXCHANGES

IT is not often realised that tapes cannot be exchanged between $\frac{1}{2}$ -track and $\frac{1}{4}$ -track recorders without certain precautions being taken. A $\frac{1}{2}$ -track tape can be reproduced on a $\frac{1}{4}$ -track machine, provided tracks 1 and 4 are used, but problems arise when a $\frac{1}{4}$ -track recording is prepared, again on tracks 1 and 4, for playback on a $\frac{1}{2}$ -track recorder.

Although the resultant tape sounds acceptable on the $\frac{1}{4}$ -track machine, the $\frac{1}{2}$ -track model will, in fact, replay both the $\frac{1}{4}$ -track recording and the previous $\frac{1}{2}$ -track recording. A study of fig. 1 will clarify what has happened. The $\frac{1}{4}$ -track machine only erases about half of the original $\frac{1}{2}$ -track recording. The only solution to the problem is erasure of the entire $\frac{1}{2}$ -track recording. This can be achieved on most $\frac{1}{4}$ -track machines by the somewhat laborious process of erasing tracks 2 and 3 before starting to record on 1 and 4. On some $\frac{1}{4}$ -track models, however, the erase head position is such that part of that tape is never wiped. One therefore has the choice of resorting to aligning the heads properly, buying a commercial bulk eraser, or fitting a full-track erase head.

Those whose knowledge of electricity does not go much beyond replacing fuses, fitting plugs and wiring up the front door bell, may find the following devices of some help. The simplest system of erasure, and suitable for message tapes, is to use a permanent magnet, but it may not be considered suitable for good quality music. It is simple and cheap to make, but does induce a certain amount of background hiss.

Fig. 2 shows an *Eclipse No. 802* pocket magnet fitted to the side of a *Ferguson* tape recorder. The tape guides were made from *Meccano* using three double arm cranks *No. 62B*, an axle rod, and two brass collars *No. 59*. The magnet was positioned so that it was against the back of the tape (to avoid scratching the magnetic coating) and was supported on a double arm crank *No. 62B* by having a brass screw passed between the magnet arms and through the boss of the double arm crank.

A *Meccano* girder bracket *No. 161* was used to clip the device on to the side of the tape recorder.

All parts against which the tape runs must

be smooth and polished. The ends of the magnet can be smoothed on an oil stone or on a very fine 'wet and dry' emery paper, the ends being finally polished with metal polish. The best method of doing this, is to stick with *Evostick* a piece of chamois leather on to a piece of wood or hardboard, leaving it to dry for 24 hours. Then a few drops of metal polish are sprinkled on to the leather and the ends of the magnet rubbed against it.

The axle rods were polished by using a long strip of quarter inch cloth tape, damped with metal polish.

It is most important that all parts that have been polished are carefully scrubbed in soapy water, well rinsed and dried before final assembly.

Instead of a permanent magnet like the *Eclipse 802*, a small permanent magnet erase head can be ordered from most radio dealers. That used in the *Grundig TK1* is suitable, the part number is *E/Head 188/32*. As this is for a $\frac{1}{2}$ -track recorder it will erase half the tape. Therefore the warning given at the end of this

(continued on page 253)

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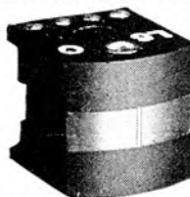
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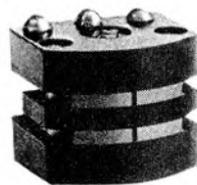
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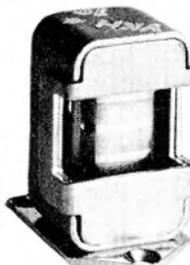
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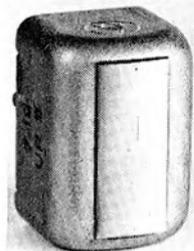
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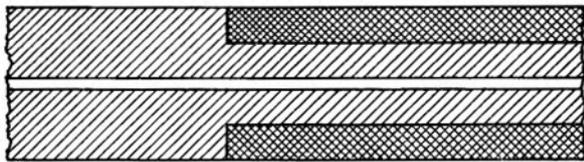
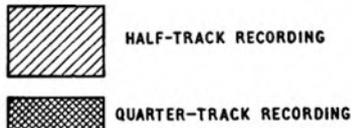
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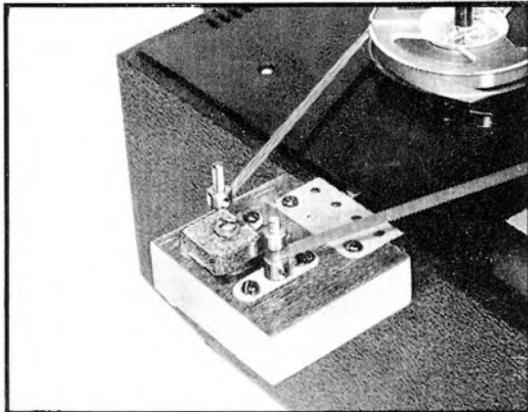
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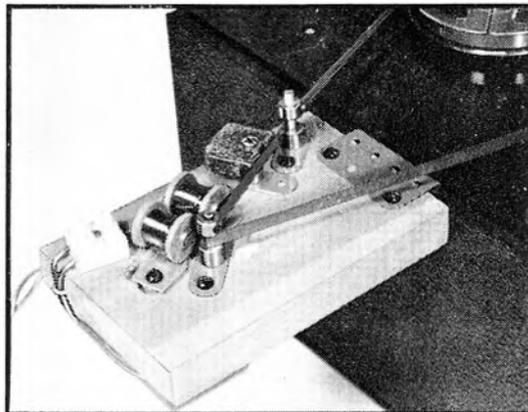
FIG. 1



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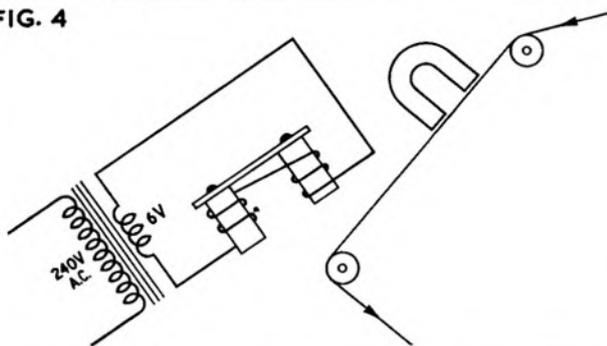


2



3

FIG. 4



4

A SIMPLE TAPE ERASER

CONTINUED

article does not apply. The tape will have to pass across it for both first and second recording.

Fig. 3 shows a device designed to reduce the background hiss that may occur if only a permanent magnet is used. The principle here is first to bring the tape to a maximum saturation as in the fig. 2 devices, and then to demagnetize it, which is the principle of the bulk erasure, by passing it through an alternating magnetic field of diminishing strength.

An old electric bell of the two pole type was used, the striker parts being removed to leave only the electromagnet. This was connected to a small mains bell transformer which was mounted on the underside of the device. Fig. 4 shows the circuit.

PLACED AT AN ANGLE

The tape must first pass the permanent magnet then pass the electromagnet whose pole pieces do not touch the tape but are placed at an angle to the tape, their distance has to be found by trial and error. The method adopted was as follows :

- (1) The tape recorder was threaded up with the tape so that the tape from the feed spool passed by the new erasure head before passing through the recorder's own head.
- (2) The recorder was switched on and set to "play" while the volume control was turned up higher than normally used, so that there was a strong background hiss.

Of the three speeds $1\frac{1}{2}$, $3\frac{3}{4}$ and $7\frac{1}{2}$ provided on the writer's recorder, $3\frac{3}{4}$ i.p.s. was found to give the loudest background hiss and this speed was used.

- (3) The A.C. mains to the bell transformer was switched on, a few seconds later the hiss level altered. All that was necessary was to find the best position for the electromagnets relative to the tape that gave the minimum background hiss.

The electromagnets were fixed into position.

To record the tape from the feed spool first passes the permanent magnet, then passes the electromagnet if used, then to the recorder's head. Recording is done in the usual way.

Both types of erasure heads using Eclipse magnets erase the total width of the tape, therefore they must only be used for the first recording and not for the second, otherwise everything that was recorded on the first track will be wiped off during the second recording. This does not apply if the Grundig head is used on its own without the electromagnets.

A MODERN tape recorder consists of three basic parts—a tape transport mechanism, a head assembly, and the electronic circuits with which we shall be concerned in this series. The tape transport comprises the mechanical parts of the recorder which drive tape over the heads at one of the standard speeds. The mechanism is so designed that the tape passes smoothly over the heads at constant speed so that distortion due to wow and flutter is minimised as far as possible. The head assembly consists of the heads of the tape recorder and the guides and adjustors needed to keep these accurately aligned with respect to the horizontal movement of the tape. The first head, for *erase*, is supplied with a high frequency current (50-100kHz) during recording which causes any modulation on the tape to be removed before a new recording is made. The second head may be a combined record/replay head, with the necessary function selected by a switch. In the record position the head is supplied with a high frequency *bias current* plus the audio signal, and the result is that the audio waveform is transferred to the magnetic coating on the tape. In the replay mode, the bias current is disconnected and the head then performs as a replay transducer, converting the magnetic pattern on the tape into an electrical playback signal which can be amplified and reproduced. In some recorders, particularly those in the higher price range, separate record and playback heads are employed. This has two main advantages. Firstly, in a combined head the designer has to compromise between the different requirements for record and playback, whereas with separate heads each can be tailored to meet specific requirements. A third head makes it possible for the signal being recorded on the tape to be monitored during the actual recording process, and this is a real asset for the serious enthusiast.

The tape recorder circuits which we shall explore in this series are shown schematically in fig. 1. Let us look at this a little more closely. The first thing to notice is that two alternative inputs are offered, as is the case with nearly all tape recorders. One of these is a low level input suitable for connection to a high impedance microphone. The other is a high level one and this is suitable for a higher input voltage like that produced by a radio tuner, another tape playback amplifier, or a crystal pickup.

A tape recorder input is usually quoted, in specifications, in terms of *sensitivity*. The low level input might, for example, have a sensitivity of 2mV RMS for a full depth recording. A *millivolt* (mV), incidentally, is one thousandth part of a volt, and *RMS* is *root mean square*, which is a way of expressing alternating voltages as we shall see in Part 3. A typical value for a high impedance microphone input, 2mV RMS, means that a microphone producing a peak output voltage of 2mV will fully load the input and fully drive the amplifier stage to which the input is coupled. A voltage much above this would over-drive the amplifier and produce harmonic and intermodulation distortion. At the other extreme, a voltage considerably lower than 2mV would not be sufficient to drive the amplifier valve fully and a poor *signal-to-noise ratio* (S/N) would result. The correct level of input is therefore very important for good quality results; however,

ELEMENTS OF TAPE RECORDER CIRCUITS

INTRODUCING THE TAPE RECORDER

we shall come back to this later in the series.

A typical high level input might have a sensitivity anywhere in the range 100-300mV RMS for a full depth recording. It is therefore an input of *lower* sensitivity than the low level input and requires a voltage in the range 100-300mV to load the input adequately and produce an acceptably high signal-to-noise ratio.

In tape recorders where two inputs of widely differing sensitivity are employed it is usual for the more sensitive input to have one or more extra stages of amplification, as shown in fig. 1. This brings the low level signal up to a level similar to that of the high level signals and from then on both could be amplified further to the same extent before going to the recording head.

Fig. 1 shows an ideal arrangement where the low and high level signals can be mixed. This is done by employing two record gain controls, passing the required proportions of high and low level signals on to the rest of the amplifier. In some recorders, either high or low level signals are selected by means of a push button and only one gain control is fitted. In this type of recorder mixing is not possible.

In addition to input sensitivity we shall have to consider input *impedance*. This will be dealt with at some length later on, but for the moment let us bring out a few important points. Firstly, the impedance at the control grid circuit of an amplifier valve can be of a very high order, as much as 1M (one million ohms) or more in some cases. This is convenient, since it means that signal input circuits of high impedance, like those derived from a radio tuner or another tape amplifier, can be connected almost directly to the control grid. However, signals from a source of low impedance, like those from a ribbon microphone, cannot conveniently be connected across this high impedance. There is nothing really wrong in connecting a low impedance source into a high impedance input, but a rather high signal *voltage* would normally be required, much larger than that obtained from

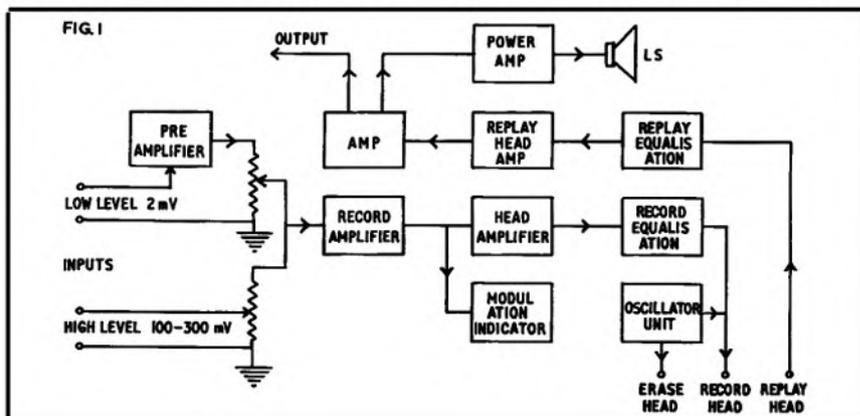
a ribbon microphone. The voltages obtained from such a microphone are quite small and a matching device is required to step up the impedance of the source to match the input impedance, so that a larger signal voltage is obtained. As we shall see very shortly in this series, all that is needed to obtain this match is a simple step-up *transformer*.

The next thing to notice in fig. 1 is the record amplifier. This has two main functions. One of these is to amplify the signal voltages to a level suitable for driving the recording head, and the other is to apply treble boost which compensates for high frequency losses associated with the record and playback heads. This compensation is termed *record equalisation*, and the equalising circuits, as they are called, are often applied as part of the coupling from the record head amplifier to the record head itself.

Closely connected with the record amplifier is the *modulation indicator*. This is a vital instrument without which one cannot tell whether the tape is being overloaded or under-recorded. The signal to drive this indicator can be taken from the record head amplifier valve before record equalisation is applied, although there are exceptions to this as we shall discover.

As already noted, the record head is supplied not only with the signal from the record head amplifier, but also with a high frequency current called *bias*. This has the important function of reducing distortion to an acceptably low level and increases the amount of signal recorded on the tape. To supply this bias all tape recorders are fitted with an oscillator circuit which incidentally also produces additional high frequency current for the erase head. The precise effect of bias current on the magnetic recording process is beyond the scope of this series, although reference to Mr. Kirk's article *Why Bias?* (June 1965) should be noted here.

During playback the signal produced by the playback head, which by the way is of very small magnitude, is amplified. The playback



□ PART 1 BY G. T. ROGERS

amplifier, like the record amplifier, also includes equalisation components, but this time they have the effect of bass boost. This is to compensate for a 6dB per octave fall in the output of the playback head as the frequency is lowered. The effect of playback equalisation is to combat this and produce a flat frequency response. This equalisation is applied either in the playback head first amplifier stage or as a result of the coupling of this amplifier with the head, or both.

In many recorders a single integrated record/playback amplifier is used in conjunction with a dual purpose record/replay head. In this case operation of the record/replay selector switch automatically changes the circuit so that it can perform either function. This selector switch will also select either the record or playback equalisation circuits. Furthermore, the modulation indicator is usually only operative when this switch is set to record.

Output arrangements on tape recorders vary considerably according to the quality of the instrument and the purpose for which it is designed. In professional gear, for example, a low impedance output (nominally 600 ohms) is available. Such an output is desirable here for it permits really long runs (100ft. in some cases) of cable between the tape recorder and the rest of the equipment, which might be a mixing console in broadcast applications.

Domestic equipment, however, usually features high impedance outputs and this means that cables of only a few feet can safely be used without risk of loss in high frequency response. This is not really a serious problem in the majority of cases, especially where the machine forms part of a permanent installation. Machines designed specifically for this purpose usually have only a single high impedance output (two for stereo of course). For the average portable or semi-portable machine the playback amplifier also incorporates a small power amplifier of, say, three watts (3W) output to drive a small internal loudspeaker.

Although it is not shown in fig. 1, the next thing to note here is the *power supply*. This circuit produces a smoothed or steady DC (direct current) high tension (HT) voltage for driving the amplifier valves as well as a low tension voltage for the valve heaters.

The above gives a broad outline of the circuits to be covered in this series of articles. In particular we shall be concerned with the working principles on which these circuits are

based, although it is hoped to explain an adequate number of practical circuits also. Whilst we shall concentrate on valve circuits, the use of transistors will be mentioned from time to time, especially where they have a distinct circuit advantage over the valve equivalent.

To begin our journey into the electronics of tape recorder circuits let us first consider some basic electrical theory, for in this way we will more quickly acquire the fundamental background knowledge which is so important in understanding the more complex circuits.

The science of electricity and magnetism dates from the time of the ancient Greeks, who discovered the magnetic properties of loadstone and the electrical properties of amber when it has been rubbed with another substance. We now know that many more substances, such as glass, ebonite and sealing wax, for example, when rubbed with flannel or silk acquire the property of attracting small objects, and such substances are said to have been electrified by friction. What is really happening is that the mechanical energy of rubbing is being converted into electrical energy.

In 1733 Du Fay was interested in this phenomenon and found that the electrification of resin and glass was different in that resin attracted a gold leaf (previously charged by contact with rubbed glass), whereas the glass repelled a gold leaf similarly charged. From this we can see that there are two types of electricity—positive and negative.

For a long time it was thought that only non-metals such as glass and ebonite could be electrified; however this was soon corrected when Stephen Gray divided all substances into two classes: those which enabled the easy passage of electricity (conductors) and those which prevented its passage (insulators). It is important to note at this point that the terms conductor and insulator are purely relative, hence there are good and bad conductors and good and bad insulators. Because of this, when talking about conductors we usually express a value relative to the conductance of a given cross-section of pure copper (see Table). The reciprocal of conductance is familiarly known by the term *resistance*, so the greater the resistance of a substance the less efficient it will be in conducting an electric current. We shall see the importance of this shortly.

Insulators are used to restrict the flow of electricity and hence will be found on the outer sheaths of electric cables. They have a very high resistance and the flow of current through them is extremely small. As a consequence of this it is impossible to measure the resistance with any degree of accuracy to determine the suitability of an insulator. Instead, the dielectric strength, in thousands of volts per millimetre thickness, is measured. Dielectric strength, by the way, is that voltage necessary to cause breakdown in the material by sparking through it, and obviously the higher this value the better the insulator will be.

All substances, whether insulators or conductors, are built up from tiny particles called atoms, and physics has shown that these may in some respects be regarded as miniature solar systems. Briefly, an atom consists of a nucleus which is composed of *neutrons* (particles with no net charge) and *protons* (particles which are positively charged). Moving in orbital fashion around the nucleus are negatively charged *electrons*. These are held in their orbits by forces of attraction between themselves and the positive nucleus and as a result the atom as a whole is electrically neutral.

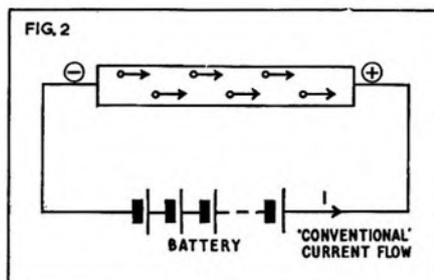
In an insulator the so-called intra-atomic forces of attraction are very strong and the electrons remain firmly attached to the atom. With conductors, on the other hand, this force is relatively weak and the outer electrons within the conductor can be detached and made to move about. *It is this movement within the conductor that we call electric current*, and it is measured in *amperes* (A). Even in a very short conductor of about half an inch there are many millions of atoms and the outer electrons of all these are potentially free to move and originate a current flow, though in practice not all electrons participate at the same time.

The direction of current in amperes is, by convention, that along which positive electricity would tend to move, which is opposite to the movement of these electrons, fig. 2. Incidentally, to maintain this flow of electrons in a conductor an electromotive force (EMF), measured in *volts*, has to be applied across its ends, hence the battery in fig. 2. Such a flow, since it moves in one direction round the circuit, is referred to as *direct current*, or DC.

In 1826, as a result of studies on the continuous flow of electricity along a metal, Georg Simon Ohm discovered an important law which is named after him. It states that the ratio of the volts *V* between the ends of a conductor, to the current *I* flowing in it, is always constant provided the physical properties of the conductor remain unaltered. The constant, called the resistance *R*, is measured in *ohms* and, as we have seen, it tells us how much opposition there is to current flow. One ohm can be defined as the resistance of a length of conductor in which flows a current of one amp when a potential difference of one volt is applied. Ohm's law, shown in symbol form thus: $V = I \times R$, is therefore of great value when calculating voltages and currents in an electric circuit, and examples of its use will be found later in this series.

Next month we shall say a little more about resistance and then go on to introduce another component—the *capacitor*, which has the property of storing electricity.

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the school recorder

A PLEA FOR DESIGN SIMPLICITY

BY MICHAEL POLLARD

EDUCATIONAL tape recording has come a long way since the first teacher lugged his own machine from home and set it up in the classroom to give children the wonder of hearing their own voices.

The developments that have taken place in the educational use of tape have fallen so thick and fast that the fairly recent memories many of us have of our first ventures into tape in the classroom already seem almost medieval. Can it be only ten years ago that the school with a tape recorder was regarded as 'progressive' to a slightly suspicious degree? Pre-recorded tapes, television and language laboratories have very quickly given the early pioneers something of an Edison air.

The tendency of all these developments is to make teachers lose sight of the value of the tape recorder, pure and simple, as a teaching aid. This is a great pity, because many schools which do not wish to use pre-recorded material and will never run to a language laboratory are discouraged by the aura of affluence which seems to surround the tape machine in its school context; the glitter of the plusher means of using tape in school takes the edge off the more mundane possibilities.

This is not the only reason why so many school recorders, bought in a fit of optimism, quite often with money raised by some special effort, languish in the stock-cupboard, but it is an important one. We need to hear less about the luxurious installations in selected schools, and more about what can be done by bringing an ordinary recorder into an ordinary classroom during normal lessons.

But is it, in fact, all that easy to bring a tape recorder into the classroom? Certainly, many teachers I know find it difficult, especially in infant schools and in teaching establishments where there are stairs to be climbed or playgrounds to be crossed. The sort of machine that local authorities supply or dealers recommend for school use is portable only in theory, and, except in those fortunate one-level schools with no awkward door-lintels or steps, where the machine can be mounted permanently on a trolley, the transport problem is very real. No teacher, however progressive, is going to run the risk of doing himself an injury for the sake of adding something to his lessons.

We seem, in education, to be committed to the idea that everything designed for use in school should have the durability of a battleship. This applies to all sorts of audio-visual hardware; compare the usual types of school film-strip projector with the lightweight models sometimes brought in by visiting speakers—perfectly adequate, much lighter, much quieter in operation, and infinitely more pleasant to look at and handle. How much more important that the school recorder, whose value in teaching terms will decline sharply if it is not mobile, should be designed for use as well as for hard wear.

I am not convinced that the school machine has necessarily to be sturdier than the domestic model. I used my own recorder, with seven- to nine-year-olds doing much of the actual operation, for about six years without any mishaps or deterioration beyond the normal wear and tear one would expect.

If schools are not going to be disappointed in the use they can make of their machines, the transport problem must be solved, and manufacturers have a duty to help. There must be, of course, a minimum weight below which manufacturers cannot go without sacrificing quality, but let them look at what conditions are like in most classrooms. There are few rooms without a fitted speaker, either on its own or as part of radio or disc equipment; so the school tape recorder need not have one. Substitute a lead and an easily-connected outlet (not the Continental type, please—it is too fiddly) and there is quite a bit of weight saved straightaway. Removing the need to build a cabinet heavy enough to defeat resonance from an internal speaker means another weight economy.

From time to time teachers have asked my advice about a suitable recorder. A letter from the headmistress of a Midlands infant school is typical. "Desirable qualities," she wrote, "are that it should be simple to work, easily transportable, not too expensive, and of good reproduction."

Although I know exactly what this teacher wants, it is impossible at present to recommend a machine which fulfils all her requirements, and difficult enough to find one which will satisfy more than two of them. It is worth noting what she puts first: it must be simple to work.

What may seem to you and me simple to work is not necessarily simple to an infant teacher trying at the same time to cope with up to 40 five-year-olds. The same criteria cannot apply to a recording enthusiast who uses his machine every day in the quiet of his own home and without any other pressures, as to a teacher using the recorder perhaps a couple of times a week, keeping an eye on the class at the same time, satisfying the children's natural fascination with gadgetry, and trying to keep a coherent lesson going.

Teachers need machines which they can operate without thinking, just as they put up blackboards, use pencil-sharpeners, and handle the everyday affairs of the classroom without thinking. They do not want their use of the recorder to be cluttered with sophistications. They need, in fact, one switch for recording, one for playback, and one for volume. Give them a tone control if you like, but most of them will not use it, not because they are insufficiently discriminating, but because the range of tone quality in any classroom is pretty limited anyway. On too many recorders, you have to make too many operations and check too many controls before you start recording.

I am not sure that many teachers want more than one speed; I would think probably not, provided the one speed is fast enough to cater for all school purposes. Two points from my own experience may be worth mentioning: a magic-eye is far easier to watch with half an eye than a meter and it is useful to have a record switch with a good loud click which children can use as a start cue.

Please do not think that I am presenting teachers as a lot of simpletons who cannot cope with sophisticated equipment. What I do say is that they are busy people who cannot spare more than a fraction of their attention for the recorder, and that if they are going to use tape then manufacturers will have to understand their difficulties and meet them at least half-way. The aids that are used most in the classroom are the simple ones; there is no sign of the blackboard going out of fashion. I honestly believe that the tape recorder is potentially the most useful all-round teaching aid to have come into schools since the blackboard. *Potentially*—if it can be made as easy to handle and simple to use.

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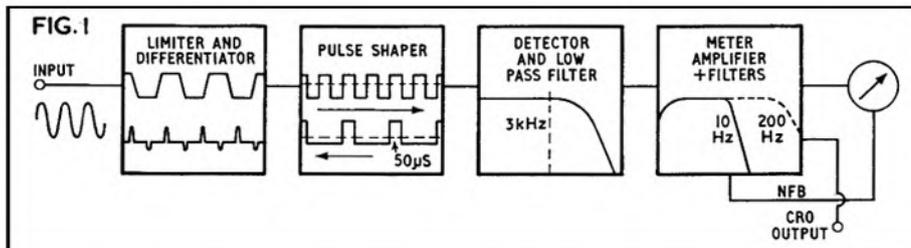
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equipment reviews



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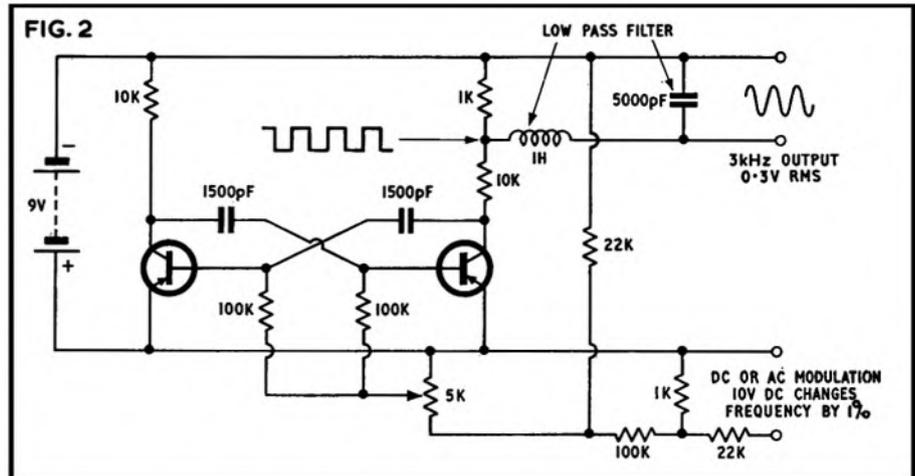


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REGULAR readers may have noticed a modest little announcement amongst the Classified Advertisements from time to time over the past month or two inviting enquiries for an inexpensive RMS Fluttermeter. The initials W.H.M. are those of Mr. Wilfred H. Myall who started development of this instrument over a year ago when he found that the only meters available cost well over £100. He realised that there might be a substantial market for such a device if the price could be reduced below £50 to bring it into line with other service and development test equipment in this price range. Good quality audio oscillators, valve voltmeters and oscilloscopes are already available at about £50, and for substantially less in kit form.

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'input' jack socket and the function switch set to the 1% RMS position. If the signal from the recorder is below a critical level of about 0.2V, the meter will not read, or may fluctuate wildly. The input level should be well above this unstable setting to ensure adequate limiting and insensitivity to drop-outs or small changes of signal strength. The meter should now give a relatively steady reading, but may oscillate slowly from a low to a high reading as the recorded 'wobble' comes in and out of step with the precisely similar playback 'wobble'. I have borrowed the word 'wobble' from David Kirk's report of his visit to the *Revox/ Studer* factories in the January issue. Thank you Revox for telescoping a clumsy phrase into a homely word!

The bandwidth of the meter amplifier can be changed from a 'linear' response (—3dB at

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(continued on page 261)

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which produces constant-width square-topped pulses. In this case the pulse duration is about $50\mu\text{s}$. If the frequency is low, the pulses are spaced well apart and the mean DC level is low. If the frequency is high, the pulses are more closely spaced and the DC level is high. With well shaped pulses, the DC output is very linear over a wide range of frequencies. In this particular application, the frequency range covered is only a few hundred cycles on either side of the nominal 3kHz, but it does mean that the circuit will take care of tape speed drift, or 3kHz signals from other sources which may not be too accurate, without critical tuning or adjustment.

TRANSISTOR CIRCUITS

When the function switch is set to either of the meter positions, the flutter waveform is switched to the 'output' socket so that it may be fed to a CRO or a high speed pen recorder for observation of the flutter frequencies and waveforms.

The transistor circuits for the meter are contained on two printed circuit panels. A small one contains the power supply and voltage stabiliser circuit, and the larger one the

is exponential over a wide frequency sweep, but for a frequency deviation of a few per cent it is sufficiently linear for our purpose.

First tests were discouraging, as a given amount of FM 'wobble' of the multivibrator output showed errors of nearly two to one when comparing my own tuned circuit discriminator and meter with the review instrument. A little investigation showed that the multiple harmonics of the multivibrator square-wave were upsetting my discriminator, and a low-pass filter to eliminate these harmonics produced almost exact agreement of the respective meter readings. The final test circuit is shown in fig. 2.

CLOSE READINGS

As the readings were close, but not identical, it was decided to attempt more exact calibration to the ultimate limits of my variegated laboratory equipment. First the LF range of my phase-shift low frequency oscillator was checked against the 50Hz mains frequency at 25, 50, 100 and 200Hz. Some drift with time was evident, and this was eliminated by stepping up the mains voltage by an external transformer so that the stabiliser circuits of the oscillator were made more effective. Next, the modulation input part of the test multivibrator was padded out so that a relatively large voltage of 10V DC gave a frequency shift of 1%, or

from the lower frequency limit of my oscillator to 200Hz and it was found that the -3dB turnover point on the 'linear' setting of the bandwidth switch was 150Hz instead of the specified 200Hz. A query to Mr. Myall produced an immediate reply, saying that this had already been discovered, and asking me to change a capacitor in the feedback circuit of the meter, in my early *Mk. 1* prototype, to bring it up to date. This was done and the 200Hz -3dB turnover was obtained. We both apparently hit on the same solution for checking the very low frequency response at 0.5Hz—or to slip back to our old terminology, one half cycle per second—by recording 10 cycles and re-recording at lower and lower tape speeds until the requisite very low frequency sine wave was obtained. This again proved to be correct at approximately -3dB from the level 'linear' response. With the bandwidth switch on 'wow', the -3dB turnover point was at 10Hz and the -20dB point at 100Hz as specified (fig. 3).

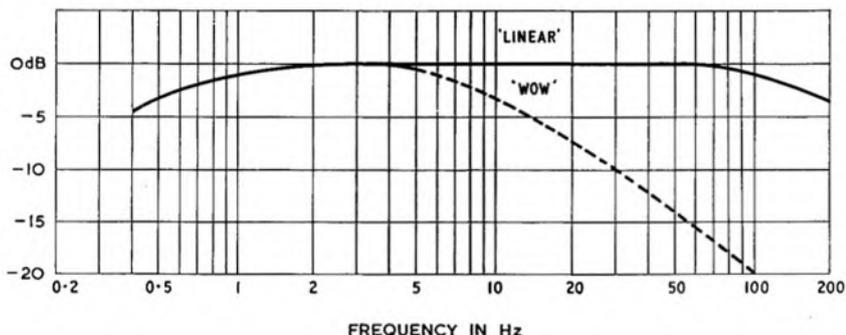
COMMENT

I think the only comment needed is to say that my tests convinced me that the calibration of the W.H.M. Fluttermeter was accurate to the limits of my test equipment, that the linearity of the meter reading at all parts of the meter scale was of a very high order, and a significant improvement on an orthodox tuned circuit discriminator, which must have a slightly 'S' shaped response; and that the pre-set controls in various parts of the circuit should ensure that all instruments can easily be set to comparable accuracy.

Finally, I have purchased a W.H.M. Fluttermeter and shall be using it for all future reviews (see following review). A. Tutchings.

FIG. 3

W.H.M. FLUTTERMETER FREQUENCY RESPONSE



oscillator, discriminator and meter amplifier circuits. Eleven transistors, eight diodes and a zener voltage-regulator diode are used in the complete instrument. Heavy negative feedback over the meter feed circuits ensures that the linearity of the meter reading is comparable with that of the discriminator, so that individual calibration of each panel meter is not necessary. A block diagram of the main circuit elements is shown in fig. 1.

A brief description of the calibration procedure may be of interest as it may lead to a better understanding of the principles involved. The prime requirement is for a test circuit which will produce a stable 3kHz tone which can be frequency modulated linearly over the range 0.1% to 1% RMS from DC to several hundred Hz. The basic circuit used is a simple two-transistor multivibrator with the modulating voltage 'wobbling' the base voltage of the transistors. The voltage/frequency relationship

30Hz. This was checked by beating the test circuit sine wave output against the stable 3kHz sine wave oscillator within the review fluttermeter, and then comparing the beat with the newly calibrated low frequency oscillator. This was also checked by recording the beat on my high speed pen recorder and counting the beats per second.

THIRTY CYCLES

Thirty cycles in 3,000 represents a peak-to-peak deviation of 1%, which is equal to $\frac{1}{2}$ or 0.35% RMS so that a sine wave modulation was applied to the test multivibrator with a peak-to-peak CRO deflection of exactly 10V. This was indicated correctly as 0.35% RMS by the Fluttermeter under review, with my meter reading slightly low at 0.33%. A peak-to-peak input of one volt gave readings of 0.035% and 0.04% RMS.

The modulation frequency was now varied

SONY TC350A

MANUFACTURER'S SPECIFICATION.

Quarter-track mono/stereo unit with line outputs only to feed external amplifiers and speakers. **Tape speeds:** $7\frac{1}{2}$ and $3\frac{3}{4}$ i/s. **Frequency response:** 50 Hz-15kHz $\pm 3\text{dB}$ at $7\frac{1}{2}$ i/s. **Signal-to-noise ratio:** 50dB unweighted at both speeds. **Wow and flutter:** less than 0.17% at $7\frac{1}{2}$ i/s, less than 0.25% at $3\frac{3}{4}$ i/s. **Inputs:** Mic—0.19mV, Aux—0.06V, DIN socket 6.15mV. **Outputs:** 0.775V on all lines. **Harmonic distortion:** less than 3% at 0dB (0.775V) output. **Weight:** 17lb. **Dimensions:** $15\frac{1}{2}$ by $6\frac{1}{2}$ by 13in. **Price:** £78 15s. **Distributor:** Sony U.K. Sales Division, Mercia Road, Gloucester.

THIS is not an entirely new recorder. The basic deck and control system, with minor circuit variations, has been available for a year or more. I found an advertisement in a December 1965 American magazine for what seemed to be an identical machine. It would seem that Sony, like Revox, Ferrograph, Ampex and other well established firms, prefer to retain a well tested design, adding only small improvements to ensure better performance and reliability.

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(continued overleaf)

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SONY TC350A REVIEW CONTINUED

sound) when required. The tape transport control consists of a single lever labelled *FF* (fast forward), *Pause*, *FWD* (forward at selected speed for record or play), *Stop* and *REW* (rewind). The lever is vertical for *Stop*, and is moved one step clockwise for record or play and one step anticlockwise for rewind. The less frequently required *Pause* and *Fast Forward* positions are found by moving the lever further clockwise.

Two rocker type switches at the centre allow left and right channel monitoring from Source or Tape (A-B switch). The record button, left and right record level controls and microphone input jacks are hidden under a small hinged panel below the twin VU-meters on the left-hand side of the deck. All other input and output sockets, with the sound-on-sound control and mains voltage selector, are at the rear of the plinth.

A change of mains frequency from 50 to 60Hz requires a change of capstan sleeve and alteration of a tapping on the motor capacitor terminals within the recorder. It seems a pity to use a capstan sleeve for this very infrequent speed change as it is well known that it is extremely difficult to fit a sleeve to the same accuracy as a properly ground capstan shaft. The total wow and flutter readings were 0.13% to 0.15% at 7½ i/s and 0.16% to 0.19% at 3¾ i/s. Reducing the bandwidth of the flutter meter from 200Hz to 10Hz exposed the wow in more detail at approx. 0.1% at 6Hz (7½ i/s) and a mean wow of 0.12% at 3Hz (3¾ i/s). The wow waveform was sinusoidal for only brief periods, but this was almost certainly due to a beat effect between record and replay speed fluctuations. It does however confirm that the wow is at capstan rotation frequency and could be due to an ill fitting capstan sleeve. The high frequency flutter is the same at both speeds and extends to the high frequency limit of my pen recorder (120Hz) so that it is probably caused by tape friction effects at guides or pressure pads.

NAB EQUALISATION

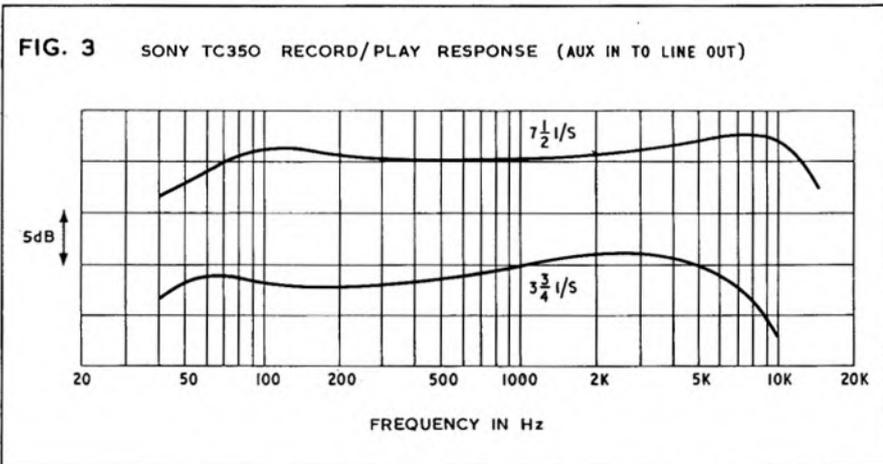
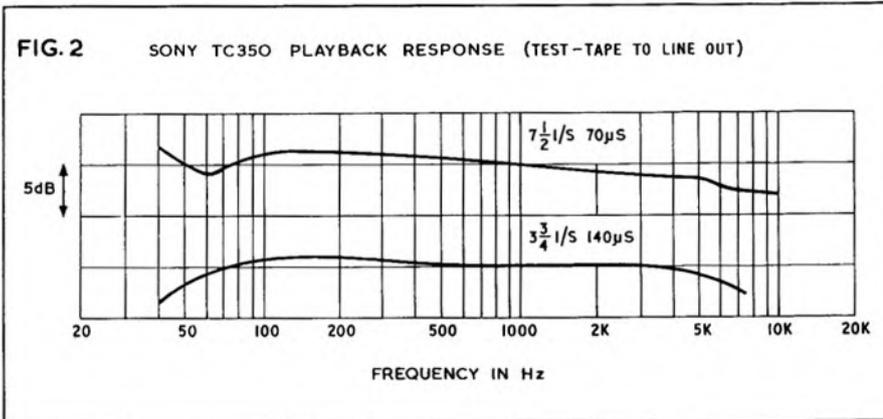
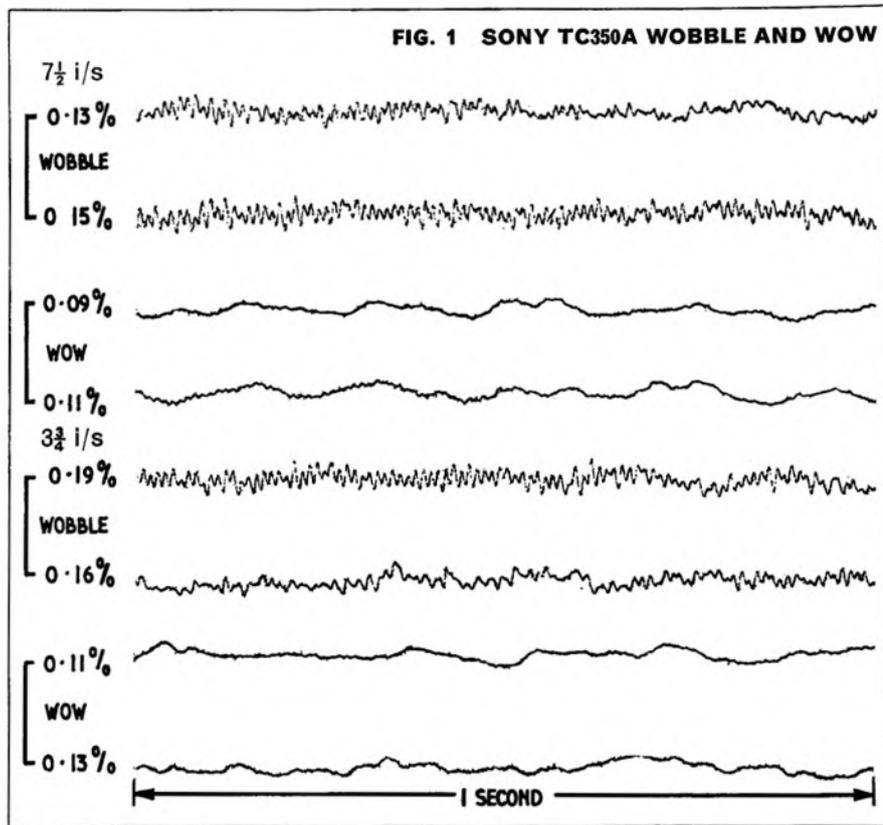
The play-only response at 7½ i/s, using a standard DIN/CCIR 70µS test-tape, shows a 3dB fall at high frequencies which indicates that the playback equalisation is to the American NAB 50µS characteristic.

The 3¾ i/s play-only response is sensibly level to 8kHz on the CCIR 140µS test-tape (Fig. 2).

System noise at 7½ i/s with no tape passing the heads was 39dB below test-tape level. Bulk erased tape gave a reading of -38dB, and tape recorded and erased on the machine gave an unweighted reading of -37dB. This indicates good bias and erase oscillator waveform.

Recording tests at 500Hz showed negligible waveform distortion at 13dB above test-tape level with the record level VU-meter needle just off the scale. Further increase of recording level showed a gradual overload with no very clipped or distorted recorded signal. This is characteristic of a well designed recorder, where the bias has been set slightly above that required for maximum output, to reduce distortion and under-signal noise to the lowest possible level. Fig. 3 shows that high tone response is well maintained to 12kHz at 7½ i/s

(continued on page 264)



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SONY TC350A REVIEW CONTINUED

and 8kHz at 3½ i/s. This is all that can be expected of a properly biased recorder, and further extension of frequency response could only be obtained at the expense of noise and distortion.

The circuits are 'solid state', which means transistorised, and silicon *n-p-n* types are used throughout, so that a positive HT rail is used and the circuits look very much like 'old fashioned' valve circuits. The only gain controls are in the record amplifiers and these alter the negative feedback over the first stage as well as acting as the usual interstage control; this reduces distortion at high input signal levels. A number of pre-set controls are fitted to equalise the source and tape monitoring levels and to ensure that the VU-meters are accurately calibrated.

COMMENT

My first reaction on playing with this recorder was a slight feeling of 'dullness' on some recordings. A long session using the A-B switches to compare incoming and taped signals convinced me that this was not a matter of poor frequency response of the recorder, as the two signals sounded almost identical on instantaneous changeover. In fact, as several contributors to *Hi-Fi News* have remarked lately, some BBC broadcasts are dull (acoustically) compared with some of the spectacular top response we get on disc due to close

microphone placement. Tape used with this recorder has to be carefully selected as the slightly high bias will in fact give a falling high note response on some of the 'softer' low coercivity tapes; but, with modern tape, the first impression of lack of glitter is really due to low distortion and lack of extra high frequency harmonics and intermodulation products which should not be there anyway! Tone control will always be available in external equipment and it will be found that the frequency balance can be adjusted to suit the room, speaker or listener without bringing up noise or distortion.

If you already have a good high fidelity installation and want to add tape facilities, this recorder would be a better buy than any self-contained stereo recorder in the £70-£80 price range containing speakers and amplifiers you would seldom use.

A. Tutchings.



NO GEN BY H. W. HELLYER

THESE remarks are dedicated to the legion of enthusiasts, cross-eyed and fumble-fingered with the effort of unravelling a strange circuit.

Apart from the fact that the cunning manufacturer conceals his connections under a mass of mechanical jugglery, disdains any sort of wiring colour code, and fits components that lose all identifying marks as soon as the works become more than lukewarm, the circuit, when finally unravelled, bears no relation to any theoretical design the investigator has ever seen.

This does not matter. Whether or not we understand the circuit, we still want to be able to replace that charred mass that was once a 2W resistor and need to nail it down in the drawing. But where to get the drawing?

There are several sources. Greatest, if you believe the advertisements, is the bottomless library of those special firms that boast: 'Any post-war set,' or 'All designs available'. Have you tried applying to them? All too often, the particular circuit one needs is "temporarily out of stock". Another source one can turn to is the collection of books by a famous publisher, containing practically all the popular circuits that have appeared, with additional notes on mechanical features, dismantling, electrical adjustments and so on. Unfortunately, it is necessary to obtain one whole book to winkle out our precious page of information—rather a pricey business at a couple of guineas a time. So we hand in our card to the supercilious young lady at the local library, draw out the volume, and under constraint of dire

penalties, scribble out the circuit on a handy piece of paper.

While we are doing this, the young lady sniffs round suspiciously. Maybe we look the type capable of defacing precious volumes, or even using toffee papers as bookmarks. So we scribble yet more feverishly.

Have you ever copied a complicated circuit? There is a tendency to short-cuts. One draws lines dashingly from A to B, then discovers that half a dozen subsequent lines have to cross them, and we have left no room for vital components. A growing respect for the technical draughtsman develops. One begins to envy the cloak and dagger merchant with his eyeglass camera and roll of microfilm.

The last source is the Editor of one of the trade magazines. Each issue contains a service sheet, often of immaculate quality. But, almost without exception, the required circuit has either gone out of print or never been considered for publication. Back to square one.

Some tape recorder makers are kind to their customers. They paste facsimile circuits in the base covers of the machines—just where the wax from an overheating transformer is going to congeal. Others include the data in a pretty polythene envelope, with the instruction book and guarantees, but these kind gentry are woefully few. They will only increase in number if we—the users—insist upon service data before we put our money on the dealers' counter. After all, there is seldom any difficulty in obtaining a handbook for practically any kind of car. So why the mystery about our equipment?

GETTING SPLICED

SOUTH AFRICAN STYLE

BY DEREK LYONS

MY boss made such a fortune from his fleet of 12 tape-recorders it always surprised me that more people did not jump on his band-wagon. Though heaven knows it was chaotic enough with two other do-or-die competitors in the field. Once all three turned up at a wedding and a fight ensued. It was all very unseemly but a reflection of business life at its lower levels in Johannesburg.

Few loving couples escaped our net. We found their names in newspapers, on church notice-boards, from florists, hotels, even the occasional vicar obliged. A little sleuthing produced telephone numbers. Then the sales patter, carefully devised by my boss who would have made a fox look ingenuous.

"Would they," we asked, "allow us to be present at their wedding to record it entirely without obligation?"

Few people can resist something for nothing and provided we did not stick the microphone in the wedding-cake or interrupt the service at its most poignant moment with feedback howls, sure we could come along.

So on the day our part-time operators would arrive at the appointed time and place. The vicar's permission was obtained earlier and a quick survey of the church would enable them to select the best place for the microphone and recorder. Sometimes this involved taking up the oddest positions in order to be both unobtrusive and effective. I once crouched for an hour beneath an altar, hidden by the cloth. Some vicars are more lax than others!

For our part-time operators it was an unusual job spiced with perks such as free drinks and food at the receptions, though the firm took a dim view of men who drank beyond their capacity and handed in recordings showing all too clearly that they had. They were paid on a commission basis and received nothing if the recording eventually failed to sell. So it was decidedly in their own interests to ensure good recordings. Nevertheless some superb recordings never saw the light of day. One couple, for example, said they would not now be requiring their recording as they were getting a divorce. Even in Johannesburg, with one of the highest divorce rates in the world, this knocked us back a little.

But other things being equal, a good recording sold better than a bad one and the skill of our weekend operators was an important factor. The good men not only did a quality

recording in the church but at the reception they were painstaking in getting plenty of "congratulations" as well as the main speeches. These congratulations were recorded messages from the couple's relatives and friends, and since the couple were often too busy at the reception to notice what was happening these messages came as a pleasant surprise when they heard the playback of the recording after returning from their honeymoon.

Of course not all were happy to oblige, but if couples were successfully wooed to the studio the battle was almost won. Some said they would come but never did. No obligation, remember? But few who came went away as rich. It was, after all, a once-in-a-lifetime experience ever to be relived due to the miracle of magnetic tape. Easy terms were arranged, but not always honoured. There is little quarter given on either side in Johannesburg.

Considering the equipment used (American Sound Mirrors and paper tape) the prices asked were pretty saucy. Yet I have seen couples swoon over the most botched recordings and others turn away perfect ones. This was a frustration that I never conquered... to erase a beautifully executed job used to hurt a lot. But there was a challenge in editing a ghastly recording so that the happy couple would at least have something worthwhile for their money.

Few people could have spent their Monday mornings week after week listening to a diet of wedding marches, first waltzes ("Always" was the most popular at the time), hymns ("Love Divine" topped the poll well above "Fight the Good Fight"!), and speeches by proud fathers, sobs by bereaved mothers. The weekend's tally was often two dozen weddings, Barmitzvahs and 21st birthdays. Each recording had to be analysed in detail, copious notes made for editing, and the quality summarized. The scissors were used ruthlessly at a later stage if the customer ordered. Otherwise it was considered a waste of time to edit since as we all know this is a most time-consuming occupation.

The finished tape was used for cutting acetates which was done on a turntable in the studio control-room, the swarf vacuumed into a cylinder making excellent stuffing for cushions! A presentation album was the end product. It had been a long, long journey from that first "no obligation" telephone call.

Your Tape Dealer

SCOTLAND

EDINBURGH'S HI-FI SPECIALIST

Amplifiers, F.M.
Tuners, P/Ups,
Speakers, etc.
Demonstrations and
Advice gladly given.

Agent for the
famous Heathkits.

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Assoc. Brit. I.E.R.E.

Recording Studios

mjb recording and transcription service

Mono and Stereo records: latest cutting methods, automatic varigroove, feedback cutter heads, limiters and equalisers, techniques hitherto available only to the professional, facilitating high undistorted cutting levels and extended playing times even from amateur recordings.

Booklet available.

40 QUEEN STREET
MAIDENHEAD

Tel. 25204 BERKS

MOBILE RECORDING

Professional service at
highly competitive rates
Anywhere; Anytime.

L. F. RECORDINGS

47a, St. Marys Road, London, W.S. Ful. 0697

TAPE RECORDERS - AUDIO EQUIP-
MENT - DISC CUTTING STD & LP
FROM TAPE - STUDIO FACILITIES
HIRESERVICE-SALES-EXCHANGES

MAGNEGRAPH

1 Hanway Place, London, W.1. LAN 2156

STUDIO REPUBLIC



professional recording services

CHURCH FARM, PINNER, MIDDX. FIE 5555

STUDIO SOUND RECORDING STUDIOS

- Recording and Disc Transcription Service.
- Latest high-level cutting techniques.
- Mono and Stereo records.
- Exceptional quality obtained from amateur recordings.
- Members A.P.R.S.

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CLASSIFIED ADVERTISEMENTS

Advertisements for this section must be pre-paid. The rate is 6d. per word (private), minimum 7s. 6d., Box Nos. 1s. 6d. extra. Trade rates 9d. per word, minimum 12s., Box Nos. 2s. extra. Copy and remittance for advertisements in **JULY 1967** issue must reach these offices by **19th MAY** addressed to: The Advertisement Manager, Tape Recorder, Link House, Dingwall Avenue, Croydon, CR9 2TA.

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

SITUATIONS VACANT

GRANADA TELEVISION offer Television Engineering Career in Manchester. Range of work is varied, covering vision control, VTR, Teletext control apparatus and sound operations.

Good prospects for men already experienced in TV broadcasting or with electronics qualifications and experience in the communications or manufacturing fields.

Good salaries, generous Granada Group pension and Life Assurance scheme.

Write details, age, experience, present salary to Derek Roberts, Granada Television, Manchester 3.

FOR SALE—PRIVATE

Fi-Cord 1A. charger, microphone, extra batteries, plugs, tapes, recent manufacturers overhaul. £25. Scrutton, 542 Dereham Road, Norwich, Norfolk.

Back Numbers, "Tape Recorder" for sale. From 1961 to 1966, only three issues missing. Cpl. Hacker, Catering Section, R.A.F. Northwood, Middx.

FOR SALE—TRADE

A unique tape buy! Top brand 7in. 2,400ft. 25/-, 5½in. 1,200ft. 15/-; p/p 1 at 2/-, 2 at 2/9, 3-6 at 3/6. Bargains in all sizes. S.a.e. for list. E. C. Kingsley & Co. Ltd., 93 Tottenham Court Road, London, W.1. EUSTON 6500.

Blackburn has Lancashire's leading Hi Fidelity/Tape Recorder stockists and Electronic Engineers at Holdings Audio Centre, Mincing Lane/Darwent Street, Blackburn (Tel. 59595).

American 4 Track Stereo Tapes covering most famous labels at realistic prices. Why pay more? Imported directly by us, saving distributors profits. Vast selection at 75/- each—send S.A.E. for free lists or call at London showrooms: Teletape of Marble Arch, 33 Edgware Road, W.2.

20% cash discount on most famous makes of Tape Recorders, Hi Fi equipment, Cameras and Typewriters. Join England's largest Mail Order Club now and enjoy the advantages of bulk buying. Send 5/- for membership card, catalogues, price lists or S.A.E. for free quotations and leaflets. C.B.A. (Dept. A1), 370 St. Albans Road, Watford, Herts.

W.H.M. Wow and Flutter Meter Model 3, £48. Literature and specification on request. 35 Villiers Road, Watford, Herts.

Petersfield Camera Centre Ltd. supply the trade with A.K.G. Microphones, Uher Tape Recorders. Deliveries ex stock. 37 Lavant Street, Petersfield, Hants. Telephone 2651/2/3.

E.M.I. TR90 stereo 7½/15 rack mounted tape recorder fitted mono heads, just overhauled—£325. **E.M.I. TR90 stereo 7½/15 rack** mounted tape recorder twin VU's, twin PPM plus 10 watt amplifiers—£375. Philips Consul stereo tape recorder 7½/15 twin VU's. Had very little use. Accept £700. Future Sounds Ltd., Amberley Court, Monmouth. Tel. 2449.

BARGAIN SALE, new goods, fully guaranteed. Telefunken M200 32 gns., Grundig 3-mike mixer 5 gns., Reslo Ribbon Mikes £7. Symphony AM/FM Tuners £14. Ferrograph mono with Reslo Mike (s/h) £40. Leak Troughline 2 tuner (s/h) £20. N.R.S., 16 King's College Road, London, N.W.3. Tel. 01-722-3314.

The **Institute of Sleep-Learning** are pleased to announce a major breakthrough in sleep-learning economics. At last we are able to offer a recorder which is not only ideal for Sleep-Learning and Therapy and gives excellent results on music but at the same time at a sensationally low price—only 25gns. Send now for our latest free catalogue of Complete Sleep-Learning Kits and accessories including our special Induction Tapes, Pillow Speakers, Time Switches, etc., etc., together with latest Press Reports on this Vital New Subject. The Institute of Sleep-Learning, Dept. TR, 153 Fellows Road, Swiss Cottage, London, N.W.3. Tel. 01-722 3314.

E.M.I. TR52 full track 7½ and 15 IPS, with trolley. Recently overhauled—£80. 2 Reslo RBT ribbon microphones, stand and cable with each—£7 each. Buyer collect. Kennet Recordings, 40 Russell Road, Newbury.

WANTED

Lee Electronics. The Tape Recorder and Hi-Fi Specialists wish to purchase good quality Tape and Hi-Fi Equipment for cash. 400 Edgware Road, W.2. Phone: PADdington 5521.

Highest prices offered for good quality Tape Recorders and Hi-Fi. See our ad. page 233 this issue. R.E.W., 266 Upper Tooting Road, London, S.W.17.

Tape of film sound tracks "Snow White" and "Birth of the Blues" for private use. 132 Harrogate Road, Yeadon, Nr. Leeds.

STUDIO FACILITIES

Rapid Recording Service. Records made from your own tapes (48-hour service). Master Discs and pressings. Recording Studio—Demo Discs. Mobile Recordings, any distances. Brochure from 21 Bishops Close, E.17.

7in. 45 from 18/-, 10in. LP 42/-, 12in. LP 48/-. 3-day postal return service. High level disc cutters Limiters, Equalisers, variable pitch, etc. Professional work at provincial rates. 40ft. Studio. Trade terms available. S.a.e. leaflet to: Deroy Sound Service, High Bank, Hawk Street, Carnforth, Lancs.

J & B Recordings. Microgroove tape to disc, mastering service, pressings, mobile, studio. 14 Willows Avenue, Morden, Surrey. MITcham 9952.

Professional mobile and dubbing. High quality mobile recording; Tape/Disc copying and mixing; quantity pressings; custom built equipment; professional tape recorders, etc., serviced. L.F. Recordings, 24 West Kensington Mansions, Beaumont Crescent, London, W.14. 01-385-0697.

MISCELLANEOUS

Repairs. Our modern service department, equipped with the latest test equipment (including a wow and flutter meter and multiple Stereo Signal Generator) is able to repair Hi Fi and Tape Recording equipment to manufacturers standards. Telesonic Ltd., 92 Tottenham Court Road, London, W.1. 01-636 8177.

HI-FI installations and servicing by professional engineers (assoc. A.P.R.S.). L.F. Recordings, 24 West Kensington Mansions, Beaumont Crescent, London, W.14. 01-385-0697.

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A Winner

The DP4 microphone is another winner—by performance alone it has achieved world wide acclaim. It is used regularly by P.A. engineers, broadcasting and television companies, film studios, etc., as well as by many professional and amateur tape recordists. Its winning qualities have been designed and produced by Grampian—specialists for over thirty years in the field of sound equipment. We shall be pleased to send you full technical details of the DP4 and other microphones, together with descriptions of various accessories.

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



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

Grampian

Grampian Reproducers Ltd.,
Hanworth Trading Estate, Feltham, Middlesex.

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50%
OFF!

FANTASTIC SAVINGS!

We have a fantastic selection of tape recorders, new, shop-soiled and secondhand showing savings on the manufacturer's list price of up to 50%. Our quoted prices are absolutely unbeatable, so why not call at any of our showrooms and see the fantastic savings that we, as Britain's largest tape recorder specialists company, are able to offer you by virtue of our ability to purchase large quantities and pass the savings thus obtained on to you! (Personal callers only.)

- UNBEATABLE NO-INTEREST TERMS
- OVER 100 MODELS ON DISPLAY
- EXPERT STAFF EXPERT ADVICE
- GENEROUS PART EXCHANGES
- SAVINGS OF UP TO 50%

THIS MONTH'S BARGAINS

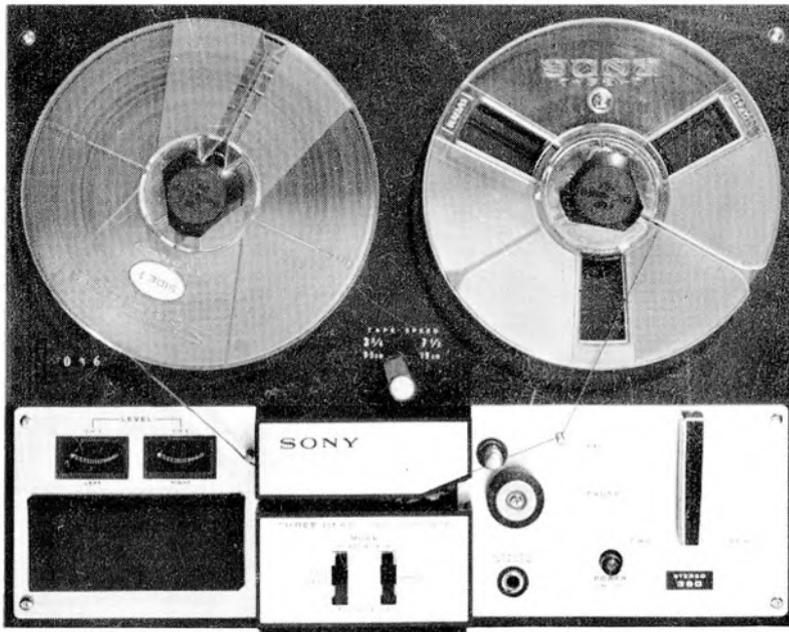
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|--------------------------------|---|-------------------|-----------------|
| UHER 400L | Battery/Mains portable. Latest 1967 model. List £108. As new. | Our price | 83 GNS. |
| PHILIPS EL4306 | Latest 1967 4-track, 2-speed model. List £44.2.0. Brand new, boxed. | Our price | 36 GNS. |
| SABA TK230 | Superb 4 track, 3 speed stereo model. Absolutely as new. List £100. | Our price | 39 GNS. |
| PHILIPS EL3534 | Stereo 4 track, 4 speed. Superb condition, as new. List £96 12 0. | Our price | 49 GNS. |
| AKAI M8 | Stereo. One only S/S. Latest 1967 model. List £146. | Our price | 99 GNS. |
| TELEFUNKEN 85KL De luxe | Superb 2 track model. As new. List £95. | Our price | 39 GNS. |
| TANDBERG 64 | 4 track, 3 speed Hi Fi tape unit. List £115. One only. | As new. Our price | 69 GNS. |
| REVOX 736 | 2 track stereo. Brand new. S/S. List £135 9 0. Two only. | Our price | 109 GNS. |
| AKAI 1710 | Latest 4 track stereo. One only. S/S. List £83. | Our price | 69 GNS. |
| VAN DER MOLEN VR7 | 4 track, 3 speed. Latest 1967 model. Brand new, boxed. List £41 19 0. Few only. | Our price | 29½ GNS. |
| PHILIPS EL3556 | Latest 1967 4 track, 4 speed model. List £65 2 0. Brand new, boxed. | Our price | 49 GNS. |
| FI-CORD 202A | Battery/Portable with all accessories. One only, perfect condition. | Our price | 55 GNS. |
| PHILIPS TYPE | Cassette battery/mains portable. Brand new. List 27gns. Few only. | Our price | 21 GNS. |
| PHILIPS EL4305 | Latest 1967 model. List £37 16 0. Brand new, boxed. Few only. | Our price | 29½ GNS. |
| GRUNDIG TK45 | 4 track stereo. Perfect condition. One only. List £112. | Our price | 59 GNS. |
| PHILIPS EL3536 | 4 track mono/stereo. Perfect condition. Original list £97. | Our price | 39 GNS. |

PERSONAL CALLERS ONLY

HURRY WHILE STILL AVAILABLE!

NoSound
TAPE RECORDER CENTRES

| | |
|---|------------------|
| 82 HIGH HOLBORN, W.C.1 (200 yards Kingsway) | CHAncery 7401 |
| 228 BISHOPSGATE, E.C.2 (opposite Liverpool St. Station) | BIshopsgate 2609 |
| 36 LEWISHAM HIGH STREET, LEWISHAM, S.E.13 | LEE Green 2399 |
| 242/4 PENTONVILLE ROAD, N.1 (200 yards Kings Cross) | TERminus 8200 |
| 2 MARYLAND STATION, STRATFORD, E.15 (Adjacent Maryland Point Station) | MARyland 5879 |



SONY research makes the difference

MODEL TC350 - FEATURES

4 track stereophonic and monophonic recording and playback Precision solid state circuitry comprising independent recording amplifiers and playback preamplifiers Professional 3 head system Sound on sound recording Language/music training facilities Vertical and horizontal operation All idler beltless tape driving mechanism Two tape speeds (7½ and 3¾ ips) 7" reel capacity automatic shut-off switch head-set monitor jack pause control digital tape index counter two VU meters integrated record/playback connector

SPECIFICATIONS:

Power requirements: 50W, 100, 110, 117, 125, 220, 240V, 50/60 c/s AC.

Reel: 7" or smaller.

Tape speed: 7½ and 3¾ ips. with automatic equalization change.

Recording system: 4-track stereophonic or monophonic.

Frequency response: 30-20,000 c/s at 7½ ips. ± 3 db 50-15,000 c/s at 7½ ips. 30-14,000 c/s at 3¾ ips.

Signal-to-noise ratio: Better than 50 db.

Wow and flutter: Less than 0.17% RMS at 7½ ips. Less than 0.25% RMS at 3¾ ips.

Harmonic distortion: Less than 3% at 0 db line output.

Level indication: Two VU meters.

Record: NAB standard.

Playback: calibrated to 0 db line output.

Recording time:

4-track stereo 4-track monophonic

1,200' tape 7½ ips. 1 hr. 2 hrs.

3¾ ips. 2 hrs. 4 hrs.

1,800' tape 7½ ips. 1½ hrs. 3 hrs.

3¾ ips. 3 hrs. 6 hrs.

Fast forward and rewind time:

Within 4 min. (1,200' tape).

Input: Microphone

Sensitivity: -72 db (0.19mV)

Impedance: low (will accommodate any microphone from 250-1K ohm impedance).

Auxiliary

Sensitivity: -22 db (0.06 V).

Impedance: approx. 100K ohms.

Integrated record/playback connector.

Sensitivity: -42 db (6.15 mV).

Impedance: approx. 100K ohms.

Output:

Line

Output level: 0 db (0.775V).

Impedance: optimum load impedance 100K ohms.

Binaural monitor

Output level: -1 db (0.692V).

Impedance: accommodates 10K ohm head-set.

Integrated record/playback connector

Output level: 0 db (0.775V).

Impedance: optimum load impedance 500K ohms.

Head: Recording RP 30-2902.

Playback PP 30-4202N.

Erase EF 18-2902H.

Transistor: 2SC402 x 18, 2SB381 x 2, 2SC291 x 1.

Diode: IT22A x 2, 5G-D x 2.

Dimensions: 15½ (W) x 6⅝ (H) x 13" (D).

Weight: Approx. 17 lbs. 3 ozs.

Accessories: Empty 7" reel. Connection cord. Capstan. Pinch roller. Reel cap.

Recommended retail price **75 Gns.**

Sony offer the finest range of tape recorders from the battery portable TC 900 to the studio quality 777.

For further details see your Sony dealer or write to:

Eastbrook Road, Gloucester.

Tel: Gloucester 21591.

London Showrooms:

70-71 Welbeck Street, London, W.1.

Tel: HUNter 2143

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